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Failure Prediction of CFRP Composites Using Weibull Analysis

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Abstract. Composite materials are extensively used in aerospace applications due to their higher specific strength. These materials are judged by its properties and behavior under different loading conditions. In this paper developed a mathematical relation to predict the failure of composite material under tensile load by using Weibull distribution. Tensile hoop stress and failure stresses of composite specimens were found by NOL ring test. Characteristics of Weibull distribution were found by the tensile test data and develop the distribution curves. Probability of failure of the composite materials can be effectively predicted by these curves.

INTRODUCTION

Composites are consists of two or more constituents that are combined at a macroscopic level without soluble in each other. They contain high performance reinforcements usually fiber form in thin diameter, mix with matrix material such as epoxy or soft metals like aluminum. Carbon fiber reinforced polymer (CFRP) composites are extensively used in various structural applications in aerospace, automobile, transportation etc. Carbon fibers are commercially available with a variety of tensile modulus values in different ranges [1, 2]. These are have exceptionally high tensile strength to weight ratios as well as tensile modulus, very low coefficient of linear thermal expansion (which provides dimensional stability in such applications as space antennas), high fatigue strengths. Carbon fibers have been extensively used in composites in the form of woven textiles, pre-pegs, continuous fiber, and chopped fiber. The composite parts can be produced through filament winding, tape winding, pultrusion, compression molding, vacuum bagging, liquid molding, and injection molding. Composites materials properties are completely different than its fibers and matrix [3, 4]. The performance of an engineering material is judged by its properties and behavior under different loading conditions in both normal and adverse test environments. This information is essential for selecting the proper material in a given application as well as designing a structure with the selected material [5]. In this research investigate the performance of CFRP composites with an emphasis on the general trends observed in their properties and behavior. Material properties are usually determined by conducting mechanical and physical tests under controlled laboratory conditions. The orthotropic nature of fiber-reinforced composites has led to the development of standard test methods that are often different from those used for traditional isotropic materials [6, 7]. Weibull analysis is the leading method in the world for fitting and analyzing data and predict material behavior. Waloddi Weibull invented the Weibull distribution in 1937 and delivered his hallmark American paper in 1951. He claimed that his distribution applied to a wide range of problems. He illustrated this point with various applications such as the strength of steels or any other materials. Leonard Johnson at General Motors improved on Weibull's plotting methods. He also proved that if a part has multiple failure modes, the time to first failure is best modeled by the Weibull distribution. It is found that the Weibull method works with extremely small samples, even two or three failures for engineering analysis. This characteristic is important with aerospace safety problems and in development testing with small samples. Pratt & Whitney Aircraft used Weibull analysis very effectively [8, 9].

The primary advantage of Weibull analysis is the ability to provide reasonably accurate failure analysis and failure forecasts with extremely small samples. Solutions are possible at the earliest indications of a problem without having to fail a few more. Small samples also allow cost effective component testing. Weibull tests are completed when the first failure occurs in each group of components. If all the components need to be tested for failure, the cost and time required is much greater. Another advantage of Weibull analysis is that it provides a simple and useful graphical plot of the failure data. The data plot is extremely important to the engineer and to the designers. In Weibull plot horizontal scale is a measure of failure strength or ultimate strength. The vertical scale is the cumulative percentage failed. In this paper develop Weibull distribution curve by the experimental data of tensile test. Find the characteristics of the curve and fit in the equation which can predict the failure of the materials before it actually happened.

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THEORY OF WEIBULL ANALYSIS

Weibull distribution is being used to model extreme values such as failure times and fracture stress. The probability density function (PDF) of two-parameter distribution has been indicated in the following Eq. (1). This PDF Equation is the most known definition of two-parameter Weibull distribution [10].

$$f(x) = \frac{\beta}{\alpha} \times \left(\frac{x}{\alpha}\right)^{\beta-1} \times e^{-\left(\frac{x}{\alpha}\right)^{\beta}} \quad (1)$$

Where, α and β is the scale, shape parameter.

If PDF is integrated, cumulative density function (CDF) is obtained. Eq. (3)

$$F_f(x) = 1 - e^{-\left(\frac{x}{\alpha}\right)^{\beta}} \quad (2)$$

$$1\text{-}F_f(x) = e^{-\left(\frac{x}{\alpha}\right)^{\beta}} \quad (3)$$

$$F_s(x) = 1\text{-}F_f(x) \quad (4)$$

$$R_x = 1 - P_x \quad (5)$$

In the above equations;

x: Variable (usually life). Failure cycles in this study (Nf),

β: Shape parameter or Weibull slope,

α: scale parameter,

$F_f(x)$: Probability of failure (P_x),

$F_s(x)$: Probability of survival or reliability (R_x).

If the natural logarithm of both sides of the Eq. (3) is taken, the following Eq. (6) can be written as,

$$ln\left(ln\left(\frac{1}{1-F_f(x)}\right)\right) = \beta ln(x) - \alpha ln(x) \quad (6)$$

When the Eq. (6) is rearranged as linear equation,

$Y = ln\left(ln\left(\frac{1}{1-F_f(x)}\right)\right)$, X= ln(x), m= β and c= -β

$$Y = mX + C \quad (7)$$

$$\alpha = e^{-\left(\frac{c}{\beta}\right)} \quad (8)$$

According to Eq. (8) characteristic life (a) is the time or the number of cycles at which the population is expected to fail.

EXPERIMENTATION

Specimen of the composite material prepared by filament winding process available in the lab. Most common properties reported for fiber-reinforced polymers are those obtained from tensile testing of specimen. In the tensile test, the specimen was subjected to increasing tensile force while simultaneous observations were made on the elongation of the specimen. In this research tensile tests were carried by National Ordnance laboratories (NOL) ring test [11, 12]. NOL ring test was performed on specimen samples to measure tensile test in different orientation. NOL ring specimens were prepared using drum winding technique on a CNC filament winding machine. Physical evaluation of the composite test specimens was carried out to ensure the suitability for mechanical property evaluation. NOL-ring test on samples were carried out at room temperature using universal testing machine with load cell of 100kN and loading speed of 2mm/min. Width and thickness of each NOL-ring specimen was measured with help of micrometer. In this prepared specimens were elongated till rupture with help of test fixture, made according to ASTM D2290. NOL-ring test fixture setup is shown in FIGURE 1.

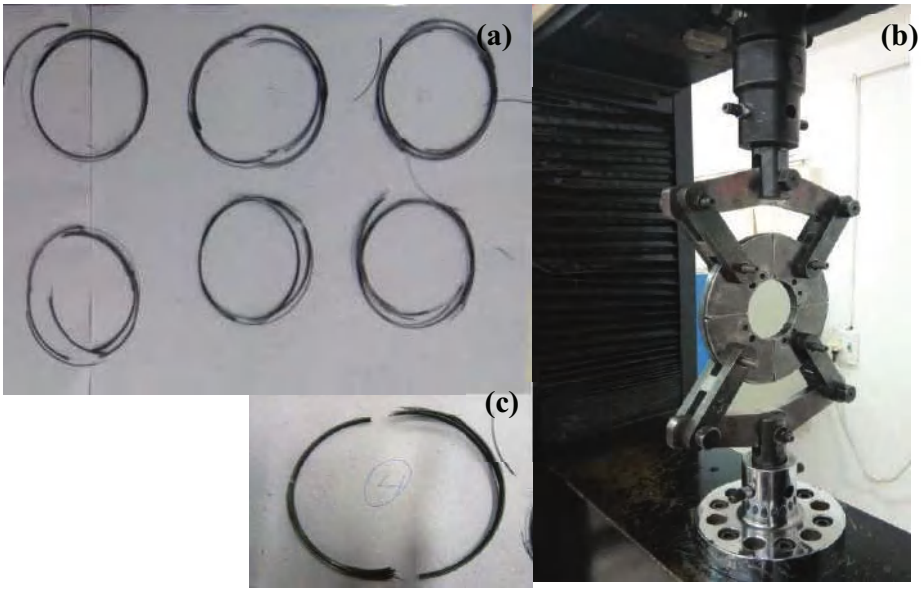

FIGURE 1. NOL Ring Test (a) Sample (b) Experimental set up (c) Fractured Sample

Composite specimen NOL-Ring test can be perform on Universal Testing Machine Instron 4505 available in the lab. The system is made up of a load frame, in which a specimen of the test material is mounted as shown in FIGURE 1. Applies a tension load to the specimen, and a control console that provides the calibration, test setup, and test operating controls. The crosshead control network allows programmable crosshead speeds and provides digital control of the crosshead position. The operating mode of the console data entry and readout functions can be SI units, as selected by a switch. A CPU-controlled sensor conditioner in the load weighing system allows calibration and balance procedures to be performed automatically. The sensor conditioner provides both an unranged analog and an automatically ranged digital load signal output suitable for several types of optional readout devices. Loading continues up to fracture of ring specimen.

RESULTS AND DISCUSSION

NOL Ring test simulate hoop conditions and measure hoop stress of the ring. It should be noted that the tensile strength, σ can be determined with help of equation 9.

$$\sigma=\frac{Fd}{2t} \qquad (9)$$

In equation (9) F is the ultimate burst force recorded in Newton (N), whereas t and d are the thickness and diameter of the NOL-ring sample in millimeter (mm), respectively according to ASTM D2290 standard. FIGURE 2 shows a typical force-displacement diagram at ambient temperature for one typical sample. The tensile strength of composite rings were determined for each experiment according to equation (9). The average values for each experiment are shown in TABLE 1. Displacements of all samples were around 6.5-8.8 mm of the tensile tests. From the results shown in the table can be observed that NOL-ring specimen No2 with tensile strength of 1962.4 MPa had shown the best results. Control system in filament winding technology is important factor in better winding patterns which is the main reason of high strength. Winding parameters during manufacturing of full section composite parts is influenced the strength [13].

Constructed histogram of fracture strength of the composite as shown in FIGURE. 3. From the histogram it is observed that the maximum frequency of repetition of failure stress is between 1675-1725 MPA with good frequency. Use the test data to construct Weibull distribution curve for analysis. Weibull distribution calculated probability of failure as per equation (2). Using this data construct a Weibull distribution curve in a software develop in house. Failure Censored was given at 2000 MPA, Total experimental values are 23. Probability plot for failure was drawn by least squares method. Plot shown in FIGURE. 4. Characteristics of Weibull distribution was calculated and tabulated in TABLE. 2.

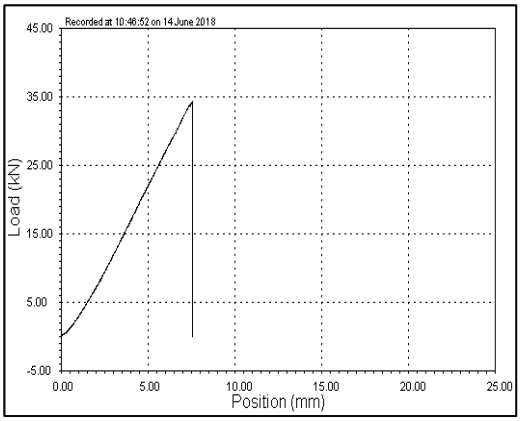

FIGURE 2. Load Vs Displacement of NOL ring test

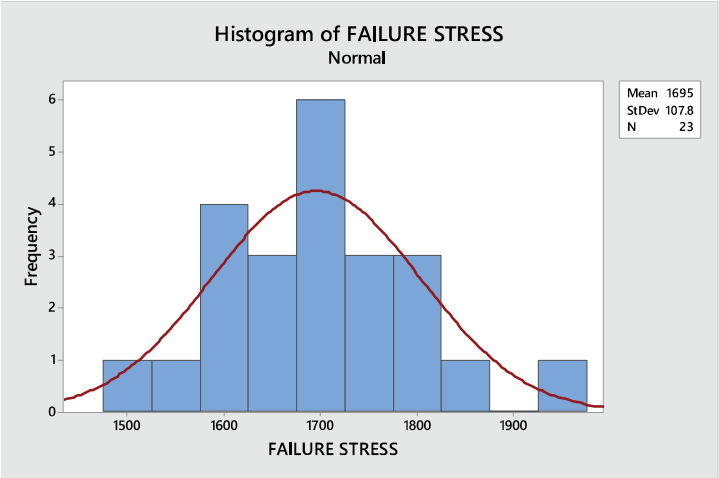

FIGURE 3. Histogram for fractured strength

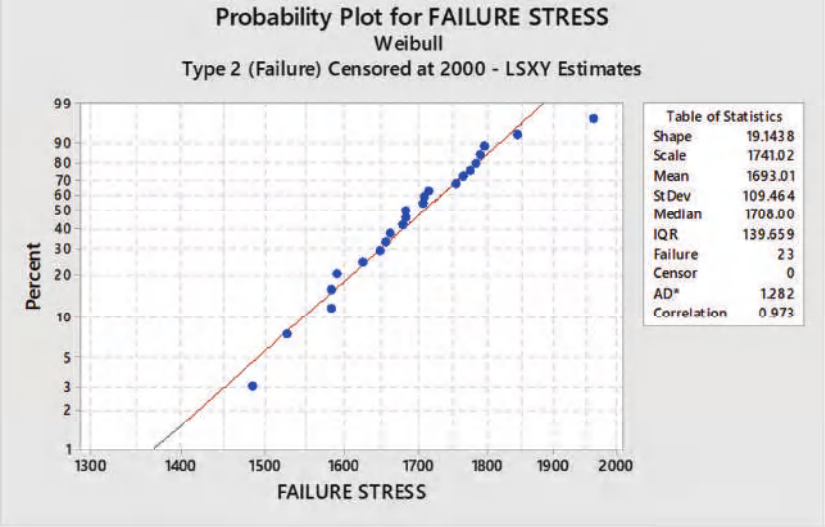

FIGURE 4. Weibull distribution Curve

TABLE 1: NOL ring test output data

S.NO.	SPECIMEN DIMENSION (mm)	MAXIMUM DISPLACEMENT (mm)	MAX. LOAD (KN)	NOL (MPa)
1.	6.46 x 1.58	7.589	34.257	1678
2.	6.57 x 1.55	8.842	39.963	1962
3.	6.60 x 1.55	7.488	32.367	1582
4.	6.50 x 1.57	8.091	36.204	1774
5.	6.58 x 1.59	7.986	35.889	1715
6.	6.45 x 1.56	7.909	35.486	1764
7.	6.48 x 1.58	8.345	36.726	1794
8.	6.54 x 1.60	8.263	36.708	1754
9.	6.49 x 1.61	8.152	37.248	1783
10.	6.47 x 1.60	7.644	34.848	1683
11.	6.60 x 1.60	8.269	38.117	1845
12.	6.60 x 1.62	7.779	36.499	1707
13.	6.33 x 1.63	7.219	33.513	1624
14.	6.56 x 1.65	7.780	36.420	1682
15.	6.64 x 1.66	8.227	39.437	1789
16.	6.49 x 1.49	6.393	29.507	1526
17.	6.52 x 1.52	6.168	29.400	1483
18.	6.38 x 1.54	6.618	31.092	1583
19.	6.52 x 1.54	7.176	34.289	1708
20.	6.48 x 1.53	7.068	32.919	1660
21.	6.59 x 1.60	7.082	34.737	1648
22.	6.72 x 1.60	7.151	34.211	1591
23.	6.56 x 1.53	7.059	33.211	1654

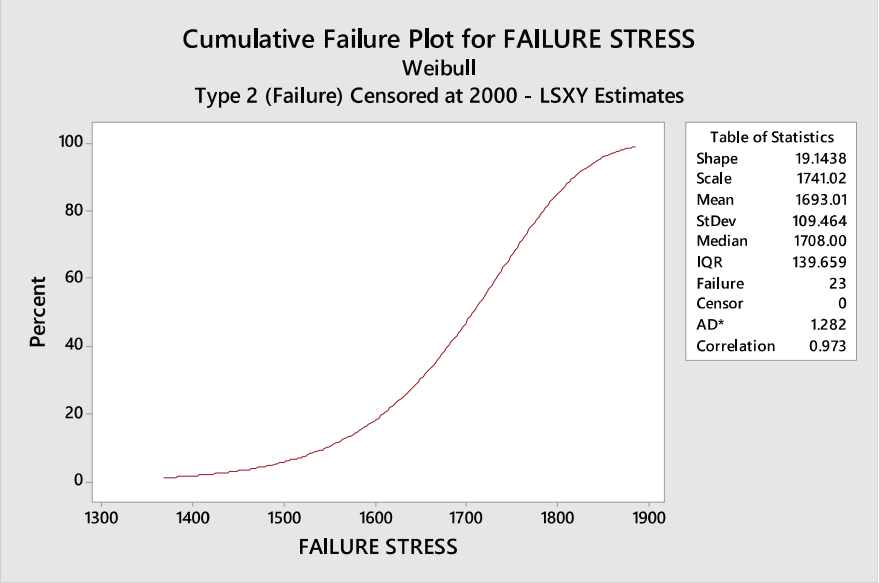

FIGURE 5. Cumulative Failure curve

Weibull distribution curve has set with calculated characteristics. Constructed cumulative failure plot shown in FIGURE.5. Calculated probability of failure stress from the curve and tabulated in TABLE. 3. It shows the probability

of failure (Px) at different stress (σ). Similarly constructed survival plot which shows the safety criteria for allowable stress in FIGURE. 6. Probability of Survival or Reliability (Rx) at different stresses are given in TABLE 4.

TABLE 2. Characteristics of distribution curve

	Estimated
Mean(MTTF)	1693.01
Standard Deviation	109.464
Median	1708.00
First Quartile(Q1)	1631.32
Third Quartile(Q3)	1770.98
Interquartile Range(IQR)	139.659

TABLE 3. Probability of Failure stresses

P_x	σ	P_x	σ	P_x	σ
1	1369.13	10	1547.93	91	1822.80
2	1419.99	20	1609.81	92	1827.35
3	1450.77	30	1649.74	93	1832.28
4	1473.13	40	1680.99	94	1837.68
5	1490.81	50	1708.00	95	1843.71
6	1505.48	60	1733.08	96	1850.65
7	1518.08	70	1757.98	97	1858.94
8	1529.13	80	1784.84	98	1869.60
9	1539.00	90	1818.54	99	1885.60

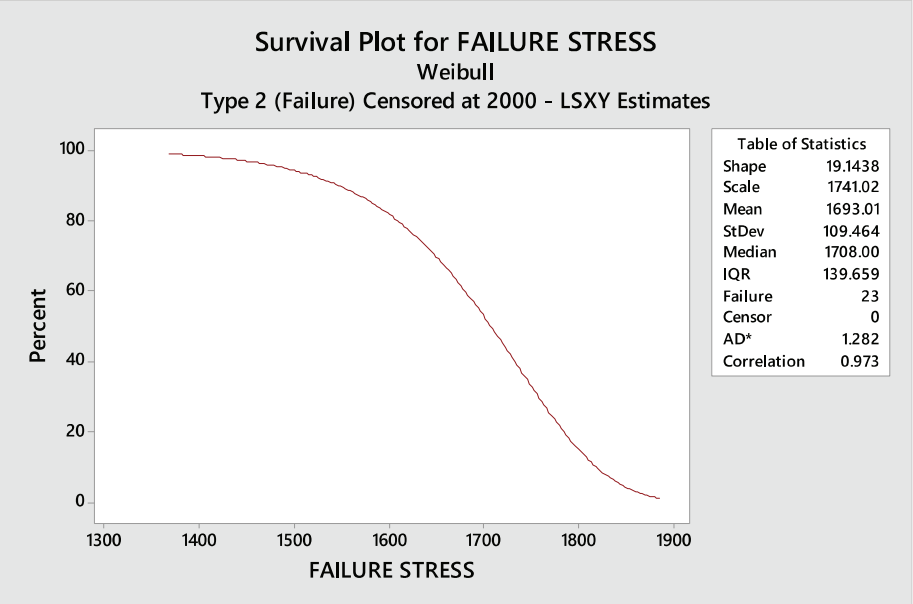

FIGURE 6. Probability of survival curve

TABLE 4. Parametric survival stresses

STRESS (MPA)	PROBABILITY OF SURVIVAL (%)	STRESS (MPA)	PROBABILITY OF SURVIVAL (%)
1380	99.0375	1590	83.8581
1380	98.8375	1620	77.7412
1410	98.2505	1650	69.9245
1410	98.2505	1680	60.3435
1440	97.3935	1710	49.2216
1440	97.3935	1740	37.1994
1470	96.1565	1770	25.367
1470	96.1565	1800	15.0718
1500	94.3934	1830	7.45171
1530	91.9158	1860	2.88685
1560	88.4926	1890	0.810291

CONCLUSION

Based on the experimental and analytical study it was found that the material could bear a stress of 1380 MPA without getting deformation with less than 1% failure chances. Failure stresses and reliability of any material can be predicted using Weibull Analysis. Maximum frequency of repetition of failure stress is between 1675-1725 MPA. The reliability stress data was forecasted that up to 1530 MPA probability of survival or reliability of the composite is more than 90%. Stress more than 1800 MPA reliability of the material was very less found to be less than 15%. This observations can be effectively utilize in designing of the CFRP for any applications.

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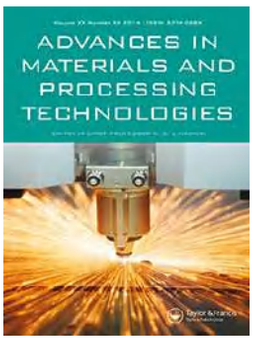

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Predictive study of Inconel718 mechanical properties at sub-zero temperatures

Jayahari L, Hussaini SM, Dinesh Varmaa & Srividyadevi P

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Predictive study of Inconel718 mechanical properties at sub-zero temperatures

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ABSTRACT

Inconel has applications in nuclear, chemical industry, aircraft and gas turbines due to their excellent mechanical properties in static and dynamic conditions. This study characterised Inconel 718 and predicted mechanical properties at sub-zero temperature. Experiments are conducted on the tensile specimens at different process parameters like temperature ranging from room temperature to −70°C, strain rate of 0.01/s and orientations in Rolling, 45° and transverse direction, and studied the fracture surface of the specimens to understand the mechanical behaviour of materials using a Scanning Electron Microscope. This study mainly focuses on calculation of the properties from tensile stress–strain graph at different temperatures. Using these properties trained an Artificial Neural Network (ANN) model to predict mechanical properties of the material at different temperatures, and validated the ANN output data with experimental data. Predicted values have very good correlation with actual values.

ARTICLE HISTORY
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KEYWORDS
Inconel 718; tensile testing; fracture study; artificial neural network

1. Introduction

In the present-day industry, there have been an increase in demand for materials with exceptional mixture of high strength, toughness and resistant to corrosion. Nickel-based superalloy is mostly used in critical applications now a days. They have been applied in the field of aircraft, power generation, turbines, rocket engines, nuclear power plants and other application [1].

Inconel 718 is a nickel-based super alloy, which is precipitated hardened nickel chromium iron-based superalloy developed by H. L. Eiselstein of International Nickel Company [2]. Inconel 718 has FCC microstructure and is a polycrystalline Ni-base wrought super alloy consisting of significant amount of Fe, Nb and Mb with lesser amount of Ti and Al, and it can be manufactured by conventional melting and casting techniques. Inconel 718 shows good mechanical properties with corrosion resistance. These alloys are well known for their creep – rupture strength and oxidation resistant at higher temperatures due to the contents of Chromium and Molybdenum [3]. Xiaoming Zhao et al. [4] investigated that Inconel 718 was prepared using Laser rapid forming from the gas atomised and plasma-rotated electrode preparation powders and evaluated for

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mechanical properties comparing GA and PREP methods, and their facture surfaces were checked to understand the difference in properties. Appa Rao et al. [5] have studied a specific process of hot isostatic pressing (HIP) route unfortunately due to microstructural phases in material has decreased ductility strength of the material when compared with wrought alloy. Janaki Ram et al. [6] studied that the mechanical properties of Inconel 718 sheet when welded using the electron beam welds and compared its properties between post weld ageing and non-aged welds. This study concluded that the aged weldments were inferior to the base metal and have showed lower tensile and stress rupture properties. Shi-Hong Zhang et al. [7] has studied the mechanical properties of Inconel 718 with varying alpha phase content. It is found that the strain-hardening exponent was reported higher when compared to deformation methods. The flow stress behaviour of Inconel 718 is studied by Guary mahalle et al. [8] depending on the variation of temperatures and slightly variant with the strain rates. As per study with increase in temperature, the difference between ultimate strength and yield strength increases, which improves workability of Inconel 718 and also studied the SEM micrographs of the broken test samples which confirms the ductile fracture at high temperatures. The complex interdependence of microstructure, composition, heat treatment and its effect on Inconel 718 alloy mechanical properties were studied. The main result of the analysis is an increase in Ti-content (by weight percent)in alloy composition, an increase in yield strength but a decrease in the percentage of elongation, which also decreases in the properties of stress rupture. High cycle fatigue properties were investigated at the cryogenic temperatures with a mean gamma grain size of 25 mm, and studied the SEM micrographs at various temperatures 4,77, 293°k and observed that Crack initiation is varied from various temperatures [9]. Sandeep et al. [10] investigated the mechanical properties at 0, −25, −50°C with different crosshead velocities in three orientations like Rolling, Nominal and Transverse direction. The objective of this project is to quantify the tensile properties by using Taguchi robust design. HRB335, HRB400 reinforcing steels mechanical properties Jian Xie et al. [11] investigated at various cryogenic temperatures −165 to 20°C. Author observed that ultimate tensile strength and yield strength increase with decreases in temperatures from room temperature to sub-zero temperatures and decreases the fracture strains. Ageladarakis et al. [12] studied the tensile properties at Room and Cryogenic Temperatures and also analysed the fracture behaviour with the help of Scanning Electron Microscope, which confirms toughness of fracture increases with decreasing of temperatures. Evaluating and comparing the mechanical properties of ASS316L at 0, −25, −50°C in 00, 450, 900 orientation to rolling directions with different cross head velocities and found that, the plastic behaviour of ASS316L strain rate is more impact compared to variation of temperatures [13,14]. R.L. Tobler [15] Tensile properties and fracture behaviour of Inconel 718 at cryogenic temperatures range from 295 to 4k, and he found that at −270°C, the yield strength is 20% greater than the room temperature.

The material properties of austenitic stainless steel 304 are predicted by using artificial neural networks (ANNs) with input data deformation conditions and vary in % elongation. In this, back-propagation algorithm was used, which gave the good performance in plastic region with accurate data set found at 0.9339 [16,18]. Huang and P.L. Blackwell [19] predicted the mechanical properties of super plastic Inconel 718 by using the ANNs, and it was successfully trained and tested by giving input variables temperatures, orientations and

the strain rate. The output of the model was used to predict the unknown outputs at certain point by the trained and existed input and models. H. Monajati et al. [20] studied steel sheets. ANN was used to describe the effect of process parameters for the determination of mechanical properties by giving the input variable data and ANN trained, which helps in determining the predictions of mechanical properties at the intermediate stages of the variables. In this, Feed forward back propagation neural network is used with a set of 19 parameters. The wear behaviour of the IN706 super alloy was investigated and Osman Palavar et al. [21] developed ANN model to predict weight loss after wear tests. It provides good results in determining weight loss values. ANN was developed on the basis of the biological and mathematical models. These methods were used to predict the outputs corresponding to a certain input value. Lade et al. [22] observed that during the characterisation of high strength material ASS 304, the material showed small regions of work hardening patterns, and there was some anisotropy of the material. ANN was mostly used in the simulation, modelling and prediction. Jayahari et al. [23] investigated that ASS 304 at room temperature is lower than that at other temperatures. At elevated temperatures, microstructure of the samples shows comparatively coarse grains than that at room temperature.

The present work investigates the deformation behaviour of cold-rolled Inconel 718 sheet using tensile specimens, which were subjected to tensile force at sub zero temperatures ranging from room temperature to −70°C in the intervals 15°C at a strain rate of $0.01/s^{-1}$. Inconel materials are used mainly in aerospace applications where materials exposed to different temperatures from higher temperatures few hundred °C to lower temperature around −100°C. The main idea is to study the behaviour of Inconel 718 at sub-zero temperatures up to −70°C. Microstructure study of the fracture surface using a Scanning Electron Microscope was carried out. ANN model was developed and trained using experimental results and predicted mechanical behaviour at different temperatures, and validated the ANN model with standard data.

2. Materials and experimental

2.1. Materials and specimen

Inconel 718 is an alloy from the Ni-Cr family of super alloys. It is used for specific applications like Turbine rotor, gas turbines blades, mostly used in applications where the high temperatures are involved. The chemical composition evaluated by optical emission spectrometry is shown in Table 1. In this study, the tensile samples were cut by wire cut

Table 1. Chemical composition of Inconel 718 alloy.

Element	Ni	Cr	Nb	Mo	Fe	Other
Wt %	50.63	18.966	4.786	3.214	19.80	Rest

Table 2. Mechanical properties of Inconel 718 sheet as received.

Base Metal	Density (g/cm^3)	Young's modulus (GPa)	UTS (MPa)	Yield Strength (MPa)	%Elongation	Poisons Ratio
Inconel 718	8.19	29	965	550	30	0.294

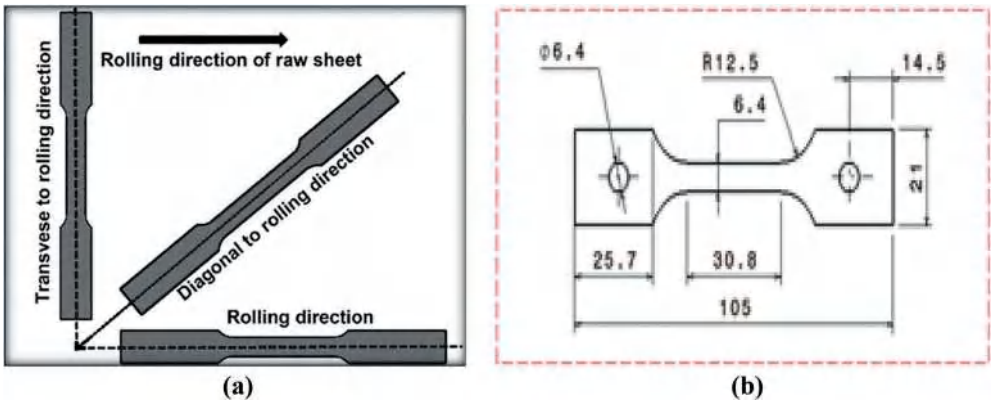

Figure 1. (a) Specimens in three directions (b) Tensile specimen dimension as standard [24].

Figure 2. Experimental setup specimen at subzero temperature inside cooling chamber.

EDM from a cold-rolled sheet of Inconel 718. The samples were cut in three different directions namely Rolling, Nominal and Transverse direction measured with respect to the rolling direction. The dimensions of the specimens are as per ASTM E08/E8M-11 [24].

2.2. Tensile experimentation

The experiments were done on a precision Universal Testing Machine (UTM) at room and sub-zero temperatures. The temperatures used were Room Temperature, 0, −15, −30, −45, −60, −70°C. Experiments were conducted on uniaxial tensile test at these temperatures with various process parameters like Strain rate (0.01/s)

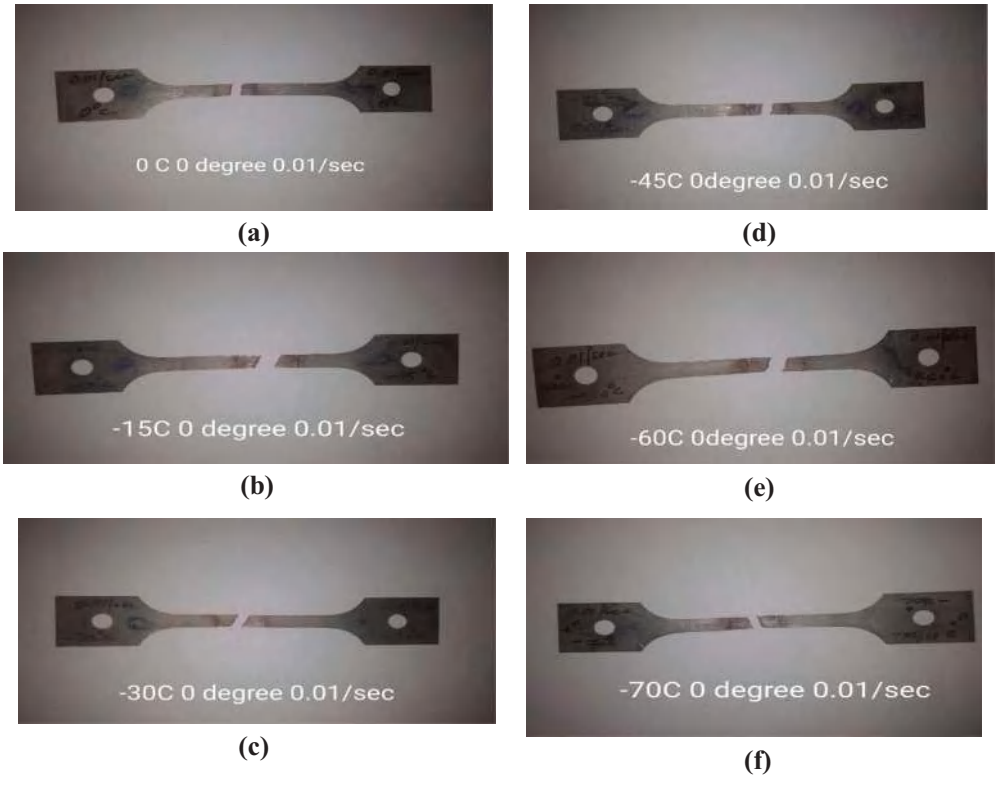

Figure 3. Fractures specimens for SEM analysis.

and Orientation (0°, 45°, 90°) with rolling direction. The experimental setup is as shown in the figure with specimens at subzero temperatures in the chamber of the Universal testing machine and plotted the true stress and strain graphs and estimated various parameters and properties.

2.3. Fractography and ANN model

The specimen used in the tensile experiment was taken from fracture specimen. A small piece of 6 mm width was cut using a wire cut EDM machine possessing at one edge to the fracture surface. This specimen was then etched using Acetone agent to clear the fracture surface. This specimen was then placed under the SEM microscope, and the images of the fracture surface were taken.

ANN contains a group of dispensation factors that are extremely interconnected and converts a set of input values to get a set of desired output values. The outcome of this transformation is determined by means of element characteristics connected with the associated weights between them. Figure 4 shows that the ANN is trained, in a way that specific inputs lead to the certain target. By adjusting the weights between the neurons & elements, functional performance was attained. The desired outputs were achieved by adaptive neural network with modifying connecting nodes. Not like professional structures, that can provide the user with a definitive solution if the characteristics, which are reviewed

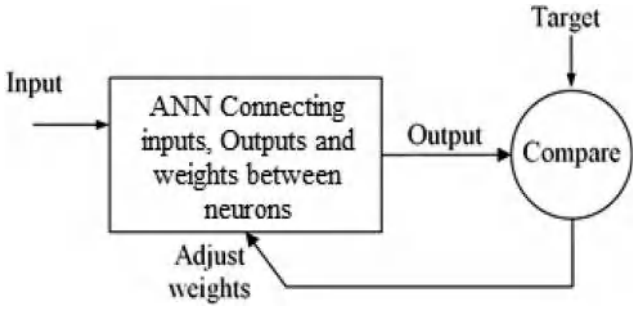

Figure 4. Block diagram of ANN training with DATA set.

precisely, fit those that have been coded in the rule base, a neural network conducts an evaluation of the records and presents a probability estimate that the facts match the characteristics, which it has been skilled to recognise.

The neural network can be very much accurate with the decisions that fully rely on the experience of the system gains while determined by the probability of the match for the stated problem in evaluating the samples. Initially, the network gains the knowledge by correctly training the system to identify the problem from the pre-selected samples. The reaction of the neural network is reviewed, and the configuration of the device is subtle until the neural network's evaluation of the training data reaches to the stage of satisfaction. In addition to the preliminary training duration, the neural network also gains experience over time as it conducts analyses on records related to the hassle.

3. Results and discussion

3.1. Fractography analysis

Figure 5 shows the scanning electron microscope (SEM) images of fractured surfaces of specimen. The fracture surface shows dimples, which represent ductile nature of materials. As the temperature decreases intensity and size of dimples are same or enhances, which is evident that as the temperature decreases ductility of materials does not decrease. At −45°C, the size of dimples appeared on fractured surface is small in size but higher in number, which shows that ductility at this temperature is improved further, than higher temperatures. It is evident that as temperature decreases, material does not become brittle but still it is ductile even at −70°C. The dimples on fracture surface indicate near-complete ductile fracture by cup and cone formation. It is believed that fracture occurred along the interface of the grains. With decrease in temperatures size of the plane of fracture, de-bonding was observed at some locations, which cause ductile fracture. Ductility of the material affected by the elemental transformation and changed in the phases by deformation at lower temperatures [25]. Strength–ductility trade off happened in multiple compositional high-entropy phases materials at cryogenic temperatures. Inconel 718 is a multi-compositional alloy, elements like Nb and Mo, may cause structure and energy change at lower temperatures. This leads to change in properties and nature of the materials.

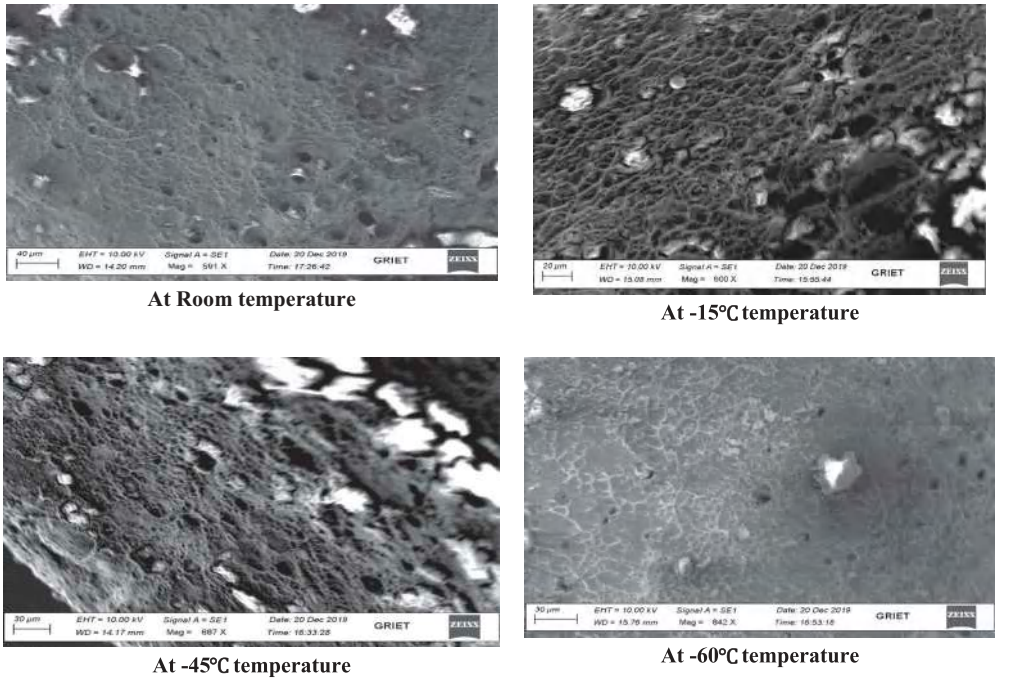

Figure 5. SEM micrographs of Inconel718 specimens at 90° orientation and 0.01/sec strain rate.

3.2. Artificial neural network

The Experimental data are trained using the ANN model to predict the target data with feed forward back propagation algorithm. Input data comprises temperature and orientation (placement angle) of about 18 samples & output data of 15 samples each comprises of target data i.e. Young's modulus(E), Yield stress, Ultimate tensile strength (UTS) MPa, % Elongation, Strength Coefficient (K), Strain hardening exponent (n) as shown in Table 3. These were taken to train the network. The network response was very promising; hence,

Table 3. Sample tensile properties of materials.

Operating temperature	Orientation (placement Angles) in	Young's Modulus (E) Gpa	Yield stress, MPa	Ultimate tensile strength (UTS) Mpa	% Elong-ation	Strength Co-efficient (K) Mpa	Strain hardening exponent (n)
26	0	13.271	381.269	759.597	67.334	13.2143	0.1535
26	90	13.72	398.884	770.255	68.369	6.9524	0.2443
26	45	12.679	403.518	769.881	69.796	6.1343	0.2599
0	0	7.85	432.329	803.163	82.623	9.9055	0.1932
0	90	11.04	425.037	801.379	71.577	16.2875	0.124
0	45	10.597	461.606	807.637	72.617	9.9125	0.1844
−15	0	11.259	414.851	769.881	70.999	3.6626	0.3028
−15	90	9.514	439.994	809.007	71.616	1.8539	0.1907
−15	45	16.591	422.563	812.429	71.681	3.7378	0.285
−30	0	10.155	434.167	821.74	70.001	4.2995	0.2778
−30	90	9.555	452.701	820.942	70.579	2.9244	0.3172
−30	45	11.68	457.584	826.816	74.042	3.3387	0.3023
−70	0	14.046	442.062	853.99	69.868	2.2512	0.3654
−70	90	14.142	475.854	871.686	70.073	9.3026	0.1993
−70	45	11.854	477.632	850.619	70.962	0.2936	0.6454

a new input of unknown temperature can be given to the network to predict the properties of the material as the outputs.

Back Propagation (BP) algorithm was used for training the neural network for iterations. The ANN was to predict the mechanical properties of 718 alloy fabricated by equal channel angular pressing. A back-propagation (BP) algorithm was used to train the neural network prediction models. The ANN predictions were shown to be in excellent agreement with experimental results, and the prediction error was shown to be minimal. These models can also be extended in the future to predict other properties, and possibly characterise other alloys. The gradient method used in the BP algorithm for training process in NN needs a continuously differentiable objective function. To optimise the ANN by minimising the mean squared error, which is considered as the fitness function, a function can be written to accept the network, weights and biases, inputs and targets. This function may return the mean squared error based on the outputs and the targets.

Figures 6 and 7 show the performance plots for the trained, test and validation data. The MSE is minimised for the trained data and the best validation is achieved at epoch 2. The trained ANN model gives an excellent correlation coefficient and mean square error values, which represents a good accuracy of the model. A two-layer feedforward network is created and trained to estimate the material properties for this system using MSE. The network's performance is measured according to the mean of squared errors. Figure 8 shows the goodness of fit for the predicted values. The good ness of fit calculations using the training data obtained from the polynomial function of equation with the order 6.

Linear model Poly6:

$$f(x) = p1^{*}x^{6} + p2^{*}x^{5} + p3^{*}x^{4} + p4^{*}x^{3} + p5^{*}x^{2} + p6^{*}x + p7 \quad (1)$$

Where x is normalised by mean 222.4 and std 305.9

Coefficients (with 99% confidence bounds):

p1 = 7.081 (−1.976, 16.14)

p2 = −27.03 (−65.15, 11.08)

p3 = 16.62 (−23.13, 56.36)

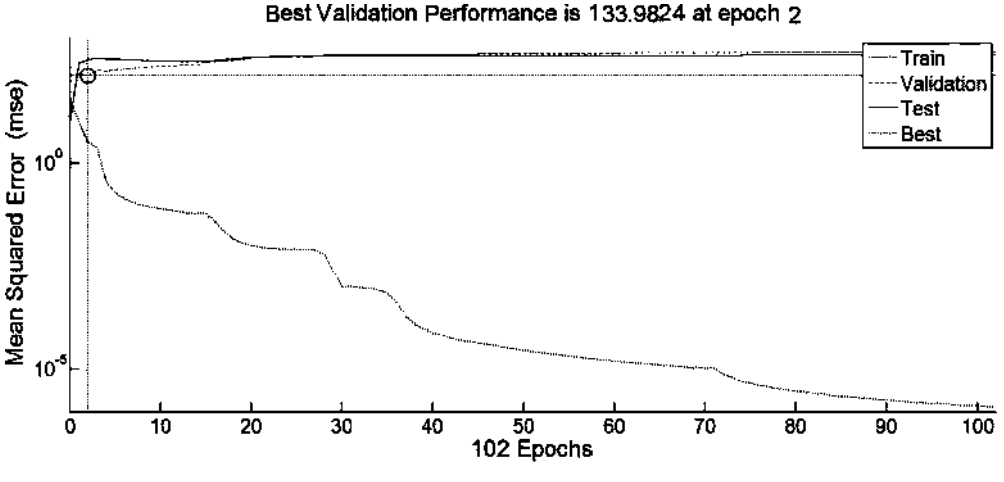

Figure 6. Performance plot with best validation at epoch 2.

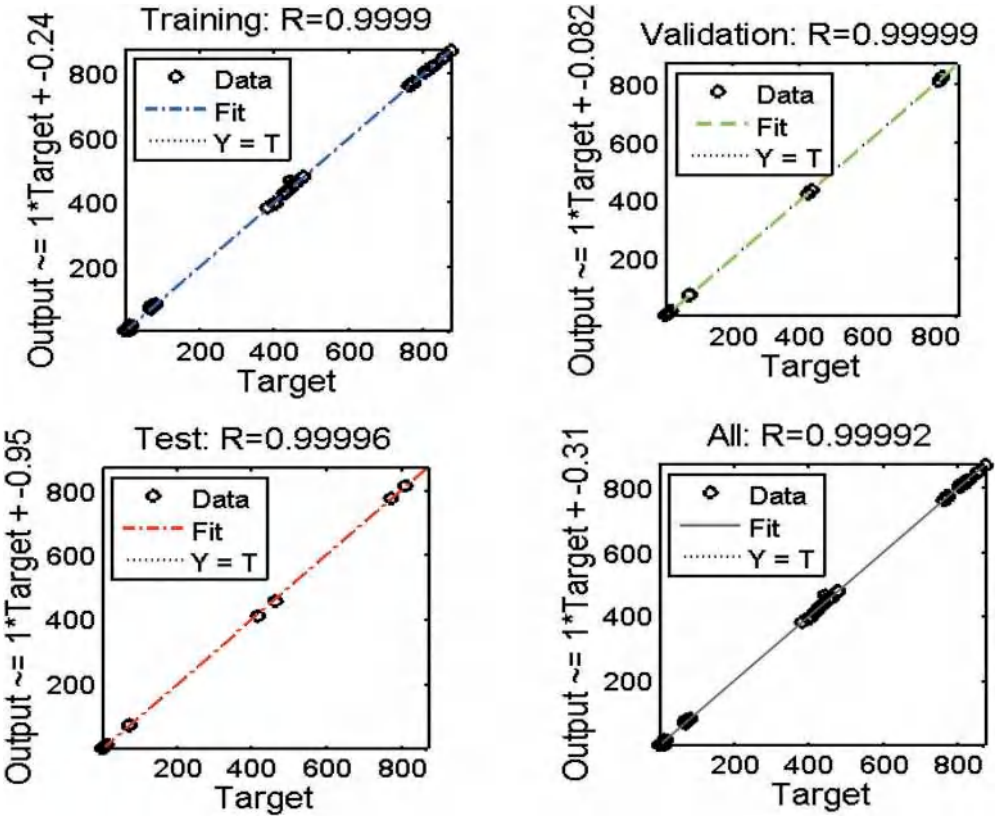

Figure 7. Performance plots w.r.to output Vs target for training, testing and validation data.

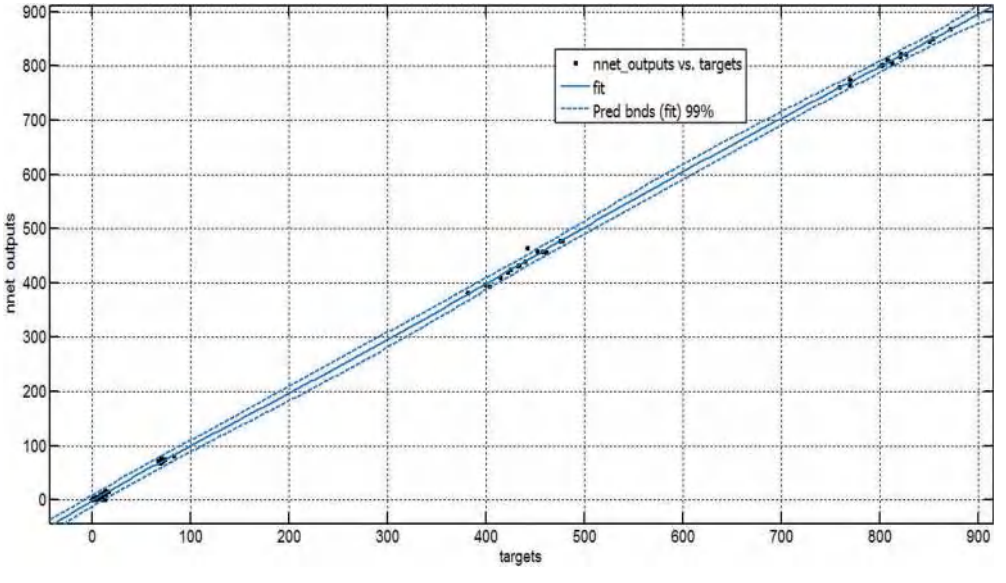

Figure 8. Curve fitting of the ANN outputs vs targets with 99% prediction band fit.

p4 = 26.96 (1.449, 52.48)
p5 = −15.04 (−53.32, 23.24)
p6 = 298.6 (292.6, 304.7)
p7 = 224.2 (216, 232.4)

The Goodness of fit:
Sum of squares due to error (SSE): 564.9
R-square: 0.9999
Adjusted R-square: 0.9999
RMSE: 2.609

4. Conclusion

This work involves the prediction of material properties and fracture analysis of Inconel 718 alloy at sub-zero temperatures.

- Normally as the temperature decreases material strength increases and loose its ductility but Inconel 718 materials ductility does not reduce by decreasing temperature, instead its ductility enhances at sub-zero temperature.
- Analysis is carried out for predicting the material properties by ANN model with minimised MSE values. The proposed model has become a robust tool for the prediction of mechanical properties at sub-zero temperatures.
- Analysis is carried out to estimate the mechanical properties for different temperatures at various orientation, obtained from the simulation. ANN model has good reliability in prediction validated by MSE.

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Disclosure statement

No potential conflict of interest was reported by the authors.

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MULTIPATH TRUST DETECTION ROUTING IN MANET

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Abstract - Mobile ad-hoc network is a self-organizing, infrastructure less network in which mobile nodes communicate using wireless channel. In MANET, the network created by the mobile nodes is dynamic in nature i.e. it is not confined to a particular topology because devices are free to move independently. Since there is no centralized node for monitoring in MANET routing path needs to be found dynamically. In this scheme we propose a novel multipath trust route approach to detect multiple malicious by implementing a route reply reverse tracing technique to help in achieving the stated goal. Proposed system helps us in defending against the multiple attack without any requirement of hardware and special detection node. This paper has been prepared keeping in mind that it needs to prove itself to be a valuable resource dealing with both the important core and the specialized security issues in this area.

Keywords - MANET, Security, Trust Management in MANET, Route trust, Path trust

I. Introduction

MOBILE ad hoc networks (MANETs) represent complex distributed systems that consist of wireless mobile nodes that can dynamically and freely self-organize into arbitrary and temporary ad hoc network topologies. This allows people and devices to seamlessly internetwork in areas where no pre-existing communication infrastructure exists, for example disaster recovery environments. The unique characteristics of MANETs, such as dynamic topology and resource constraint devices, pose a number of nontrivial challenges for efficient and lightweight security protocols design. Due to the lack of centralized identity management in MANETs and the requirement of a unique, distinct, and persistent identity per node for their security protocols to be viable, DoS attacks pose a serious threat to such networks.

Active Attacks

Recently, there has been an increasing interest in mobile ad hoc networks (MANETs), which are composed solely of mobile nodes. Since such self-distributed networks do not require pre-existing base stations, they are expected to apply to various situations such as military affairs and rescue work in disaster sites. In MANETs, if a normal node becomes malicious owing to an attack from outside the network, the malicious node tries to disrupt the operations of the system. In this case, the user who has the malicious node operates normally but the malicious node does various attacks (e.g. DoS attack such as blackhole attack).

An active attack attempts to alter or destroy the data being exchanged in the network there by disrupting the normal functioning of the network. Active attacks can be internal or external. External attacks are carried out by nodes that do not belong to the network. Internal attacks are from compromised nodes that are part of the network. Since the attacker is already part of the network, internal attacks are more severe and hard to detect than external attacks. Active attacks, whether carried out by an external advisory or an internal compromised node involves actions such as impersonation, modification, fabrication and replication. We focus our work on network layer attacks such as Black hole attack and Denial of Service attack.

Black hole attack. The black hole attack has two properties. First, the node exploits the mobile ad hoc routing protocol, such as AODV, to advertise itself as having a valid route to a destination node, even though the route is spurious, with the intention of intercepting packets. Second, the attacker consumes the intercepted packets without any forwarding. However, the attacker runs the risk that neighboring nodes will monitor and expose the ongoing attacks. There is a more subtle form of these attacks when an attacker selectively forwards packets. An attacker suppresses or modifies packets originating from some nodes, while leaving the data from the other nodes unaffected, which limits the suspicion of its wrongdoing.

Denial of Service attack Denial of service (DoS) is another type of attack, where the attacker injects a large amount of junk packets into the network. These packets overspend a significant portion of network resources, and introduce wireless channel contention and network contention in the MANET. For example, consider the following Fig. 3. Assume a shortest path exists from S to X and C and X cannot hear each other, that nodes B and C cannot hear each other, and that M is a malicious node attempting a denial of service attack. Suppose S wishes to communicate with X and that S has an unexpired route

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X in its route cache. S transmits a data packet toward X with the source route S --> A --> B --> M --> C --> D --> X contained in the packet's header. When M receives the packet, it can alter the source route in the packet's header, such as deleting D from the source route. Consequently, when C receives the altered packet, it attempts to forward the packet to X. Since X cannot hear C, the transmission is unsuccessful.

S ↔A↔ B↔ M ↔C↔ D↔ X

Figure 1: Denial of Service attack

A DoS attacker can cause damage to the ad hoc networks in several ways. For example, a Sybil attacker can disrupt location based on multipath routing by participating in the routing, giving the false impression of being distinct nodes on different locations or node-disjoint paths. A chance to consider a reason for pernicious node attacking top-k inquiry handling. Fundamentally, noxious nodes endeavor to disturb inquiry issuing node's obtaining of the worldwide top-k result for a long stretch, without being distinguished. In any case, DoS attacks in MANETs have been effectively concentrated on for long years, and subsequently, utilizing existing methods, such attacks can be uncovered by the question issuing node then again middle nodes. Here, a wonderful normal for top-k question handling is that the inquiry issuing node does not know the worldwide top-k come about. In order to identify the malicious the novel Multiple Routes Trust Discovery processing method maintains query data item results, such as k highest scores along with multiple routes and reply route information enable to detect attacks. In addition, the route reply messages incorporate information about route and along with reply messages which are forwarded, so that the query-issuing node can distinguish the data items that properly belong to the message. The query issuing node narrows down the attack nodes based on the received message information and along with the request information on the data items, during identifying the malicious in a network and in this manner, the query-issuing node can discover the malicious node.

First we analyze an attack model of DoS, in such attacks the attack replaces data items with some fake data, we analyze suck kind of attacks to detect multiple malicious nodes using novel **Multiple Routes Trust Discovery** process. In order to determine multiple malicious nodes in a MANET we propose a novel **Multiple Routes Trust Discovery** which helps to identify malicious, the proposed model describes an attack model to determine route efficiency, we simulate this model to determine the accuracy and efficiency.

The remainder of this paper is organized as follows. In Section II we review the related work to the area of trust-based routing protocols. Section III provides problem definition. Section IV presents our novel trust-based routing protocol details the solution and describes the designed protocol. Section V shows the experimental study. Section VI we study the performance of our new protocol. Finally, Section VII concludes our work and provides future research directions.

II. Related Work

Pirzada et al. define a trust mechanism [1] for a reactive routing protocol. They propose a model in which each node in an ad-hoc wireless environment maintains an evaluation procedure to reward or punish nodes in future collaborations. The evaluation generates trust values, which are based on transactions' history and the forwarding quality, that are shared with other nodes to choose a trust path. However, the proposal in [1] does not employ any measures to protect the evaluations conducted by the nodes and any malicious node can access these trust values and harm the routing functionality.

B. Chen, W. Liang et al. [2] have proposed methods to reduce energy consumption and traffic in unstructured P2Pnetworks or wireless sensor networks, by enabling nodes to filter unnecessary data items. However, these methods do not protect against DRA, and are unsuitable for use in MANETs, because they are not adapted to node mobility.

Raihana Ferdous et al [3] have proposed a Cluster head(s) selection algorithm based on an efficient trust model. This algorithm aims to elect trustworthy stable cluster head(s) that can provide secure communication via cooperative nodes. However the way the messages passed through may overload the Cluster head, creating a bottleneck due to additional message exchanges. Another possible limitation is the way that the message authentication between intermediate Cluster heads are treated, where there can be a delay in identifying a malicious neighboring node.

D. Amagata et al. [4] proposed a security of top-k queries in MANETs, in which data items are ordered according to a particular attribute score, and query-issuing nodes acquire the data items with the k highest scores in the network (the global top-k result). A large number of nodes participate in processing a top-k query in MANETs by both sending their own data items with high scores and relaying data items to the query-issuing node. Computational cost is high.

Although the above mentioned contributions provide important discussions that tackle various aspects of trust-based routing protocols, none of them has addressed the support of privacy in these protocols. We focus on this problem in this paper.

III. Problem Definition

However, DoS attacks in MANETs have been actively studied for long years, and as a result, using

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existing techniques, such attacks can be exposed by the query-issuing node or intermediate nodes. Here, a remarkable characteristic of top-k query processing is that the query-issuing node does not know the global top-k result beforehand.

MOBILE ad hoc networks (MANETs) represent complex distributed systems that consist of wireless mobile nodes that can dynamically and freely self-organize into arbitrary and temporary ad hoc network topologies. This allows people and devices to seamlessly internetwork in areas where no pre-existing communication infrastructure exists, for example disaster recovery environments. The unique characteristics of MANETs, such as dynamic topology and resource constraint devices, pose a number of nontrivial challenges for efficient and lightweight security protocols design. Due to the lack of centralized identity management in MANETs and the requirement of a unique, distinct, and persistent identity per node for their security protocols to be viable, Sybil attacks pose a serious threat to such networks.

IV. Multiple Routes Trust Discovery or Path Trust

Multiple route discovery approach discovers the multiple trust routes to select highest trust path routing to compensate for the dynamic and unpredictable nature of ad hoc networks. We have designed a multipath trust routing protocol based on the trust information of the node involved. To calculate path trust, the RREQ and RREP packets are modified so that they contain the trust value of the node from which the packet is received. Both packets are changed because during route discovery a node transmits the RREQ packet by broadcasting. A node knows only the node from which the packet is received, not the node to which it is to be transmitted. Therefore, the RREQ packet is modified to incorporate the previous node's trust value and the RREP packet is modified to incorporate the next node's trust value. In initial process the route discovery process broadcast RREQ packet to corresponding neighbours. In order to identify the neigbhor node trust, the proposed protocol organizes the RREQ packet header with trust field, the trust field p, the p represent trust path of each route,

$$RREQ : \{Srcid, Destid, Seqnum, TTL\}||p\ trust.$$

After broadcasting the RREQ packet, the source node sets a timer whose time period T is equal to the 1-way propagation delay and is calculated using formula given below:

To calculate route trust, the RREQ and RREP packets are modified so that they contain the trust value of the node from which the packet is received. Both packets are changed because during route discovery a node transmits the RREQ packet by broadcasting. A node knows only the node from which the packet is received, not the node to which it is to be transmitted. Therefore, the RREQ packet is modified to incorporate the previous node's trust value and the RREP packet is modified to incorporate the next node's trust value.

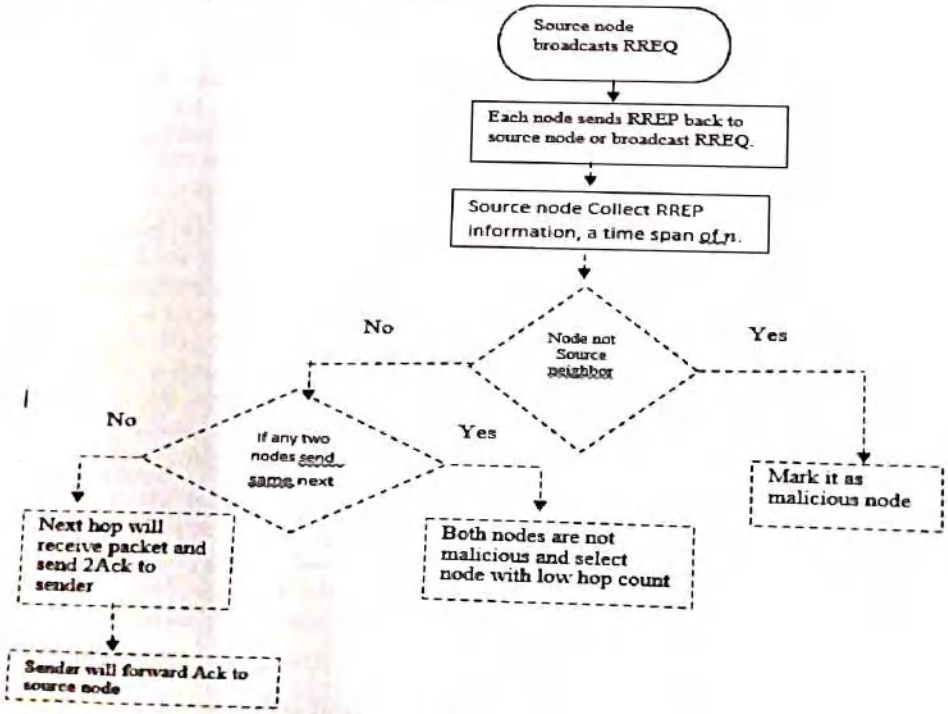

Figure2: Flowchart of the Proposed Scheme

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A. Route Trust Calculation

At a given time 0 t , we take a close look at node A and node B. Here we assume at certain time 0 t their velocity vectors are V1 and V2 respectively.

A as a stationary node and node B as a moving node, then we can calculate the relative velocity vector of node B to node A as $V = V_2 - V_1$ (1)

We take A as the reference node, from the view of node A, node B moves at a relative velocity V

A period time t, node B will travel out of the transmission range of node A, the relative movement track is $B \rightarrow B$

tdifs DCF interframe space

tbo backoff time

tdata delay for transmitting the data packet

tsifs short interframe space

tack delay of acknowledge

Te slot time in IEEE 802.11

tRTS delay of a RTS packet

tCTS delay of a CTS packet

L number of retries

B queue size

1. The delay of attempting to transmit a single packet over a link is

$$t_{packet} = T_c + t_{bo}$$

2. The delay associated with the transmission attempt, Tc, is equal to the delay associated with a successful transmission, Ts:

$$T_c = T_s = t + t_{data} + t_{siffs} + t_{ack}$$

3. The mean total delay for one single packet with L retries is then approximately

$$t_{packet-L} = L + 1 . T_c + \sum t_{bo}$$

4. The trust rate TRout out of queue when each packet has to be transmitted L times

$$TR_{out} = \min \left[\frac{1}{t_{packet-L}} , R_{in} \right] = \min \left[\frac{1}{(L+1).T_c + \sum t_{bo}} , R_{in} \right]$$

5. The total routing time is: $t_{rerouting} = t_d + t_e$

The RREP packet header is modified such that it contains two fields p trust and n trust in addition to other fields. The updated RREP is:

where p trust is assigned from the RREQ packet received at the destination and n trust is initialized to 0. It has the same significance as p trust in the RREQ packet and denotes the trust value of the path up to that node from the destination.

Algorithm 1- RREQ Trust

1: /* Receive a rreq message */

2: If node Nq receives a RREQ for the first time then

3: Store rreq path and hop counts as its Parent RREQ path

4: Compute the delay of single transmitting packet t_{packet}

5: Set RD for replying data items

6: /* Send the rreq message to neighbour nodes */

7: Add NNrreq, s node ID, t_{packet} to the end of RREQ path

8: Send the rreq query to neighbor nodes

9: else

10: Compute the mean total delay TR_{out} for one single packet with L retries and hop count as its Neighbor RREQ Query path

11: Store the node ID at the end of RREQ Query path as its neighbour

12: end if

In reply message algorithm, the replying node *Mr* sends a reply message when its The mean total delay $t_{packet-L}$ time has passed. Here, REP signifies an reply message what's more, REP. Forwarding Route node signifies the sending routes list comprising of (Sender node ID, dest node ID), which means the set of sender and next node list, and *R* means the most extreme number of reply messages to be re-sent. The replying node *Mr* chooses the following node from its neighbouring nodes, which has the least hop count and least overlap between its re*lying node RREP path and the sender node's RREQ path

Algorithm 2- Sending a Reply Message

1: /* Sends a reply message after t_{packet} time has elapsed */

2: /* Select a node to send a reply message */

3: **for** each Neighbor **do**

4: **if** Neighbor's hopCount is the minimum **then**

5: Insert Neighbor into DestNode

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6: **end if**

7: **end for**

8: If DestNode > 1 **then**

9: Select a Neighbor whose Neighbor RREQ path least overlaps with the parent Query path as a DestNode

10: end if

11: Add the local top-k result to REP

12: **for** i = 0 to 1 do **do**

13: **if** i = 0 **then**

14: Add source node to received REP Forward node route FR and send

REP to source node

15: **else if** i = 1 **then**

16: Add (Replying node Mr , DestNode) to received REP. Forwarder Route and send

REP to DestNode

17: **end if**

18: **end for**

19: /* Receive a reply message */

20: Send ACK to the sender node of REP

21: **if** before $t_{packet-L}$ **then**

22: Store REP

23: **else if** after $t_{packet-L}$ and reply node Mr receives a data item with higher score than with the kth-highest score among data items already sent **then**

24: Send REP including new local top-k result to parent node and DestNode

25: **end if**

26: /* Resend the reply message */

27: **if** Mr does not receive ACK from its parent by waiting time for retransmission and the number of retransmis sions < R **then**

28: Resend REP to parent

29: **else if** Mr does not receive ACK from DestNode by waiting time for retransmission and the number of retransmissions < R **then**

30: Resend REP to DestNode

31: **else if** the number of retransmissions > R **then**

32: /* Mr detects the disconnection of radio link */

33: **if** Mr has sent REP to all Neighbor **then**

34: Discard REP

35: **else if** Mr knows a Neighbor whose Neighbor Query path includes DestNode **then**

36: Send REP to the Neighbor

37: **else**

38: Select randomly a Neighbor among Neighbors which have not been selected yet

39: Send REP to the Neighbor

40: **end if**

41: **end if**

B. Malicious Node Detection

After the query-issuing node, *Mp*, receives all the reply messages, it detects a routing attacks according to Detection attack Algorithm. Each node calculates the local reputation scores of other nodes from correctness of received data, and computes the trust score TR_{out} information in the network. Then, each node calculates the global reputation score from its own and received local trust scores. At last, it determines the node whose global score is lower than a threshold as the malicious nodes. The proposed method in which each node manages the reputation values of its neighbouring nodes in MANET.

Algorithm – Attack Detection

1: /* After the source node receives all reply messages */

2: INPUT: Top-k Result, REPs

3: OUTPUT: SendRoute

4: SendRoute← Ø ;

5: **for** each REP **do**

6: **for** each Top-k Result **do**

7: **if** REP. forwarder route FR includes the node ID of a node processing

a data item in Top-k Result and REP.Data does not

include the data item **then**

8:Update a route from the node with the missing data

item to the query-issuing node into SendRoute

9: **end if**

10: **end for**

11: **end for**

12: **if** SendRoute ≠ Ø ; **then**

13: Detect Attack

14: **end if**

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C. Malicious Node Identification

The malicious node identification structured in three different stages such as 1. The initial query issuing node step; 2. The reverse tracing step; and 3. the shifted to reactive defense step, The first two steps are initial proactive defense steps, whereas the third step is a reactive defense step. A. Initial query node Step The goal of the query node phase is to entice a malicious node to send a reply RREP by sending the query node RREQ' that it has used to advertise itself as having the shortest path to the node that detains the packets that were converted. To achieve this goal, the following method is designed to generate the destination address of the query node RREQ'. The source node stochastically selects an adjacent node, i.e., nr , within its one-hop neighbourhood nodes and cooperates with this node by taking its address as the destination address of the query node RREQ'.

Reverse Tracing Step The reverse tracing step is used to detect the behaviors of malicious nodes through the route reply to the RREQ' message. If a malicious node has received the RREQ', it will reply with a false RREP. Accordingly, the reverse tracing operation will be conducted for nodes receiving the RREP, with the goal to deduce the dubious path information and the temporarily trusted zone in the route.

V. Experimental Study

In this section, the performance of the proposed ARDDT approach and the existing trustbased routing mechanism of TSCP, TEDR in MANET. The metrics used for the performance evaluation of the proposed ARDDT approach and existing approaches are PDR, throughput, average delay and energy consumption rates. The proposed system is simulated with the network simulator-2 (NS-2) with the simulation parameters of Table 1.

No. of Nodes	50,100,150 and 200.
Area Size	1000 X 1000
Mac	802.11
RadioRange	250m
Simulation Time	20 sec
Traffic Source	CBR
Packet Size	512
Receiving Power	0.395
Sending power	0.660
Idle Power	0.035
Initial Energy	10.0 J
Attacks	Blackhole, Flooding Attacks
Data rate	2 Mbps

Table1 . Simulation Parameters

(1) Packet delivery ratio - data packets successfully delivered to the destination / data packets generated by the source,

(2) End-to-End Delay – the total time consumed that the data packet takes to reach from the source to destination vice versa,

(3) Routing packet overhead - the total number of control packets transmitted for each delivered data packet and

(4) Throughput – the average number of data packets transmitted per unit of time.

(5) Number of malicious detection rate: The total number of malicious predicted and detection is estimated

VI. Simulation Results

The performance of ARDDT protocol is analyzed and the observations are made with respect to the parameters of packet delivery ratio, End-to-End Delay, routing packet overhead and throughput. Fig. 5 demonstrates the performance of ARDDT protocol and TSCP at different moving speeds of mobile node with the traffic load of 4 packets/second

We evaluate mainly the performance according to the following metrics.

Average Packet Delivery Ratio: It is the ratio of the number .of packets received successfully and the total number of packets transmitted.

Average Routing overhead: It is the average number of routing packets by nodes.

Delay: It is the time taken by the packets to reach the receiver.

Average Throughput: It is the amount of successful message delivery over a node

A. Results and Discussion

The performance of MRDT protocol is analyzed and the observations are made with respect to the parameters of packet delivery ratio, End-to-End Delay, energy consumption and throughput. Fig. 2 demonstrates the performance of MRDT protocol and Top-k at different mobile nodes

According to Fig. 1, MRDT has the better packet delivery ratio than Top-k under different malicious nodes. Fig. 2 shows that end to end delay between the proposed MRDT protocol and Top-k, according to the fig-2, Top-k end-to-end delay rate increased when there are more number of attack nodes.

According to Fig. 3, MRDT performs slightly better throughput than TOP-k. The throughput of the both protocols decreases as the node speed increases.

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Figure 1- PDR- MRDT vs TOP-K

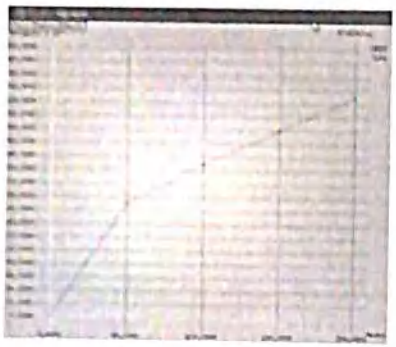

Figure 2- End-to-End Delay- MRDT vs TOP-K

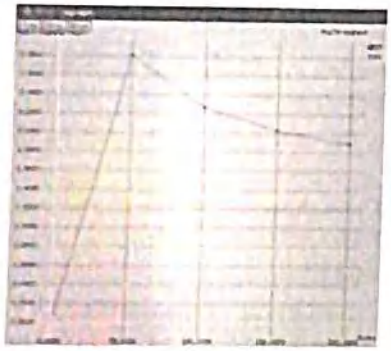

Figure 3- Average Throughput

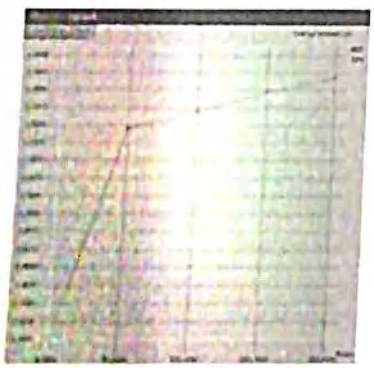

Figure 4 Energy Consumption

VII. Conclusion

In this paper, we have analyzed the security threats an ad-hoc network faces and presented the security objective that need to be achieved. On one hand, the security-sensitive applications of an ad-hoc networks require high degree of security on the other hand, ad-hoc network are inherently vulnerable to security attacks. Therefore, there is a need to make them more secure and robust to adapt to the demanding requirements of these networks. The flexibility, ease and speed with which these networks can be set up imply they will gain wider application. In this system, the methods for top-k query processing and malicious node identification based on node grouping in MANETs is proposed. In order to maintain high accuracy of the query result and detect attacks, nodes reply with k data items with the highest score along multiple routes. After detecting attacks, the query-issuing node narrows down malicious node and then tries to identify the malicious nodes through message exchanges with other nodes. When multiple malicious nodes are present, the query issuing node may not be able to identify all malicious nodes at a single query. It is effective for node to share the information about the identified malicious nodes with other nodes. In our method, each node divides all nodes into some groups by using the similarity of the information about the identified malicious nodes. Then, it identifies malicious nodes based on the information on the groups.

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CONCEPTS, OPPORTUNITIES & CHALLENGES IN 5G WIRELESS COMMUNICATION USING WI-FI AND LI-FI

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Abstract- Nowa days, Wireless technology playing an vitalrole in communication process. The main way we send and receive wireless data by using electromagnetic waves. However, these waves can support less bandwidth because of compact spectrum availability and intrusion. The solution to this problem is data transmission using Visible Light Communication (VLC).VLC applications include Li-Fi, vehicle to vehicle communication, robots in hospitals, underwater communication and information displayed on sign boards.The Li-Fi uses visible light for communication to provide high speed internet up to 10Gbits/s.Both Wi-Fi and Li-Fi transmit data over the electromagnetic spectrum, Where as Wi-Fi uses radio waves, Li-Fi uses visible light, Ultraviolet and Infrared. In Li-Filight is transmitted using a LED. It works as a Transmitter. And light detector works as a receiver,which can be placed in the phone, camera, tablet or PC.

Keywords-Wi-Fi (Wireless Fidelity), Li-Fi (Light Fidelity), VLC (Visible Light Communication), LED (Light Emitting Diode).

I. Introduction

Li-Fi is a bidirectional, high-speed and fully networked wireless communication technology similar to Wi-Fi.Li-Fi basically transmits data between two terminals using LEDs. The speed of data transmission was about 10 mbps. Wi-Fi uses radio waves for data transmission and communication between terminals proves fatal in areas like oil petroleum which can harm the environment causing vast destruction so to avoid such situation using of light in some area proves beneficial. Li-Fi is more secure as it does not allow data leakage[2].

II. Proposed System

In Li-Fi technology data transmission is done through light or LED. The working concept of Li-Fi will be categorized in two modules i.e. Transmitter and Receiver.

A Transmitter

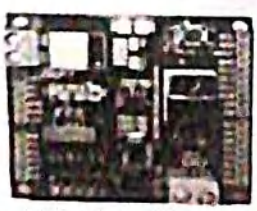

Figure 1:Working of Transmitter

Atthe transmitter section we use PC which contains MATLAB software. This MATLAB softwareconverts the data into its binary form and it also transmits the binary conversion to the receiver through LED. Next is the USB to TTL which is used so deal with the communication of a microcontroller. The microcontroller helps to generate square wave form from the binary data converted by MATLAB and inputs the square wave to the LED. Later which helps the LED to glow and allow transmission[1].

B. Receiver

Figure 2: Working Of Receiver

At the receiver section exact opposite operation of Transmitter takes place. The light received from the LED is captured by the photo diode. This photo diode works as a Sensor and passes the output to the Comparator which

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compares the binary input data.Similarly the original data is recovered using Mat labsoftware[1].

C. Visible Light Communication

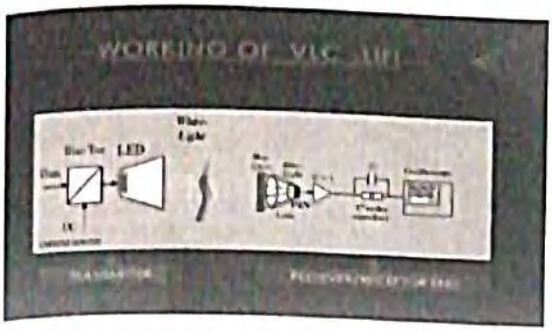


Figure 3: Visible Light Communication

Visible Light Communication (VLC) is a modern communication technology which employs visible light sources (LEDs). Li-Fi is implemented using LEDs. If the LED is ON we transmit a digital '1' and if the LED is OFF we transmit a digital '0'. The continuous flickering of LED helps in data travelling from one terminal to another[7].

Figure 4: Visible Light Communication

III. Block Diagram Of Li-Fi

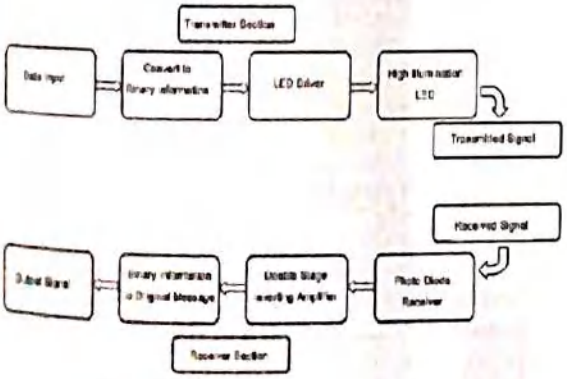


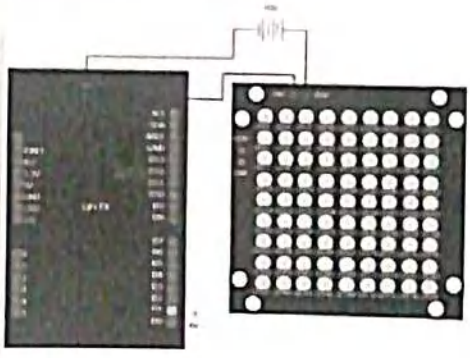
Figure 5 Block Diagram of Li-Fi

- **MICROCONTROLLER**: Microcontroller is low power, high performance 8bit CMOS microcomputer with 4kb of EPROM (Electrically Programmable Read Only Memory).
- **PC (Transmitter & Receiver)**: It is used to provide the operation of image processing to be done at the transmitter side for sending the input image and at the receiver side for reconstructing the sent image. This processing is done by using MatLab software in PC.
- **Phototransistor**: It produces some voltage at its output terminal connected to microcontroller when lights from LEDs fall on it. Phototransistor is a device that converts light energy into electric energy. Phototransistors are same as photo resistors that produce both current and voltage, where as photo resistors produce current only.
- **USB to TTL**: The cable is easiest way ever to connect to the microcontroller router serial solace port.
- **Comparator (LM358N)**: In electronics, a comparator is a device that equates two voltages or two currents and outputs a digital signal indicating larger voltage.

IV.Experimental Setup

Experimental setup basically comprises of transmitter setup and receiver setup.

A. Transmitter Setup



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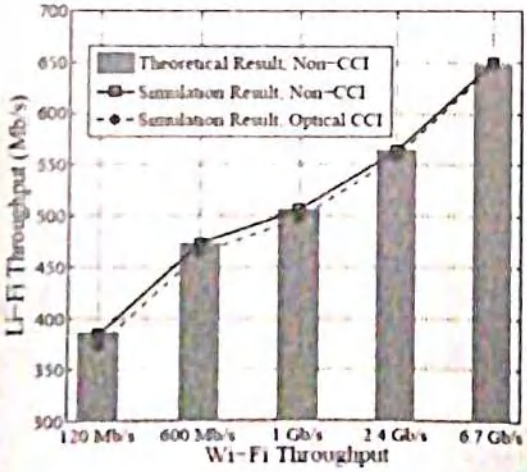
B. Receiver Setup

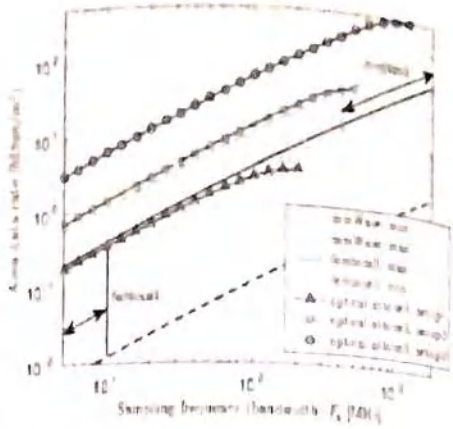
V. Results And Discussions

Using light as a data transmission medium helps to securely transmit data as it overcomes the problems of data leakage and efficiently transmit multimedia data over a medium. It uses Visible Light Communication technology[3]. Visible light communication using white LEDs offers the potential for such alternative. The main reasons are as follows.

- Bandwidth is not limited.
- Existing local power line infrastructure can potentially be utilized.

C. Communication Between Wi-Fi And Li-Fi





Following Table-I mentions comparison between Li-Fi and Wi-Fi.

Feature	Li-Fi	Wi-Fi
Full Form	Light Fidelity	Wireless Fidelity
Operation	Li-Fi transmits data using light with the help of LED bulbs.	Wi-Fi transmits data using radio waves with the help of Wi-Fi router
Interference	Do not have any interference issues similar to radio frequency waves.	Will have interference issues from nearby access points(routers)
Technology	Present IrDA compliant devices	WLAN 802.11a/b/g/n/ac/ad standard compliant devices
Applications	Used in airlines, Undersea explorations, Operation theatres in the hospitals, Office and Home premises for data transfer and internet browsing.	Used for internet browsing with the help of Wi-Fi kiosks or Wi-Fi hotspots
Merits(Advantages)	Interference is less, can pass through salty sea water, works in density region	Interference is more, cannot pass through sea water. Works in less density region

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Privacy	In Li-Fi, light is blocked by the walls and hence will provide more secure data transfer	In Wi-Fi, RF signal cannot be blocked by the walls and hence need to employ techniques to achieve secure data transfer.
Data transfer speed	About 1 Gbps	WLAN-11n offers 150Mbps, About 1-2 Gbps can be achieved using WiGig/Giga-IR
Frequency of operation	10 thousand times frequency spectrum of the radio	2.4GHz, 4.9GHz and 5GHz
Data density	Works in high dense environment.	Works in less dense environment due to interference related issues
Coverage distance	About 10 meters	About 32 meters (WLAN 802.11b/11g), vary based on transmit power and antenna type
System components	Lamp driver, LED bulb(lamp) and photo detector will make up complete Li-Fi system.	requires routers to be installed, subscriber devices(laptops,PDAs, Desktops) are referred as stations

V. Conclusion And Future Scope

Conclusion from the above implemented concept is data Transmission using light is cheaper and secured. We can use Li-Fi in future in which data for smart phones, tablets etc can be dealt using lights fitted in the room. Radio waves cannot be used by commuters in aircrafts. LED-based lights are already used in aircraft cabins and each of these lights could be potentials VLC transmitters to provide both illumination and media services for travellers. Moreover, this will reduce the aircraft construction costs and its weight [6]. Underwater ROVs (Remotely Operated Vehicles) operate from large cables that supply their power and allow them to receive signals from their pilots above. They could also use their front lights to communicate with each other, processing data independently and sending their information back to the surface [4].

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CONCEPTS, OPPORTUNITIES & CHALLENGES IN 5G WIRELESS COMMUNICATION USING WI-FI AND LI-FI

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Abstract- Nowa days, Wireless technology playing an vitalrole in communication process. The main way we send and receive wireless data by using electromagnetic waves. However, these waves can support less bandwidth because of compact spectrum availability and intrusion. The solution to this problem is data transmission using Visible Light Communication (VLC).VLC applications include Li-Fi, vehicle to vehicle communication, robots in hospitals, underwater communication and information displayed on sign boards.The Li-Fi uses visible light for communication to provide high speed internet up to 10Gbits/s.Both Wi-Fi and Li-Fi transmit data over the electromagnetic spectrum, Where as Wi-Fi uses radio waves, Li-Fi uses visible light, Ultraviolet and Infrared. In Li-Filight is transmitted using a LED. It works as a Transmitter. And light detector works as a receiver,which can be placed in the phone, camera, tablet or PC.

Keywords-Wi-Fi (Wireless Fidelity), Li-Fi (Light Fidelity), VLC (Visible Light Communication), LED (Light Emitting Diode).

I. Introduction

Li-Fi is a bidirectional, high-speed and fully networked wireless communication technology similar to Wi-Fi.Li-Fi basically transmits data between two terminals using LEDs. The speed of data transmission was about 10 mbps. Wi-Fi uses radio waves for data transmission and communication between terminals proves fatal in areas like oil petroleum which can harm the environment causing vast destruction so to avoid such situation using of light in some area proves beneficial. Li-Fi is more secure as it does not allow data leakage[2].

II. Proposed System

In Li-Fi technology data transmission is done through light or LED. The working concept of Li-Fi will be categorized in two modules i.e. Transmitter and Receiver.

A Transmitter

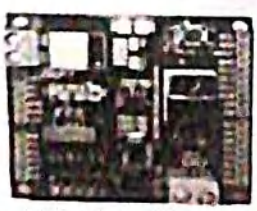

Figure 1:Working of Transmitter

Atthe transmitter section we use PC which contains MATLAB software. This MATLAB softwareconverts the data into its binary form and it also transmits the binary conversion to the receiver through LED. Next is the USB to TTL which is used so deal with the communication of a microcontroller. The microcontroller helps to generate square wave form from the binary data converted by MATLAB and inputs the square wave to the LED. Later which helps the LED to glow and allow transmission[1].

B. Receiver

Figure 2: Working Of Receiver

At the receiver section exact opposite operation of Transmitter takes place. The light received from the LED is captured by the photo diode. This photo diode works as a Sensor and passes the output to the Comparator which

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compares the binary input data.Similarly the original data is recovered using Mat labsoftware[1].

C. Visible Light Communication

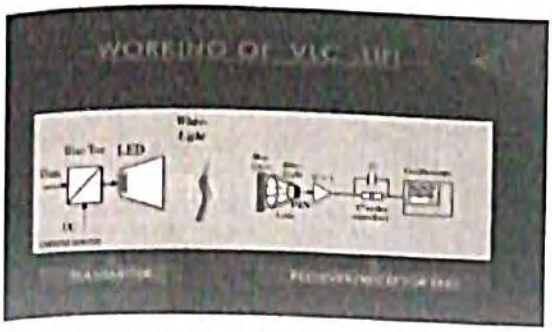


Figure 3: Visible Light Communication

Visible Light Communication (VLC) is a modern communication technology which employs visible light sources (LEDs). Li-Fi is implemented using LEDs. If the LED is ON we transmit a digital '1' and if the LED is OFF we transmit a digital '0'. The continuous flickering of LED helps in data travelling from one terminal to another[7].

Figure 4: Visible Light Communication

III. Block Diagram Of Li-Fi

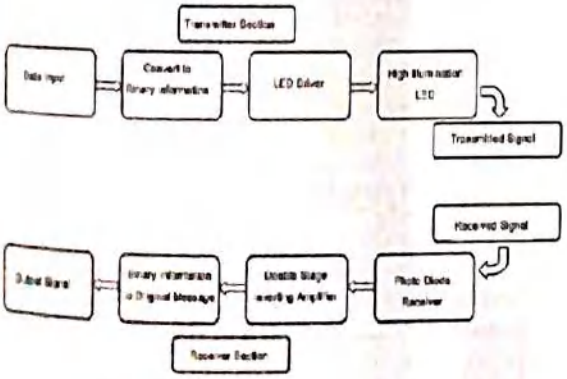


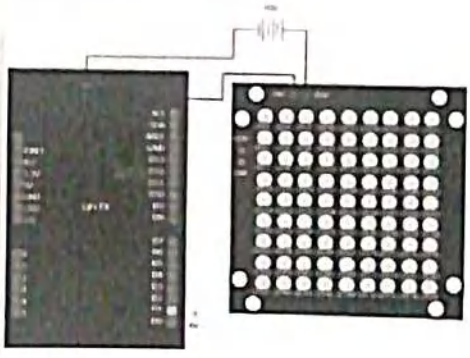
Figure 5 Block Diagram of Li-Fi

- **MICROCONTROLLER**: Microcontroller is low power, high performance 8bit CMOS microcomputer with 4kb of EPROM (Electrically Programmable Read Only Memory).
- **PC (Transmitter & Receiver)**: It is used to provide the operation of image processing to be done at the transmitter side for sending the input image and at the receiver side for reconstructing the sent image. This processing is done by using MatLab software in PC.
- **Phototransistor**: It produces some voltage at its output terminal connected to microcontroller when lights from LEDs fall on it. Phototransistor is a device that converts light energy into electric energy. Phototransistors are same as photo resistors that produce both current and voltage, where as photo resistors produce current only.
- **USB to TTL**: The cable is easiest way ever to connect to the microcontroller router serial solace port.
- **Comparator (LM358N)**: In electronics, a comparator is a device that equates two voltages or two currents and outputs a digital signal indicating larger voltage.

IV.Experimental Setup

Experimental setup basically comprises of transmitter setup and receiver setup.

A. Transmitter Setup



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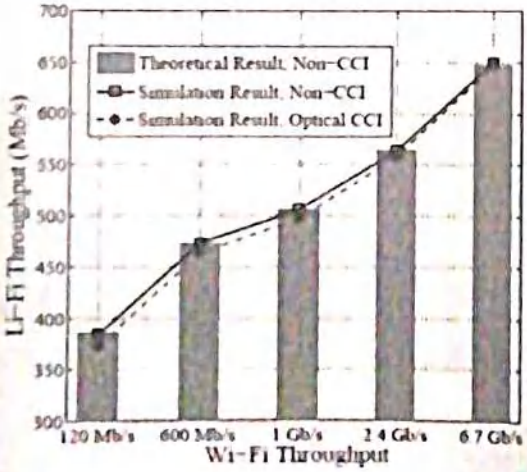
B. Receiver Setup

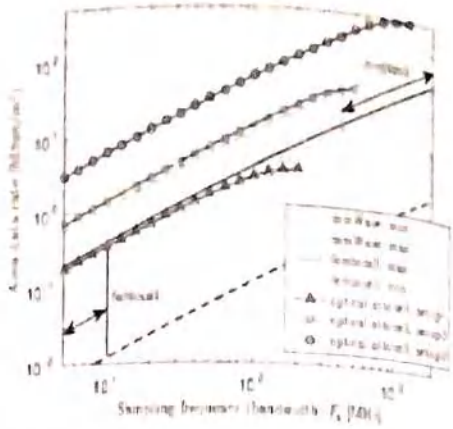
V. Results And Discussions

Using light as a data transmission medium helps to securely transmit data as it overcomes the problems of data leakage and efficiently transmit multimedia data over a medium. It uses Visible Light Communication technology[3]. Visible light communication using white LEDs offers the potential for such alternative. The main reasons are as follows.

- Bandwidth is not limited.
- Existing local power line infrastructure can potentially be utilized.

C. Communication Between Wi-Fi And Li-Fi





Following Table-I mentions comparison between Li-Fi and Wi-Fi.

Feature	Li-Fi	Wi-Fi
Full Form	Light Fidelity	Wireless Fidelity
Operation	Li-Fi transmits data using light with the help of LED bulbs.	Wi-Fi transmits data using radio waves with the help of Wi-Fi router
Interference	Do not have any interference issues similar to radio frequency waves.	Will have interference issues from nearby access points(routers)
Technology	Present IrDA compliant devices	WLAN 802.11a/b/g/n/ac/ad standard compliant devices
Applications	Used in airlines, Undersea explorations, Operation theatres in the hospitals, Office and Home premises for data transfer and internet browsing.	Used for internet browsing with the help of Wi-Fi kiosks or Wi-Fi hotspots
Merits(Advantages)	Interference is less, can pass through salty sea water, works in density region	Interference is more, cannot pass through sea water. Works in less density region

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Privacy	In Li-Fi, light is blocked by the walls and hence will provide more secure data transfer	In Wi-Fi, RF signal cannot be blocked by the walls and hence need to employ techniques to achieve secure data transfer.
Data transfer speed	About 1 Gbps	WLAN-11n offers 150Mbps, About 1-2 Gbps can be achieved using WiGig/Giga-IR
Frequency of operation	10 thousand times frequency spectrum of the radio	2.4GHz, 4.9GHz and 5GHz
Data density	Works in high dense environment.	Works in less dense environment due to interference related issues
Coverage distance	About 10 meters	About 32 meters (WLAN 802.11b/11g), vary based on transmit power and antenna type
System components	Lamp driver, LED bulb(lamp) and photo detector will make up complete Li-Fi system.	requires routers to be installed, subscriber devices(laptops,PDAs, Desktops) are referred as stations

V. Conclusion And Future Scope

Conclusion from the above implemented concept is data Transmission using light is cheaper and secured. We can use Li-Fi in future in which data for smart phones, tablets etc can be dealt using lights fitted in the room. Radio waves cannot be used by commuters in aircrafts. LED-based lights are already used in aircraft cabins and each of these lights could be potentials VLC transmitters to provide both illumination and media services for travellers. Moreover, this will reduce the aircraft construction costs and its weight [6]. Underwater ROVs (Remotely Operated Vehicles) operate from large cables that supply their power and allow them to receive signals from their pilots above. They could also use their front lights to communicate with each other, processing data independently and sending their information back to the surface [4].

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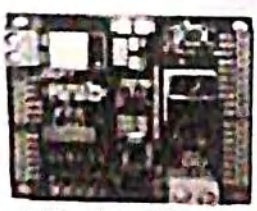

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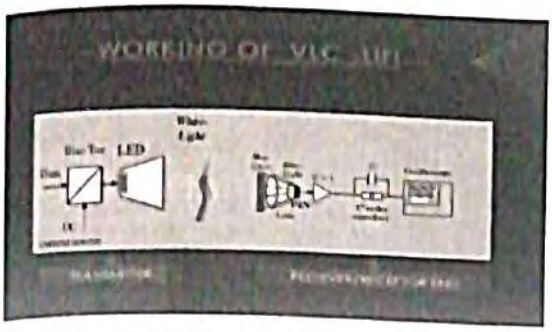

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Figure 4: Visible Light Communication

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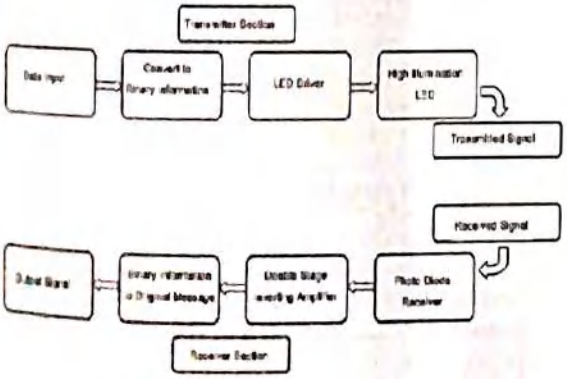

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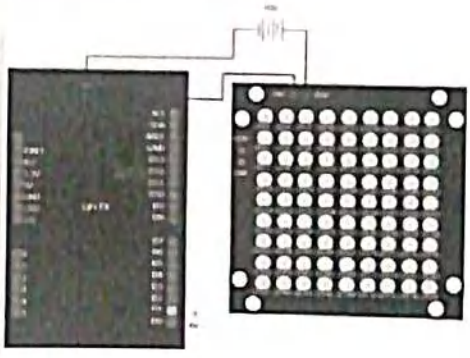

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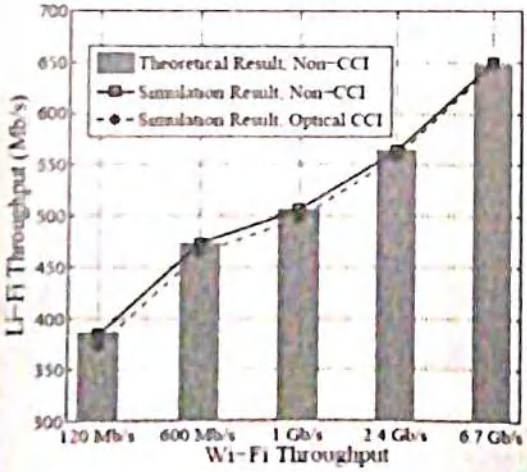

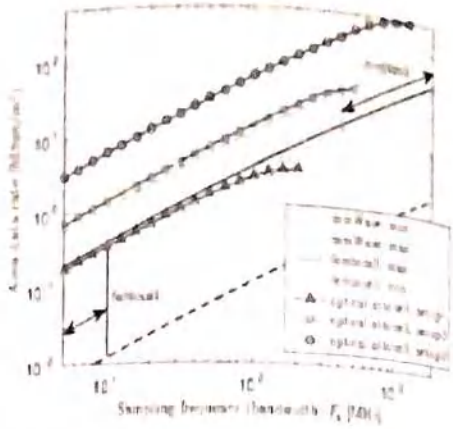

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Interference	Do not have any interference issues similar to radio frequency waves.	Will have interference issues from nearby access points(routers)
Technology	Present IrDA compliant devices	WLAN 802.11a/b/g/n/ac/ad standard compliant devices
Applications	Used in airlines, Undersea explorations, Operation theatres in the hospitals, Office and Home premises for data transfer and internet browsing.	Used for internet browsing with the help of Wi-Fi kiosks or Wi-Fi hotspots
Merits(Advantages)	Interference is less, can pass through salty sea water, works in density region	Interference is more, cannot pass through sea water. Works in less density region

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A HIGHLY SECURE CRYPTO – KEY MODEL (SCKM) FOR 4G/LTE NETWORKS

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Abstract: The fourth generation cellular networks are raising trend in the present world is the fourth generation (4G) cellular network. It is the result of the evolution termed as the long term evolution (LTE), hence also known as the 4G/LTE networks. The 4G/LTE network posse's extremely high data transfer speeds to handle the heavy loads of data. The high-speed attracts hackers and crackers to the networks, who always try to find the vulnerabilities in the existing networks to exploit them. In the performance evaluation of the existing models, we have evaluated that the predictive key management scheme, which is based upon the computational engine is more prone the hitch or guessing attack and can offer the early exposure to the hacking attempts over the non-predictive non-crypto scheme. In this paper, we have proposed the non-predictive crypto-key management scheme to ensure the security of the 4G/LTE networks. The proposed model has been named as highly secure crypto – key Model (SCKM) scheme.

Keywords: 4G/LTE security, authentication, pre-setup authentication, post-setup authentication, multi-level authentication, secure access

I. Introduction

Both 2G and 3G systems were basically anticipated for emphasize telephones; for voice calls and messages, as conflicting to information. The 4G LTE innovation covers a more far-reaching scope of frequencies and can possibly be up to 100 hundred times speedier than slower 2G and 3G systems, however this prolonged velocity includes some significant pitfalls - security. In any case, 4G was planned particularly to send and getting information, making it more prepared for the employment. While this makes it speedier, the systems taken to accomplish these paces additionally make it more vulnerable.

The elementary security issue with 4G systems is that client data can turn out to be fluently available to programmers. As they can put themselves either between two oblivious sufferers or between the client and the application or even between two machines. This gives the assailants full access to the information being sent over the system, and a few programmers might even control it.

A notable new jeopardy to flexible clients originates from the change to IP (Internet Protocol).Thorough multi-layer security ought to be a vital piece of any LTE to convey the level of security firm with the numerous points of interest of 4G [10].

4G versatile systems are all-IP, while 3G systems are a mix of IP and portable conventions (SS7). IP is significantly more transparent, and has been effectively battered by programmers for a long time, opening up various approaching dangers. There could be a colossal augmentation in the complexity and exhibit of spam and phishing assaults offering programmers new systems to convey, for example, through 'video spam' assaults. For instance, convenient administrators will soon be dispatching new administrations on top of 4G, including voice and video conferencing.

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The LTE system embraces an all-IP, Internet based configuration, offering much higher access speed (e.g., 100– 300 Mbps). In LTE, two voice solutions are proposed appropriately: CSFB (Circuit-Switched Fallback) [10] and VoLTE (Voice over LTE) [9]. LTE transporters have been utilizing a famous answer for voice supervision, called circuit-exchanged fallback (CSFB) [1]. It transfers LTE voice calls to the legacy 3G/2G arranges and empowers CS-based voice administration. CSFB influences the sent 3G/2G framework and its CS conveyance.

II. Related Work

Ivan Damgård et. Al. proposed technical administration protected key for cloud computing situations focusing on the safety levels on hypothesis and security models. Seddigh Nabil et. al. presents an assessment of safety advances and difficulties of advanced remote 4G rise treated with an overview on the 4G advanced remote security system and its difficulties Add to package association interface alongside the sender. On collector side, these novel codes will be confirmed utilizing code checking computation strategy.

This method uses random Key table of two, Alezabi, Kamal Ali,et.al proposed powerful EPS-Alias assention (EEI-AKA) to defeat these issues. The proposed Convention relies on upon the pass Exponential Key Exchange (SPEKE) straightforward tradition. [1]

Zongwei Zhou et. al. proposed "a Key administration calculation named as Key It Simple and Secure (KISS). This article presents another key modeling with extensive customer empower, reliable, clear, and key administration warned.

Ramaswamy Chandra mouli et. Al. took cryptographic key management issues and challenges in cloud services. A review of the basic condition of the routine cryptographic operations that give these security capabilities discovers that the administration of cryptographic keys multifaceted covers an additional quality in contrasting situations with large cloud computing situations of the company due to (a) individual distinction (between consumers and cloud providers) and (b) control of the foundations on which both the key management system (KMS).

N. Suganthi, V. Sumathy proposed the calculation of three kinds of keys for each sensor hub, an individual key communicated to the base station, imparted to neighboring sensor hub and a gathering of key that is shared by each of the centers in the system.

A question key, which carries an answer key K_A All of the keys in the table (question/answer keys) are generated using a random function which is non-track-able and non-trace- able. The new scheme will add least overhead because it will not generate key at every time. It will generate the key table on the starting phase and will share the key table with the neighbor nodes. Each node will share a key only during the first packet exchange of a packet stream between two mobile nodes. This scheme will be capable of handling both DoS and DDoS attacks.

Algorithm 1: Key generation

1. A large prime number is generated from the p and q which are classified as the large prime numbers. The minimum length acceptable for the large number generation has been set default to 512 values each and maximum of 1024 digits in both p and q.

2. Then modulus depicted n undergoes the Computation on the basis of input values of p and q.

3. Then the quotient is calculated n,Φ(n).

4. Further, The range is defined to produce the public key, where the range is denoted by [3, Φ (n))] and a common divisive value is assigned at 1 with Φ (n) and defined as the mandatory prime number value only.

5. In the next step, the private key defined on the basis of Φ (n), because of the existence of the prime number mentioned on step 4 as 1 with Φ (n) with respect to the modulus calculated as mod Φ (n).

The decryption is always done on the basis of opposite key combination used for the encryption methods.

III. Experimental Design

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In this paper, we offer a genuine change in the SAD-SJ technique to make it ready to secure the particular scrambling to react to numerous hubs undertaking to join the system in conjunction say (DDoS). This convention will create different arbitrary extraordinary codes and

Algorithm 2: RSA Enc/Dec Process

1. At very first step, the plaintext is transformed into the cipher wise information using the encoding method.

The key k and data d remains the primary inputs to the RSA function, which can be written as following

F(m,k)=mk modn(9)

2. The RSA produces the data in the form of two cases; one is the encryption with public key and other for private key. Both the methods can be termed as the mirrored methods to each other. Both the methods can be described with the following statements:

a. If encryption uses the public key, the decryption will be done using the private key.

b. If encryption uses the private key, the decryption will be performed with the public key.

3. The encryption method can be elaborated in form of following formulas: Fn(mx,ex)=md modulus(n=cx)

Where mx defines the plaintext message, ex for the public key and cx depicts the cipher data produced after the encryption process.

4. The decryption process can be elaborated in the form of following mathematical formula:

Fn(cx,dx)=cd_modulus_n=mx.

Primary Key Gen Algorithm: The proposed model is termed as the SCKM which uses the following mathematical equation for the purpose of the key table population generation.

Algorithm 3: Generate Key algorithm

1. Provide the input to the generation function which is depicted as the seed value S

2. The seed value undergoes the sin function and the sin value is returned.

3. Value obtained from Sx is returned and saved.

4. Then the seed value undergoes the calculation of LOG and the value is returned and saved in the corresponding variable.

5. Perform the multiplication over the values obtained in the Step 2, 3 and 4.

6. Do negation if it's negative.

7. The key is converted to non decimal

8. Further, the final key value is produced by rounding the value of Main Key produced variable produced at the step 7.

Key Management Policy

Algorithm 4: Key Scheme Algorithm Sequence for Function Calling

1. The LTE base station when receives the request for a call from some other nodes, it initiates the authentication process.

2. The mobile node who receives the request replies with the connection setup request.

3. If LTE base station (LTE-BS) replies to the setup request once it is accepted and the acknowledgement code is replies.

a. Then the LTE-BS asks for the pre-shared Information with mobile stations node.

b. The MT packs the pre-shared information in the packet and return to the LTE-BS.

4. If pre-shared information is successfully verified a. The communication successfully starts

5. Else

a. The communication request is rejected

6. Once the pre-setup phase is successfully completed a. The seed value is handed over to the MT

b. The seed value exchange bit enabled Assigning the positive bit.

7. The key exchange timer t is started

8. When the timer gets expired

a. The key exchange is performed

9. If key matches successfully

a. The communication begins successfully.

10. Else

a. Communication is terminated.

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Robust Crypto-Key Management Algorithm

SCKM scheme has been designed to calculate the attack threat from the authorized or unauthorized sources. SCKM scheme design has been given below:

Algorithm 5: SCKM Algorithm

1. The IDS (Ix) calculates the available bandwidth on the node.

2. The Ix scans for the active connections with the node being analyzed.

3. The Ix checks for the input data volumes D= {dv1, dv2, dv3 … dvx} coming from the different nodes.

4. The Ix decides the threshold The value by computing upon the D matrix.

5. The individual data volumes are then scanned against the threshold value Th to find the traffic abnormalities.

6. The traffic streams with abnormal traffic volumes are noticed and analyzed individually.

7. The traffic volume is calculated against the assigned individual connection bandwidth (AConBan)

8. If the traffic volume is found more than AConBan Overhead traffic filtered

9. Otherwise

1. The traffic is permitted

IV. Result Analysis

The SCKM scheme has been well tested under various situations in the sensor network simulation. The proposed energy based routing protocol on sensor network has been well tested for the performance parameters of delay, throughput, and network load.

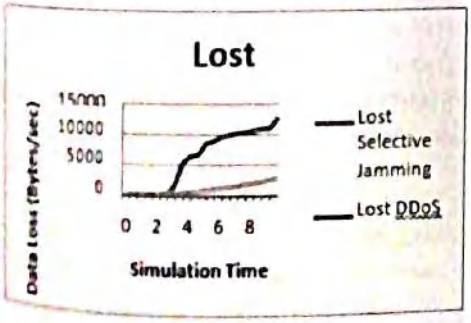

Figure 1: Data Loss comparison between all three simulations

In Figure 1 Data Loss comparison between all three simulations. The performance of SCKM scheme is found most efficient against the DDoS attack and least against the selective jamming in case of data loss. SCKM efficiency in mitigating the DDoS attack shows the effectiveness of the SCKM scheme in mitigating the most dangerous attack over any kind of networks.

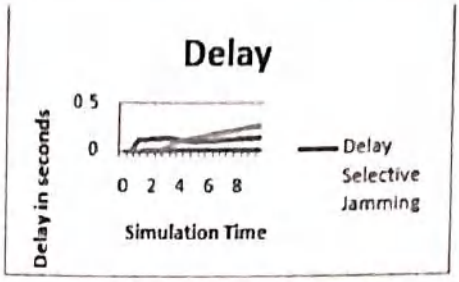

Figure 2: Delay based comparison between all three simulations

In figure 2: The SCKM scheme has been deeply evaluated on the basis of all of the attacks individually in Delay based comparison between all three simulations, above, the minimum delay has been recorded in the case of DDoS simulation, whereas the maximum delay has been recorded against the black hole attack.

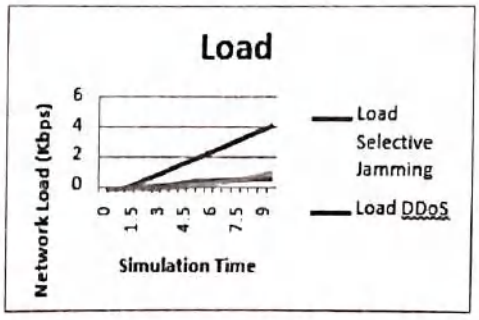

Figure 3: Load based comparison between all three simulation results

In Figure 3 Load based comparison between all three simulations. The SCKM scheme has been found the most efficient against the selective jamming and black hole attacks.

In Figure 4 PDR based comparisons between all three simulations, the performance evaluation has been done on the basis of the packet delivery ratio. The SCKM scheme has been found efficient for the DDoS attack against the black hole or selective jamming.

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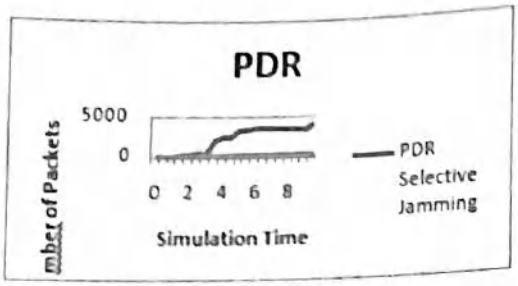

Figure 4: PDR based comparison between all three simulations

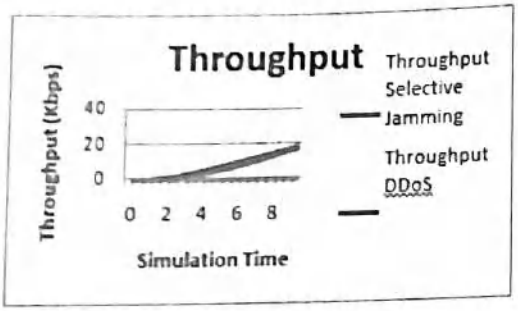

Figure 5: Throughput based comparison between all three simulations

In Figure 5 above, again the throughput has been recorded higher than the other two due to the similar reasons as per figure 5 (packet delivery ratio).

Comparison With Existing Models

Black hole Comparison: Defense against black hole attack in the sensor network under SCKM scheme has been tested and compared with the existing black hole detection and prevention model. SCKM comparison has been listed as below:

Table 1: The comparative analysis of SCKM against existing model for black hole attack

	Norm al Flow	Under black hole attack existing	Under black hole attack proposed
End-to- End Delay (ms)	31.22	35.25	19.09
Through put (bps)	70099.91	65072.06	143440

SCKM has been found efficient. The comparative analysis proves the efficiency of SCKM scheme for detection and prevention of the black hole attack.

V. Conclusion

SCKM scheme developed as the intrusion detection system (IDS) and intrusion prevention system (IPS) for the wireless sensor networks. Designed in the multi-layered model with inter- nodal relationship competence. In SCKM every node or every host is handling the intrusion detection and prevention on itself, which can be also categorized in the self-adaptive mechanism to filter out the attacker nodes from the network in the initial phase. SCKM scheme is based upon the multi-hop authentication scheme, where the intermediate hops remains invisible between the two nodes, while the authentication process is going on between two non-neighbor nodes.

SCKM scheme is offering the crypto key based authentication using the dynamic key generation policy. The RSA encryption, which is public-key cryptosystem, and based upon the public and private keys, where the data is encrypted using the public key and decrypted using the private key and vice-versa. The RSA cryptosystem is named after the inventors Ron Rinvest, Adi Shamir and Leonard Adleman.

SCKM scheme has been designed to analyze the anomalies in the traffic to avoid the attack on the sensor networks. To detect and mitigate the blackhole, selective jamming and distributed denial of service (DDoS) attacks on the sensor networks in order to run the error-free service.

VI. Future Work

In future, more innovative methods can be used for enhanced authentication and high level traffic analysis and attack pattern detection models. SCKM scheme can be improved using the intelligent algorithm based upon the swarm intelligent computing. The particle swarm optimization, grey wolf optimizer, mobile ant colony optimization, etc. can be used for the intelligent improvement in SCKM scheme for the swarm intelligent addition

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HANDOVER KEYMANAGEMENT IN 4GLTE/SAE NETWORKS SECURITYANALYSIS

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Abstract **:** The goal is to move mobile cellular wireless technology into its fourth generation by using 3GP Long Term Evolution/System Architecture Evolution (LTE/SAE) .To close a security gap through which a single compromised or malicious device can endanger an entire mobile network because of the open nature of these networks is one of the unique challenges of fourth-generation technology. To revoke any compromised key(s) and as a consequence isolate corrupted network devices Hand over key management in the 3GPPLTE/SAE has been designed.This.paper, identifies .and .details .the .vulnerability .of. this hand over key management to what are called resynchronization attacks; such attacks jeopardize secure communication between users and mobile networks. Although period updates of the root key are an integral part of hand over key management, our work here emphasizes how essential these updates are to minimizing the effect of resynchronization attacks that ,as of now ,cannot be effectively prevented. Our main contribution, however, is to explore how network operators can determine for themselves an most favorable interval for updates that minimizes the signaling load they impose while protecting the security of user traffic. Our analytical and simulation studies demonstrate the impact of the key update interval on such performance criteria as network topology and user mobility.

Keywords:Authentication and keyagreement,evolvedpacketsystem,handoverkeymanagement,long-termevolution security.

I. Introduction

The enormous popularity of the Internet has produced a significant stimulus to P2Pfile sharing systems. There are two types of P2P systems: unstructured and structured. Unstructured P2P networks such as Gnutella and Free net do not allocate responsibility for data to specific nodes. According to some loose rules no disjoin and leave the network. Currently, unstructured P2Pnetworks' file query method is based on either flooding where the query is propagated to all the node's neighbors, or random-walkers where the query is forwarded to randomly chosen neighbors until the file is found. Flooding and random walkers cannot guarantee data location.

Structured P2P networks ,i.e. Distributed Hash Tables(DHTs), with their features of higher efficiency, scalability, and deterministic data location can over come the drawbacks. They have strictly proscribed topologies, and their data residency and lookup algorithms are precisely defined based on a DHT data structure and consistent hashing function. Even if the system is in a continuous state of change then responsible for a key can always be found.

Most of the DHTs require *O(log n)* hops per lookup request with *O(logn)* neighbors per node, where n is the number of no desin the system. Akey condition to judge is its file location efficiency for P2P file sharing system.several methods have been propose to enhanced this efficiency. One method uses a super peer topology, which consists of supernodes with fast connections and regular nodes with slower connections. Some regular nodes,and a regular node connects with a super node and a supernode connects with other super nodes. Then odesat the center of the network are faster and therefore produce a more reliable and stable backbone in this super-peer topology.This allows more messages to be routed than a slower backbone and,therefore ,allows greater scalability.

Super-peer networks occupy the middle-ground between centralized and entirely symmetric P2P networks, and have the potential to combine the benefits of both centralized and distributed searches.Another class of methods to improve file location efficiency is through a proximity-aware structure.A logical proximity abstraction derived from a P2P system doesnot essentially match the physical proximity information in reality. The shortest path according to the routing protocol(i.e.,the least hop count routing)is not essentially the shortest physical path. This difference becomes a big obstacle for the deployment and performance optimization of P2Pfilesharingsystems.

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P2P system should utilize proximity information to reduce file query over head and improve its efficiency. In addition, allocating or replicating a file to anode that is physically closer to a request er can significantly help the requester to recover the file efficiently. Proximity-aware clustering can be used to group physically close peers to competently improve efficiency. To improve file location efficiency is to cluster nodes with similar interests, which reduce the file location latency is the third method. Although numerous proximity-based and interest-based super-peer topologies have been proposed with different features, few methods are able to cluster peers according to both proximity and concern. Most of these methods are on unstructured P2P systems that have no strict policy for topology construction. Inspite of their higher file location efficiency they cannot be directly applied to general DHTs

II.RelatedWork

The related works most relev an to PAIS in three groups: super-peer topology is discussed, proximity-awareness, and interest-based filesharing. Super-peer topology. Fast Track[10] and Morpheus[20]use super-peer topology. The super-peer network in[8]is for resource fuland scalable file consistency maintenance in structured P2Psystems.

A super-peer network for load balancing[9] was built in previous work Garbackietal.[21]proposed a self-organizing super-peer network architecture that solves four issues in a fully decentralized manner: how client peers are related to super-peers ,how super-peers locate files, how the load is balanced among the super-peers, and how the system deals with node failures. Proximity-awareness Techniques to make use of topology informationinP2Poverlay routing include geographic layout.

Proximity routing and proximity-neighbour selection. Geographic layout way maps the overlay's logical ID space to the physical networks or that neighboring nodes in the ID space are also close in the physical network. It is employed in topologically-aware CAN [11].In the proximity routing method, the reasonable overlay is constructed with out considering the essential physical topology.

Interest-base file sharing. One class of interest-base file sharing networks is called schema based networks. They use explicit schemas to depict peers' contents based on semantic description and allow the aggregation and in corporation of data from distributed data sources. Hang and Wu proposed a method for clustering peers that share similar property together and a new intelligent query routing strategy.

Kubiatowicz proposed on line storage systems with peer assistance. The works in employ the Bloom filter method for file searching. Despite the efforts devoted to proficient file locationinP2P systems, there are few works that merge the super-peer topology with both interest and proximity based clustering methods.

In addition,it is difficult to realize in DHTs due to their harshly defined topology and data allocation policy. howPAIS tackles the challenge by taking advantage of the hierarchical structure of a DHT is describes in this paper.

III. Problem Statement

Exiting Model

Existing analyzes the authentication and key agreement protocol adopted by Universal Mobile Telecommunication System (UMTS), an emerging standard for third-generation(3G)wireless communications. The protocol, knownas3GPPAKA,is based on the security framework in GSM and provides significant improvement to address and correct real and professed weaknesses in GSM and other wireless communication systems.

3GPPAKA protocol is susceptible to a alternate of the so-called false base station attack. The defense lessness allows an adversary to re direct user traffic from one network to another. Moreover, we demonstrate that the use of synchronization between a mobile station and its home network in considerable complexity for the normal operationof3GPPAKA.

Securityproblemsinthe3GPPAKA,we then present a new authentication and key agreement protocol which defeat sre direction attack and drastically lowers the impact of network corruption. The protocol, called AP-AKA ,also eliminates the need of synchronization between a mobile station and its home network. AP-AKA specifies a sequence of multiple flows.

IV.Proposed System

Our proposed method an unaffected session key would permit target e Node B to know which session key the source e Node B used .To prevent this, the source e Node B computes a new session key by applying a one-way function to a current session key. This ensures backward key separation in the handover. However, backward key separation blocks an e Node B only from deriving past session keys from the current session key.Otherwise, this e Node B would know all session keys used in further sessions in a whole chain of hand overs. As a consequence, forward key separation was introduced to ensure that network elements add fresh materials to the process of creating a new session key for then ext serving e Node B. The current e Node B,unaware of this additive, would be unable to derive the next key.

The main contributions of this paper are threefold:

1) Hand over key management of the EPS security mechanism flaws has been identified.

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2)Promising mathematical model for the EPS hand over key management to measure the effect of a compromised key has been designed

3)Investigated the performance criteria(e.g., user mobility, network topology, and so on)involved in selecting an optimal operational point for key updating.

V. Overview

PAIS: A Proximity Aware Interest-Clustered P2P File Sharing System.

we studied a Bit Torrent user activity trace to analyze the user file sharing behaviors. We found that long distance file recovery does exist.Thus, we can cluster physically close no des into a cluster to enhance file sharing efficiency Also, peers tend to visit files in a few interests. Thus, we can further cluster nodes that share an interest into a sub-cluster. Finally, popular files in each interest are shared among peers that are globally distributed.

Thus ,we can use file replication between locations for popular files, and use system-wide file searching for unpopular files .We introduce the detailed design of PAIS below.It is suitable for a file sharing system where files can be classified to a number of interests and each interest can be classified to a number of sub-interests.

VI. PAIS Structure

PAIS is developed based on the Cycloid structured P2P network. Cycloidis a lookup efficient, constant-degree over lay with $n=d.2^d$ nodes,where d is its dimension. It achieves a time complexity of $O(d)$ per look up request by using$O(1)$ neighbors per node. Each Cycloid node is represented by a pair of in dices$(k,a_{d-1}a_{d-2}....a_0)$where k is a cyclic index and$(a_{d-1}a_{d-2}... a_0)$ is a cubical index. The cyclic index is an integer ranging from 0to d-1,and the cubical index is a binary number between 0 and 2d-1. The nodes with the same cubical index are ordered by their cyclic index mod do n a small cycle,which we calla cluster.

Figure 1

VII.PAIS Construction And Maintenance

Node proximity representation. A land marking method can be used to represent node closeness on the network by in dices used in .Landmark clustering has been widely adopted to generate proximity information.It is based on the intuition that nodes close to each other are likely to have similar distances to a few selected land mark nodes. We assume there are m land mark nodes that are randomly scattered in the Internet.

VIII. Experimental Result

We implemented a prototype of PAIS on Planet La a real world distributed test bed.to measure the performance of PAIS in comparison with other P2P file sharing systems. We set the experiment environment according to the study results of a B it Torrent trace We randomly selected 1[illegible] Planet Lab nodes all over the world.Among these nodes we randomly selected 80 nodes as landmark nodes to calculate the Hilbert numbers of nodes We clustered all nodes into 160 different locations according to the closeness of their Hilbert numbers.

We used the 56,076files in the Bit Torrent trace.The number of interests in the system was set to 20,so we also set the dimension of the Cycloid DHTto20 We simulated 100,000 peers by default in the experiments Each peer was randomly assigned to a location cluster among all 160 clusters, and further randomly assigned to a Planet Lab node with in this location .According to ,a peer's requests mainly focus on around 20 percent of all of its interests. Thus,we randomly selected four interests(20percentof total20interests)for each peer as its interests.

The files are randomly assigned to a sub-cluster with the files'interestoverthetotal160 locations, and then randomly assigned to no desin the sub-cluster.Eighty percent of all queries of a requester target on files with owners with in the same location,among which 70 percent of its queries are in the interests of the requester.

According to [48],80 percent of all requests from a peer focus on its interests,and each of other requests is in a randomly selected interest outside of its interests.A request in a n interest means a request for a randomly selected file in this interest.We also let each file have a copy in another peer in a different location in order to test the proximity-aware file searching performance.

In recent years,to enhance file location efficiency in P2P systems, interest-clustered super-peer networks and proximity-clustered super-peer networks have been proposed. Although both strategies improve the performance of P2P systems, few works cluster peers based on both peer interest and physical proximity simultaneously. Moreover ,it is harder to realize it in structured P2P systems due to their strictly defined topologies, although they have high efficiency of file location than unstructured P2Ps.

IX.Conclusion

In this paper ,we introduce aproximity-aware and interest-clustered P2P file sharing system based on a structured P2P.It groups peers based on both interest and proximity by

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taking advantage of a hierarchical structure of a structured P2P.PAIS uses an intelligent file replication algorithm that replicates a file frequently requested by physically close nodes near their physical location to enhance the file look up efficiency.

Finally, PAIS enhances the file searching efficiency among the proximity-close and common interest nodes through a number of approaches. The trace-driven experimental results on Planet Lab demonstrate the efficiency of PAIS in comparison with other P2Pfile sharing systems. It dramatically reduces the over head and yields significant improvements in file location efficiency even in node dynamism. Also, the experimental results show the effectiveness of the approaches for improving file searching efficiency among the proximity close and common-interest nodes.

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PERSPECTIVE DESCRIPTORS OF IMAGE SEGMENTATON IN VARIOUS MODALITIES

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Abstract-Image segmentation refers to the process of partitioning an image into groups of pixels which are homogeneous with respect to some criterion. Segmentation of nontrivial images is one of the most difficult tasks in image processing. Segmentation accuracy determines the eventual success or failure of computerized analysis procedures. The main objective of image segmentation is to extract various features of the image which can be merged or split in order to build objects of interest on which analysis & interpretation can be performed. Image segmentation represents the first step in image analysis & pattern recognition. The goal of segmentation is to simplify the representation of an image into something that is more meaningful &easier to analyse. Due to the importance of image segmentation a number of algorithms have been proposed but based on the image that is inputted the algorithm should be chosen to get the best results. This paper discusses the various segmentation techniques which are available.

Keywords-Segmentation; Artificial Intelligence techniques; thresholding; edge models; region oriented images; textural features.

I. Introduction

Segmentation is the process dividing an image into regions with similar properties such as gray level, color, texture, brightness, and contrast. The role of segmentation is to subdivide the objects in an image. Automatic segmentation is a difficult task as images are complex in nature and rarely have any simple linear feature. Further, the output of segmentation algorithm is affected due to

- Partial volume effect.
- intensity inhomogeneity
- presence of artifactscloseness in gray level of different soft tissue

Image segmentation continues to be a complex and challenging problem. Different researchers have done the classification of segmentation techniques in one or another way.

II.ClassificationOf Segmentation Techniques:

Thus, the broad classification of techniques available for segmentation of an image classified into two classes is as follows:

Methods based on gray Level

Features:

- Amplitude segmentation based on histogram features
- Edge based segmentation
- Region based segmentation

II.I.Amplitude segmentation based on histogram features

This includes segmentation of an image based on thresholding of histogram features and gray level thresholding is perhaps the simplest example of this technique. This is particularly suitable for an image with region or object of uniform brightness placed against a back ground of different gray level, athreshold can be applied to segment the object and background. Mathematically the threshold can be defined as follows

$$r_{i,j}=\{1 p_{i,j} \geq T p_i, 0, p_{i,j} < T \quad \text{Equation(1)}$$

Where $r_{i,j}$ is the resulting pixel at co-ordinate (i, j). $p_{i,j}$ is the pixel of input image and T is the value of threshold.The equation (1) gives good results for segmentation of image with bi-modal histogram and fails in the case of an image with multi-modal histogram. To overcome this limitation, band thresholding based multiple thresholding operation is applied as follows:

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$r_{i,j}$=1 for T1<$p_{i,j}$≤T2

=2 for T2<$p_{i,j}$≤T3

=3 for T3<$p_{i,j}$≤T4

=k for Tk<$p_{i,j}$≤Tk

=0 otherwise Equation (2)

Here, the K^{th} band is corresponding to object/region having pixel values in the range of T_k to T_{k+1} where T_k is the lower limit of gray level and T_{k+1} is the upper limit of Gray level band.For application of thresholding based segmentation technique, it is required to apply the correct threshold values in order to achieve proper segmentation results, otherwise results are poor. The histogram of an image is particularly used to determine the value of threshold

For Example: abdomen CT image

The Histogram of abdomen CT image is shown in Figure 2. There are three peaks (maxima) separated by two minima. The values of these minima are selected as segmentation of image; the original abdominal CT scan image and corresponding segmentation result are shown in figuresrespectively

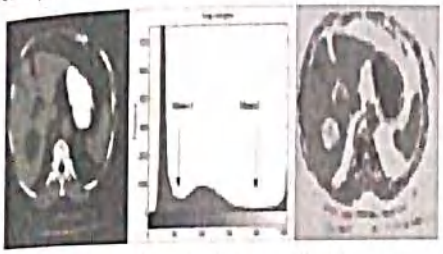

Fig 1(a): Original Abdomen CT Image

Fig 1(b): Image Histogram (three peaks separated by two minima)

Fig 1(c): Segmentation of Abdomen (CT image using threshold technique)

Object 1 belongs (0 to 55)

Object 2 belongs (55 to 200)

Object 3 belongs (200 to 255)

Limitations

Selection of proper values of threshold is quite difficult. Performance is affected in presence of artifacts.

II.II.Edge based segmentation

Edge based segmentation is the most common method based on detection of edges i.e. boundaries which separate distinct regions. Edge detection method is based on marking of discontinuities in gray level, color etc., and often these edges represent boundaries between objects. This method divides an image on the basis of boundaries.Number of edge detecting operators based on gradient (derivative) function are available e.g. Prewitt, Sobel, Roberts (1st derivative type) and Laplacian (2nd derivative type), Canny, Marr-Hildreth edge detector. The different edge based segmentation algorithms are:

- Edge relaxation,
- Border detection method,
- Hough transform based

The generalized algorithm for edge based segmentation has the following steps.

1. Apply the derivative operator to detect edges of the image
2. Measure the strength of edges by measuring amplitude of the gradient
3. Retain all edge having magnitude greater than threshold T (removal of weak edge)
4. Find the position of crack edges; the crack edge is either retained or rejected based on the confidence it receives from its predecessor and successor edges
5. Step 3 and 4 are repeated with different values of threshold so as to find out the closed boundaries; segmentation of an image is achieved.

Fig 2:Result of Edge-based Segmentation of Abdomen (CT image)

The limitations of edge based method are:

- Performance is affected by the presence of noise
- fake edges and weak edges may be present in the detected edge image which may have a negative influence on segmentation results
- Edge detection techniques are required to be used in conjunction with region-based technique for complete segmentation.

II.III.Region based segmentation

Region based methods are based on the principle of homogeneity - pixels with similar properties are clustered together to form a homogenous region. The criteria for homogeneity is most of the time gray level of pixelsand this criteria can be specified by following conditions

R1∪R2∪R3∪....∪Ri=I

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WhereR$_1$, R$_2$, R$_3$,Ri are the region in the image I, Region merging

- In this method some seeding points are required to initialize the process, the segmentation results are dependent on the choice of seeds.Regions are grown iteratively by merging the neighboringpixels depending upon the merging criterion.
- This process is continued until all pixels are assigned to their respective regions as per merging criterion.

2.3.1 Region splitting:

Its principle is just opposite to region merging and whole image is continuously split until no further splitting of a region is possible.

Split and merge method:

This is the combination of splits and merges utilizing the advantage of the two methods. This method is based on quad quadrant tree representation of data whereby image segment is split into four quadrants provided the original segment is non-uniform in properties. After this the four neighboring squares are merged depending on the uniformity of the region (segments). This split and merge process is continued until no further split and merge is possible. And further, R1∩R2∩R3∩...∩Ri=0.This is as per the set theory of homogeneity.Region based segmentation is further divided into three types based on the principle of region growing:

a. Region merging

b. Region splitting

c. Split and merge

2.3.2 Region merging

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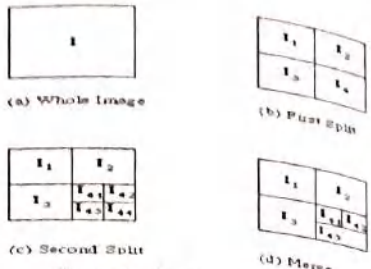

Fig 3:Region Split & Merge

2.3.5 Watershed segmentation

Watershed segmentation based on the concept of topography and hydrography is also a region-based segmentation.

The limitation of region based segmentation is that there are chances of under segmentation and over segmentation of regions in the image. However, this problem can be rectified in two ways

- By optimally selecting the criterion for segmentation, for this several algorithm utilizing artificial intelligence techniques have been developed.
- By combining region based approach with edge based approach

II.IV.Method based on the textural features

Textural features of image are important from image segmentation and classification point of view. The aim of texture based segmentation method is to subdivide the image into region having different texture properties, while in classification the aim is to classify the regions which have already been segmented by one or other method.

Definition of texture:

Texture is defined as something consisting of mutually related elements. A texture may be fine coarse, smooth, or grained depending upon its tone and structure.

Other approaches of segmentation

Apart from the above methods, the following two methodsof image segmentation are also available.

- Model based segmentation and
- Atlas based segmentation.

Model based segmentation:

The basic approach is that the structure of organs has a repetitive form of geometry and can be modelled probabilistically for variation of shape and geometry. This can be used as constraint while segmenting the image and involves problems.

Disadvantages

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1. They require manual interaction to place an initial model and choose appropriate parameters.
2. Standard deformable models can also exhibit poor convergence to concave boundaries.

Atlas based segmentation approaches are the most frequently used and powerful approaches in the field of medical image segmentation. In this, information on anatomy, shape, size, and features of different, organs, soft tissues is compiled in the form of atlas or look up table (LUT).

II.V.Artificial Intelligence Tools for Segmentation and Classification

Automatic segmentationmethods have been based on artificial intelligence (AI) based techniques. AI techniques can be classified as supervised and unsupervised.

2.5.1 Supervised methods

In the supervised category, we can place mostly Artificial Neural Network (ANN) based algorithms. ANN is composed of large number of interconnected processing elements (artificial neurons) working in unison to solve specific problems. The main advantages of ANN are ability to learn adaptively, using training data to solve complex

2.5.2 Unsupervised methods

Most of the unsupervised algorithms are cluster based and not dependent on training and training data. The two commonly used algorithms for clustering are K-mean or Hard C-mean and Fuzzy C-means.

In clustering, the aim is to construct decision boundaries based on unlabelled training data.Clustering is the process of finding natural grouping clusters in multidimensional feature space. It is difficult because clusters of different shapes and sizes can occur in multidimensional feature space. However, the main limitations of fuzzy clustering algorithm are: (a) sensitivity to initial partition matrix (b) stopping criterion (c) solution may get stuck at local minima. Hence, clustering techniques may not result in optimal solution and there is no best clustering algorithm for a particular application. A number of different algorithms are required to be tried to find the best one.

Fig 4: Individual segments of this image obtained using simulated annealing based fuzzy-c-means algorithm

III. Conclusion

The present review provides the basics of segmentation approaches and their respective features. The approaches for image segmentation discussed in this review can be ranked on the basis of applicability, suitability,performance, and computational cost. Computer-aided segmentation is a key step finding application in computer aided diagnosis, clinical studies, and treatment planning. Segmentation techniques based on gray level techniques such as thresholding, and region based techniques are the simplest techniques and find limited applications. However, their performance can be improved by integrating them with artificial intelligence techniques. Techniques based on textural features utilizing atlas or look-up-table have excellent results on medical image segmentation. However, they need expert knowledge in building the atlas. The limitation of atlas based technique is that under certain circumstances it becomes difficult to correctly select and label data; has difficulties in segmenting complex structure with variable shape, size, and properties. In such situations it is better to use unsupervised methods such as fuzzy-c-means algorithm.A variety of different neural network-based algorithms are also available for texture-based segmentation and classification having good accuracy. However, most of these neural network-based algorithms require extensive supervision and training and their performance depends upon the training method and data used in training. Finally, it is desired from medical image segmentation and classification algorithms that they must have the following features: a) accuracy, b) reliability, c) repeatability, d) robustness and e) least dependency on the operator.

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SMART APPLICATION OF WSN IN BORDER SECURITY AREA

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Abstract-Wireless Sensors Network (WSN) combines sensing, signal processing, decision capability, and wireless networking capability in a compact, low power system. Among countries, border protection is a sensitive issue and measures are being taken to improve security at the borders. In addition to physical fencing, smart methods using technology are being employed to increase the alertness of security officials at the borders. Border control using wireless sensor network is one way to do.

Keyword-: WSN, Fencing, Low Power System, Signal Processing, ecological monitoring, false alarms.

I. Introduction

Over the past two decades, wireless sensor networks (WSNs) together with the various applications that they have been assigned have undergone a rapid evolution, becoming a vital technology in today's evolving world as well as a central research area in academia. Sun et al. define wireless sensor networks as the spatially distributed self-directed sensors that are used to monitor the physical and environmental changes within their area of implementation –such as changes in motion, temperature, pressure or noise. Over the years, the application of these sensor networks has met tremendous evolution and customization, with users deploying the solutions in security, agriculture, ecological monitoring, healthcare sciences and the even in the military. Meanwhile, the need for the implementation of real-time border intrusion detection and control has become an increasingly tough factor for most countries, often necessitating a large outlay of manpower and financial resources, which are inextricably faced with a high level of false alarms, together with sightline constraints. In this regards, the implementation of the WSNs in border control, surveillance and monitoring presents a suitable and intelligence means through which these problems can be solved. The WSNs combine the properties of signal sensing, transmission, decision-making as well as wireless network capabilities within low-power consumption, low-cost, compact device, presenting suitable solution that can be implemented across a large-scale geographical area

II Detection Of Intruder Using WSN

WSN detect the intruders in a previously unknown territories. The intruders are detected and investigated. WSN applied hierarchical learning/communication structure. Each model of the network can monitor the local region and then communicate through the wireless channels with the other nodes for the collaborative production of a high-level representing on the state of the environment. Such networks can be used to monitor the large areas for a low cost. The system can uses the mobile robots to make the process of detection more autonomous and flexible. The senor nodes of WSN learn the model of the environment applying the ART neural network and then, the changes are compared to the normal model and are reflected as anomalies, caused by the possible intruders.

III Wireless Sensor System Architecture

A primary consideration in the implementation of the WSNs is the associated power consumption requirements and sources for battery energy. The placement of the WSNs in an extended geographical area requires the deployment of a low-power sensor –based architecture that is fitted with components that are characterized by low power consumption and reduced monitoring requirements. While the conventional handheld, mobile technologies are supported by the implementation of protocols that are directed towards reducing the amount of power consumed through the implementation of a narrow-set of application requirements, WSNs have to support a large-scale number

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of sensors within a wide geographical area that is characterized by a comparatively low average bit-rate transmission (smaller than 1Kbps). In this regards, the design of the WSN architecture should make considerations of this power consumption requirements, together with the density of the population of the sensors within a given geographical area. Multi-hop routing architecture presents a suitable design topology for the sensor distribution, allowing significant power saving options as well as scalability in order to cover a larger area within the border

IV Wireless Sensor Node Architecture

The node architecture is comprised of the sensor which is connected to a low-power analog-to-digital converter so as to transform the detected analog signal from the environment into an digital signal for transmission. A spectrum analyzer is connected to this output so as to examine the current conditions and possibly invoke reactive actions depending on the current conditions. These components are in continuous operation, thereby necessitating the implementation of low-power cycles[3]. A control unit and wireless distribution interface is also attached to the node, which makes it possible for the node to transfer current environmental and physical settings to the next-neighboring node in a multi-hop architecture. Depending on the conditions detected, the protocols that have been embedded within the node determine whether the remote user or the next-neighboring WSN node should be alerted. In either case, the detecting node supplies the attributes of the event to the remote user and/or next WSN, thereby making it possible for environmental disturbances to be detected.

a. Node Hierarchy:

The wireless sensor network is comprised of a large distribution of small sensor nodes, spatially distributed across the expanse of the border. In order to save on power consumption, the node architecture is configured in a hierarchical manner such that the nodes within the architecture are either in an election phase of data transfer state. During the election phase, the nodes scan the physical characteristics of the environment in order to determine the occurrence of any changes. At the beginning of this phase, a set of hierarchical nodes is selected from the available node hierarchy on a random basis, allowing the clustered nodes to send a short range of broadcast messages to the neighboring nodes in order to alert them of their presence. During this phase, each of the neighboring nodes, on receiving the broadcast message, sends an acknowledgement message to the cluster head, allowing the cluster head to determine a set of associate cluster heads based on the amount of elapsed time after sending of the request as well as the signal strength of the acknowledgement. According to the node hierarchy structure, the head-set architecture of the node consists of the cluster head together with the associated nodes that are located within the enterprise. Different states of the wireless sensors are contained within the hierarchy, with new sensors joining the hierarchy as candidate nodes. During the beginning of the iteration phase, a given set of cluster heads are selected from the available set of clusters with the selection made depending on whether they are active or not-cluster heads are chosen as all those sensor nodes that have an active status. This defines the election phase which determines the cluster heads and a set of associate nodes in accordance with the signal strength. During the data transfer phase, the active nodes transfer data to the next nearest associate node, which is followed by the active node changing its state to passive associate status. At this time, the node that receives the transmission is transformed to become the active node, remaining in this state until it passes the message to the next available node. At the end of the iteration, the members are assigned a non-candidate role, until the next iteration is started where the next head-set is selected.

b.Area Coverage and Connectivity:

WSN area coverage is a measure of the quality of service provided by the sensor networks, interpreted as the measurable level of signal availability of the devices which effectively determines how well the sensors are able to monitor their environment. In addition to the coverage of the sensor nodes, another vital consideration is the connectivity of the signals that are sent, necessitating that all the nodes be placed in a position to reach the data sink [2]. If the node has no direct route through which it can be able to reach the data, then it has been placed beyond the coverage area and there exists no possible means through which its data can be collected. The first step in the deployment of the WSN as suitable solutions for border security is determining the level of traffic and environmental conditions that is to be monitored. The coverage problem for wireless sensor networks relates to the need for the arrangement to significantly decrease the number of nodes that are placed within the area, while at the same time guaranteeing that each point within the border is suitably and optimally covered so as to detect the presence of intrusion. It is also worthwhile to note that the degree of coverage defines the total number of wireless sensors within the network whose sensory range have influence over a given location within the field of interest[3]. In this case, since the border requires to be monitored at every location thereby making significantly difficult to carry out an intrusion, multiple sensors can be deployed to simultaneously monitor given points within the border, guaranteeing that the failure of one node would not necessarily compromise the network's integrity. Typically, border security requires the monitoring of a large geographical area, primarily working towards the

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identification of the presence of an environmental breach within a set barrier. The sensor networks in this case would need to carry out a full or blanket coverage, implyingthat the entire border is within the sensing range of the sensors that have been deployed. In order to achieve this type of coverage within a border setup, the nodes are placed in an ordered construct such that each node within the configuration is placedat an r distance away from the next neighboring node, thereby creating a region where each location has a sensor associated with it[5]. At the intersection of the sensor coverage regions are areas that are covered by two sensors at the same time. Connectivity within the WSN scenario defines the ability of one node to reach the other node either through one hop or a series of multiple hops. Similar to the degree of coverage, the degree of connectivity of a given wireless sensor network is said to be k (read as k-node-connectivity) in a situation where the removal of one node from the network disconnects the existent communication routes

V. Deployment Methodology

The WSN deployment technique is either categorized as being dense or sparse depending on the number of nodes that are required to suitably cover the network. In order to suitably cover the border, the dense deployment model is used, making it possible for the security coverage of the entire border to be achieved[6]. The dense deployment model is achieved by ensuring that the radius of coverage of each of the sensors is contained within the next neighboring sensor, thereby guaranteeing that each point within the border is optimally covered. Newer wireless sensor networks have the ability of relocating after deployment, thereby making it possible for the remote use to control their placement and distribution within the border.

VI. Routing Between Nodes

Routing of the sensed environmental and physical conditions within the border is achieved through thetransmission of the results in a multi-hop manner, based on the shortest distance to the remote user. This means that in order to adequately route the signals within the network, the considerations of the level of traffic between the nodes is carried out in lieu of the physical distance between them. While a particular node might be physically close to the transmitting node, the level of traffic directed towards this node by other communicating nodes in the network may prevent the first node from using this route as it would incur too much delay in navigating through the traffic.

VII. Shortest Distance Algorithm.

The shortest distance algorithm seeks to determine the mean packet delay of a communicating node, given that the current network capacity together with the average network flow can be calculated. After determining the mean delay from all the communication routes, we can be able to determine a flow-weighted average communication speed for the network, making it possible to calculate the mean packet delay for the entire wireless network[4]. These weights determine the differentiated route capabilities for each direction, expressed in terms of the number of packets per second. The average delay for each routing direction can be calculated using the formula:)/(1λμ−=cT)Where, TI represents the amount of packet delay in seconds, C represents the network capacity for the given route in bits per second, λ represents the average packet flow in number of packets per second, and represents average packet size expressed in bits. The average delay time for the wireless network can thence be derived from the weighted sum of the delay from all the routes. Accordingly, this makes it possible to find the path that has the smallest value for the average delay time. To calculate the shortest distance, we also need to calculate the waiting factor for each route. That route that has the least value calculated for the waiting factor represents the shortest route. This done using the formula[5]: λλ/iW=Where, λi represents the average packet flow in a given route, and λ represents the average packet flow within the wireless network.

VIII. Application

The application of the Wireless Sensor Networks will require the deployment of small, limited sensing devices throughout the entire geographical expanse of the border, having the capability of interacting with the WINs node architecture within a heterogeneous network. This implementation will also require integration with Linux-based sensing devices that can be integrated with the existent network infrastructure. Additionally, scalable application of the WSN encompasses the use of small, low power devices with the ability to scavenge for energy from the operating environment, through the use of attached photocells and other piezoelectric materials that have the ability of generating electrical energy, thereby increasing the relative lifespan of the transmission.

IX. Conclusion

The design successfully details the implementation of multi-hop, low-power Wireless Sensor Networks for border patrol. While the design implications present significant complexities with regards to the management of power, it is a far better solution as compared to other alternatives such as manual patrols and radar surveillance. Through the calculation of the shortest distance, the technique makes it possible for the determination of the least amount of time and shortest route for transmission, leading to significant reductions in delay. On a national scale, the WSN solution will make it possible for countries to carry out border monitoring over land, air and even water.

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AN ADVANCED GLOBAL SYSTEM DESIGN FOR INDUSTRIAL MANAGEMENT USING RASPBERRYPI

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Abstract-The project proposes an advanced system for process management via a credit card sized single board computer called raspberry pi based multi parameter monitoring hard ware system designed using RS232 and microcontroller that measures and controls various global parameters. The system comprises of a single master and multiple slaves with wireless mode of communication and a raspberrypi system that can either operate on windows or linux operating system.The parameters that can be tracked are temperature , light intensity , waterlevel ,gasde-tection and fire extinguisher.Along these lines we can screen and control the gadgets through re-mote PC as it is specifically transmitted through program it can be seen any place on the planet and can be effortlessly controlled..Now the users are no longer required to dedicatedly present on-site to monitor the process.Instead any employ of industry can do this task along with his other activities.

Keywords—Raspberrypi, Zigbee ,SENSORS—Temperature sensor ,gas sensor,fire sensors, LDR

I. Introduction

In our system the single board computer will be in-ternet enabled and hence the industrial process parameters can be monitored from any where through a browser interface .Now the users are no longer re-quired to dedicatedly present on-site to monitor the process. Instead any employ of industry can do this task along with his other activities.

II. Existing Method

In the current work ,the created frame work was not effective in the perspective of assignment booking as the frame work utilized was an on-Linux gadget and further more outside Ethernet was utilized for corre- spondence Each time the undertaking will be done physically.

III. Proposed Method

The proposed strategy is utilized to be at the disad-vantages exhibit in existing technique.Here we are utilizing ARM I ntelligent Monitoring Center which utilizes Samsung's processor as its fundamental con-troller.The natural conditions exhibit in side the lab can be checked utilizing sensors like temperature ,gas and LDR. Everyone of the sensors are associated with sensor board. From the sensor board we are sending checked esteems to control room(ARMboard) through RS232 seriallink.The serial link is associated with one of UART port of ARM board.At what ever point a man is entered inside the lab,the individual's picture can be caught by camera and send it to controller.

The controller transmits the information to remote PC through Ethernet by utilizing FTP .FTP is a con-vention through which clients can transfer records from their frame works to server. When information is set at server we can see the information at remote PC(withweb)onsite page with one of a kind IP address. We can see cease less spilling of video and additionally senor's information.

On the off chance that we need to control the gadgets in view of sensor's data we can control through site page from remote are a utilizing HTTP convention .HTTP convention constantly asks for the server for control (killonorturn) the gadgets.Along these lines we can screen and control the gadgets through remote PC as it Is specifically transmitted through program it can be seen any place on the planet and can be effortlessly controlled consequently.

IV.System Architecture

This undertaking is a usage of modern process checking through remote correspondence.

A.BlockDiagram

Modules :Raspberrypi ,Zigbee ,UART ,Temperature sensor ,gas sensor ,firesensors, LDR.

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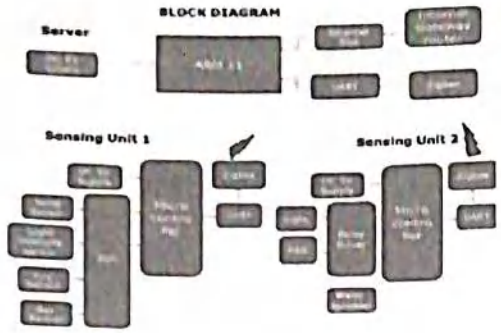

Figure 1:BlockDiagram

B. Temperature sensor:

LM35 is an exactness IC temperature sensor with its yield relative to the temperature(in°C).The sensor hardware is fixed and in this manner it is not subject-ed to oxidation and different procedures.With LM35,temperature can be measured more precisely than with a thermistor. It additionally have low self warm-ing and doesnot cause more than0.1°Ctemperature a scend in still air.The working temperature un is from-55°C to150°C. The yield voltage fluctuates by10mV because of each °Crise/fall in encompassing temperature,i.e., its scale factor is0.01V/°C.

Figure 2:Temperaturesensors

C.LDRSensor:

ALDR is made of a high-resistance semi conductor.On the off chance that light falling on the gadget is of sufficiently high recurrence,photo ns consumed by the semi conductor give bound electrons enough vitality to hop into the conduction band.The subsequent free electron(and its gap accomplice)direct power,along these lines bringing down resistance.

Figure 3:LDRsensors

D.Fire Sensor:

Infrared(IR)fire indicators work inside the infrared ghostly band.Hot gasses produce a particular ghastly example in the infra red area,which can be detected with a warm imaging camera(TIC)a sort of thermo realistic.False cautions can be caused by other hot surfaces and found a ti

on warm radiation in the range and in addition blinding from water and sunoriented vitality.A normal recurrence where single recurrence IR fire indicator is delicate is at the 4.4 micro meter run..

E. GasSensor:

A smoke locator like wise called a smoke caution is a gadget that distinguishes smoke,normally as a marker of flame.Business,modern,and mass private gadgets issue a flag to a fire alert frame work,while family unit identifiers,known as smoke cautions,for them ost part issue an earby capable of being heard or visual caution from the finder itself.

F.Raspberry Pi:

The Raspberry Pi is a V is a measured single-board PC made in the UK by the Raspberry Pi Foundation with the objective of propelling the educating of principal programming building in schools.

TheRaspberryPi is created in two board setups through approved a massing over sees Newarkele-ment14(PremierFarnell),RSComponents andEgoman.These associations of ferthe RaspberryPi on the web.Egoman produces a frame for spread only in China and Taiwan,which can be perceived from various PIs by their red shading and non appear-ance of FCC/CEchecks.The gear is the same over all creators.The RaspberryPi has a Broad com BCM2835structure on a chip(SoC),which joins an ARM1176JZF-S700MHzprocessor,VideoCore IVGPU,and was at first dispatched with 256 megabytes of RAM,later climbed to512MB.

G.ZigBee:

The ZigBee Alliance is not pushing an innovation;rather it is giving an institution alized base arrangement of answers for sensor and control frameworks.The physical layer was intended to suit the requirement for a minimal effort yet taking into consideration elevated amounts of combination.The utilization of direct succession enables the simple hardware to be extremely straight forward and exceptionally tolerant towards economical usage.

The media get to control(MAC)layer was intended to permit various topologies without tintricacy.The power administration operation doesn't require various methods of operation.The MAC permits a lessened useful ness gadget(RFD)that needn't have streak noralo to f ROMorRAM.TheMAC was intended to deal with vast quantities of gadgets without expecting them to be"stopped".

VDescriptionOfTheSystem

Industrial process monitoring and control system is developed to speed up them a nufacturing process of the industry and to improve the efficiency and accu-racy of the system manufacturing the plant,vital pa-rameters in the

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industry Which effect the robust ness of the plant to monitor with the help of highly sensitive sensor un its connect-ing to the 8bit microcontroller un it and transmitter to ARM11 RaspberryPi processor using ZigBee of 2.4 GHz protocol for web enabled monitoring and con-trolling to have video streaming live telecast a USB camera connected to RaspberryPi processor with Wi-Ficonnectivity.

(In a RaspberryPi(Single-BoardComputer)board of ARM11 architecture will be ported with an Em-bedded Linux operating system and using Ethernet protocol for IOT applications,we will acquire the data from the WirelessSensorNetwork(WSN),post the data over the web such that it can be viewed over internet on any browser as well also in ad-vance ment will operate the appliance from the web.

Schematic:Temperature sensor,gas sensor,fire sensor and LDR sensor are connected with ADC0808,which is of 8channel and measures read-in gat precision time period of 10microseconds hav-ing a channel length of 8bits and supporting 8 dif-ferent channels.These valves are given to 8052 con-troller and from this controllers end wirelessly with ZigBee UART transmitter.

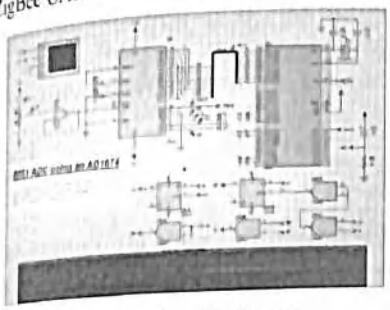

Figure4:schematic diagram

VI.Hardware Snapshot

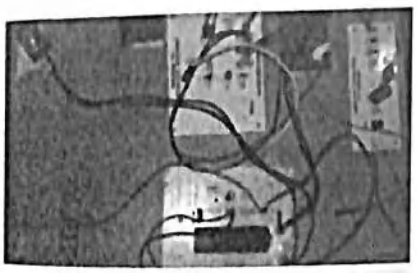

Figure5:MonitoringSection

Figure6:(a)Controlling section

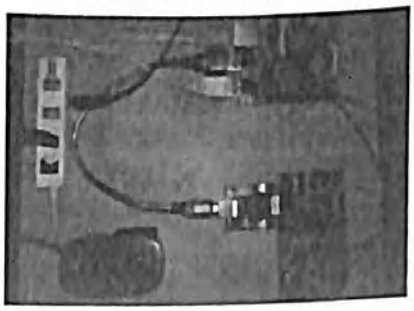

Figure6(b)Controllingsection

VI.Advantages

- Low support cost.

Easy to implement and low power consumption. Avoid un planned lab operation interruptions.

- Increase laboratory efficiency.

Remote lytrack critical system parameters.Controlling is done by using web technology.

VII. FutureScope

We can like wise record these live gushing information by interfacing outer memory stockpiling.We can finish our undertaking utilizing remote innovation.Infuture we can give greater security to information by utilizing encryption,unscrambling strategies.

VIII. Conculsion

The task"mechanical process checking through re-mote correspondence"has been effectively outlined and tried.It has been created by coordinating high-lights of all the equipment segments and program-ming utilized and tried.

It is a reconfigurable keen sensor interface for mechanicalWSN.The framework can gather sensor information cleverly.

It is extremely appropriate for continuous and powerful necessities of the rapid information obtaining framework.Atlast,by taking continuous observing of water condition we checked that the frame work accomplished great impacts unfeasible application.

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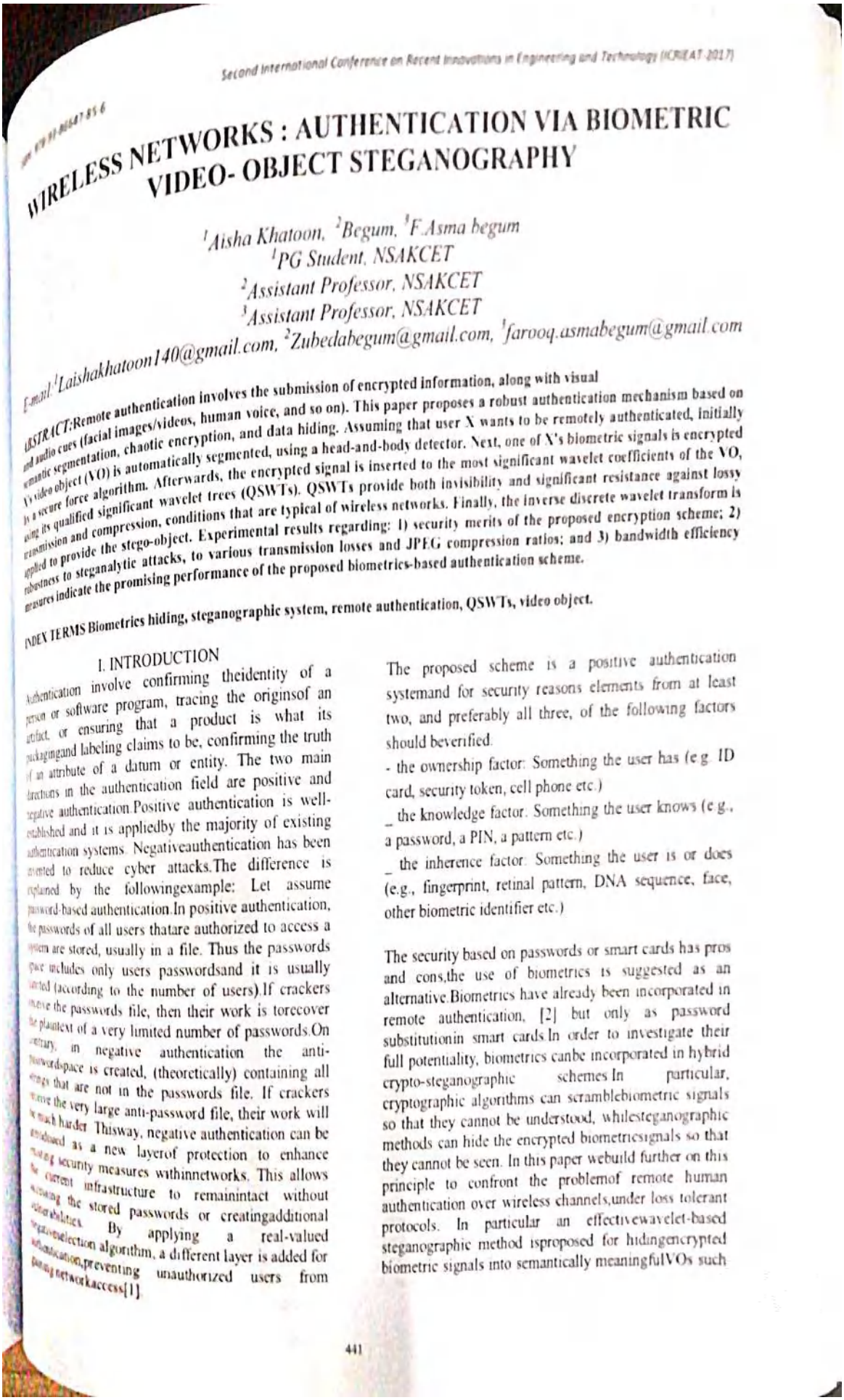

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WIRELESS NETWORKS : AUTHENTICATION VIA BIOMETRIC VIDEO- OBJECT STEGANOGRAPHY

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ABSTRACT:Remote authentication involves the submission of encrypted information, along with visual and audio cues (facial images/videos, human voice, and so on). This paper proposes a robust authentication mechanism based on semantic segmentation, chaotic encryption, and data hiding. Assuming that user X wants to be remotely authenticated, initially X's video object (VO) is automatically segmented, using a head-and-body detector. Next, one of X's biometric signals is encrypted by a secure force algorithm. Afterwards, the encrypted signal is inserted to the most significant wavelet coefficients of the VO, using its qualified significant wavelet trees (QSWTs). QSWTs provide both invisibility and significant resistance against lossy transmission and compression, conditions that are typical of wireless networks. Finally, the inverse discrete wavelet transform is applied to provide the stego-object. Experimental results regarding: 1) security merits of the proposed encryption scheme; 2) robustness to steganalytic attacks, to various transmission losses and JPEG compression ratios; and 3) bandwidth efficiency measures indicate the promising performance of the proposed biometrics-based authentication scheme.

INDEX TERMS Biometrics hiding, steganographic system, remote authentication, QSWTs, video object.

I. INTRODUCTION

Authentication involve confirming theidentity of a person or software program, tracing the originsof an artifact, or ensuring that a product is what its packagingand labeling claims to be, confirming the truth of an attribute of a datum or entity. The two main directions in the authentication field are positive and negative authentication.Positive authentication is well-established and it is appliedby the majority of existing authentication systems. Negativeauthentication has been invented to reduce cyber attacks.The difference is explained by the followingexample: Let assume password-based authentication.In positive authentication, the passwords of all users thatare authorized to access a system are stored, usually in a file. Thus the passwords space includes only users passwordsand it is usually limited (according to the number of users).If crackers receive the passwords file, then their work is torecover the plaintext of a very limited number of passwords.On contrary, in negative authentication the anti-passwordspace is created, (theoretically) containing all strings that are not in the passwords file. If crackers receive the very large anti-password file, their work will be much harder. Thisway, negative authentication can be considered as a new layerof protection to enhance existing security measures withinnetworks. This allows the current infrastructure to remainintact without increasing the stored passwords or creatingadditional vulnerabilities. By applying a real-valued negativeselection algorithm, a different layer is added for authentication,preventing unauthorized users from gaining networkaccess[1].

The proposed scheme is a positive authentication systemand for security reasons elements from at least two, and preferably all three, of the following factors should beverified:

- the ownership factor: Something the user has (e.g. ID card, security token, cell phone etc.)
- the knowledge factor. Something the user knows (e.g., a password, a PIN, a pattern etc.)
- the inherence factor. Something the user is or does (e.g., fingerprint, retinal pattern, DNA sequence, face, other biometric identifier etc.)

The security based on passwords or smart cards has pros and cons,the use of biometrics is suggested as an alternative.Biometrics have already been incorporated in remote authentication, [2] but only as password substitutionin smart cards.In order to investigate their full potentiality, biometrics canbe incorporated in hybrid crypto-steganographic schemes.In particular, cryptographic algorithms can scramblebiometric signals so that they cannot be understood, whilesteganographic methods can hide the encrypted biometricsignals so that they cannot be seen. In this paper webuild further on this principle to confront the problemof remote human authentication over wireless channels,under loss tolerant protocols. In particular an effectivewavelet-based steganographic method isproposed for hidingencrypted biometric signals into semantically meaningfulVOs such

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as the head-and-shoulders VO, which is common inseveral teleconferencing applications.

II. RELATED WORK AND CONTRIBUTION

A. REMOTE AUTHENTICATION

Different solutions have been proposed. For instance, Liao et al [3] proposed a scheme that utilizes the Diffie-Hellman key agreement protocol over insecurenetworks, which allows the user and the system to agree on asession key to encrypt/decrypt their communicated messagesusing a symmetric cryptosystem.However several passwords aresimple and they can be easily guessed or broken. Furthermore, most people use the same password acrossdifferent applications; if a malicious user determines a singlepassword, they can access multiple applications. Additionally, users should always have their smart cards with them in order to do transactions. if a user loses his hersmart card, he/she will not be able to do any transactions and should wait for the reissuing of the card (sometimes several days).

B. STEGANOGRAPHIC METHODS

Steganographic algorithms can be roughly divided into those performed in the spatial domain and those applied in a transform domain. Among transform-based data hiding approaches, DCT [4] and DWT [5] methods are, by far, the most popular since they are related with popular digital image and video compression schemes (i.e., JPEG, MPEG, JPEG-2000, H264, etc).In [6] fingerprints are hidden in the region of interest of images. Both DFT and DWT domains areexamined. However, again, no encryption is incorporated. Object-oriented data hiding is more secure and robust against deciphering attacks but it usually creates visually sensitive artifacts, thus, lowering the capacity of encryption. Detection of skin like color and feature descriptors are quite robust but rarelylead to large compact objects, reducing further encryption capacity.

C. CONTRIBUTION OF CURRENT WORK

To summarize the contents of this paper, in contrast to existing methods mentioned in the previous sections, its main contributions are analyzed below:

1) Biometrics-based human authentication over wireless channels under fault-tolerant protocols: The overriding majority of current works does not consider fault-tolerant protocols during transmission of stego-objects. With the proposed approach several mobile applications could benefit. For example, in an emerging scenario, let us imagine that a user would like to be authenticated via her cell phone, tablet etc. Her mobile device has a camera, while its touch-screen collaborates with a fingerprints capturing application. In case the signal strength is low, erroneous packets may arrive at the receiver. Thus, a scheme like the proposed one is required.

2) Automatic extraction of semantically meaningful video objects embedding the encrypted biometric information Most of the existing schemes do not consider semantically meaningful VOs as hosts, but a whole image. The proposed scheme offers some possible advantages. Firstly, the scheme provides a secondary complementary authentication mechanism in case when the person under authentication is also captured by the camera. Thus her face and body is transmitted together with another biometric feature forpossible double authentication. Secondly, in every recenttransaction, the overall architecture can store the latest samplepictures of one's face and body. This could help in casesof hybrid remote authentication, when both a machine anda human remotely authenticate a person. The machine canauthenticate the fingerprint and the human can authenticatethe face (like the teller does in a bank). Another advantage has to do with more efficient bandwidth usage, especiallyin the aforementioned case of hybrid remote authentication.An image usually does not only contain semantically meaningfulinformation but also background blocks. On the otherhand, in order to hide a specific amount of information,a host with proper capacity should be selected. If the hostis an image, then irrelevant blocks will also be transmitted,occupying valuable bandwidth. On the contrary, whenthe host is a semantic VO, all transmitted information isrelevant to the authentication task. Last but not least, theproposed scheme allows for more efficient rate control and can better confront traffic congestions. On the other hand, the proposed scheme is content-aware. In case of traffic congestion, the rate control mechanism could discard blocks from the body region that do not also contain hidden information, instead of discarding face areas.

3) Secure force algorithm which works like a one-time pad, to encrypt biometric identifiers: Symmetric encryption is faster, thus in contemporary systems a key of size $2n$ bits is produced (usually n 2 [6 11]) and it is exchanged between the communicating entities, using public key cryptography. However, even though large keys are considered to be safe, it has been proven that any cipher withthe perfect secrecy property must use keys with effectively the same requirements as one-time pad keys. In our case, biometric identifiers are encrypted by a secure force algorithm. In the proposed scheme this exchange is also performed by incorporating public key cryptography.

III. THE PROPOSED METHOD

The proposed remote human authentication scheme over wireless channels under loss tolerant transmission protocols, aims to ensure: (a) robustness against deciphering,noise and compression, (b) good encryption capacity,and (c) ease of implementation. For this purpose we:(a) employ wavelet-based steganography, (b) encrypt biometricsignals to allow for natural authentication, (c) involve aChaotic Pseudo-Random Bit Generator (C-

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PRBG) to createthe keys that trigger the whole encryption to increase security,and (d) the encrypted biometric signal is hidden in a VO,which can reliably be detected in modern applications thatinvolve teleconferencing.Initially the biometric signalis encrypted by incorporating a chaotic pseudo-random bitgenerator and a chaos-driven cipher, based on mixed feedbackand time variant S-boxes. The use of such an encryption mechanism is justified since,

1) Chaos presents sensitivity to initial conditions,

2) A C-PRBG statistically works very well as a one-timepad generator,

3) Implementations of popular public key encryptionmethods, such as RSA or El Gamal, cannot providesuitable encryption rates. This is why almost all ofthe contemporary encryption algorithms combine symmetricand public key cryptography. On the otherhand the security of these algorithms relies, in theory, on the difficulty of quickly factorizing large numbersor solving the discrete logarithm problem, and, in practice, on the difficulty of recording acoustic emanations from computers during operation.

4) Private-key bulk encryption algorithms such asTriple-DES or Blowfish, similarly to chaotic algorithms,are more suitable for transmission of large amounts ofdata.

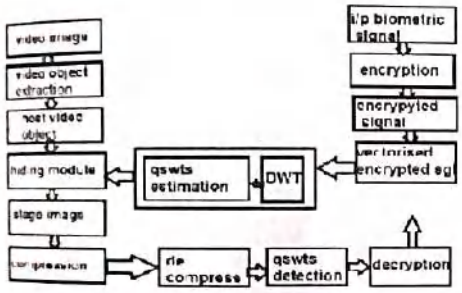

figure1;data flow in the proposed scheme

Afterwards, a head-and-body image of the biometricsignal's owner is analyzed and the host VO is automaticallyextracted based on the method proposed in [7]. Nexta DWT-based algorithm is proposed for hiding the encryptedbiometric signal to the host VO. The proposed algorithmhides the encrypted information into the largest-value QSWTs of energy-efficient pairs of subbands. Compared toother related schemes, the incorporated approach has thefollowing advantages [8]:

- it is one of the most efficient algorithms of literaturethat facilitates robust hiding of visually recognizablepatterns,
- it is hierarchical and has multiresolution characteristics,
- the embedded information is hard to detect by the humanvisual system (HVS),
- it is among best known techniques with regards tosurvival of hidden info after image compression.

Initially the extracted host object is decomposed intotwo levels by the separable 2-D wavelet transform, providingthree pairs of subbands (*HL*2, *HL*1), (*LH*2, *LH*1) and(*HH*2, *HH*1). Afterwards, the pair of subbands with thehighest energy content is detected and a QSWTs approachis incorporated [9] in order to select the coefficientswhere the encrypted biometric signal should be casted.Finally, the signal is redundantly embedded to both subbandsof the selected pair, using a non-linear energy adaptableinsertion procedure. Differences between the original and thestego-object are imperceptible to the human visual system(HVS), while biometric signals can be retrieved even undercompression and transmission losses.

IV. CHAOTIC ENCRYPTION

Before hiding, each biometric signal is initially encrypted.

A. ENCRYPTION KEYS' GENERATION

In this paper,the generated key has size equal to the size of each biometric signal. Each key is generated by a C-PRBG. In this paper we propose a PRBG based on a triplet of chaotic systems, which can provide higher security than other C-PRBGs [10]. The basic idea of the C-PRBG is to generate pseudo-random bits by mixing three different and asymptotically independent chaotic orbits. Towards this direction let $F1(x1; p1)$, $F2(x2; p2)$ and $F3(x3; p3)$ be three different *1-D* chaotic maps:

$x1(i+1) = F1(x1(i); p1)$

$x2(i+1) = F2(x2(i); p2)$

$x3(i+1) = F3(x3(i); p3)$

where$p1$, $p2$ and $p3$ are control parameters, $x1(0)$, $x2(0)$ and$x3(0)$ are initial conditions and $x1(i)$, $x2(i)$, $x3(i)$ denote thethree chaotic orbits. Then a pseudo-random bit sequence can be defined as:

$$k(i) = \begin{cases} 1 & F3(x1(i); p3) > F3(x2(i); p3 \\ k(i-1) & F3(x1(i);p3) = F3(x2(i);p3) \\ 0 & F3(x1(i); p3) < F3(x2(i); p3) \end{cases} \quad (1)$$

According to this scheme the generation of each bit is controlledby the orbit of the third chaotic system, having asinitial conditions the outputs of the other two chaotic systems [12].

B. THE ENCRYPTION MECHANISM

After generating the initial pseudo-random key, the ciphermodule is activated. Before encryption, the samples of eachbiometric signal are properly ordered. In case of 1-D signals (e.g. voice) the order is defined by the sequence of samples, while in 2-D signals (e.g. fingerprint image) pixels are line perline zig-zag scanned from top-left to bottom-right, providingplain text pixels *Pi*. Assume that *Pi* and *Ci*represent the *i-th*plain text and

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*i-th*ciphertext samples respectively (both in *n-bit* formats). Thenthe encryption procedure is defined by:
$Ci=fS(fS(Pi; i)$ XOR $xi; i)$ (2)
Where $fS(Pi; i)$ are time-variant nxnS-boxes (bijections defined on0; 1; : : : ; $2n$ - 1) and xi is produced from the states ofthree chaotic functions through the bit generation procedure defined in Eq. 1.

C. SECURITY ANALYSIS OF THE CHAOTICENCRYPTION SCHEME

For each biometric signal a key that has size equal to the sizeof the signal to be encrypted is produced. In particular, the first component of the proposed encryption module is theC-PRBG, which controls the encryption process.This component depends on three secret control parameters$p1$, $p2$ and $p3$ and three secret initial conditions $x1(0)$, $x2(0)$and $x3(0)$. These six variables are exchanged between thesender and receiver using public-key cryptography.

D. DECRYPTION

The decryption module receives at its input a vector ofencrypted samples, the initial control parameters and initialconditions for the triplet of chaotic maps (C-PRBG module)and the initial cipher value $C0$ (used at the first feedback).The procedure is terminated after the final samplеis decrypted.

V. HIDING THE ENCRYPTED BIOMETRIC SIGNAL

The encrypted biometric signal is robustly hidden inthe host video object.QSWTsprovide one of themost robust solutions to data recovery, after several signalprocessing manipulations. In particular let us assume thatthe host video object has been extracted using the methoddescribed in [7]. Next the host video object is decomposedinto two levels using the shape-adaptive discrete wavelettransform (SA-DWT) [11]. By applying the SA-DWT onceto an area of arbitrary shape, four parts of low, middle, andhigh frequencies, i.e., $LL1$, $HL1$, $LH1$, $HH1$, are produced Band $LL1$ ($HH1$) includes low (high) frequency componentsboth in horizontal and vertical direction, while the $HL1$ ($LH1$),includes high (low) frequencies in horizontal direction andlow (high) frequencies in vertical direction.Subband$LL1$ can be further decomposed in a similarway into four different subbands, denoted as $LL2$, $HL2$,$LH2$, $HH2$ respectively.

Algorithm 1 QSWTs Estimation
1: **procedure** QSWTest(I ; S; L)
2: /* I = input frame */
3: /* S = subband selection (e.g. LH) */
4: /* L = subband level (e.g. 3) */
5: /* Thresholds $T1$ and $T2$ are globally defined */
6: [LL; LH; HL;HH] =$DWT(S; L$ -1)
7: SL-1 =LH
8: [$LL1$; $LH1$; $HL1$;$HH1$] =$DWT(LL; 1)$
9: SL =$LH1$
10: $t = 0$
11: $QSWT[t] = \phi$
12: N =$rows(SL)$
13: M =$columns(SL)$
14: **for** i = 1 to N **do**
15: **for** j = 1 to M **do**
16: **if** $SL(i; j)$ is In_Node AND $|SL(i; j)|>T1$ **then**
17: $C1$ =SL-1($2i$ - 1; $2j$ -1) is In_Node AND $|SL$-1($2i$ - 1; $2j$ -1)$|>T2$
18:$C2$ = SL-1($2i$ - 1; $2j$) is In_Node AND $|SL$-1($2i$ - 1; $2j$)$|>T2$
19: $C3$ = SL-1($2i$; $2j$ - 1) is In_Node AND $|SL$-1($2i$; $2j$ - 1)$|>T2$
20:$C4$=SL-1($2i$; $2j$) is In_Node AND $|SL$-1($2i$; $2j$)$|>T2$
21:**if** ($C1$ AND $C2$ AND $C3$ AND $C4$) **then**
22:$QSWT[t]$ = $SL(i; j)$ +SL-1($2i$ - 1; $2j$ - 1) +SL-1($2i$ - 1; $2j$) +SL-1($2i$; $2j$ - 1) +SL+1($2i$; $2j$)
23:$t = t + 1$
24: **return** $QSWT$

VI. EXPERIMENTAL EVALUATION

For evaluation purposes, the proposed video objects-orientedbiometric signals hiding scheme is examined in terms of security, effectiveness and robustness. The general methodology included: (a) extraction of the host video object from a videoconference frame and detection of the QSWTs to embed the encrypted signal, (b) encryption of the fingerprint, (c) embedding of the encrypted signal to the host video object, (d) compression of the final content and simulated noisy transmission, (e) decompression and extraction of the encrypted signal, (f) decryption and (g) authentication.

VII. LIMITATIONS OF PROPOSED SCHEME

In this paper, a robust remote authentication mechanism based on semantic segmentation, chaotic encryption and data hiding has been presented.

FIGURE 4.Indicative results: (a) The 1st video frame , (b) The (assumed) fingerprint, (c) Encrypted biometric signal, (d) The automatically extracted video object, (e) stego-object containing the encrypted biometric signal of Fig. 4c, (f) Decryption of pattern of Fig. 4c using a key thatdiffers by just one bit.

Even though several successfulexperiments have been carried out, the proposed scheme hasstill its limitations and open issues, which should be further,investigated in future research. In particular:

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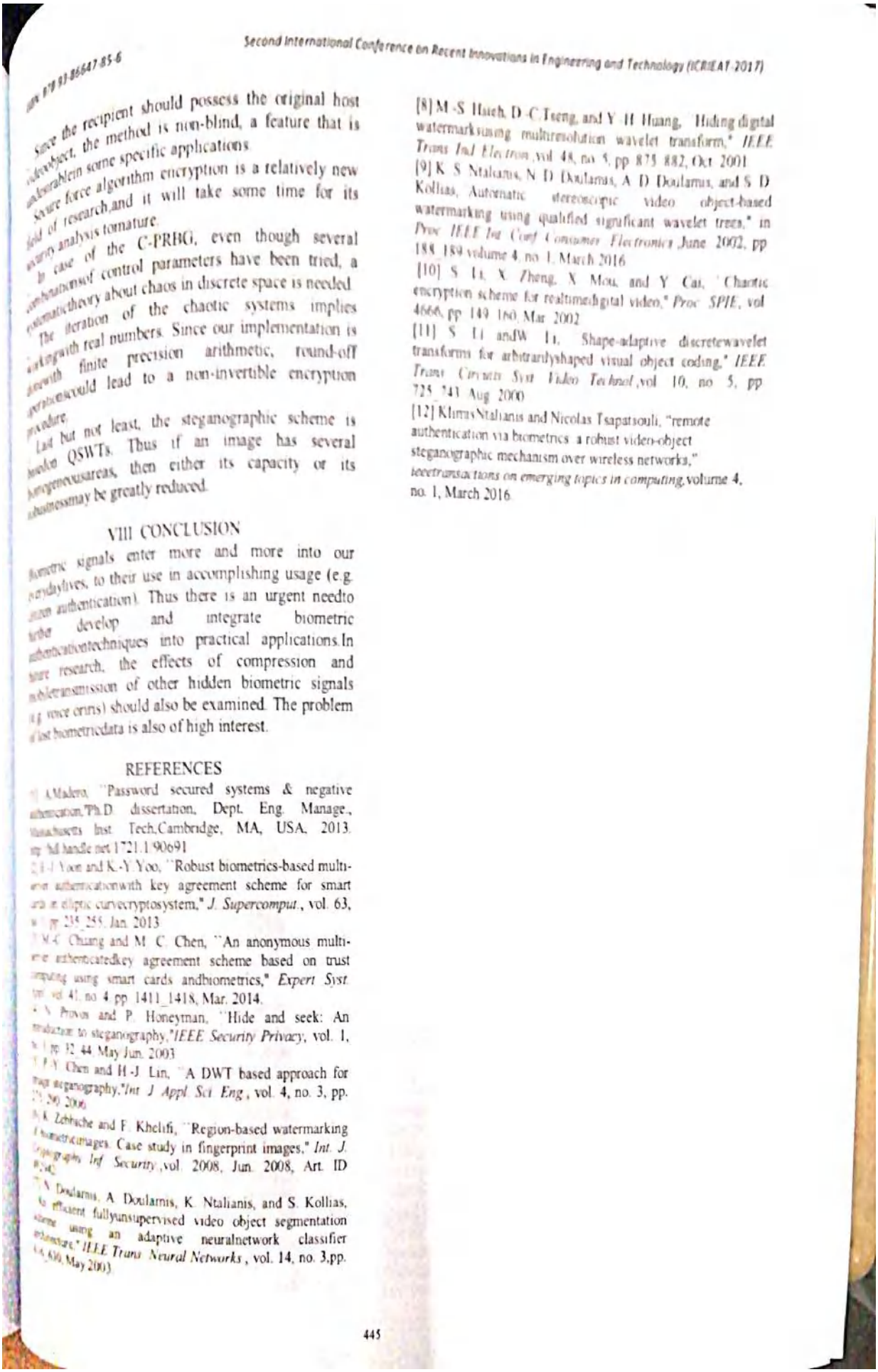

Since the recipient should possess the original host video object, the method is non-blind, a feature that is unfavorable in some specific applications.

Brute force algorithm encryption is a relatively new field of research, and it will take some time for its security analysis to mature.

In case of the C-PRBG, even though several combinations of control parameters have been tried, a systematic theory about chaos in discrete space is needed. The iteration of the chaotic systems implies working with real numbers. Since our implementation is dealing with finite precision arithmetic, round-off errors would lead to a non-invertible encryption procedure.

Last but not least, the steganographic scheme is based on QSWTs. Thus if an image has several homogeneous areas, then either its capacity or its robustness may be greatly reduced.

VIII CONCLUSION

Biometric signals enter more and more into our everydaylives, to their use in accomplishing usage (e.g. citizen authentication). Thus there is an urgent needto further develop and integrate biometric authenticationtechniques into practical applications. In future research, the effects of compression and mobiletransmission of other hidden biometric signals (e.g. voice errors) should also be examined. The problem of lost biometricdata is also of high interest.

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ECE - 5

HIGH-SPEED MULTI OUTPUT CLA-ADDERS USING 8-BIT MCC ADDER IN DOMINO LOGIC

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Abstract *- Adders are the critical parts of processor circuits. The performance of processors increases by improving the performance and functionality of adders. Carry look-ahead (CLA) adder's principle remains dominant in High-speed adder architectures, so the carry delay can be improved by calculating each stage in parallel. In this project by using an 8-bit Manchester carry chain (MCC) adder block in multi output domino CMOS logic. The even and odd carries of this adder are computed in parallel by two independent 4-bit carry chains. Implementation of wider adders based on the use of 8-bit adder module improves the operating speed compared to adders based on the standard 4-bit MCC adder module. Proposed design technique can be used for the implementation of 8, 16, 32 and 64 bit adders in multi output domino logic by using mentor graphics.*

Keywords: *Carry Look Ahead, Manchester Carry Chain adder, CMOS, VLSI*

I INTRODUCTION:

ADDITION is the most commonly used arithmetic operation and also the speed-limiting element to make faster VLSI processors. With the rapid growth of the portable electronics market in the last few years, the emphasis in VLSI design is shifting from high speed to low power. Portable applications like wireless communication and imaging systems (digital diaries, smart cards) demand high-speed computations, complex functionalities, and often real-time processing capabilities along with low power consumption. Traditional approaches to minimizing the power consumption of static complementary metal-oxide semiconductor (CMOS) logic networks have advocated straightforward reduction in the supply voltage. Since the dynamic power is proportional to the square of the supply voltage, this is the most effective technique for power reduction. The resulting increase in delay can be effectively compensated through increased data-path parallelism in special-purpose signal-processing applications and by careful transistor sizing [1], [2]. In some situations it has been recommended that the threshold voltage of the transistors be reduced to improve the circuit performance [3], [4]. However, the static power component of the power dissipation has an inverse exponential dependency on the threshold voltage. This implies that reducing the threshold voltage could cause a significant increase in the static power component. Methodologies for minimizing the sum total of static and dynamic energy consumption in general-purpose CMOS circuits have been proposed in [5–7]. Total power is minimized through careful selection of supply and threshold voltage values and device sizes such that the leakage and switching components of the dissipation are equal. The use of dual-threshold voltages for power reduction has been examined in [8] and [9]. In both the methods, all the transistors in the circuit are initially set to have a low threshold voltage. Subsequently, using the algorithms developed, the threshold voltage of some of the gates that do not lie on critical paths is increased. The leakage power can be reduced by up to 50% without affecting the performance of the circuit. In this paper we explore a mixed-swing topology wherein multiple supply voltages are used in a dual rail domino logic gate that offers simultaneous power and delay reductions. Dynamic logic gates and circuits have been excellent choice for the design of high-performance modules such as multiple bit adders, subtractors, multipliers, comparators, multiplexers, registers, etc. in modern VLSI microprocessors [1]. The advancement in fabrication technology along with the shrinking device size has allowed for placement of nearly two billion transistors on Intel's latest processor [2]. The digital logic gates and circuits designed using dynamic domino technique is considerably faster than the logic gates and circuits designed with standard static logic style. The aggressive technology scaling to improve the performance as well as the integration level makes the noise play a major role in design parameters like area, power and speed [3]. Therefore the digital integrated circuit noise has become one of the most important issues in the design of deep submicron VLSI chips [4] - [9]. The performance of the dynamic circuits can be significantly improved by precise design and properly sizing the transistors. Usually in all the digital circuits the transistor gate length remains uniform. So the size of the transistor in digital circuits depends on the width of the transistor. In this paper the multiple bit domino adders are implemented with L = 0.016nm technology along with a supply voltage of 0.7V. The modern technologies move towards smaller, faster, and cheaper computing systems. This has been facilitated by exponential increase in device density and operating frequency through VLSI technology scaling. We require improved digital logic technique and style which is at the same time energy efficient, fast and noise robust. CMOS technology is the dominant logic style in today's IC design because of its high speed, low power and high packaging density. High-speed adders based on the CLA principle remain dominant since the carry delay can be improved by calculating each stage in parallel. The Manchester carry chain (MCC) is the most common dynamic (domino) CLA adder architecture with a regular, fast, and simple structure adequate for implementation in VLSI. The recursive properties of the carries in MCC have enabled the development of multi-output domino gates, which have shown area-speed improvements with respect to single-output gates. a new 8-bit carry chain adder block in multi-output domino CMOS logic is proposed. The even and odd carries of this adder are computed in parallel by two independent 4-bitcarry chains. We propose the design of an 8-bit adder module which is composed of two independent carry chains. These chains have the same length (measured as the maximum number of series-connected transistors) as the 4-bit MCC adders. According to our simulation results, the use of the proposed 8-bit adder as the basic block, instead of the 4-bitMCC adder, can lead to high-speed adder implementations. To evaluate the speed performance of the proposed (PROP) design over the conventional (CONV) one, 8, 16, 32 and64-bit adders have been designed according to the carry chain principle and simulate using mentor graphics in a standard 130-nm CMOS technology. The PROP design provides a performance improvement than the CONV design for the 8-bitadder. The MCC is an efficient and widely accepted design approach to construct CLA adders. In this brief, we have

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present new Manchester design style that is based on two independent carry chains. Each chain computes, in parallel with the other, half of the carries. In this way, the speed performance is significantly improved with respect to that of the standard MCC topology.

II. 8-bit MCC circuit of existed system:

It can be implemented as parallel combination of two 4bit MCC's these are shown in below figures as

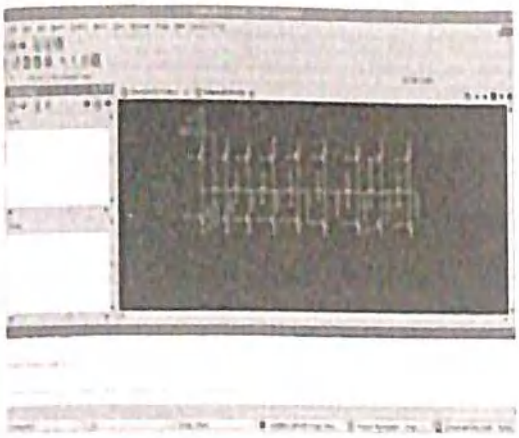

Fig (i) conventional 8-bit MCC carry chain implemented in domino CMOS logic

Fig (ii) 8-bit MCC symbol circuit

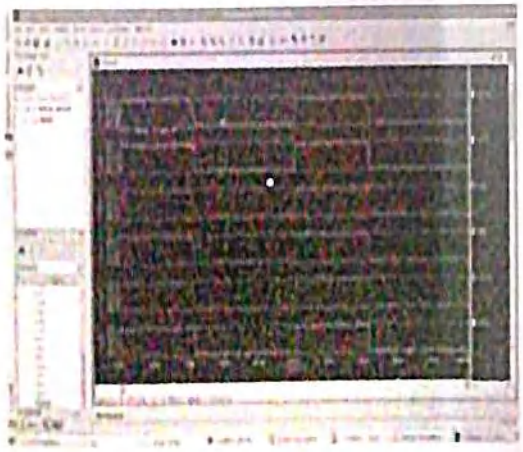

Fig (iii) conventional 8 bit MCC output wave forms

III. PRACTICAL RESULTS

Power consumption of 8-bit MCC in conventional 23.645 uw
Delay of 8-bit MCC in conventional 20.401 ns

IV. CONCLUSION

A high speed and an efficient 8 bit Manchester Carry Chain implemented in domino CMOS logic is suitable for Carry Look-Ahead Adders in processor applications is discussed in this project. This circuit is designed and simulated using MENTOR- GRAPHICS software. This design realizes better improvement in reducing the delay by introducing parallelism concept in carry chains. As a result, the 2 separate carry chains namely odd carry chain and even carry chain work in parallel thus increases speed of operation by reducing the delay considerably compared with 4 bit MCC. Hence this 8 bit carry chain is more efficient and can operate at low supply voltages with high speed, thus making this carry chain suitable for most of the high speed processor applications. This high speed Manchester Carry Cain is found to have a delay less than compared to conventional 4 bit MCC delay. Even though the delay of 8 bit MCC gets reduced, number of transistors gets increased in the high speed 8 bit Manchester Carry Chain. As a further work reducing the area of this chain and further reducing the delay by analyzing this design in submicron technology and implementing it in a variable bits like 16 bit, 32 bit Manchester Carry Chain in multi output domino CMOS logic can be considered.

V. FUTURE SCOPE

We design our logic circuit by using transmission gate logic will minimize number of transistors, Minimize all internal capacitances, by minimizing the active area of the transistors, and thus minimizing power.

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ECE - 7

CORONA BASED ENERGY EFFICIENT CLUSTERING IN WSN

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Abstract *- Abstract — Wireless sensor network represents one of the most interesting research areas with profound impact on technological development. Here we implement an energy efficient approach for optimal cluster head selection and clustering. We also pinpoint cluster head rotation technique using the concept of back off timer that prolongs the life time of the network. Addition and deletion of nodes can be done in the clustered network without affecting the existing infrastructure.*

Index Terms - Wireless Sensor Networks, Corona, Clustering, Cluster Head, Routing, Nodes, Sink, Back off Timer, VCCB, Optimal Distance.

I. INTRODUCTION

Many future applications will increasingly depend on embedded wireless sensor networks. A sensor network consists of numerous sensor/actuator devices. Wireless Sensor Networks have emerged as an important new area in wireless technology. In the near future, the wireless sensor networks are expected to consist of thousands of inexpensive nodes, each having sensing capability with limited computational and communication power, which enable us to deploy a large-scale sensor network. A critical aspect of applications in wireless sensor network is network lifetime.
Wireless sensor network are usable as long as they can communicate sensed data to processed node. Sensing and communication are important activities and they consume energy. So power management and sensor scheduling can effectively increase the networks lifetime. The use of wireless sensor networks is increasing day by day and at the same time it faces the problem of energy constraints in terms of limited battery lifetime.

WSN has considerable technical challenges in data processing and communication to deal with dynamically changing Energy, Bandwidth and Processing power. Another important issue in Wireless Sensor Network is to maximize Sensor Network lifetime. The vital issue in WSN is to maximize the network operational life. In order to achieve this, it is necessary to minimize the energy utilization of a node. Most of the energy consumption in wireless sensor node is attributed to transmitting/receiving, processing, and forwarding the data to neighboring nodes.
Clustering has been shown to improve network lifetime, a primary metric for evaluating the performance of a sensor network. The clustering techniques proposed for data processing typically consider many parameters such as the distance between the nodes, and assume that nodes are more reliable.

The sensors are capable of sensing the data from the environment in which they are deployed, processes that data and transmit it to the base-station (BS). The sensor circuit senses the environment and converts the signals into electrical signals which are then transmitted to the BS using a transmitter via a routing node. In clustering, nodes with higher power levels perform the fusion of data gathered from the other sensor nodes and transmit the aggregated data to the base-station (BS) while the nodes with low power levels only perform the sensing of the environment. They transmit the sensed data to the higher node, known as the cluster-head (CHs) which are at a lesser distance to the base station. The cluster formation and the assignment of special tasks to the cluster heads (CHs) reduce the power dissipation within a particular cluster, which improves the scalability of the sensor network. Also by aggregating the sensed data the amount of data to be transmitted to the base-station (BS) is reduced and the lifetime of the overall sensor network is increased.

II. RELATED WORKS

Paper [1] proposes a model for energy efficient clustering and cluster head selection method. It is based on a circular monitoring area with a uniform node density and a sink node at the center. The area is divided into concentric circles known as corona, each of width R/2, where R is the transmission range of the sensor node. Cluster head selection is performed by finding out the optimal distance from VCCB, where VCCB lies at the midway between two concentric circles.

One of the main design goals of WSNs is to carry out data communication while trying to prolong the lifetime of the network and prevent connectivity degradation by employing aggressive energy management techniques [2].

The clustering concept offers tremendous benefits for wireless sensor networks. However when designing for a particular application, designers must carefully examine the formation of clusters in the network. Depending on the application, certain requirements for the number of nodes in a cluster or its physical size may play an important role in its operation. This prerequisite may have an impact on how cluster heads are selected in this application [3].

There are many clustering protocols are exists, such as LEACH, HEED etc. As the need for efficient use of WSNs on large regions increased in the last decade dramatically, more specific clustering protocols were developed to meet the additional requirements (increased network lifetime, reduced and evenly distributed energy consumption, scalability, etc.). The most significant and widely used representatives of these focused on WSN clustering protocols (LEACH, EEHC, and HEED). Some of them (such as LEACH, EEHC, and their extensions) follow a random approach for CH election (the initially assigned probabilities serve as the basis for the random election of the CHs), whereas others (like HEED and similar approaches) follow a hybrid probabilistic methodology (secondary criteria are also considered during CH election—i.e., the residual energy) [4].

The LEACH protocol [3] is an application-specific clustering protocol which has been shown to significantly improve the network lifetime. It assumes that every node is reachable in a single hop and that load distribution is uniform among all nodes. LEACH assigns a fixed probability to every node so as to elect itself as a CH. The clustering process involves only one iteration, after which a node decides whether to become a CH or not. Nodes take turns in carrying the role of a CH [5].

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HEED (Hybrid Energy-Efficient Distributed clustering), has four primary goals: (i) prolonging network lifetime by distributing energy consumption, (ii) terminating the clustering process within a constant number of iterations/steps, (iii) minimizing control overhead (to be linear in the number of nodes), and (iv) producing well-distributed cluster heads and compact clusters. In classical distributed systems, a node can either be a server or a source, but not both. A fixed number of servers are known to every source in the system, and a server is always available for processing. In our model, every node can act as both a source and a server (cluster head), which motivates the need for efficient algorithms to select servers according to the outlined system goals [6].

The execution of a clustering algorithm can be carried out at a centralized authority (e.g., a base station) or in a distributed way at local nodes. Centralized approaches require global information about the network topology. Banerjee et al. [7] proposed a centralized technique that does not require knowledge of node locations. Even though t is a spanning tree based idea, we are designing a new idea which is also a network in which node locations are unknown [4].

III. SYSTEM MODEL

A. NEED FOR CLUSTERING

WSN offer unique systems for creating communications infrastructures on-demand. Their use is dependent on the effective deployment of these systems to areas of interest. There are several challenging issues involved in the deployment of WSN, mostly due to their small size and large number of nodes required to establish proper operation.

WSN is an emerging technology that shows great promise for various futuristic applications both for mass public and military. The sensing technology combined with processing power and wireless communication makes it lucrative for being exploited in abundance in future. The inclusion of wireless communication technology also incurs various types of security threats. A WSN must also be self-monitoring and able to proactively reconfigure to mitigate certain malfunctions before they actually occur.

Clustering means grouping of nodes. As each node depends on energy for its activities, this has become a major issue in wireless sensor networks. The failure of one node can interrupt the entire system or application. Every sensing node can be in active (for receiving and transmission activities), idle and sleep modes. In active mode nodes consume energy when receiving or transmitting data. In idle mode, the nodes consume almost the same amount of energy as in active mode, while in sleep mode, the nodes shutdown the radio to save the energy.

B. CLUSTERING BASICS

In cluster based architectures, mobile nodes are divided into virtual groups. Each cluster has adjacencies with other clusters. All the clusters have the same rules. A cluster can be made up of a Cluster Head node and Cluster Members. In this kind of network, Cluster Head nodes are used to control the cluster and the size of the cluster is usually about one or two hops from the Cluster Head node. Grouping sensor nodes into clusters has been widely adopted by the research community to satisfy the above scalability objective and generally achieve high energy efficiency and prolong network lifetime in large-scale WSN environments. The corresponding hierarchical routing and data gathering protocols imply cluster-based organization of the sensor nodes in order that data fusion and aggregation are possible, thus leading to significant energy savings.

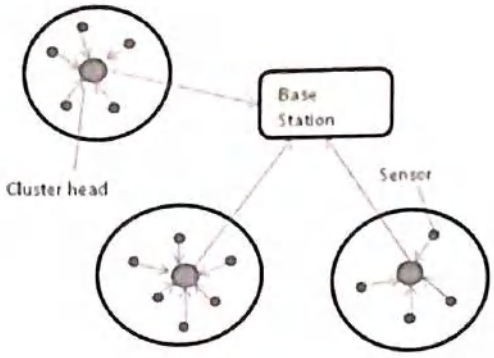

Fig 1 Clustered Network

The sink node gets all information from the cluster heads those are connected to the other nodes under control of them. Here is the most challenging part will come to place that, if the clustering head pass the same events to the sink node it will leads to more energy consumption .Another fact is that if the clustering node having the capability to compress/data aggregation energy consumption can be reduced to a optimum level. So, here we select the clusters as the nodes which having maximum resources and monitoring power.

IV. PROPOSED MODEL

This paper mainly focuses on energy efficient and a secure Wireless Sensor Network. We use clustering method for communication between nodes and sink, since it is energy efficient when compared to single hop and multi hop routing.

All non-CH nodes transmit their data to the CH they are connected to, while the CH node receives data from all the cluster members, performs specific processing functions on the data (e.g., aggregation, filtering, compression, etc.), and forwards data to the BS. We implement a clustering mechanism which performs optimum selection of cluster heads and rotates the role of cluster head in an energy efficient way.

A. ASSUMPTIONS

The proposed model made some assumptions. These are

- The nodes are deployed over circular monitoring area A of radius Z with uniform node distribution density [].
- The sink node will be plotted at the centre.
- The nodes are deployed randomly on the region.
- All nodes having same energy.
- Selection of CHs based on timer expiration.

B. STEPS NEEDED

The various steps that we follow are:

Step 1: Read the maximum number of nodes that must be deployed, the sensing range and transmission range of the node, the radius of the circular area, and the coordinates of the centre of the circular area where the sink node is to be plotted.

Step 2: We randomly choose a set of coordinates that come within the circular region and plot them in the specified area. For this, we compare the distance between the chosen coordinate and the centre, and the radius of the circular area. We plot the point only if the distance falls under the given radius. We count the number of points plotted.

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Step 2 We randomly choose a set of coordinates that come within the circular region and plot them in the specified area. For this, we compare the distance between the chosen coordinate and the centre, and the radius of the circular area. We plot the point only if the distance falls under the given radius. We count the number of points plotted.

Step 3 Now we divide the circular area into a number of concentric circles each of width R/2, where R is the maximum transmission range of the node. Each of these concentric circles is called corona. We find the Euclidian distance of each node from the sink node and then the sensor nodes are assigned concentric circle index using the formula

$$C_i = \frac{2|d_{si}|}{R}$$

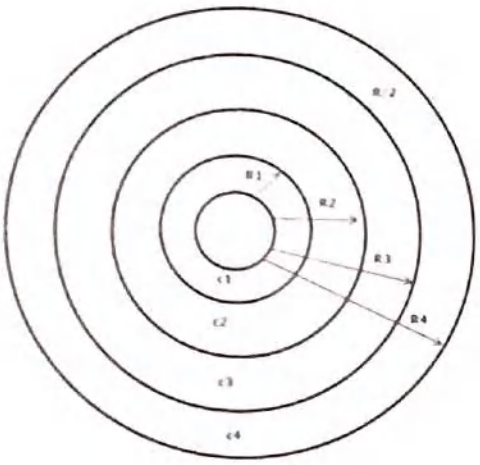
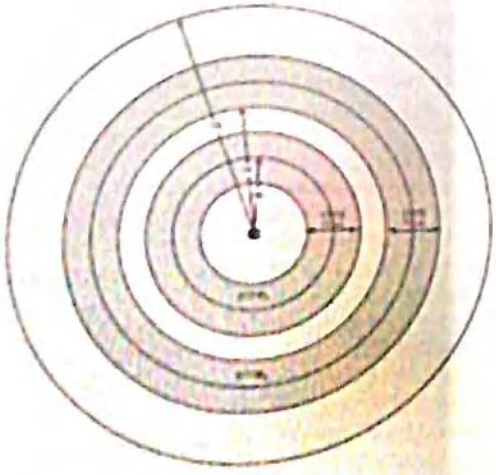


Fig 2 Corona based WSN model

Step 4: In order to implement energy balanced clustering, the concept of Virtual Concentric Circle Band (VCCB) is introduced, where each sensor node calculates their respective VCCB index using the formula

$$V_j = [x_i \pm \delta]$$

$$x_i = \left\{\left(\frac{R}{2} * C_i\right) + \frac{R}{4}\right\}$$



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The value of δ depends on node density. If the sensing area is densely populated, the value of δ is small for sparsely populated area, the value of δ is large. If the distance of a node from the sink, d_{si} falls within VCB index, then the corresponding sensor node is chosen as a primary candidate for cluster head election. These candidate nodes then calculate their distance from the centre of their respective VCCB as

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Step 5 The cluster formation phase begins when the sink node sends START message to the candidates. Upon receiving this start message each candidate starts its back of timer. Since the back off timer value is proportional to the distance of the candidate from the centre of VCCB, the back off timer of the node near to the centre will expire first. The node whose back of timer expired first, will send as advertisement to all nodes within the radio range R/4, announcing itself as the cluster head. All the cluster head candidates within this radio range, will stop their back off timer and all the cluster head candidates as well as non-cluster head candidates within this range will acknowledge the receipt of announcement, thus forming a cluster. This process is carried out throughout the network area, thus forming a number of non uniform clusters.

Step 6 In order to prolong the life time of the network, we change the role of cluster head with in a cluster when the remaining energy of the current head lowers below a particular threshold value. Find out the candidate nodes among the members of that cluster. Sink node sends a START message to those candidates, upon which each candidate starts their back off timer. The nodes whose timer expires first will be chosen as the new cluster head.

C. IMPLEMENTATION OF SCALABILITY

Many applications of wireless sensor networks adopt hierarchical structure for the scalability and simplify of management. Clustering is the most popular method that imposes such a scalable topology. Here we implement addition and deletion of nods to the existing sensor network.

In order to add a new node in to the specified clustered network, we keep track of an array inside the node structure for every cluster head which stores the ids of the member nodes of the corresponding cluster heads. Then new node sends a message to sink node about its arrival then it will forwarded to all cluster heads. After that it will join to the cluster head that has minimum distance from that node and it should have high monitoring capability.

Deletion means removing out-of-date, redundant, or inconsistent nodes. Then update the nodes in clusters to eliminate redundancy. In order to perform deletion we can use the same array that defined for the addition of nodes. Delete the node id from the array for deletion and update the array. The goals of this scalability approaches are maintaining stable clustering structure, minimizing the overhead for the clustering set up, maximizing lifespan, and achieving good end to end performance.

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The network simulation is done in MATLAB environment. A circular area with specified radius is considered. The nodes have to be deployed independently and randomly. Certain numbers of nodes are deployed over the area. The nodes which satisfy the criteria specified in the algorithm will plot over the area. That is, we compare the distance between the chosen coordinate and the centre, and the radius of the circular area. We plot the nodes only if the distance falls under the given radius.

The probable candidates and the cluster members are represented with various colors in the graph. The transmission energy of the nodes while sending k bits of data over the distance will found out by the equations

$$E_{Tx}(k,d) = E_{elect-Tx}(k) + E_{amp-Tx}(k,d)$$

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Where E_{elect} is the transmission electronics energy and d_0 is the optimum distance.

The energy consumption of sensor node to receiver k bits of data is given by:

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The messages exchanged between each and every node is represented by colored lines in the graph. Probable candidates are those nodes which are more suitable nodes to become cluster heads. These nodes are selected on the basis of calculated VCCB indices during the execution.

Cluster heads are selected by timer expiration. The candidate node whose back off timer expires first will be chosen as the cluster heads. After the selection of cluster heads they advertises these information to the nodes within the R/4 transmission range of the selected cluster head.

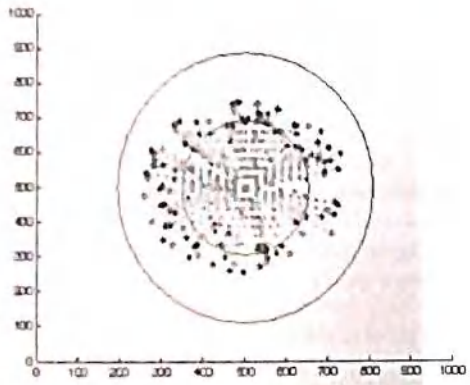

Fig 4 Clustered Network

Here energy is the heterogeneity parameter. Whenever the remaining energy less than a particular threshold, cluster head rotation will be performed. Cluster head rotation is performed by finding next powerful probable candidate which has higher monitoring capability. So, the sink node sends START message to these candidates and they start their back off timer. As in the previous case the node whose timer expires first, it will become the cluster head.

This kind of cluster head rotation avoids the need for reclustering. Reclustering takes more energy to maintain the topology and all the nodes will again performs clustering and joins to the clusters. In our approach, we can avoid reclustering thus avoids the higher energy utilization. Hence energy consumption of corona approach is less than that of other clustering approaches.

Scalability is one of the major issues when WSN is considered. An efficient sensor network should be extensible without affecting the performance characteristics. Here we implement addition and deletion of nodes from the sensor network.

For performing addition to the wireless sensor network, create an array that stores the IDs of the member nodes for each cluster head. Also create a variable that stores the number of members. When a new node wants to join to the sensor network, new node sends the information to the sink node about its arrival. Then find the distance to each cluster head and join to the cluster head which has minimum distance from the new node. After join to the cluster head member array of that cluster head will be update by adding the new node ID.

Deletion means removing the redundant or lower energy nodes from the sensor network. Deletion of such nodes improves the performance of the network because, these nodes can't monitoring the area efficiently and sending messages to these kinds of nodes will leads to unnecessary energy consumption. Here deletion is done based on the residual energy. Whenever energy of the existing node reduces than the threshold value, the IDs of such nodes are maintained in an array. Already we have count of the members under each cluster head. We check the ID of the node to be deleted with the member IDs. Then delete the ID of the node to be removed from its CH's member array. Update the array after deletion.

COMPARISON WITH LEACH

LEACH is called "Energy efficient Adaptive protocol for clustered Wireless sensor networks". Low Energy Adaptive Clustering Hierarchy (LEACH) is the first energy efficient routing protocol for hierarchical clustering. LEACH is a self organized protocol based on a probability approach. LEACH mainly focuses homogeneous environments. The probability to become a CH after once it is selected is higher because in LEACH all nodes get chance to become CH and it leads to reduced lifetime. In our protocol, we select only certain number of efficient candidates to become CH and it leads to enhanced lifetime of cluster. LEACH sends JOIN request to all other nodes over deployed area leads to higher energy consumption. In corona-based approach we send JOIN message only to those nodes that are within the radio range which leads low energy consumption.

The following figure shows the comparison between LEACH and corona based approach based on the number of nodes deployed and number of probable candidates to become CH.

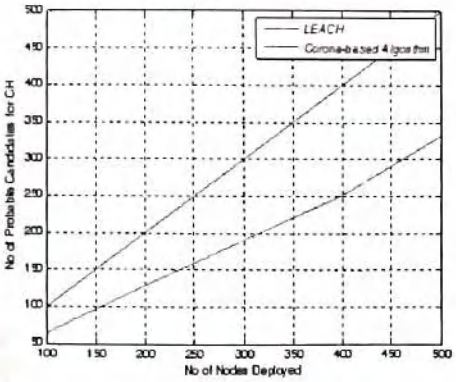

Fig 5 Number of Nodes Deployed vs. Number of Probable Candidates for CH Graph

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From the analysis of above graph, it is clear that, in corona based approach we select only optimum number of cluster heads.

The following table describes the various statistics of the corona based approach

Numb er of nodes deployed	Number of probable candidates	Numb er of CHs selected during round 1	Numb er of nodes failed after round 1	Numb er of CHs selected during round 2
100	64	26	0	0
200	128	34	21	21
300	190	34	27	27
400	251	39	33	33
500	331	40	36	36
600	378	40	36	36

Table 1 Simulation Analysis-1

During each round of CH rotation, the number of CHs selected equals the number of CHs failed during the previous round. This ensures a clustering method that effectively monitors all the nodes in the network even after a certain number of rounds.

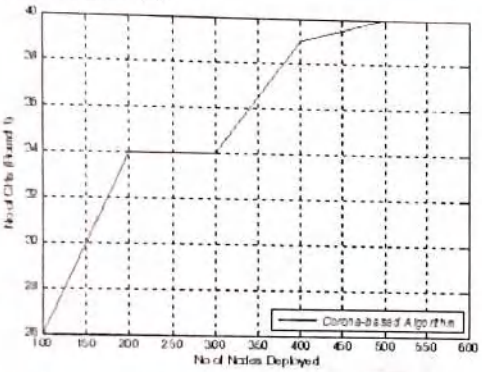

Fig 6 Number of Nodes Deployed vs. Number of CHs Selected (During Round 1)

After the first round of CH selection, a certain number of CHs fail as their energy fall below a particular threshold value. Those nodes are deleted and the same numbers of CHs are selected in the second round of CH rotation.

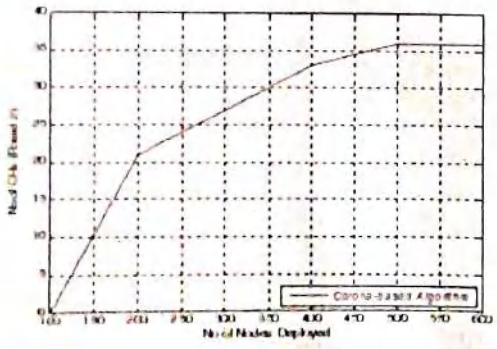

Fig 7 Number of Nodes Deployed vs. Number of CHs Selected (During Round 2)

The time elapsed for first round of cluster head selection and second round of cluster head rotation for various numbers of nodes deployed can be tabulated as follows:

Number of nodes deployed	Time taken for first round of CH selection (in seconds)	Time taken f second round Ch rotation (in seconds)
100	329.631565	0.756115
200	446.454966	190.816695
300	681.083411	266.269403
400	692.684151	264.298860
500	863.258635	319.014914
600	1024.648643	387.028500

Table 2 Simulation Analysis-2

VI. CONCLUSIONS

Node clustering is a useful topology-management approach to reduce communication overhead and exploit data aggregation in sens networks. Clustering is highly efficient because the nodes are deploy over a large area which is also insecure. So, monitoring is one of the critic tasks over a large area. In our corona based approach the best monitori can be assured because even though one CH is drained, we have possibility to rotate them and the monitoring is more specific due different corona exist over a region. The major concern of scalability c also be resolved by dynamic addition and deletion of nodes in the netwo maintaining the same performance efficiency thereby aiding a wide ran of applications.

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ECE - 7

CORONA BASED ENERGY EFFICIENT CLUSTERING IN WSN

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Abstract *- Abstract — Wireless sensor network represents one of the most interesting research areas with profound impact on technological development. Here we implement an energy efficient approach for optimal cluster head selection and clustering. We also pinpoint cluster head rotation technique using the concept of back off timer that prolongs the life time of the network. Addition and deletion of nodes can be done in the clustered network without affecting the existing infrastructure.*

Index Terms - Wireless Sensor Networks, Corona, Clustering, Cluster Head, Routing, Nodes, Sink, Back off Timer, VCCB, Optimal Distance.

I. INTRODUCTION

Many future applications will increasingly depend on embedded wireless sensor networks. A sensor network consists of numerous sensor/actuator devices. Wireless Sensor Networks have emerged as an important new area in wireless technology. In the near future, the wireless sensor networks are expected to consist of thousands of inexpensive nodes, each having sensing capability with limited computational and communication power, which enable us to deploy a large-scale sensor network. A critical aspect of applications in wireless sensor network is network lifetime.
Wireless sensor network are usable as long as they can communicate sensed data to processed node. Sensing and communication are important activities and they consume energy. So power management and sensor scheduling can effectively increase the networks lifetime. The use of wireless sensor networks is increasing day by day and at the same time it faces the problem of energy constraints in terms of limited battery lifetime.

WSN has considerable technical challenges in data processing and communication to deal with dynamically changing Energy, Bandwidth and Processing power. Another important issue in Wireless Sensor Network is to maximize Sensor Network lifetime. The vital issue in WSN is to maximize the network operational life. In order to achieve this, it is necessary to minimize the energy utilization of a node. Most of the energy consumption in wireless sensor node is attributed to transmitting/receiving, processing, and forwarding the data to neighboring nodes.
Clustering has been shown to improve network lifetime, a primary metric for evaluating the performance of a sensor network. The clustering techniques proposed for data processing typically consider many parameters such as the distance between the nodes, and assume that nodes are more reliable.

The sensors are capable of sensing the data from the environment in which they are deployed, processes that data and transmit it to the base-station (BS). The sensor circuit senses the environment and converts the signals into electrical signals which are then transmitted to the BS using a transmitter via a routing node. In clustering, nodes with higher power levels perform the fusion of data gathered from the other sensor nodes and transmit the aggregated data to the base-station (BS) while the nodes with low power levels only perform the sensing of the environment. They transmit the sensed data to the higher node, known as the cluster-head (CHs) which are at a lesser distance to the base station. The cluster formation and the assignment of special tasks to the cluster heads (CHs) reduce the power dissipation within a particular cluster, which improves the scalability of the sensor network. Also by aggregating the sensed data the amount of data to be transmitted to the base-station (BS) is reduced and the lifetime of the overall sensor network is increased.

II. RELATED WORKS

Paper [1] proposes a model for energy efficient clustering and cluster head selection method. It is based on a circular monitoring area with a uniform node density and a sink node at the center. The area is divided into concentric circles known as corona, each of width R/2, where R is the transmission range of the sensor node. Cluster head selection is performed by finding out the optimal distance from VCCB, where VCCB lies at the midway between two concentric circles.

One of the main design goals of WSNs is to carry out data communication while trying to prolong the lifetime of the network and prevent connectivity degradation by employing aggressive energy management techniques [2].

The clustering concept offers tremendous benefits for wireless sensor networks. However when designing for a particular application, designers must carefully examine the formation of clusters in the network. Depending on the application, certain requirements for the number of nodes in a cluster or its physical size may play an important role in its operation. This prerequisite may have an impact on how cluster heads are selected in this application [3].

There are many clustering protocols are exists, such as LEACH, HEED etc. As the need for efficient use of WSNs on large regions increased in the last decade dramatically, more specific clustering protocols were developed to meet the additional requirements (increased network lifetime, reduced and evenly distributed energy consumption, scalability, etc.). The most significant and widely used representatives of these focused on WSN clustering protocols (LEACH, EEHC, and HEED). Some of them (such as LEACH, EEHC, and their extensions) follow a random approach for CH election (the initially assigned probabilities serve as the basis for the random election of the CHs), whereas others (like HEED and similar approaches) follow a hybrid probabilistic methodology (secondary criteria are also considered during CH election—i.e., the residual energy) [4].

The LEACH protocol [3] is an application-specific clustering protocol which has been shown to significantly improve the network lifetime. It assumes that every node is reachable in a single hop and that load distribution is uniform among all nodes. LEACH assigns a fixed probability to every node so as to elect itself as a CH. The clustering process involves only one iteration, after which a node decides whether to become a CH or not. Nodes take turns in carrying the role of a CH [5].

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HEED (Hybrid Energy-Efficient Distributed clustering), has four primary goals: (i) prolonging network lifetime by distributing energy consumption, (ii) terminating the clustering process within a constant number of iterations/steps, (iii) minimizing control overhead (to be linear in the number of nodes), and (iv) producing well-distributed cluster heads and compact clusters. In classical distributed systems, a node can either be a server or a source, but not both. A fixed number of servers are known to every source in the system, and a server is always available for processing. In our model, every node can act as both a source and a server (cluster head), which motivates the need for efficient algorithms to select servers according to the outlined system goals [6].

The execution of a clustering algorithm can be carried out at a centralized authority (e.g., a base station) or in a distributed way at local nodes. Centralized approaches require global information about the network topology. Banerjee et al. [7] proposed a centralized technique that does not require knowledge of node locations. Even though t is a spanning tree based idea, we are designing a new idea which is also a network in which node locations are unknown [4].

III. SYSTEM MODEL

A. NEED FOR CLUSTERING

WSN offer unique systems for creating communications infrastructures on-demand. Their use is dependent on the effective deployment of these systems to areas of interest. There are several challenging issues involved in the deployment of WSN, mostly due to their small size and large number of nodes required to establish proper operation.

WSN is an emerging technology that shows great promise for various futuristic applications both for mass public and military. The sensing technology combined with processing power and wireless communication makes it lucrative for being exploited in abundance in future. The inclusion of wireless communication technology also incurs various types of security threats. A WSN must also be self-monitoring and able to proactively reconfigure to mitigate certain malfunctions before they actually occur.

Clustering means grouping of nodes. As each node depends on energy for its activities, this has become a major issue in wireless sensor networks. The failure of one node can interrupt the entire system or application. Every sensing node can be in active (for receiving and transmission activities), idle and sleep modes. In active mode nodes consume energy when receiving or transmitting data. In idle mode, the nodes consume almost the same amount of energy as in active mode, while in sleep mode, the nodes shutdown the radio to save the energy.

B. CLUSTERING BASICS

In cluster based architectures, mobile nodes are divided into virtual groups. Each cluster has adjacencies with other clusters. All the clusters have the same rules. A cluster can be made up of a Cluster Head node and Cluster Members. In this kind of network, Cluster Head nodes are used to control the cluster and the size of the cluster is usually about one or two hops from the Cluster Head node. Grouping sensor nodes into clusters has been widely adopted by the research community to satisfy the above scalability objective and generally achieve high energy efficiency and prolong network lifetime in large-scale WSN environments. The corresponding hierarchical routing and data gathering protocols imply cluster-based organization of the sensor nodes in order that data fusion and aggregation are possible, thus leading to significant energy savings.

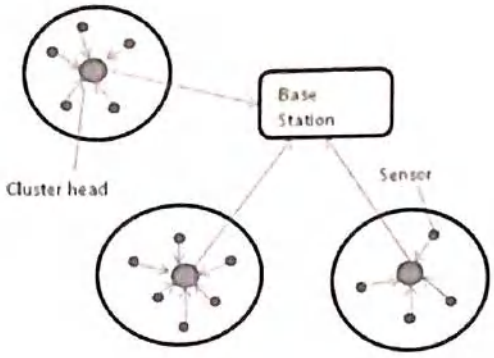

Fig 1 Clustered Network

The sink node gets all information from the cluster heads those are connected to the other nodes under control of them. Here is the most challenging part will come to place that, if the clustering head pass the same events to the sink node it will leads to more energy consumption .Another fact is that if the clustering node having the capability to compress/data aggregation energy consumption can be reduced to a optimum level. So, here we select the clusters as the nodes which having maximum resources and monitoring power.

IV. PROPOSED MODEL

This paper mainly focuses on energy efficient and a secure Wireless Sensor Network. We use clustering method for communication between nodes and sink, since it is energy efficient when compared to single hop and multi hop routing.

All non-CH nodes transmit their data to the CH they are connected to, while the CH node receives data from all the cluster members, performs specific processing functions on the data (e.g., aggregation, filtering, compression, etc.), and forwards data to the BS. We implement a clustering mechanism which performs optimum selection of cluster heads and rotates the role of cluster head in an energy efficient way.

A. ASSUMPTIONS

The proposed model made some assumptions. These are

- The nodes are deployed over circular monitoring area A of radius Z with uniform node distribution density [].
- The sink node will be plotted at the centre.
- The nodes are deployed randomly on the region.
- All nodes having same energy.
- Selection of CHs based on timer expiration.

B. STEPS NEEDED

The various steps that we follow are:

Step 1: Read the maximum number of nodes that must be deployed, the sensing range and transmission range of the node, the radius of the circular area, and the coordinates of the centre of the circular area where the sink node is to be plotted.

Step 2: We randomly choose a set of coordinates that come within the circular region and plot them in the specified area. For this, we compare the distance between the chosen coordinate and the centre, and the radius of the circular area. We plot the point only if the distance falls under the given radius. We count the number of points plotted.

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Step 3 Now we divide the circular area into a number of concentric circles each of width R/2, where R is the maximum transmission range of the node. Each of these concentric circles is called corona. We find the Euclidian distance of each node from the sink node and then the sensor nodes are assigned concentric circle index using the formula

$$C_i = \frac{2|d_{si}|}{R}$$

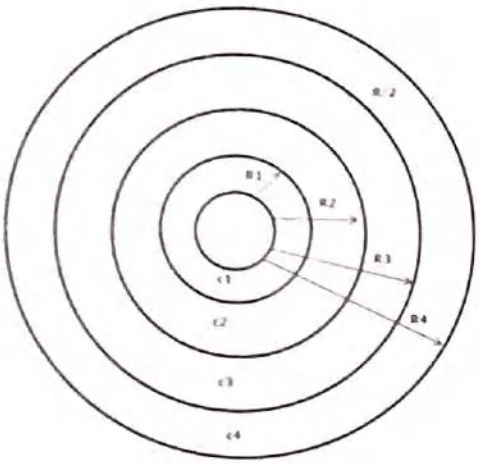
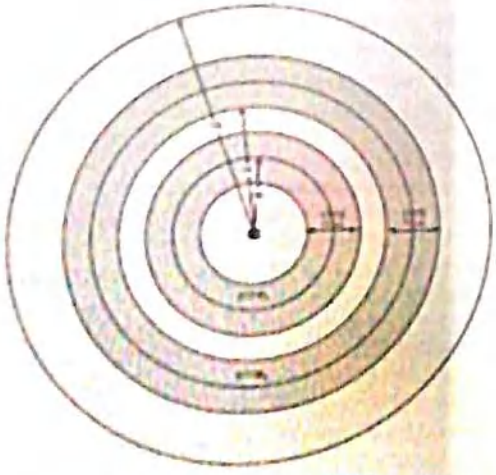


Fig 2 Corona based WSN model

Step 4: In order to implement energy balanced clustering, the concept of Virtual Concentric Circle Band (VCCB) is introduced, where each sensor node calculates their respective VCCB index using the formula

$$V_j = [x_i \pm \delta]$$

$$x_i = \left\{\left(\frac{R}{2} * C_i\right) + \frac{R}{4}\right\}$$



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Here we use the concept of a back-off timer. Its initial value is proportional to the distance of the candidate from the centre of VCCB. For a node N_i, the initial value of back off timer is given by

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Where E_{elect} is the transmission electronics energy and d_0 is the optimum distance.

The energy consumption of sensor node to receiver k bits of data is given by:

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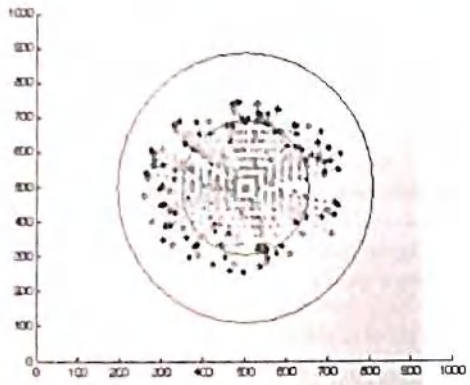

Fig 4 Clustered Network

Here energy is the heterogeneity parameter. Whenever the remaining energy less than a particular threshold, cluster head rotation will be performed. Cluster head rotation is performed by finding next powerful probable candidate which has higher monitoring capability. So, the sink node sends START message to these candidates and they start their back off timer. As in the previous case the node whose timer expires first, it will become the cluster head.

This kind of cluster head rotation avoids the need for reclustering. Reclustering takes more energy to maintain the topology and all the nodes will again performs clustering and joins to the clusters. In our approach, we can avoid reclustering thus avoids the higher energy utilization. Hence energy consumption of corona approach is less than that of other clustering approaches.

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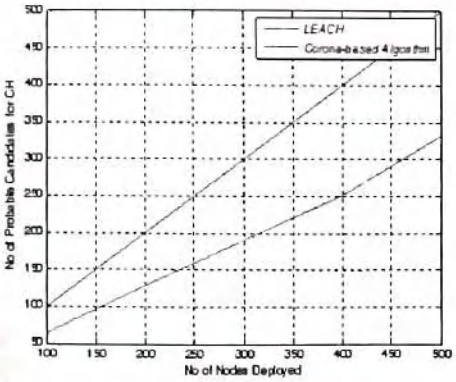

Fig 5 Number of Nodes Deployed vs. Number of Probable Candidates for CH Graph

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The following table describes the various statistics of the corona based approach

Numb er of nodes deployed	Number of probable candidates	Numb er of CHs selected during round 1	Numb er of nodes failed after round 1	Numb er of CHs selected during round 2
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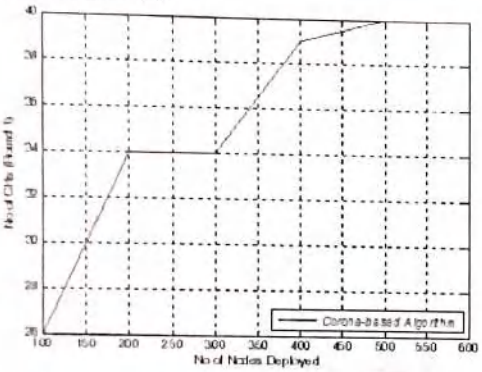
During each round of CH rotation, the number of CHs selected equals the number of CHs failed during the previous round. This ensures a clustering method that effectively monitors all the nodes in the network even after a certain number of rounds.



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After the first round of CH selection, a certain number of CHs fail as their energy fall below a particular threshold value. Those nodes are deleted and the same numbers of CHs are selected in the second round of CH rotation.

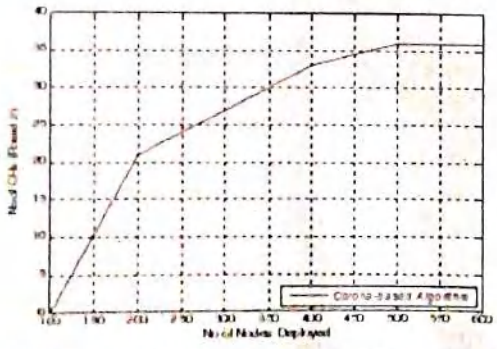

Fig 7 Number of Nodes Deployed vs. Number of CHs Selected (During Round 2)

The time elapsed for first round of cluster head selection and second round of cluster head rotation for various numbers of nodes deployed can be tabulated as follows:

Number of nodes deployed	Time taken for first round of CH selection (in seconds)	Time taken f second round Ch rotation (in seconds)
100	329.631565	0.756115
200	446.454966	190.816695
300	681.083411	266.269403
400	692.684151	264.298860
500	863.258635	319.014914
600	1024.648643	387.028500

Table 2 Simulation Analysis-2

VI. CONCLUSIONS

Node clustering is a useful topology-management approach to reduce communication overhead and exploit data aggregation in sens networks. Clustering is highly efficient because the nodes are deploy over a large area which is also insecure. So, monitoring is one of the critic tasks over a large area. In our corona based approach the best monitori can be assured because even though one CH is drained, we have possibility to rotate them and the monitoring is more specific due different corona exist over a region. The major concern of scalability c also be resolved by dynamic addition and deletion of nodes in the netwo maintaining the same performance efficiency thereby aiding a wide ran of applications.

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ECE - 7

CORONA BASED ENERGY EFFICIENT CLUSTERING IN WSN

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Abstract *- Abstract — Wireless sensor network represents one of the most interesting research areas with profound impact on technological development. Here we implement an energy efficient approach for optimal cluster head selection and clustering. We also pinpoint cluster head rotation technique using the concept of back off timer that prolongs the life time of the network. Addition and deletion of nodes can be done in the clustered network without affecting the existing infrastructure.*

Index Terms - Wireless Sensor Networks, Corona, Clustering, Cluster Head, Routing, Nodes, Sink, Back off Timer, VCCB, Optimal Distance.

I. INTRODUCTION

Many future applications will increasingly depend on embedded wireless sensor networks. A sensor network consists of numerous sensor/actuator devices. Wireless Sensor Networks have emerged as an important new area in wireless technology. In the near future, the wireless sensor networks are expected to consist of thousands of inexpensive nodes, each having sensing capability with limited computational and communication power, which enable us to deploy a large-scale sensor network. A critical aspect of applications in wireless sensor network is network lifetime.
Wireless sensor network are usable as long as they can communicate sensed data to processed node. Sensing and communication are important activities and they consume energy. So power management and sensor scheduling can effectively increase the networks lifetime. The use of wireless sensor networks is increasing day by day and at the same time it faces the problem of energy constraints in terms of limited battery lifetime.

WSN has considerable technical challenges in data processing and communication to deal with dynamically changing Energy, Bandwidth and Processing power. Another important issue in Wireless Sensor Network is to maximize Sensor Network lifetime. The vital issue in WSN is to maximize the network operational life. In order to achieve this, it is necessary to minimize the energy utilization of a node. Most of the energy consumption in wireless sensor node is attributed to transmitting/receiving, processing, and forwarding the data to neighboring nodes.
Clustering has been shown to improve network lifetime, a primary metric for evaluating the performance of a sensor network. The clustering techniques proposed for data processing typically consider many parameters such as the distance between the nodes, and assume that nodes are more reliable.

The sensors are capable of sensing the data from the environment in which they are deployed, processes that data and transmit it to the base-station (BS). The sensor circuit senses the environment and converts the signals into electrical signals which are then transmitted to the BS using a transmitter via a routing node. In clustering, nodes with higher power levels perform the fusion of data gathered from the other sensor nodes and transmit the aggregated data to the base-station (BS) while the nodes with low power levels only perform the sensing of the environment. They transmit the sensed data to the higher node, known as the cluster-head (CHs) which are at a lesser distance to the base station. The cluster formation and the assignment of special tasks to the cluster heads (CHs) reduce the power dissipation within a particular cluster, which improves the scalability of the sensor network. Also by aggregating the sensed data the amount of data to be transmitted to the base-station (BS) is reduced and the lifetime of the overall sensor network is increased.

II. RELATED WORKS

Paper [1] proposes a model for energy efficient clustering and cluster head selection method. It is based on a circular monitoring area with a uniform node density and a sink node at the center. The area is divided into concentric circles known as corona, each of width R/2, where R is the transmission range of the sensor node. Cluster head selection is performed by finding out the optimal distance from VCCB, where VCCB lies at the midway between two concentric circles.

One of the main design goals of WSNs is to carry out data communication while trying to prolong the lifetime of the network and prevent connectivity degradation by employing aggressive energy management techniques [2].

The clustering concept offers tremendous benefits for wireless sensor networks. However when designing for a particular application, designers must carefully examine the formation of clusters in the network. Depending on the application, certain requirements for the number of nodes in a cluster or its physical size may play an important role in its operation. This prerequisite may have an impact on how cluster heads are selected in this application [3].

There are many clustering protocols are exists, such as LEACH, HEED etc. As the need for efficient use of WSNs on large regions increased in the last decade dramatically, more specific clustering protocols were developed to meet the additional requirements (increased network lifetime, reduced and evenly distributed energy consumption, scalability, etc.). The most significant and widely used representatives of these focused on WSN clustering protocols (LEACH, EEHC, and HEED). Some of them (such as LEACH, EEHC, and their extensions) follow a random approach for CH election (the initially assigned probabilities serve as the basis for the random election of the CHs), whereas others (like HEED and similar approaches) follow a hybrid probabilistic methodology (secondary criteria are also considered during CH election—i.e., the residual energy) [4].

The LEACH protocol [3] is an application-specific clustering protocol which has been shown to significantly improve the network lifetime. It assumes that every node is reachable in a single hop and that load distribution is uniform among all nodes. LEACH assigns a fixed probability to every node so as to elect itself as a CH. The clustering process involves only one iteration, after which a node decides whether to become a CH or not. Nodes take turns in carrying the role of a CH [5].

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HEED (Hybrid Energy-Efficient Distributed clustering), has four primary goals: (i) prolonging network lifetime by distributing energy consumption, (ii) terminating the clustering process within a constant number of iterations/steps, (iii) minimizing control overhead (to be linear in the number of nodes), and (iv) producing well-distributed cluster heads and compact clusters. In classical distributed systems, a node can either be a server or a source, but not both. A fixed number of servers are known to every source in the system, and a server is always available for processing. In our model, every node can act as both a source and a server (cluster head), which motivates the need for efficient algorithms to select servers according to the outlined system goals [6].

The execution of a clustering algorithm can be carried out at a centralized authority (e.g., a base station) or in a distributed way at local nodes. Centralized approaches require global information about the network topology. Banerjee et al. [7] proposed a centralized technique that does not require knowledge of node locations. Even though t is a spanning tree based idea, we are designing a new idea which is also a network in which node locations are unknown [4].

III. SYSTEM MODEL

A. NEED FOR CLUSTERING

WSN offer unique systems for creating communications infrastructures on-demand. Their use is dependent on the effective deployment of these systems to areas of interest. There are several challenging issues involved in the deployment of WSN, mostly due to their small size and large number of nodes required to establish proper operation.

WSN is an emerging technology that shows great promise for various futuristic applications both for mass public and military. The sensing technology combined with processing power and wireless communication makes it lucrative for being exploited in abundance in future. The inclusion of wireless communication technology also incurs various types of security threats. A WSN must also be self-monitoring and able to proactively reconfigure to mitigate certain malfunctions before they actually occur.

Clustering means grouping of nodes. As each node depends on energy for its activities, this has become a major issue in wireless sensor networks. The failure of one node can interrupt the entire system or application. Every sensing node can be in active (for receiving and transmission activities), idle and sleep modes. In active mode nodes consume energy when receiving or transmitting data. In idle mode, the nodes consume almost the same amount of energy as in active mode, while in sleep mode, the nodes shutdown the radio to save the energy.

B. CLUSTERING BASICS

In cluster based architectures, mobile nodes are divided into virtual groups. Each cluster has adjacencies with other clusters. All the clusters have the same rules. A cluster can be made up of a Cluster Head node and Cluster Members. In this kind of network, Cluster Head nodes are used to control the cluster and the size of the cluster is usually about one or two hops from the Cluster Head node. Grouping sensor nodes into clusters has been widely adopted by the research community to satisfy the above scalability objective and generally achieve high energy efficiency and prolong network lifetime in large-scale WSN environments. The corresponding hierarchical routing and data gathering protocols imply cluster-based organization of the sensor nodes in order that data fusion and aggregation are possible, thus leading to significant energy savings.

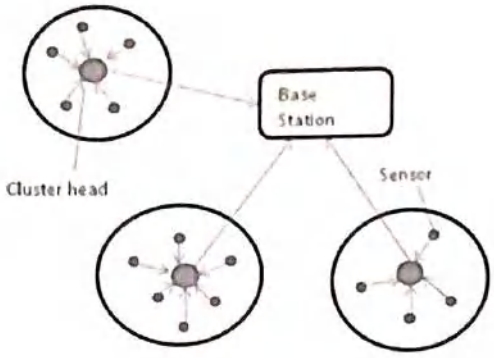

Fig 1 Clustered Network

The sink node gets all information from the cluster heads those are connected to the other nodes under control of them. Here is the most challenging part will come to place that, if the clustering head pass the same events to the sink node it will leads to more energy consumption .Another fact is that if the clustering node having the capability to compress/data aggregation energy consumption can be reduced to a optimum level. So, here we select the clusters as the nodes which having maximum resources and monitoring power.

IV. PROPOSED MODEL

This paper mainly focuses on energy efficient and a secure Wireless Sensor Network. We use clustering method for communication between nodes and sink, since it is energy efficient when compared to single hop and multi hop routing.

All non-CH nodes transmit their data to the CH they are connected to, while the CH node receives data from all the cluster members, performs specific processing functions on the data (e.g., aggregation, filtering, compression, etc.), and forwards data to the BS. We implement a clustering mechanism which performs optimum selection of cluster heads and rotates the role of cluster head in an energy efficient way.

A. ASSUMPTIONS

The proposed model made some assumptions. These are

- The nodes are deployed over circular monitoring area A of radius Z with uniform node distribution density [].
- The sink node will be plotted at the centre.
- The nodes are deployed randomly on the region.
- All nodes having same energy.
- Selection of CHs based on timer expiration.

B. STEPS NEEDED

The various steps that we follow are:

Step 1: Read the maximum number of nodes that must be deployed, the sensing range and transmission range of the node, the radius of the circular area, and the coordinates of the centre of the circular area where the sink node is to be plotted.

Step 2: We randomly choose a set of coordinates that come within the circular region and plot them in the specified area. For this, we compare the distance between the chosen coordinate and the centre, and the radius of the circular area. We plot the point only if the distance falls under the given radius. We count the number of points plotted.

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Step 3 Now we divide the circular area into a number of concentric circles each of width R/2, where R is the maximum transmission range of the node. Each of these concentric circles is called corona. We find the Euclidian distance of each node from the sink node and then the sensor nodes are assigned concentric circle index using the formula

$$C_i = \frac{2|d_{si}|}{R}$$

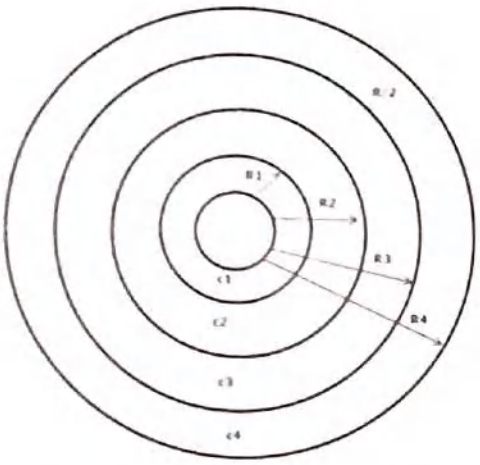

Fig 2 Corona based WSN model

Step 4: In order to implement energy balanced clustering, the concept of Virtual Concentric Circle Band (VCCB) is introduced, where each sensor node calculates their respective VCCB index using the formula

$$V_j = [x_i \pm \delta]$$

$$x_i = \left\{\left(\frac{R}{2} * C_i\right) + \frac{R}{4}\right\}$$

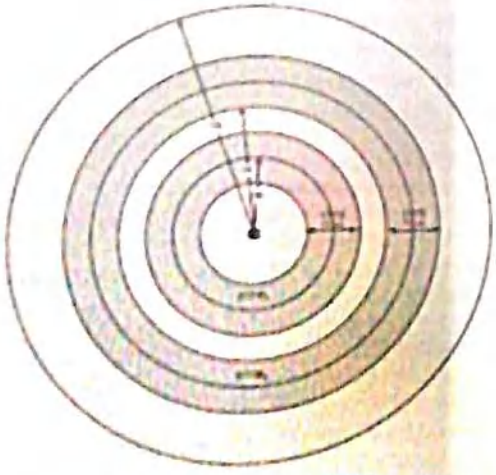

Fig 3 Assigning VCCB to nodes

The value of δ depends on node density. If the sensing area is densely populated, the value of δ is small for sparsely populated area, the value of δ is large. If the distance of a node from the sink, d_{si} falls within VCB index, then the corresponding sensor node is chosen as a primary candidate for cluster head election. These candidate nodes then calculate their distance from the centre of their respective VCCB as

$$d_{i(vc)} = \left|\left[\left\{\left(\frac{R}{2} * C_i\right) + \frac{R}{4}\right\} - d_{si}\right]\right|$$

Here we use the concept of a back-off timer. Its initial value is proportional to the distance of the candidate from the centre of VCCB. For a node N_i, the initial value of back off timer is given by

$$t_i = \left[\frac{d_{i(vc)}}{\delta} * T_{ch}\right] + rand(0,1)$$

Step 5 The cluster formation phase begins when the sink node sends START message to the candidates. Upon receiving this start message each candidate starts its back of timer. Since the back off timer value is proportional to the distance of the candidate from the centre of VCCB, the back off timer of the node near to the centre will expire first. The node whose back of timer expired first, will send as advertisement to all nodes within the radio range R/4, announcing itself as the cluster head. All the cluster head candidates within this radio range, will stop their back off timer and all the cluster head candidates as well as non-cluster head candidates within this range will acknowledge the receipt of announcement, thus forming a cluster. This process is carried out throughout the network area, thus forming a number of non uniform clusters.

Step 6 In order to prolong the life time of the network, we change the role of cluster head with in a cluster when the remaining energy of the current head lowers below a particular threshold value. Find out the candidate nodes among the members of that cluster. Sink node sends a START message to those candidates, upon which each candidate starts their back off timer. The nodes whose timer expires first will be chosen as the new cluster head.

C. IMPLEMENTATION OF SCALABILITY

Many applications of wireless sensor networks adopt hierarchical structure for the scalability and simplify of management. Clustering is the most popular method that imposes such a scalable topology. Here we implement addition and deletion of nods to the existing sensor network.

In order to add a new node in to the specified clustered network, we keep track of an array inside the node structure for every cluster head which stores the ids of the member nodes of the corresponding cluster heads. Then new node sends a message to sink node about its arrival then it will forwarded to all cluster heads. After that it will join to the cluster head that has minimum distance from that node and it should have high monitoring capability.

Deletion means removing out-of-date, redundant, or inconsistent nodes. Then update the nodes in clusters to eliminate redundancy. In order to perform deletion we can use the same array that defined for the addition of nodes. Delete the node id from the array for deletion and update the array. The goals of this scalability approaches are maintaining stable clustering structure, minimizing the overhead for the clustering set up, maximizing lifespan, and achieving good end to end performance.

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V. SIMULATION RESULTS

The network simulation is done in MATLAB environment. A circular area with specified radius is considered. The nodes have to be deployed independently and randomly. Certain numbers of nodes are deployed over the area. The nodes which satisfy the criteria specified in the algorithm will plot over the area. That is, we compare the distance between the chosen coordinate and the centre, and the radius of the circular area. We plot the nodes only if the distance falls under the given radius.

The probable candidates and the cluster members are represented with various colors in the graph. The transmission energy of the nodes while sending k bits of data over the distance will found out by the equations

$$E_{Tx}(k,d) = E_{elect-Tx}(k) + E_{amp-Tx}(k,d)$$

$$E_{TX}(k,d) = \begin{cases} kE_{elect} + k\varepsilon_{fs}d^2 & d < d_0 \\ kE_{elect} + k\varepsilon_{mp}d^4 & d \geq d_0 \end{cases}$$

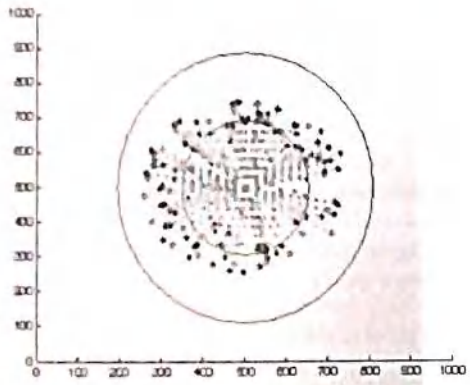
Where E_{elect} is the transmission electronics energy and d_0 is the optimum distance.

The energy consumption of sensor node to receiver k bits of data is given by:

$$E_{Rx} = kE_{elect}$$

The messages exchanged between each and every node is represented by colored lines in the graph. Probable candidates are those nodes which are more suitable nodes to become cluster heads. These nodes are selected on the basis of calculated VCCB indices during the execution.

Cluster heads are selected by timer expiration. The candidate node whose back off timer expires first will be chosen as the cluster heads. After the selection of cluster heads they advertises these information to the nodes within the R/4 transmission range of the selected cluster head.



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Here energy is the heterogeneity parameter. Whenever the remaining energy less than a particular threshold, cluster head rotation will be performed. Cluster head rotation is performed by finding next powerful probable candidate which has higher monitoring capability. So, the sink node sends START message to these candidates and they start their back off timer. As in the previous case the node whose timer expires first, it will become the cluster head.

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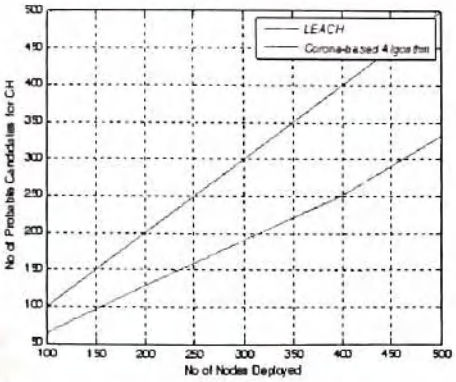

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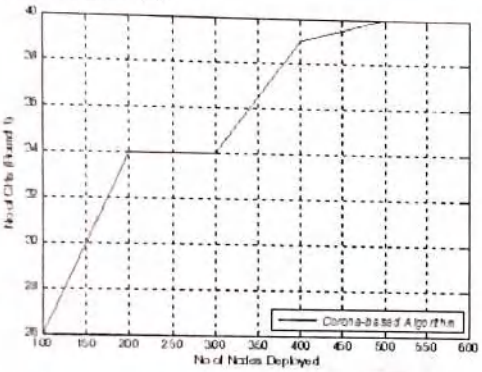

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After the first round of CH selection, a certain number of CHs fail as their energy fall below a particular threshold value. Those nodes are deleted and the same numbers of CHs are selected in the second round of CH rotation.

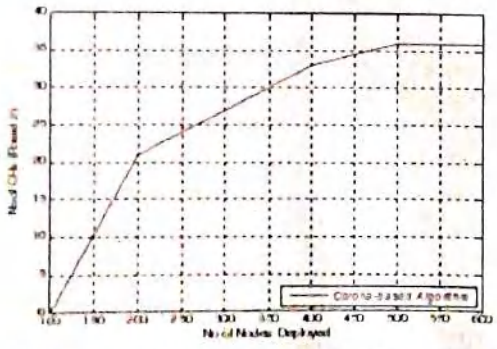

Fig 7 Number of Nodes Deployed vs. Number of CHs Selected (During Round 2)

The time elapsed for first round of cluster head selection and second round of cluster head rotation for various numbers of nodes deployed can be tabulated as follows:

Number of nodes deployed	Time taken for first round of CH selection (in seconds)	Time taken f second round Ch rotation (in seconds)
100	329.631565	0.756115
200	446.454966	190.816695
300	681.083411	266.269403
400	692.684151	264.298860
500	863.258635	319.014914
600	1024.648643	387.028500

Table 2 Simulation Analysis-2

VI. CONCLUSIONS

Node clustering is a useful topology-management approach to reduce communication overhead and exploit data aggregation in sens networks. Clustering is highly efficient because the nodes are deploy over a large area which is also insecure. So, monitoring is one of the critic tasks over a large area. In our corona based approach the best monitori can be assured because even though one CH is drained, we have possibility to rotate them and the monitoring is more specific due different corona exist over a region. The major concern of scalability c also be resolved by dynamic addition and deletion of nodes in the netwo maintaining the same performance efficiency thereby aiding a wide ran of applications.

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ECE - 8

A SURVEY ON ATTACK RESISTANCE ACTIVE DETECTION ROUTING IN MANET

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Keywords: *MANET, Security, Trust Management in MANET*

I. Introduction

MANETs are autonomous systems consisting of mobile hosts that are connected by multi-hop wireless links. Trust Model which are developed for wired network cannot be used in wireless network. MANETs are highly vulnerable to various security attacks. Providing secure Communication in MANET is proved to be a significant challenge. Common authentication schemes are not applicable in Ad hoc network since public key infrastructure is hard to deploy [1] [2].

In mobile ad hoc networks (MANETs), the distributed decision making should take into account trust in the elements, the sources of information, the processors of information, the elements of the communications network across which the information is transmitted, etc.[3] This trust must often be derived under time-critical conditions, and in a distributed way.

In MANETs, reputation-based trust management systems are shown to be an effective way to cope with adversary. [4] By establishing trust with the nodes it has or has not directly interacted, a node in the network diagnoses other nodes and predicts their future behavior in the network. Hence, trust plays a pivotal role for a node in choosing with which nodes it should cooperate, improving data availability in the network. Further, examining trust values has been shown to lead to the detection of malicious nodes in MANETs. Despite all the progress for securing MANETs, leads to additional challenges.

Trust management mechanism is considered to be an effective measurement to solve these problems [4]. In the context of MANET, there are several trust management models that have been proposed in the realm of network [5], where trust can be considered as the reliance of a network node on the ability to forward packets or offer services timely, integrally and reliably. In the existing models, decision factors are often incomplete in the trust derivation, which are not fully integrated with the inherent characteristics of MANET. When the factors of decision-making are given, though we know that different factors have different weights, the precise weights are difficult to determine. Existing methods in these models for weight determination are lack of rationality and practicability. As a result, they cannot calculate an accurate trust value for each node. Hence, these models are ineffective in MANET trust management, and their applications are very simple. [5]

1.1 Motivation for Trust Management in MANETs.

The concept of "Trust" originally derives from social sciences and is defined as the degree of subjective belief about the behaviors of a particular entity [7]. Blaze et al. [8] first introduced the term "Trust Management" and identified it as a separate component of security services in networks and clarified that "Trust management provides a unified approach for specifying and interpreting security policies, credentials, and relationships." Trust management in MANETs is needed when participating nodes, without any previous interactions, desire to establish a network with an acceptable level of trust relationships among themselves. Examples would be in building initial trust bootstrapping [9], coalition operations without predefined trust, and authentication of certificates generated by another party when links are down or ensuring safety before entering a new zone [10]. In addition, trust management has diverse applicability in many decision making situations including intrusion detection, authentication, access control, key management, isolating misbehaving nodes for effective routing, and other purposes. Trust management, including trust establishment, trust update, and trust revocation, in MANETs is also much more challenging than in traditional centralized environments. For example, collecting trust information or evidence to evaluate trustworthiness is difficult due to changes in topology induced by node mobility or node failure. Further, resource constraints often confine the trust evaluation process only.

2 Related Work

Govindan and Prasant [8] considered trust propagation, aggregation and prediction as the main trust dynamics which can help in trust computations. According to them the trust computation is based on following metrics Trust propagation • Trust aggregation • Trust prediction • Trust applications. The trust values will be propagated in the network so that the trust can be established between nodes which are not in immediate contact. While propagating the trust, trust values from multiple paths will be aggregated to get a combined trust value which can be stored in the history. The stored trust value will be used in the trust predictions and this predicted trust value will be further used in the applications that need security. The stored trust value can also be used in the trust computation block in the form of feedback knowledge. Therefore, trust computations, trust propagation, trust aggregation and trust prediction blocks are closely interconnected in our envisioned trust system but the system computes extract computational resources to organize trust in MANET and the trust prediction is not accurate.

In the ATM scheme [9] there are two major functional modules: behavior data collection and trust management. The trustworthiness of each node is then assessed in the trust management module. In the ATM scheme, we train and then use a SVM classifier to evaluate the trustworthiness of the nodes. The trust management module supports the following two modes for the SVM classifier: training mode and testing mode. In the training mode, several known adversaries exhibiting known misbehaviours are deployed in the network to generate the training dataset so that a SVM classifier can be learned from this dataset.

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In [10], proposes a fully distributed trust-based public key management approach for MANETs using a soft security mechanism based on the concept of trust. Instead of using hard security approaches, as in traditional security techniques to eliminate security vulnerabilities, our work aims to maximize performance by trading off risk (i.e., security vulnerability) for trust. In this work, we propose a composite trust-based public key management (CTPKM) with no centralized trust entity with the goal of maximizing performance (e.g., service availability or efficiency) while mitigating security vulnerability. Each node employs a trust threshold to determine whether or not to trust another node. Each node's decision making using the given trust threshold affects performance and security of CTPKM.

In [11], classify the clustering scheme for trust-based clustering schemes and illustrate how reputations are integrated in these schemes. Trust-based clustering algorithms integrate the trust management systems with clustering algorithms to decrease the overheads of reputation management. The growing interest in the reputation-based systems inspired numerous trust-based clustering schemes for MANETs. But there is a lack of solution to operate in both secure and hostile environments.

RaihanaFerdous et al [12] have proposed a Cluster head(s) selection algorithm based on an efficient trust model. This algorithm aims to elect trustworthy stable cluster head(s) that can provide secure communication via cooperative nodes. However the way the messages passed through may overload the Cluster head, creating a bottleneck due to additional message exchanges. Another possible limitation is the way that the message authentication between intermediate Cluster heads are treated, where there can be a delay in identifying a malicious neighboring node.

Li et al. [13] classify trust management as reputation-based framework and trust establishment framework. A reputation based framework uses direct observation and second-hand information distributed among a network to evaluate other nodes. A trust establishment framework evaluates neighbouring nodes based on direct observations while trust relations between two nodes with no prior direct interactions are built through a combination of opinions from intermediate nodes.

Marti et al. [14] proposed mitigating routing misbehaviour by detecting non-forwarding nodes and rating every path so that those nodes are avoided when the routes are recalculated. The resulting behaviour is that non-routing nodes are not included in routing paths for non-cooperation but they still can ask others to forward their messages. This scheme detects the misbehavior but it does not isolate it. Therefore, in our system, we are considering only those nodes which are isolated by rating their trust value as low as 0 for non-cooperation.

3. Problem Definition

In this section, the research problem that is addressed in thispaper will be described in more detail, including the networkmodel as well as the adversary model.

A. Network Model

A Mobile Adhoc Network generally refers to a wireless network of heterogeneousnodes or other computing devicesresponsible for dynamically discovering other nodes for forwarding packets to their destination. This type of network enables continuous monitoringof mob nodesand securedata transmission. All of the nodes in MANETs equipped with the samewireless communication interface, such as IE 802.11g. Thenodes are limited in energy as well as computation andstorage capabilities.

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First of all, the nodes are assumed to be trustworthy sincethey are usua better protected. The connected mobile nodes, are generally mo susceptible to various attacks,and they can be compromised at any tim after the MANET isformed.

The adversary can be an outsider located in the wirelessrange of th mobile nodes, or the adversary can first compromise oneor more node and behave as an insider later. The adversaryis able to eavesdrop, jam modify, forge, or drop the wirelesscommunication between any devices i range. The goalsof the adversary may include intercepting the normal dat transmission,forging or modifying data, framing the benign devicesb deliberately submitting fake recommendations. Morespecifically malicious attacks are considered inthis paper.

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The main goal is to convince the adversary to launch an attack where th system can identify the attack behavior and then isolate the attacker. Thus the proposed system can lower the trust of suspicious nodes an increases the node trust in network routing. In attack resistance detectio routing, nodal trust can be easily identified and it can easily identify th trusted routes by choosing trusted nodes by resisting the route agains black holes.

4.1 Classification of Trust Types

There are three different trust types such as Route trust, Data trust a Evidence trustconsidered in proposed model.

Route Trust or Path trust: The route trust expresses the credibility for t set of nodes on a routing path, and its value is defined as the minimum one-hop trust values. The source nodes determine service level basing t the assessment of route trust value. Theroute trust value can be defined a constraint in the trusted routing decision making.

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In this paper astudy on AttackResistance Active Detection Routing MANET for resisting MANET against DoS attacks is carried. The propos schemedetermines the trust level at routing level, data level and eviden level. The trustworthiness of data and nodes are modelled andevaluated two separate metrics, namely data trust and nodetrust, respectively. particular, data trust is used to assesswhether or not and to what extent reported traffic dataare trustworthy. On the other hand, node tr indicatestrustworthy nodes in MANETs.

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ECE - 8

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ECE - 8

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Keywords: *MANET, Security, Trust Management in MANET*

I. Introduction

MANETs are autonomous systems consisting of mobile hosts that are connected by multi-hop wireless links. Trust Model which are developed for wired network cannot be used in wireless network. MANETs are highly vulnerable to various security attacks. Providing secure Communication in MANET is proved to be a significant challenge. Common authentication schemes are not applicable in Ad hoc network since public key infrastructure is hard to deploy [1] [2].

In mobile ad hoc networks (MANETs), the distributed decision making should take into account trust in the elements, the sources of information, the processors of information, the elements of the communications network across which the information is transmitted, etc.[3] This trust must often be derived under time-critical conditions, and in a distributed way.

In MANETs, reputation-based trust management systems are shown to be an effective way to cope with adversary. [4] By establishing trust with the nodes it has or has not directly interacted, a node in the network diagnoses other nodes and predicts their future behavior in the network. Hence, trust plays a pivotal role for a node in choosing with which nodes it should cooperate, improving data availability in the network. Further, examining trust values has been shown to lead to the detection of malicious nodes in MANETs. Despite all the progress for securing MANETs, leads to additional challenges.

Trust management mechanism is considered to be an effective measurement to solve these problems [4]. In the context of MANET, there are several trust management models that have been proposed in the realm of network [5], where trust can be considered as the reliance of a network node on the ability to forward packets or offer services timely, integrally and reliably. In the existing models, decision factors are often incomplete in the trust derivation, which are not fully integrated with the inherent characteristics of MANET. When the factors of decision-making are given, though we know that different factors have different weights, the precise weights are difficult to determine. Existing methods in these models for weight determination are lack of rationality and practicability. As a result, they cannot calculate an accurate trust value for each node. Hence, these models are ineffective in MANET trust management, and their applications are very simple. [5]

1.1 Motivation for Trust Management in MANETs.

The concept of "Trust" originally derives from social sciences and is defined as the degree of subjective belief about the behaviors of a particular entity [7]. Blaze et al. [8] first introduced the term "Trust Management" and identified it as a separate component of security services in networks and clarified that "Trust management provides a unified approach for specifying and interpreting security policies, credentials, and relationships." Trust management in MANETs is needed when participating nodes, without any previous interactions, desire to establish a network with an acceptable level of trust relationships among themselves. Examples would be in building initial trust bootstrapping [9], coalition operations without predefined trust, and authentication of certificates generated by another party when links are down or ensuring safety before entering a new zone [10]. In addition, trust management has diverse applicability in many decision making situations including intrusion detection, authentication, access control, key management, isolating misbehaving nodes for effective routing, and other purposes. Trust management, including trust establishment, trust update, and trust revocation, in MANETs is also much more challenging than in traditional centralized environments. For example, collecting trust information or evidence to evaluate trustworthiness is difficult due to changes in topology induced by node mobility or node failure. Further, resource constraints often confine the trust evaluation process only.

2 Related Work

Govindan and Prasant [8] considered trust propagation, aggregation and prediction as the main trust dynamics which can help in trust computations. According to them the trust computation is based on following metrics Trust propagation • Trust aggregation • Trust prediction • Trust applications. The trust values will be propagated in the network so that the trust can be established between nodes which are not in immediate contact. While propagating the trust, trust values from multiple paths will be aggregated to get a combined trust value which can be stored in the history. The stored trust value will be used in the trust predictions and this predicted trust value will be further used in the applications that need security. The stored trust value can also be used in the trust computation block in the form of feedback knowledge. Therefore, trust computations, trust propagation, trust aggregation and trust prediction blocks are closely interconnected in our envisioned trust system but the system computes extract computational resources to organize trust in MANET and the trust prediction is not accurate.

In the ATM scheme [9] there are two major functional modules: behavior data collection and trust management. The trustworthiness of each node is then assessed in the trust management module. In the ATM scheme, we train and then use a SVM classifier to evaluate the trustworthiness of the nodes. The trust management module supports the following two modes for the SVM classifier: training mode and testing mode. In the training mode, several known adversaries exhibiting known misbehaviours are deployed in the network to generate the training dataset so that a SVM classifier can be learned from this dataset.

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In [10], proposes a fully distributed trust-based public key management approach for MANETs using a soft security mechanism based on the concept of trust. Instead of using hard security approaches, as in traditional security techniques to eliminate security vulnerabilities, our work aims to maximize performance by trading off risk (i.e., security vulnerability) for trust. In this work, we propose a composite trust-based public key management (CTPKM) with no centralized trust entity with the goal of maximizing performance (e.g., service availability or efficiency) while mitigating security vulnerability. Each node employs a trust threshold to determine whether or not to trust another node. Each node's decision making using the given trust threshold affects performance and security of CTPKM.

In [11], classify the clustering scheme for trust-based clustering schemes and illustrate how reputations are integrated in these schemes. Trust-based clustering algorithms integrate the trust management systems with clustering algorithms to decrease the overheads of reputation management. The growing interest in the reputation-based systems inspired numerous trust-based clustering schemes for MANETs. But there is a lack of solution to operate in both secure and hostile environments.

RaihanaFerdous et al [12] have proposed a Cluster head(s) selection algorithm based on an efficient trust model. This algorithm aims to elect trustworthy stable cluster head(s) that can provide secure communication via cooperative nodes. However the way the messages passed through may overload the Cluster head, creating a bottleneck due to additional message exchanges. Another possible limitation is the way that the message authentication between intermediate Cluster heads are treated, where there can be a delay in identifying a malicious neighboring node.

Li et al. [13] classify trust management as reputation-based framework and trust establishment framework. A reputation based framework uses direct observation and second-hand information distributed among a network to evaluate other nodes. A trust establishment framework evaluates neighbouring nodes based on direct observations while trust relations between two nodes with no prior direct interactions are built through a combination of opinions from intermediate nodes.

Marti et al. [14] proposed mitigating routing misbehaviour by detecting non-forwarding nodes and rating every path so that those nodes are avoided when the routes are recalculated. The resulting behaviour is that non-routing nodes are not included in routing paths for non-cooperation but they still can ask others to forward their messages. This scheme detects the misbehavior but it does not isolate it. Therefore, in our system, we are considering only those nodes which are isolated by rating their trust value as low as 0 for non-cooperation.

3. Problem Definition

In this section, the research problem that is addressed in thispaper will be described in more detail, including the networkmodel as well as the adversary model.

A. Network Model

A Mobile Adhoc Network generally refers to a wireless network of heterogeneousnodes or other computing devicesresponsible for dynamically discovering other nodes for forwarding packets to their destination. This type of network enables continuous monitoringof mob nodesand securedata transmission. All of the nodes in MANETs equipped with the samewireless communication interface, such as IE 802.11g. Thenodes are limited in energy as well as computation andstorage capabilities.

B. Adversary Model

First of all, the nodes are assumed to be trustworthy sincethey are usua better protected. The connected mobile nodes, are generally mo susceptible to various attacks,and they can be compromised at any tim after the MANET isformed.

The adversary can be an outsider located in the wirelessrange of th mobile nodes, or the adversary can first compromise oneor more node and behave as an insider later. The adversaryis able to eavesdrop, jam modify, forge, or drop the wirelesscommunication between any devices i range. The goalsof the adversary may include intercepting the normal dat transmission,forging or modifying data, framing the benign devicesb deliberately submitting fake recommendations. Morespecifically malicious attacks are considered inthis paper.

4.Proposed Model

The main goal is to convince the adversary to launch an attack where th system can identify the attack behavior and then isolate the attacker. Thus the proposed system can lower the trust of suspicious nodes an increases the node trust in network routing. In attack resistance detectio routing, nodal trust can be easily identified and it can easily identify th trusted routes by choosing trusted nodes by resisting the route agains black holes.

4.1 Classification of Trust Types

There are three different trust types such as Route trust, Data trust a Evidence trustconsidered in proposed model.

Route Trust or Path trust: The route trust expresses the credibility for t set of nodes on a routing path, and its value is defined as the minimum one-hop trust values. The source nodes determine service level basing t the assessment of route trust value. Theroute trust value can be defined a constraint in the trusted routing decision making.

Data Trust.The main idea of this trust type is to determine trustworthine of traffic data (data trust) evaluated based on the data sensed and collecte from multiple mobile nodes. We propose the use of the semantics of t data, and correlate it with observations from neighbour [3] nodes.

5. Conclusion

In this paper astudy on AttackResistance Active Detection Routing MANET for resisting MANET against DoS attacks is carried. The propos schemedetermines the trust level at routing level, data level and eviden level. The trustworthiness of data and nodes are modelled andevaluated two separate metrics, namely data trust and nodetrust, respectively. particular, data trust is used to assesswhether or not and to what extent reported traffic dataare trustworthy. On the other hand, node tr indicatestrustworthy nodes in MANETs.

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ECE - 12

3D STEREOLITHOGRAPHIC RECONSTRUCTION AND ANALYSIS OF BRAIN TUMOR FROM MAGNETIC RESONANCE IMAGES

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Abstract *- The tumor is an abnormal mass of tissue found in Brain. Magnetic Resonance Imaging (MRI) 2D images of internal elements of the body. As 2D images never offer the particular feel of how a tumor precisely seems like. With the event of computer image process technology, 3D image has become a vital methodology of the medical diagnose, it offers superabundant and appropriate data for surgeons. So during this paper, we have a tendency to propose associate degree economical approach to 3D reconstruction of tumor and estimation of its volume from a collection of 2D cross sectional MR Images of the brain. Within the initiative, these images are preprocessed to enhance the standard of the image. Next, abnormal slices are identified based on Histogram Analysis and tumor on those slices is segmented. Next, the proposed slice interpolation technique is applied to estimate the missing slices accurately and expeditiously. Then, the surface mesh of the tumor is reconstructed by applying the Marching Cubes (MC) algorithm on a collection of abnormal slices. Finally, rendering was performed on the reconstructed mesh to feature realism to the 3D model of the brain tumor. 3D Stereolithograph model enhances the standard of visualization and utility of surface image to help the radiotherapist find the tumor location, volume.*

Keywords: *Magnetic Resonance Imaging; 3-Dimensional; Segmentation; Marching Cubes*

I. Introduction

Human brain is that the most significant and complicated organ of our central system. It is very necessary to convert available 2-D MR Images to a 3D brain image to see if there are any irregularities. 3D reconstruction of medical pictures is wide applied to tumor localization, surgical strategy and removing the necessity for rescanning. The brain MR pictures contain wide range of the gray-scales and extremely irregular boundaries. Thus it is tough to classify different tissues using existing strategies.

MRI uses radio waves and magnetic fields to acquire a group of cross sectional images of the brain. The anatomic details of the 3D tumor are given as a set of 2D parallel cross sectional slices. Illustration of 3D information in the form of 2D projected slices will lead to loss of data and will result in inaccurate interpretation of results. Although radiotherapists are trained to interpret these images, they typically notice issue in communicating their interpretations to a physician, who could have issue in imagining the 3D anatomy. Hence, there is a necessity for 3D reconstruction of the tumor from a set of 2D parallel cross sectional pictures of the tumor. 3D visualization allows higher understanding of the topology and shape of the tumor, and allows measurements of its geometrical characteristics. The extracted data is useful in staging of tumor, surgical strategy planning, and scientific research.

II. PROPOSED ALGORITHM

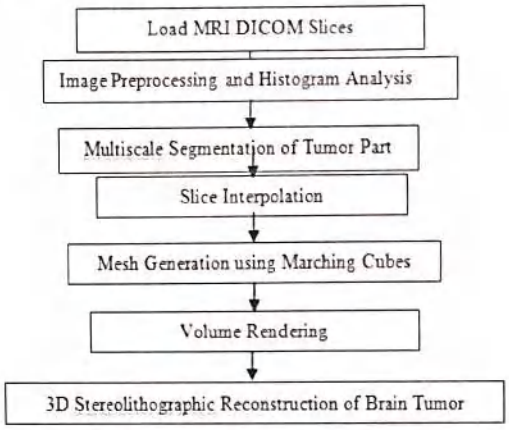

Fig. 1. Flowchart for Stereolithographic reconstruction

A. DICOM Slices

Digital Imaging and Communications in Medicine (DICOM) may be a commonplace for handling, storing, printing, and transmittal data in medical imaging. It includes a file format definition and a network prescript. The communication protocol is associate application protocol that uses TCP/IP to interact between systems. DICOM files are often changed between two entities that are capable of receiving image and patient information in DICOM format. The National Electrical Manufacturers Association (NEMA) holds the copyright to the present standard. It absolutely was developed by the DICOM Standards Committee, whose members also are partially members of NEMA.

B. Preprocessing of Image and Histogram Equalization

Preprocessing of Image is performed to boost the standard of the non heritable pictures. The noise will mask and blur the vital options in the Magnetic resonance Image and therefore create further steps in medical image analysis troublesome. Hence, to boost the perceptibility of the tumor and alternative structures within the brain, Gaussian filtering is used. Image contrast is increased by applying Histogram Equalization. The traditional normal slice consists of three regions White Matter (WM), Gray Matter (GM) and Cerebrospinal fluid (CSF). Where as a slice with tumor consists of four regions (WM, GM, CSF and tumor). Therefore so as to see whether or not the given MR image of the brain is normal or abnormal, the histogram of the brain region is computed. If the Histogram consists of three peaks then the given MR image is taken into account as the normal slice and more process of the MR image isn't dole out. Otherwise, we tend to consider that the slice contains the abnormal region and proceed to use

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Consider a discrete grayscale image {x} and let ni be the number of occurrences of gray level i. The probability of an occurrence of a pixel of level i in the image is given in Eq. (1)

$$p_x(i) = p(x = i) = \frac{n_i}{n}, \quad 0 \le i < L \qquad (1)$$

Where L being the total no. of gray levels in the image (typically 256), n being the total number of pixels in the image, and $P_x(i)$ being in fact the image's histogram for pixel value i, normalized to [0,1].

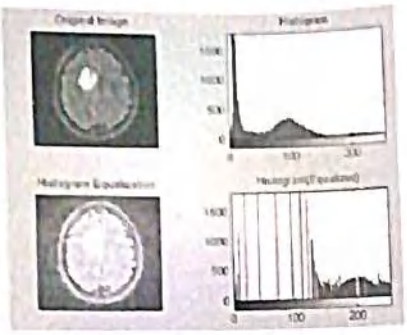

Fig. 2. Histogram of an image before and after Equalization

C. Multiscale Segmentation

Thresholding is that the simplest methodology of image segmentation. From a grayscale image, thresholding may be used to produce binary pictures. in order that objects of interest are isolated from the background. Throughout the thresholding method, individual pixels in a slice are marked as "object" pixels if their value is greater than few threshold values (assuming associate object to be brighter than the background) and as "background" pixels otherwise.

MRI of the brain offers a group of slices containing normal and abnormal slices. Hence, before segmentation we would like to spot the abnormal slices containing the tumor. The conventional slice consists of three regions white matter (WM), gray matter (GM) and cerebrospinal fluid (CSF). Whereas a slice with tumor consists of four regions (WM, GM, CSF and tumor). So as to see whether the given MR image of the brain is normal or abnormal, the histogram of the brain region is computed using the given equation and also the variety of clusters present within the brain region is set supported based on Histogram analysis given by Eq. (2)

$$h(g) = \frac{\sum_{x=0}^{M-1}\sum_{y=0}^{N-1}\delta(I(x,y)-g)}{M \times N}$$

Where, the function h(g) gives the number of pixels having a gray level equal to g in the image of size M×N. The gray level g lies in the range [0:L-1] and L is the maximum gray level in the image. Function $\delta(0) = 1$ and $\delta(g \neq 0) = 0$

(a) (b) (c) (d)

D. Slice Interpolation

After the segmentation, slices of the segmented tumor are unit stacked up to create the volume information within the 3D area. Generally, the set of slices extracted from the MRI device is such the gap between the slices is larger than the gap between the pixels within the slice. The ... reconstructed with such a collection of slices is inaccurate and ... Therefore during this work, the missing slices are predicted ... interpolation technique shown in Fig. 4

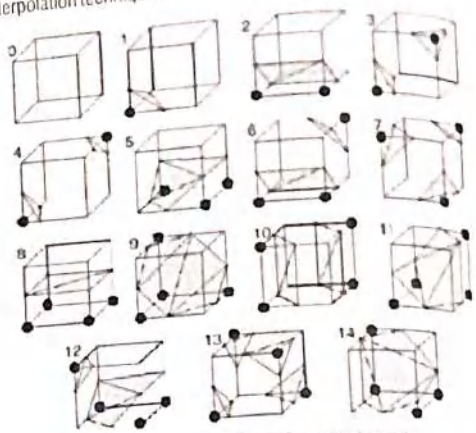

Fig. 5. Basic Cube-Isosurface Intersection Patterns

It was determined that solely patterns 3, 6, 7, 10, 12 & 13 have ... face and therefore modification was needed just for these patterns ... to solve the hole problem in these patterns, we tend to utilized the ... developed by Montani. By this methodology, the extra six patterns ... in Figure 6 that are complement of patterns 3, 6, 7, 10, 12, 13 were ... to the list of basic fifteen patterns. Thus, we tend to consider total ... one patterns to spot cube-surface intersection within the mesh ... surface reconstruction of the tumor. With the assistance of inter ... points and cube-isosurface intersection patterns the mesh of ... was generated to represent the 3D surface of the tumor.

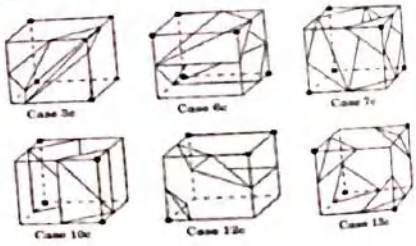

Fig. 6. Cube Configurations to Solve the Ambiguity Problem

F. Volume Rendering

In the final step, realistic effects are supplemented to the surface ... model by applying Ray casting Model. First the normals of the ... within the mesh are computed by taking the common of ... triangle normals. Then the shading model linearly interpolates ... normal and so applies the lighting model at every purpose on ... see the intensity at that point and therefore shades the complete ...

III. 3D VOLUME RECONSTRUCTION

Image reconstruction is the method of mapping the radio ... function of location for parcels or bits of tissue and can be ... planned (converting the 1D protection to cross sectional ... image plane fashioned between 2 crystals within the same ... plane) or between 2 crystals in adjacent rings (n-1 Cross-P ... (2n-1) image planes. Coincidence events will be classified ... pictures (called sinograms). If the septa between crystals ... number of planes is going to be n x n that produces the 3D ...

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The volume of tumor is the very important data which will be extracted from the 3D model of tumor for knowing the severity of cancer and treatment strategy. In this work, the volume of the tumor is calculable by considering the slice thickness, inter-slice gap and area of the tumor on every abnormal slice as given within the following Eq. (3).

$$\text{Tumor Volume} = (\text{Interslice gap} + \text{slice thickness}) * \sum_{i=1}^{n} Ai$$

Where, n indicates the total number of slices containing tumor and A is the area of tumor on each slice which is calculated by

Ai = No of pixels on slice i * Pixel dimension

IV. EXPERIMENTAL IMPLIMENTATION

The proposed technique was tested for many slices of brain Magnetic Resonance Images. The area of the detected tumor has been calculated for every slice. Later the tumor has been represented in three dimensional (3D) view by stacking all the slices, and at last the volume of tumor has been analyzed. Volume of the tumor is 64.25mm ^3.

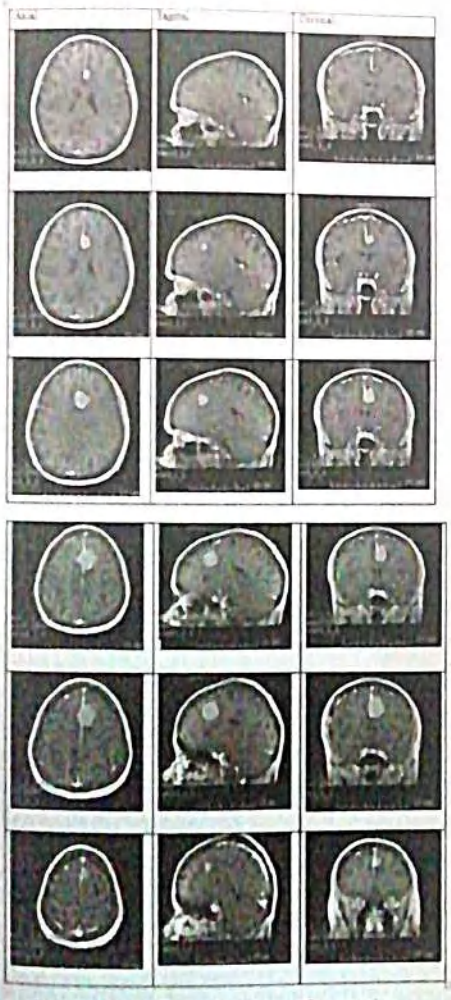

Fig.7. Slices having Tumor after Multiscale Segmentation

After the brain tumor segmentation, 2D tumor contours are organized specifically in real spatial positions. This forms the volume data of the tumor. Fig. 8 shows the meshing results when applying Marching Cubes (MC) algorithmic rule.

Fig. 8. 3D reconstruction of Tumor using Marching Cubes

The surface of the brain may also be reconstructed using the similar 3D reconstruction approach however by considering the brain region rather than tumor region. Using our planned approach numerous kinds of cuts may also be performed on the brain by the radiotherapist so as to know the tumor growth as shown in Fig. 9.

Fig. 9. 3D reconstruction of Brain using Marching Cubes

The surface of the brain with tumor is reconstructed using the 3D reconstruction Volume Rendering approach by considering the brain region and conjointly the tumor region. The rendered 3d reconstructed Brain with tumor is shown in Fig. 10.

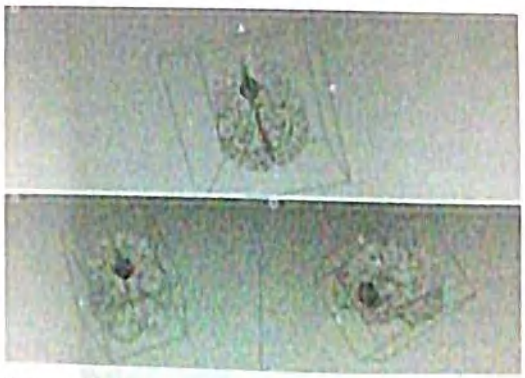

Fig. 10. 3D Stereolithographic reconstruction of Brain with Tumor after Rendering

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V. CONCLUSION

The aim of this paper was to develop a 3D reconstruction and quantification approach for aiding the doctor in surgical strategy planning and volume computation of the tumor. The 3D model of the tumor was reconstructed from a given set of 2D slices of the brain by developing strategies for segmentation, inter-slice interpolation, mesh generation and simplification. Slices containing tumor were extracted from a given set of slices of the brain and therefore the tumor was segmented with the proposed multiscale segmentation technique. The centroid alignment technique in the proposed enhanced shape based interpolation helped in accurately estimating the missing slices by handling the shifts within the cross sections and therefore the inclusion of the chamfer distance rework improved the potency of shape based interpolation technique. Rendering part was accelerated by simplifying the mesh with the planned mesh simplification algorithmic program. The reconstructed growth was additionally quantified by measure its volume. The experimental results showed that our proposed 3D reconstruction approach will generate an accurate 3D model in less amount of time and therefore will assist the specialist within the diagnosing, identifying the stage of the tumor and treatment coming up with.

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ECE - 12

3D STEREOLITHOGRAPHIC RECONSTRUCTION AND ANALYSIS OF BRAIN TUMOR FROM MAGNETIC RESONANCE IMAGES

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Abstract *- The tumor is an abnormal mass of tissue found in Brain. Magnetic Resonance Imaging (MRI) 2D images of internal elements of the body. As 2D images never offer the particular feel of how a tumor precisely seems like. With the event of computer image process technology, 3D image has become a vital methodology of the medical diagnose, it offers superabundant and appropriate data for surgeons. So during this paper, we have a tendency to propose associate degree economical approach to 3D reconstruction of tumor and estimation of its volume from a collection of 2D cross sectional MR Images of the brain. Within the initiative, these images are preprocessed to enhance the standard of the image. Next, abnormal slices are identified based on Histogram Analysis and tumor on those slices is segmented. Next, the proposed slice interpolation technique is applied to estimate the missing slices accurately and expeditiously. Then, the surface mesh of the tumor is reconstructed by applying the Marching Cubes (MC) algorithm on a collection of abnormal slices. Finally, rendering was performed on the reconstructed mesh to feature realism to the 3D model of the brain tumor. 3D Stereolithograph model enhances the standard of visualization and utility of surface image to help the radiotherapist find the tumor location, volume.*

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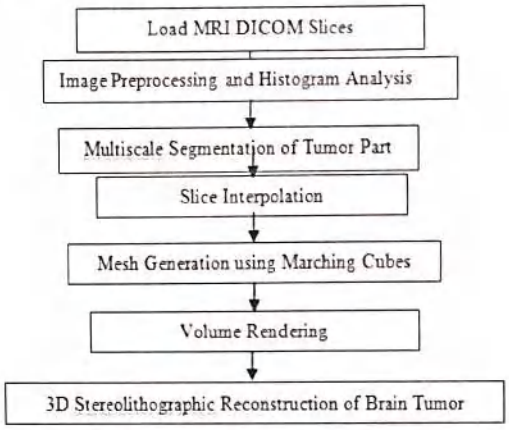

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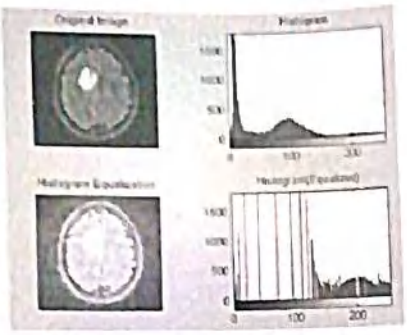

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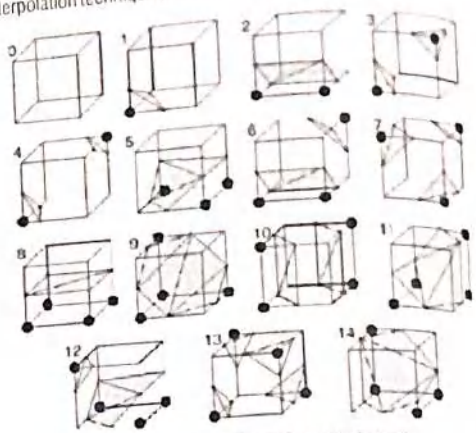

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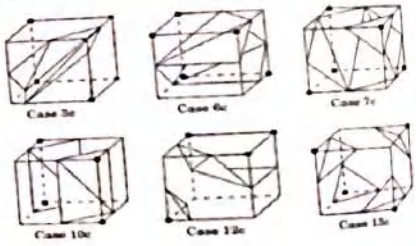

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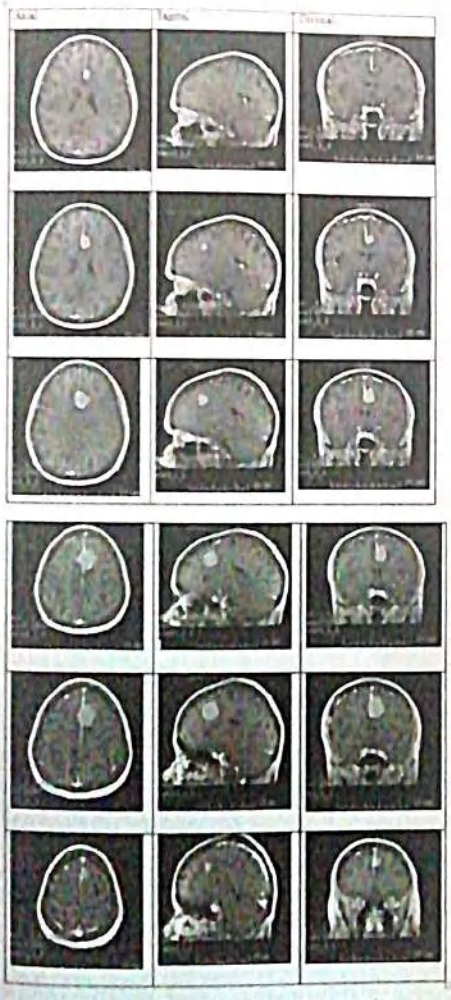

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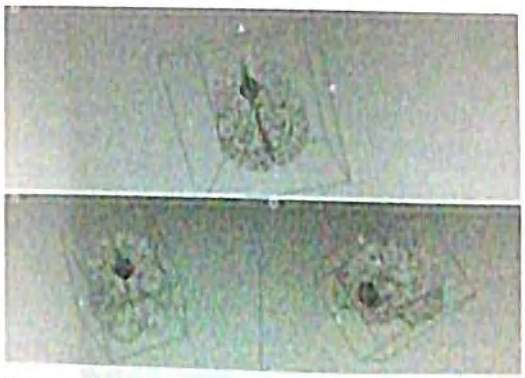

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ECE - 12

3D STEREOLITHOGRAPHIC RECONSTRUCTION AND ANALYSIS OF BRAIN TUMOR FROM MAGNETIC RESONANCE IMAGES

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Abstract *- The tumor is an abnormal mass of tissue found in Brain. Magnetic Resonance Imaging (MRI) 2D images of internal elements of the body. As 2D images never offer the particular feel of how a tumor precisely seems like. With the event of computer image process technology, 3D image has become a vital methodology of the medical diagnose, it offers superabundant and appropriate data for surgeons. So during this paper, we have a tendency to propose associate degree economical approach to 3D reconstruction of tumor and estimation of its volume from a collection of 2D cross sectional MR Images of the brain. Within the initiative, these images are preprocessed to enhance the standard of the image. Next, abnormal slices are identified based on Histogram Analysis and tumor on those slices is segmented. Next, the proposed slice interpolation technique is applied to estimate the missing slices accurately and expeditiously. Then, the surface mesh of the tumor is reconstructed by applying the Marching Cubes (MC) algorithm on a collection of abnormal slices. Finally, rendering was performed on the reconstructed mesh to feature realism to the 3D model of the brain tumor. 3D Stereolithograph model enhances the standard of visualization and utility of surface image to help the radiotherapist find the tumor location, volume.*

Keywords: *Magnetic Resonance Imaging; 3-Dimensional; Segmentation; Marching Cubes*

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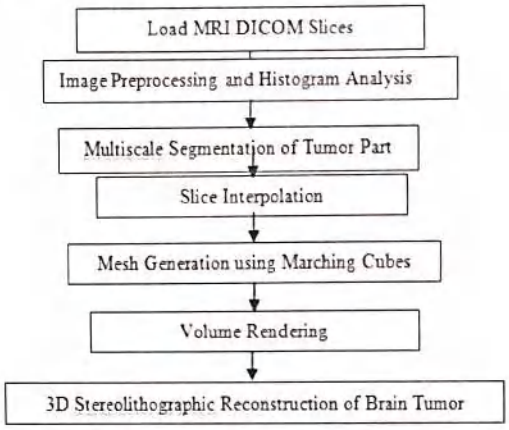

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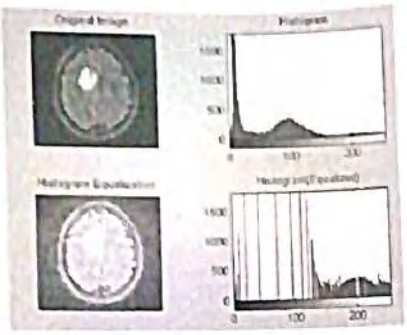

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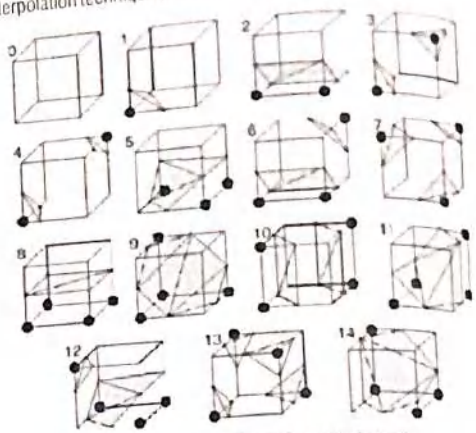

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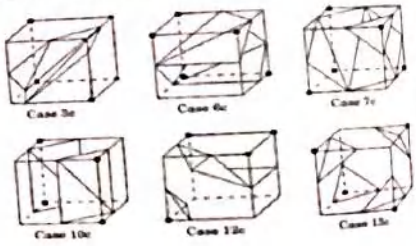

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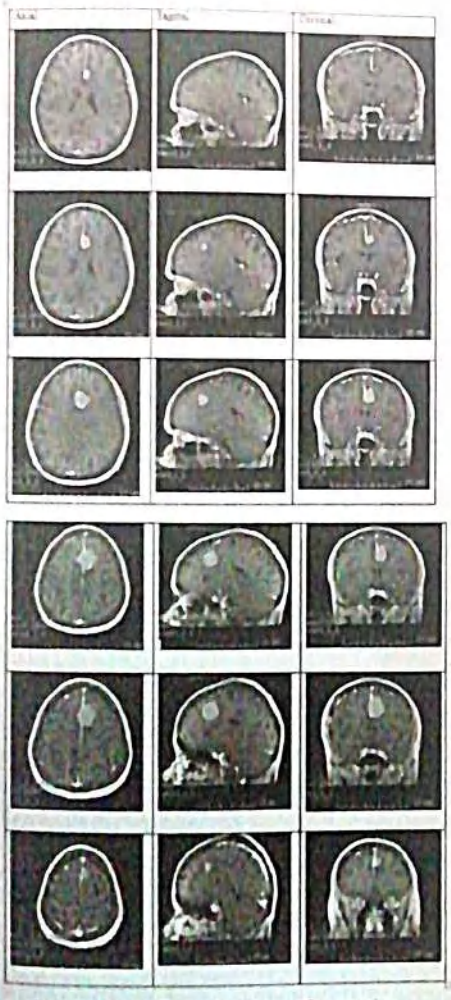

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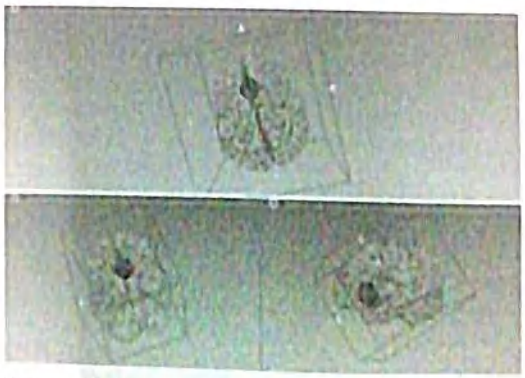

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ECE - 19

PERFORMANCE ANALYSIS OF MOBILE AD HOC NETWORKS USING LOCAL ROUTE REPAIRING MECHANISM

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Abstract - *One of the key challenges for routing protocols in wireless multi-hop networks is to deal with link failures, and to repair the routes in these situations. Routes can either be repaired by re-establishing a new route from scratch starting from the source node (Source Repair), or they can be locally repaired by the node that detects the link break along the end-to-end path (Local Repair). In some situations Source Repair will lead to better performance, in other situations Local Repair will be the more appropriate choice. Mobile Ad-hoc Networks (MANETs) and in particular deployed for a wide range of application scenarios, including public access, transportation, public safety, mining, emergency response & disaster recovery, etc. This paper relates some analysis of the local repairing mechanism.*

Keywords— Adhoc network, MANET, Local repair, contention window

INTRODUCTION:

Mobile Ad hoc Network is a kind of self-coordinating wireless network of autonomous mobile nodes [14]. The Adhoc network is ideally suited for potential crisis management services applications in civil and military environments, such as responses to hurricane, earthquake, tsunami, terrorism and battlefield conditions where the entire communication infrastructure is destroyed and restoring communication quickly is crucial. In such a network, each node plays the role of as a router, forwarding packets for other nodes in the network, which may not be within the direct reach of wireless transmission range of each other. The unique features of MANETs such as operating without a central coordinator, multi hop relaying, node mobility and instant deployment, grant them a high degree of flexibility and survivability.

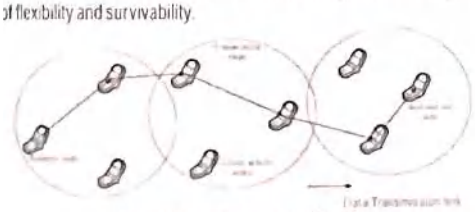

Fig 1 Schematic diagram of MANET

One of the basic problems of today's mobile ad hoc network is the network nodes and protocol layers are unable to make intelligent adaptations on different network stimulation. Limited interaction among the protocols makes the individual elements unable to get the entire picture of the network scenario. In this research work we bring an effective interaction among the protocols by sharing valuable state information among them. This information is used for making a correct decision for an optimized adaptation or reasonable response. We have made a value addition for different network variables.

Secondly, as in all real situations foundation need to be strong and efficient for designing a high performance MANET. Performance of MANET will be poor whatever enhancement is made on higher layers without having an efficient and robust base layer. Performance is to be achieved without creating any security vulnerabilities for malicious nodes in the network. In this research work we propose an adaptive collision aware contention resolution mechanism at MAC layer which effectively deals with channel access issues among several competing nodes and prevent the certain type of attacks by malicious nodes in an extend.

Capacity utilization of the channel can be increased by reducing the presence of exposed terminals. This can be achieved with the reduced use RTS/CTS packet. In our work we put forward an enhanced pre-data handshake mechanism which overcomes the limitations of the standard method employed in IEEE 802.11 standards with a controlled exchange of RTS/CTS in Mobile Adhoc Networks taking into account the traffic intensity in the different parts of the network. Network is virtually divided into different traffic sub domains. Direct data transmission is allowed in the network part of having less probability for hidden terminals. Besides increasing the channel utilization it reduces the delay and overhead in the network.

Lastly, Because of high mobility of the nodes and other reasons like battery failure and low transmission power no route in MANET will be stable for long period of time. The performance of MANETs depends in large extend on the efficiency in repairing the route. Classic local repairing scheme and several recent proposals fail to resolve the link breakage in a short time period with minimum control overhead. Besides it creates more traffic congestion during the link repairing process. In this synopsis we put forward a novel method to resolve link breakage without making much delay and congestion which is essential for today's high demand to facilitate multimedia communication in MANET.

II. APPLICATIONS

As Mobile Adhoc network (MANET) is usually used in the critical situations, its efficiency and performance is significant. Several works are done to deal with hidden terminal issues in MANETs. The hidden terminal problem happens when the simultaneous transmissions of two transmitters that lie outside carrier-sense (CS) range cause interference at one or both receivers and prevent successful reception [1]. To solve this problem of hidden station, 802.11 define a Request-to-Send Clear-to-Send (RTS/CTS) mechanism [2, 3]. But this causes for channel wastage due to exposed terminal problem [4].

In [1] authors proposed a method of delayed response to RTS from destination nodes but it causes for idleness in every second slot of RTS transmission. In [1] it uses an approach of calculating the number of hidden nodes around the receiver. Since mobility is common in adhoc networks hidden nodes will change frequently. Another common approach is to tune the CS threshold for having an improved spatial reuse [5, 6]. The main drawback of this approach is the poor fairness due to asymmetric CS ranges. Another approach for better spatial reuse is to control the transmission power [7]. However, hidden and exposed terminals cannot both be eliminated by either adjusting the CS threshold or controlling the transmission power. Other notable proposals are MACA-P [8] and two phase approach.

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Relatively less works are carried out in the field of route maintenance. In AODV routes can either be repaired by re-establishing a new route from scratch starting from the source node (Source Repair), or they can be locally repaired by the node that detects the link break along the end-to-end path (Local Repair)[9]. Once a route fails, consequent route maintenance is triggered. The initiator of the route update process attempts to use flooding search to obtain other path to the destination [10]. This will result in the decrease of the network throughput as well as long delays. The problem worsens when mobility is high [11]. As per the basic AODV local repairing scheme if a link break in an active route occurs, the node upstream of that break will choose to repair the link locally if the distance already travelled is more than that of to be travelled [11].

The local repair techniques are necessary to be employed in reactive protocols to make them suitable for large ad hoc networks which are applied in mission critical applications [12]. If the intermediate node tries for a local repair, the newly find shortest route from that intermediate node to destination node may not be the shortest route from source to destination. Besides, this alternative route may be getting after a long search on the network. This results in high delay and is unacceptable in MANETs. The chance for getting suboptimal route increases as the distance between broken link and destination increases. Therefore the above condition for local repairing is insufficient.

The Defense is very important to save the nation in the world. As this network is infrastructure less, so we can deploy easily in the areas where network setup is time and cost effective.

III. Objective of the Performance Analysis

In MANETS, usually used in the critical situations, its efficiency and performance is significant. Several works are done to deal with hidden terminal issues in MANETs [15,16]. The hidden terminal is one of the important proposals is Enhanced Local Repair AODV (ELRAODV). ELRAODV is based on an important assumption that major link failures are singular failure, only one node is down on the route and node next to the broken node in the route still carries route to the destination. ELRAODV is existed purely on the assumption that maximum link failures in Adhoc network are singular failures. This assumption has no support from any statistical study on Adhoc network failure and too optimistic to rely on. One of the improvements suggested for classical AODV is Pre-emptive Local Route Repair (PLRR), that objective to avoid route failures by pre-emptively local repairing routes when a link break is about to occur. But in this scheme location and mobility information needs to be propagated between neighbors.

Another remarkable enhancement is proposed by Hua Qu et al. According to this when a link break occurs, the node that is upstream of the lost link classifies the link breaks and adopts different methods for different link breaks depending on the status of its downstream node[13]. Even though this method is helpful to solve the issue effectively it causes delay due to the neighbour involvement for making decision. Classic local repairing scheme and several recent proposals fail to resolve the link breakage in a short time period with minimum control overhead.
Hence objective is design appropriate methods to Adhoc networks in order to improve performance analyzing using on Local repairing method.

IV. Performance Analysis

The whole protocol consists of the following procedures Route Request, Route Reply, Data Transmission, and Route Maintenance[11]. At the beginning of the Route Request procedure, the source broadcasts the request to its neighbors, and the request is forwarded recursively and flooding the whole network. Before forwarding the packet, the intermediate node modifies the packet in two ways: (1) replace the one-time public key of the upstream node with the one of itself; (2) update a specific field of the packet denoted as Ui. As such, at the end of the Route Request procedure, each node has the one-time public key of its upstream node. Making use of the shared secret with the source, the destination can deduce the length of the route. Similar to route request, route reply is forwarded recursively till reaching the source. However, since the packet is encrypted with one-time public key of the upstream node, it will be forwarded along the route instead of flooding. Before forwarding the packet, the intermediate node modifies the packet in two ways: (1) generate a random secret, which will be used as the shared secret with the upstream node during the session, and encrypt it with the upstream node's one-time public key; (2) update a specific field of the packet denoted as Ui. At the end of the Route Reply procedure, each node en route has shared secrets with its upstream and downstream nodes, if exist. In addition, each of the nodes en route hold the public key of the PKI pair generated by the destination for current session. Moreover, making use of the shared secret with the destination, the source can deduce additional information from the route reply, including the private key of the PKI pair and the shared secrets between each pair of consecutive nodes enroute. Using the shared secrets with the upstream and downstream node, each node en route can establish anonymous data transmission. The local repair mechanism is built on the fact that the source knows the shared secrets between each pair of consecutive nodes en route, although it has no knowledge of their identities.

According to the empirical results, as the only anonymous routing protocol supporting the local-repair mechanism, EASE provides better efficiency than previous work.

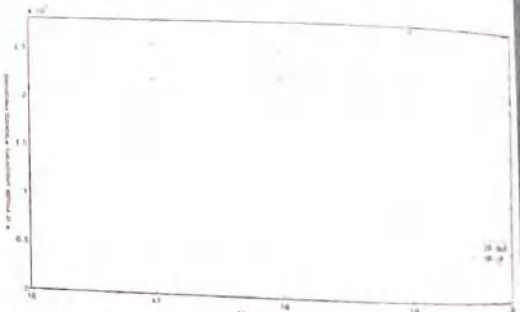

Fig. 2 Rout Discovery packet Received under different mobility setting

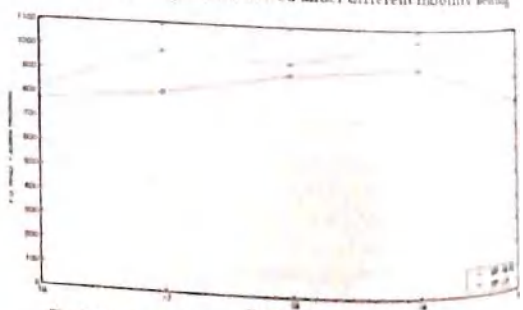

Fig. 3 RREP packet Received under different mobility setting

To maximize WLAN throughput, lots of algorithm has been developed, most of these ideas focus on [12] maximizing the throughput of the less is done on delay guarantee and delay jitter guarantee. No matter which algorithm is used, in order to support these ideas, it is always necessary to make a accurate information extracting system based on physical layer for source STA to make correct decision dynamically. More practically, the extracting system is, more efficiently the dynamic optimizing algorithm can work in MAC or upper layers.

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Table 1

parameter	Meaning and unit	Effect when decreased	Effect when increased
RTS Threshold	Frame larger than the threshold are preceded by RTS/CTS exchange	Greater effective throughput if there are a large number of hidden node situations	Maximum theoretical throughput is increased, but an improvement will be realized only if there is no interference Increases throughput in error free area by reducing fragmentation acknowledgment overhead
Fragmentation Threshold	Frame larger than the threshold are transmitted using the fragmentation procedure	Interference corrupts only fragments, not whole frames, so effective throughput may increase	

Another approach is to repair the route within a short time with less overhead in the network[14]. When a situation for route repair arises at a node, traffic condition around the node is analyzed. Decision for local repairing cannot be taken at network layer merely based on distance travelled by the packets. Instead, we need more accurate link level information on traffic experienced by the nodes. If the traffic is above a pre-defined threshold no attempt is made for local repairing. Local repairing at a node with heavy traffic congestion not only fails to find the route but also result in further increase in congestion. Even if maintenance attempt is successful it will take long time to repair the route. Mobile adhoc network is not a delay tolerant one since it is usually applied in emergency and delay sensitive multimedia like applications.

Simulation is conducted on both the enhanced scheme and standard scheme with different number of nodes and different rate of node mobility and the results were compared based on four key performance metrics (i) packet delivery ratio. (ii)Average end-to-end packet delay. (iii) MAC level Control overhead and (v) Throughput

Result Analysis

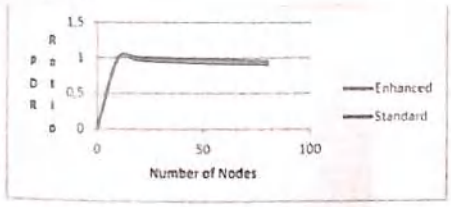

Fig. 4 Packet Delivery Ratio with different nodes

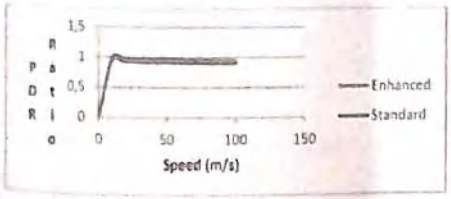

Fig. 5 Packet Delivery Ratio with different Mobility Rate

In Fig 4 and Fig. 5, the packet delivery ratio for different number of nodes and node speed are depicted respectively. It is clear that the enhanced scheme outperforms the standard scheme in small and large network as well as in networks having slow and fast mobile nodes. This performance enhancement is mainly because our virtual carrier mechanism and enhanced local repairing technique reduces the congestion in the network and prevent packet dropping considerably. Performance difference is more visible in the case of different node compared to different speed. In the first case collisions and presence of large number of RTS/CTS packets plays main role to determine the successful delivery of packets where as in second case link breakage due to mobility plays vital role to effect the performance. Since collision and presence of control packets plays bigger role than link breakage performance difference is more in the first case.

V. Conclusion

In this paper we have suggested some MANETS performances analysis on the basic principle of this approach is to repair the route within a short time with less overhead in the network. We collect link level information on traffic experienced by the nodes to take a decision on local repairing. If the traffic is above a pre-defined threshold no attempt is made for local repairing. All these enhancements are made in such a way that network element in one layer is useful for the improvement of network element in other layer. Performance of Our solution is evaluated and compared with standard scheme against various performance metrics.

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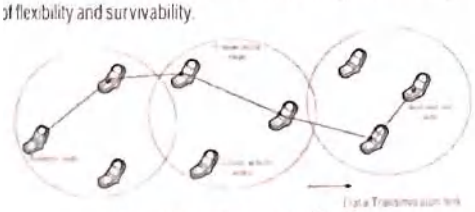

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IV. Performance Analysis

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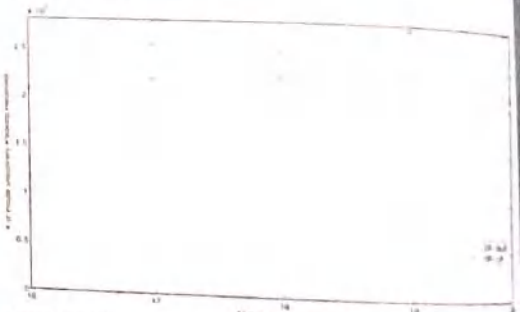
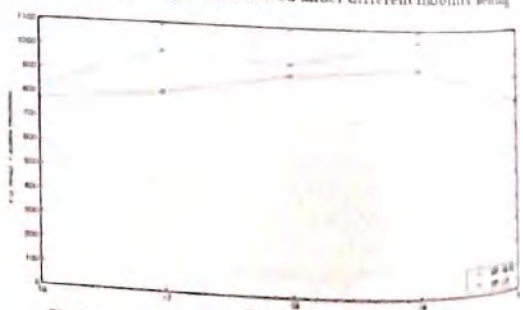


Fig. 2 Rout Discovery packet Received under different mobility setting



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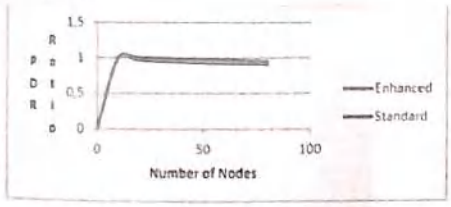
Simulation is conducted on both the enhanced scheme and standard scheme with different number of nodes and different rate of node mobility and the results were compared based on four key performance metrics (i) packet delivery ratio. (ii)Average end-to-end packet delay. (iii) MAC level Control overhead and (v) Throughput

Result Analysis



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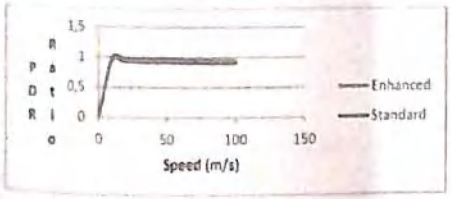

Fig. 5 Packet Delivery Ratio with different Mobility Rate

In Fig 4 and Fig. 5, the packet delivery ratio for different number of nodes and node speed are depicted respectively. It is clear that the enhanced scheme outperforms the standard scheme in small and large network as well as in networks having slow and fast mobile nodes. This performance enhancement is mainly because our virtual carrier mechanism and enhanced local repairing technique reduces the congestion in the network and prevent packet dropping considerably. Performance difference is more visible in the case of different node compared to different speed. In the first case collisions and presence of large number of RTS/CTS packets plays main role to determine the successful delivery of packets where as in second case link breakage due to mobility plays vital role to effect the performance. Since collision and presence of control packets plays bigger role than link breakage performance difference is more in the first case.

V. Conclusion

In this paper we have suggested some MANETS performances analysis on the basic principle of this approach is to repair the route within a short time with less overhead in the network. We collect link level information on traffic experienced by the nodes to take a decision on local repairing. If the traffic is above a pre-defined threshold no attempt is made for local repairing. All these enhancements are made in such a way that network element in one layer is useful for the improvement of network element in other layer. Performance of Our solution is evaluated and compared with standard scheme against various performance metrics.

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NATIONAL CONFERENCE ON EMERGING TRENDS IN ENGINEERING & TECHNOLOGY (ETET 2016)

ECE - 19

PERFORMANCE ANALYSIS OF MOBILE AD HOC NETWORKS USING LOCAL ROUTE REPAIRING MECHANISM

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Abstract - *One of the key challenges for routing protocols in wireless multi-hop networks is to deal with link failures, and to repair the routes in these situations. Routes can either be repaired by re-establishing a new route from scratch starting from the source node (Source Repair), or they can be locally repaired by the node that detects the link break along the end-to-end path (Local Repair). In some situations Source Repair will lead to better performance, in other situations Local Repair will be the more appropriate choice. Mobile Ad-hoc Networks (MANETs) and in particular deployed for a wide range of application scenarios, including public access, transportation, public safety, mining, emergency response & disaster recovery, etc. This paper relates some analysis of the local repairing mechanism.*

Keywords— Adhoc network, MANET, Local repair, contention window

INTRODUCTION:

Mobile Ad hoc Network is a kind of self-coordinating wireless network of autonomous mobile nodes [14]. The Adhoc network is ideally suited for potential crisis management services applications in civil and military environments, such as responses to hurricane, earthquake, tsunami, terrorism and battlefield conditions where the entire communication infrastructure is destroyed and restoring communication quickly is crucial. In such a network, each node plays the role of as a router, forwarding packets for other nodes in the network, which may not be within the direct reach of wireless transmission range of each other. The unique features of MANETs such as operating without a central coordinator, multi hop relaying, node mobility and instant deployment, grant them a high degree of flexibility and survivability.

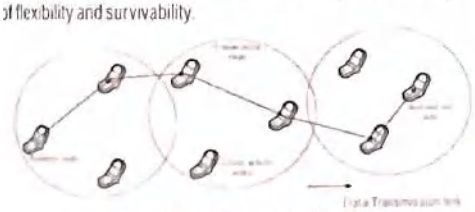

Fig 1 Schematic diagram of MANET

One of the basic problems of today's mobile ad hoc network is the network nodes and protocol layers are unable to make intelligent adaptations on different network stimulation. Limited interaction among the protocols makes the individual elements unable to get the entire picture of the network scenario. In this research work we bring an effective interaction among the protocols by sharing valuable state information among them. This information is used for making a correct decision for an optimized adaptation or reasonable response. We have made a value addition for different network variables.

Secondly, as in all real situations foundation need to be strong and efficient for designing a high performance MANET. Performance of MANET will be poor whatever enhancement is made on higher layers without having an efficient and robust base layer. Performance is to be achieved without creating any security vulnerabilities for malicious nodes in the network. In this research work we propose an adaptive collision aware contention resolution mechanism at MAC layer which effectively deals with channel access issues among several competing nodes and prevent the certain type of attacks by malicious nodes in an extend.

Capacity utilization of the channel can be increased by reducing the presence of exposed terminals. This can be achieved with the reduced use RTS/CTS packet. In our work we put forward an enhanced pre-data handshake mechanism which overcomes the limitations of the standard method employed in IEEE 802.11 standards with a controlled exchange of RTS/CTS in Mobile Adhoc Networks taking into account the traffic intensity in the different parts of the network. Network is virtually divided into different traffic sub domains. Direct data transmission is allowed in the network part of having less probability for hidden terminals. Besides increasing the channel utilization it reduces the delay and overhead in the network.

Lastly, Because of high mobility of the nodes and other reasons like battery failure and low transmission power no route in MANET will be stable for long period of time. The performance of MANETs depends in large extend on the efficiency in repairing the route. Classic local repairing scheme and several recent proposals fail to resolve the link breakage in a short time period with minimum control overhead. Besides it creates more traffic congestion during the link repairing process. In this synopsis we put forward a novel method to resolve link breakage without making much delay and congestion which is essential for today's high demand to facilitate multimedia communication in MANET.

II. APPLICATIONS

As Mobile Adhoc network (MANET) is usually used in the critical situations, its efficiency and performance is significant. Several works are done to deal with hidden terminal issues in MANETs. The hidden terminal problem happens when the simultaneous transmissions of two transmitters that lie outside carrier-sense (CS) range cause interference at one or both receivers and prevent successful reception [1]. To solve this problem of hidden station, 802.11 define a Request-to-Send Clear-to-Send (RTS/CTS) mechanism [2, 3]. But this causes for channel wastage due to exposed terminal problem [4].

In [1] authors proposed a method of delayed response to RTS from destination nodes but it causes for idleness in every second slot of RTS transmission. In [1] it uses an approach of calculating the number of hidden nodes around the receiver. Since mobility is common in adhoc networks hidden nodes will change frequently. Another common approach is to tune the CS threshold for having an improved spatial reuse [5, 6]. The main drawback of this approach is the poor fairness due to asymmetric CS ranges. Another approach for better spatial reuse is to control the transmission power [7]. However, hidden and exposed terminals cannot both be eliminated by either adjusting the CS threshold or controlling the transmission power. Other notable proposals are MACA-P [8] and two phase approach.

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Relatively less works are carried out in the field of route maintenance. In AODV routes can either be repaired by re-establishing a new route from scratch starting from the source node (Source Repair), or they can be locally repaired by the node that detects the link break along the end-to-end path (Local Repair)[9]. Once a route fails, consequent route maintenance is triggered. The initiator of the route update process attempts to use flooding search to obtain other path to the destination [10]. This will result in the decrease of the network throughput as well as long delays. The problem worsens when mobility is high [11]. As per the basic AODV local repairing scheme if a link break in an active route occurs, the node upstream of that break will choose to repair the link locally if the distance already travelled is more than that of to be travelled [11].

The local repair techniques are necessary to be employed in reactive protocols to make them suitable for large ad hoc networks which are applied in mission critical applications [12]. If the intermediate node tries for a local repair, the newly find shortest route from that intermediate node to destination node may not be the shortest route from source to destination. Besides, this alternative route may be getting after a long search on the network. This results in high delay and is unacceptable in MANETs. The chance for getting suboptimal route increases as the distance between broken link and destination increases. Therefore the above condition for local repairing is insufficient.

The Defense is very important to save the nation in the world. As this network is infrastructure less, so we can deploy easily in the areas where network setup is time and cost effective.

III. Objective of the Performance Analysis

In MANETS, usually used in the critical situations, its efficiency and performance is significant. Several works are done to deal with hidden terminal issues in MANETs [15,16]. The hidden terminal is one of the important proposals is Enhanced Local Repair AODV (ELRAODV). ELRAODV is based on an important assumption that major link failures are singular failure, only one node is down on the route and node next to the broken node in the route still carries route to the destination. ELRAODV is existed purely on the assumption that maximum link failures in Adhoc network are singular failures. This assumption has no support from any statistical study on Adhoc network failure and too optimistic to rely on. One of the improvements suggested for classical AODV is Pre-emptive Local Route Repair (PLRR), that objective to avoid route failures by pre-emptively local repairing routes when a link break is about to occur. But in this scheme location and mobility information needs to be propagated between neighbors.

Another remarkable enhancement is proposed by Hua Qu et al. According to this when a link break occurs, the node that is upstream of the lost link classifies the link breaks and adopts different methods for different link breaks depending on the status of its downstream node[13]. Even though this method is helpful to solve the issue effectively it causes delay due to the neighbour involvement for making decision. Classic local repairing scheme and several recent proposals fail to resolve the link breakage in a short time period with minimum control overhead.
Hence objective is design appropriate methods to Adhoc networks in order to improve performance analyzing using on Local repairing method.

IV. Performance Analysis

The whole protocol consists of the following procedures Route Request, Route Reply, Data Transmission, and Route Maintenance[11]. At the beginning of the Route Request procedure, the source broadcasts the request to its neighbors, and the request is forwarded recursively and flooding the whole network. Before forwarding the packet, the intermediate node modifies the packet in two ways: (1) replace the one-time public key of the upstream node with the one of itself; (2) update a specific field of the packet denoted as Ui. As such, at the end of the Route Request procedure, each node has the one-time public key of its upstream node. Making use of the shared secret with the source, the destination can deduce the length of the route. Similar to route request, route reply is forwarded recursively till reaching the source. However, since the packet is encrypted with one-time public key of the upstream node, it will be forwarded along the route instead of flooding. Before forwarding the packet, the intermediate node modifies the packet in two ways: (1) generate a random secret, which will be used as the shared secret with the upstream node during the session, and encrypt it with the upstream node's one-time public key; (2) update a specific field of the packet denoted as Ui. At the end of the Route Reply procedure, each node en route has shared secrets with its upstream and downstream nodes, if exist. In addition, each of the nodes en route hold the public key of the PKI pair generated by the destination for current session. Moreover, making use of the shared secret with the destination, the source can deduce additional information from the route reply, including the private key of the PKI pair and the shared secrets between each pair of consecutive nodes enroute. Using the shared secrets with the upstream and downstream node, each node en route can establish anonymous data transmission. The local repair mechanism is built on the fact that the source knows the shared secrets between each pair of consecutive nodes en route, although it has no knowledge of their identities.

According to the empirical results, as the only anonymous routing protocol supporting the local-repair mechanism, EASE provides better efficiency than previous work.

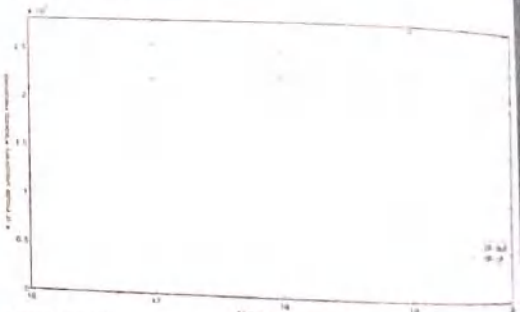

Fig. 2 Rout Discovery packet Received under different mobility setting

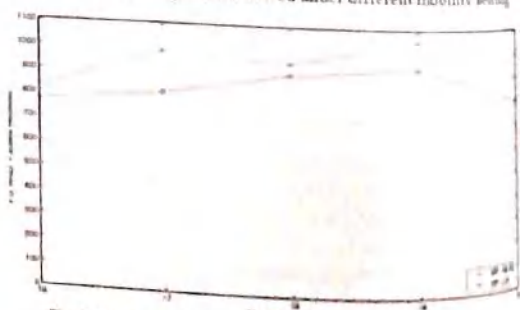

Fig. 3 RREP packet Received under different mobility setting

To maximize WLAN throughput, lots of algorithm has been developed, most of these ideas focus on [12] maximizing the throughput of the less is done on delay guarantee and delay jitter guarantee. No matter which algorithm is used, in order to support these ideas, it is always necessary to make a accurate information extracting system based on physical layer for source STA to make correct decision dynamically. More practically, the extracting system is, more efficiently the dynamic optimizing algorithm can work in MAC or upper layers.

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Table 1

parameter	Meaning and unit	Effect when decreased	Effect when increased
RTS Threshold	Frame larger than the threshold are preceded by RTS/CTS exchange	Greater effective throughput if there are a large number of hidden node situations	Maximum theoretical throughput is increased, but an improvement will be realized only if there is no interference Increases throughput in error free area by reducing fragmentation acknowledgment overhead
Fragmentation Threshold	Frame larger than the threshold are transmitted using the fragmentation procedure	Interference corrupts only fragments, not whole frames, so effective throughput may increase	

Another approach is to repair the route within a short time with less overhead in the network[14]. When a situation for route repair arises at a node, traffic condition around the node is analyzed. Decision for local repairing cannot be taken at network layer merely based on distance travelled by the packets. Instead, we need more accurate link level information on traffic experienced by the nodes. If the traffic is above a pre-defined threshold no attempt is made for local repairing. Local repairing at a node with heavy traffic congestion not only fails to find the route but also result in further increase in congestion. Even if maintenance attempt is successful it will take long time to repair the route. Mobile adhoc network is not a delay tolerant one since it is usually applied in emergency and delay sensitive multimedia like applications.

Simulation is conducted on both the enhanced scheme and standard scheme with different number of nodes and different rate of node mobility and the results were compared based on four key performance metrics (i) packet delivery ratio. (ii)Average end-to-end packet delay. (iii) MAC level Control overhead and (v) Throughput

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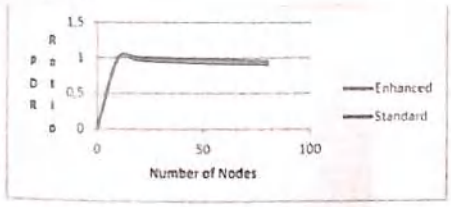

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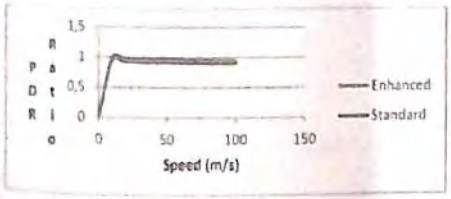

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NATIONAL CONFERENCE ON EMERGING TRENDS IN ENGINEERING & TECHNOLOGY (ETET-2016)

CSE & IT - 5

ADVANCE SECURITY IN DATABASE BY USING REDACTION TECHNIQUES

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Abstract- *As organizations increase their trust on perhaps distributed information systems for day to day business, they have become more exposed to security breaches even as they increase their productivity and efficiency advantages. Though a number of techniques, such as many encryption techniques and electronic signatures are presently available to protect data when it gets transmitted across sites, an actually broad approach for protection of data must also include some mechanism for enforcing access control policies based on qualifications and characteristics.*

Keywords:, *Data Redaction, PII, SQL, Oracle Database kernel, Oracle Advance Security, Oracle Enterprise Manager, PCI,DSS*

I.INTRODUCTION

In the present day scenario, ever increasing security threats, diversifying compliance requirements and cloud computing technology are just a few of the reasons to establish the fact that data security has become critical. Advanced Security option delivers two essential preventive controls covering encryption of data-at-rest and redaction of sensitive data displayed by applications.[1] These controls help, protect sensitive data from being exposed directly from storage or through applications.

The sensitive data in the database can be protected from the malicious users by means of data redaction technique which is the recent innovative feature available in Oracle 12c version. Data redaction suppresses the sensitive data such as any personally identifiable information (PII). PII can be used on its own or with other information to identify or locate a single person, or to identify an individual in context.

2 LITERATURE SURVEY

Traditional approaches to redacting sensitive data typically relied on application coding or installing third-party software on the database server to modify its behavior. These alternatives have important drawbacks compared to Data Redaction. Approaches that require coding new application logic, modifying existing SQL statements, or authoring custom application scripts are likely to result in disparate solutions that are inconsistent across the enterprise and costly to maintain over their lifetime. In addition, strict controls must be placed on new application development to make sure that custom application code and new objects are properly accessed.

The code also needs to take into consideration multiple factors under which the redaction policies are enforced, while maintaining the performance and semantics of the application. Approaches that add new components to the Oracle Database, overwrite existing components, establish proxies, and modify basic behavior of the database also are fraught with problems [2] Not only does the new component introduce new attack surfaces, but they also can create performance overhead, impact operational activities of the database, and may fail when attempting to transform complex database queries that are generated by applications.

Approaches that add new components to the Oracle Database, overwrite existing components, establish proxies, and modify basic behavior of the database also are fraught with In contrast, redacting directly in the Oracle Database kernel using Data Redaction has tighter security, superior performance, and better compatibility with a range of database configurations, use cases, and workloads.

3 PROPOSED SYSTEM

Data Redaction enables you to mask (redact) data that is returned from queries issued by applications. You can redact column data by using one of the following methods.

Full redaction: You redact all of the contents of the column data. The redacted value returned to the querying application user depends on the data type of the column. For example, columns of the NUMBER data type are redacted with a zero (0), and character data types are redacted with a single space.

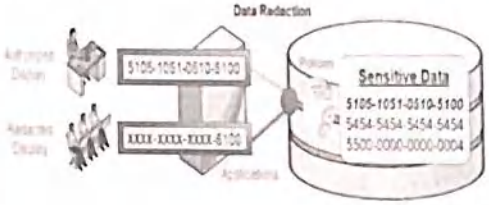

Figure 3 1 Full Data Redaction

Partial redaction: You redact a portion of the column data. For example, you can redact a Social Security number with asterisks (*), except for the last 4 digits.

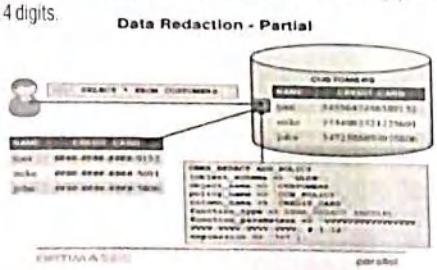

Figure 3 2 Partial Data Redaction

Figure 3 3 Regular Expression Redaction

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Random redaction The redacted data presented to the querying application user appears as randomly generated values each time it is displayed, depending on the data type of the column

No redaction: The No redaction type option enables you to test the internal operation of our redaction policies, with no effect on the results of queries against tables with policies defined on them [3]. You can use this option to test the redaction policy definitions before applying them to a production environment

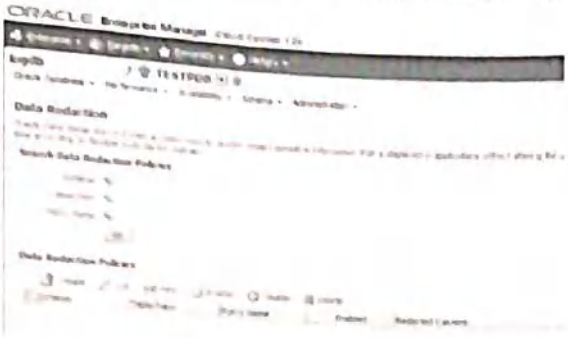

Figure 3 4 OEM for Data Redaction

Oracle Database applies the redaction at runtime, when users access the data (that is, at query-execution time). This solution works well in a production system. During the time that the data is being redacted, all of the data processing is performed normally, and the back-end referential integrity constraints are preserved [4]

Data redaction can help you to comply with industry regulations such as Payment Card Industry Data Security Standard (PCI DSS) and the Sarbanes-Oxley Act.

2.2. When to use Data Redaction

Use Oracle Data Redaction when you must disguise sensitive data that our applications and application users must access. Data Redaction enables you to easily disguise the data using several different redaction styles.

Oracle Data Redaction is ideal for situations in which you must redact specific characters out of the result set of queries of Personally Identifiable Information (PII) returned to certain application users. For example, you may want to present a U.S. Social Security number that ends with the numbers 4320 as ***-**-4320 [5]. Oracle Data Redaction is particularly suited for call center applications and other applications that are read-only. Take care when using Oracle Data Redaction with applications that perform updates back to the database, because redacted data can be written back to this database.

2.3. Benefits of Using Data Redaction

Oracle Data Redaction provides several benefits when you use it to protect our data

These benefits are as follows:

- You have different styles of redaction from which to choose.
- Because the data is redacted at runtime, Data Redaction is well suited to environments in which data is constantly changing.
- You can create the Data Redaction policies in one central location and easily manage them from there.
- The Data Redaction policies enable you to create a wide variety of function conditions based on SYS_CONTEXT values, which can be used at runtime to decide when the Data Redaction policies will apply to the results of the application user's query.

2.4. Target Use Cases for Data Redaction

Oracle Data Redaction protects sensitive data that is displayed in

applications.

Oracle Data Redaction fulfils common use case scenarios

2.4.1. Using Oracle Data Redaction with Database Applications

Data Redaction is transparent to application users because it preserves original data type and (optionally) the formatting. It is highly transparent the database because the data remains the same in buffers, cache storage only being changed at the last minute just before SQL query are returned to the caller. The redaction is enforced consistently across of the applications that use the same underlying database. You can which application users should see only redacted data by using application user information that is passed into the database through SYS_CONTEXT function; you can redact data based on attributes current database or application user, and you can implement logical conditions within a given redaction policy.

Data Redaction is implemented in a way that minimizes performance overhead. These characteristics make Oracle Data Redaction particularly well suited for usage by a range of applications, analytics tools, reporting tools, and monitoring tools that share common production data. Although its primary target is redaction of production data for applications, Oracle Data redaction also can be used in combination with Oracle Enterprise Manager Data Masking and Sub setting Pack for protecting sensitive data in testing and development environments.

2.4.2. Oracle Data Redaction with Ad Hoc Database Queries

You may encounter situations where it is convenient to redact sensitive data for ad hoc queries that are performed by database users.

For example, in the course of supporting a production application, you may need to run ad hoc database queries to troubleshoot and fix any problem with the application [6]

This is different from the application-based scenarios described in "Oracle Data Redaction with Database Applications"[7], which typically generate a bounded set of SQL queries, use defined database accounts and have fixed privileges.

Even though Oracle Data Redaction is not designed to prevent exposure to database users who run ad hoc queries directly against the database, it can provide an additional layer to reduce the chance of accidental data exposure [8]. Because such users may have the ability to change data, alter the database schema, and circumvent the SQL interface entirely, it is possible for a malicious user to bypass Oracle Data Redaction policies in certain circumstances.

Remember that the Oracle Database security tools are designed to work together to improve overall security. By deploying one or more of these tools as a complement to Oracle Data Redaction, you can significantly increase our overall security posture [9].

4. Results

SQL Script demonstrating Redaction Policy

To set up a demonstration, uses the setup.sql script, then uses the shown in below listing to set up a redaction policy on the EMP

Title of PDF Document

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```
Setup sql
create table emp
( empno number,
 ename varchar2(20),
 salary number,
 hire_date date,
 email_id varchar2(30) ) ;
insert into emp(empno,ename,salary,hire_date,email_id)
values(1,'Zaheer',1013,sysdate,'Zaheer@gmail com'),
insert into emp(empno,ename,salary,hire_date,email_id)
values(2 'Shanu',1578,sysdate-2,'shanu@gmail com'),
insert into emp(empno,ename,salary,hire_date,email_id)
values(3,'Ayaz',1398,sysdate-3,'Ayaz@gmail com'),
commit;
SQL > select * from emp;
```

EMP

NNO	ENAME	SALARY	HIRE_DATE	EMAIL_ID
1	Zaheer	1013	06-MAR-2015 02:20:42 PM	Zaheer@gmail.com
2	Shanu	1578	04-MAR-2015 02:20:42 PM	shanu@gmail.com
3	Ayaz	1398	03-MAR-2015 02:20:42 PM	Ayaz@gmail.com

3 rows selected.

When the owner of the table "EMP" selects data, the result displays the values intact - but when any other user selects data from the table, the data must be masked

Column	Description of redaction
Salary	replace with some random numbers and don't show actual values
Hire_date	show only the day and month year should be replaced with 1990
Email_id	Keep the domain name and rest others should be masked

Table 4.1 Description of Data redaction applied on Employee Database

```
SQL > grant select on emp to scott;
Grant succeeded
SQL > begin
 2  dbms_redact.add_policy
 3  (object_schema => user,
 4   object_name => 'EMP',
 5   policy_name => 'EMP_REDACT',
 6   column_name => 'SALARY',
 7   function_type => dbms_redact.random,
 8        expression => q'[sys_context('userenv','current_user')!=
'WAHEED']'
 9   ),
10 end,
11 /
PL/SQL procedure successfully completed.
SQL >
SQL > begin
 2  dbms_redact.alter_policy
 3  (object_schema => user,
 4   object_name => 'EMP',
 5   policy_name => 'EMP_REDACT',
 6   action => dbms_redact.add_column,
 7   column_name => 'HIRE_DATE',
 8   function_type => dbms_redact.partial,
 9   function_parameters => 'MDy1990').
10 end,
11 /
PL/SQL procedure successfully completed.
SQL > begin
 2  dbms_redact.alter_policy
 3  (object_schema => user,
 4   object_name => 'EMP',
 5   policy_name => 'EMP_REDACT',
 6   action => dbms_redact.add_column,
 7   column_name => 'EMAIL_ID',
 8   function_type => dbms_redact.regexp,
 9   regexp_pattern => dbms_redact.RE_PATTERN_EMAIL_
     ADDRESS,
10   regexp_replace_string => dbms_redact.RE_REDACT_ EMAIL_
     NAME,
11   regexp_match_parameter => dbms_redact.RE_CASE_
     INSENSITIVE );
12   end,
13   /
     PL/SQL procedure successfully completed.
     SQL > select * from emp ;
```

EMP

NNO	ENAME	SALARY	HIRE_DATE	EMAIL_ID
1	Zaheer	1013	06-MAR-2015 02:20:42 PM	Zaheer@gmail.com
2	Shanu	1578	04-MAR-2015 02:20:42 PM	shanu@gmail.com
3	Ayaz	1398	03-MAR-2015 02:20:42 PM	Ayaz@gmail.com

When connected from Scott schema the redacted data look like this.

```
SQL > select * from WAHEED.emp;
```

EMP

NNO	ENAME	SALARY	HIRE_DATE	EMAIL_ID
1	Zaheer	1013	06-MAR-2015 02:20:42 PM	xxxxxx@gmail.com
2	Shanu	1578	04-MAR-2015 02:20:42 PM	xxxxx@gmail.com
3	Ayaz	1398	03-MAR-2015 02:20:42 PM	xxxx@gmail.com

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Information's on redaction policies and policy columns are maintained in REDACTION_POLICIES and REDACTION_COLUMNS data dictionary.

```
SQL > @printtbl ' select * from redaction_policies '
OBJECT_OWNER              : "WAHEED"
OBJECT_NAME               : "EMP"
POLICY_NAME               "EMP_REDACT"
EXPRESSION                  : "sys_context('userenv','current_user')!=
'WAHEED'"
ENABLE                  : "YES  "
POLICY_DESCRIPTION          : ""
----------
SQL > PL/SQL procedure successfully completed
SQL > @printtbl ' select * from redaction_columns '
OBJECT_OWNER              : "WAHEED"
OBJECT_NAM                : "EMP"
COLUMN_NAME               : "SALARY"
FUNCTION_TYPE             : "RANDOM REDACTION"
FUNCTION_PARAMETERS       : ""
REGEXP_PATTERN            : ""
REGEXP_REPLACE_STRING     : ""
REGEXP_POSITIO            : "0"
REGEXP_OCCURRENCE         : "0"
REGEXP_MATCH_PARAMETER    : ""
COLUMN_DESCRIPTION        : ""
----------
OBJECT_OWNER              : "WAHEED"
OBJECT_NAME               : "EMP"
COLUMN_NAME               : "EMAIL_ID"
FUNCTION_TYPE             : "REGEXP REDACTION"
FUNCTION_PARAMETERS       : ""
REGEXP_PATTERN            : "([A-Za-z0-9._%+-]+)@([A-Za-z0-9.-
]+\.[A-Za-z]{2,4})"
REGEXP_REPLACE_STRING     : "xxxx@\2"
REGEXP_POSITION           : "1"
REGEXP_OCCURRENCE         : "0"
REGEXP_MATCH_PARAMETER    : "i"
COLUMN_DESCRIPTION        : ""
----------
OBJECT_OWNER              : "WAHEED"
OBJECT_NAME               : "EMP"
COLUMN_NAME               : "HIRE_DATE"
FUNCTION_TYPE             : "PARTIAL REDACTION"
FUNCTION_PARAMETERS       : "MDy1990"
REGEXP_PATTERN            : ""
REGEXP_REPLACE_STRING     : ""
REGEXP_POSITION           : "0"
REGEXP_OCCURRENCE         : "0"
REGEXP_MATCH_PARAMETER    : ""
COLUMN_DESCRIPTION        : ""
----------
SQL > PL/SQL procedure successfully completed
```

However if the querying user has the EXEMPT REDACTION POLICY system privilege redaction will not be performed

```
SQL > select * from WAHEED.emp;
```

EMP NNO	ENAME	SALARY	HIRE_DATE	EMAIL_ID
1	Zaheer	1013	06-MAR-2015 02:20:42 PM	Zaheer@gmail.com
2	Shanu	1578	04-MAR-2015 02:20:42 PM	shanu@gmail.com
3	Ayaz	1398	03-MAR-2015 02:20:42 PM	Ayaz@gmail.com

5. Conclusions

Redaction technique is applied to the tables for masking the sensitive d here. I have used 3 types of masking i) full redaction ii) partial redac and iii) regular expression. These actions can be applied either by m of Oracle Enterprise Manager Wizard and by writing SQL/PL S procedures. Both I have shown in the paper.

Oracle Advanced Security provides such protection without ca performance or functional issues with database schemas O Advanced Security was easy to configure and implement, and encryption and redaction functions operated efficiently and secur Encryption key management was easy to set up, and keys can be stor a secure wallet or hardware module. Redaction functions were eas configure and automatically deploy by setting a few parameters.

Oracle makes a declarative policy-based approach to encryption redaction simple to create, manage and change, thanks to Or Advanced Security's data redaction and transparent data encryp features. In addition, applying the encryption and redaction functions t data, as well as verifying that these functions were operating properly w straightforward and easy to document, which is important from a compliance or regulatory perspective.

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[7] http://docs.oracle.com/database/121/ASOAG/redaction.htm CACHJCCJ

[8] http://docs.oracle.com/cd/E11882_01/network.112/e40393.pdf

[9] http://docs.oracle.com/database/121/ASOAG/asotrans.htm

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NATIONAL CONFERENCE ON EMERGING TRENDS IN ENGINEERING & TECHNOLOGY (ETET-2016)

CSE & IT - 5

ADVANCE SECURITY IN DATABASE BY USING REDACTION TECHNIQUES

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Abstract- *As organizations increase their trust on perhaps distributed information systems for day to day business, they have become more exposed to security breaches even as they increase their productivity and efficiency advantages. Though a number of techniques, such as many encryption techniques and electronic signatures are presently available to protect data when it gets transmitted across sites, an actually broad approach for protection of data must also include some mechanism for enforcing access control policies based on qualifications and characteristics.*

Keywords:, *Data Redaction, PII, SQL, Oracle Database kernel, Oracle Advance Security, Oracle Enterprise Manager, PCI,DSS*

I.INTRODUCTION

In the present day scenario, ever increasing security threats, diversifying compliance requirements and cloud computing technology are just a few of the reasons to establish the fact that data security has become critical. Advanced Security option delivers two essential preventive controls covering encryption of data-at-rest and redaction of sensitive data displayed by applications.[1] These controls help, protect sensitive data from being exposed directly from storage or through applications.

The sensitive data in the database can be protected from the malicious users by means of data redaction technique which is the recent innovative feature available in Oracle 12c version. Data redaction suppresses the sensitive data such as any personally identifiable information (PII). PII can be used on its own or with other information to identify or locate a single person, or to identify an individual in context.

2 LITERATURE SURVEY

Traditional approaches to redacting sensitive data typically relied on application coding or installing third-party software on the database server to modify its behavior. These alternatives have important drawbacks compared to Data Redaction. Approaches that require coding new application logic, modifying existing SQL statements, or authoring custom application scripts are likely to result in disparate solutions that are inconsistent across the enterprise and costly to maintain over their lifetime. In addition, strict controls must be placed on new application development to make sure that custom application code and new objects are properly accessed.

The code also needs to take into consideration multiple factors under which the redaction policies are enforced, while maintaining the performance and semantics of the application. Approaches that add new components to the Oracle Database, overwrite existing components, establish proxies, and modify basic behavior of the database also are fraught with problems [2] Not only does the new component introduce new attack surfaces, but they also can create performance overhead, impact operational activities of the database, and may fail when attempting to transform complex database queries that are generated by applications.

Approaches that add new components to the Oracle Database, overwrite existing components, establish proxies, and modify basic behavior of the database also are fraught with In contrast, redacting directly in the Oracle Database kernel using Data Redaction has tighter security, superior performance, and better compatibility with a range of database configurations, use cases, and workloads.

3 PROPOSED SYSTEM

Data Redaction enables you to mask (redact) data that is returned from queries issued by applications. You can redact column data by using one of the following methods.

Full redaction: You redact all of the contents of the column data. The redacted value returned to the querying application user depends on the data type of the column. For example, columns of the NUMBER data type are redacted with a zero (0), and character data types are redacted with a single space.

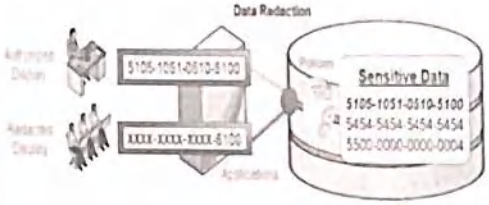

Figure 3 1 Full Data Redaction

Partial redaction: You redact a portion of the column data. For example, you can redact a Social Security number with asterisks (*), except for the last 4 digits.

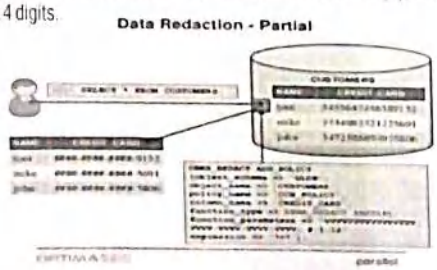

Figure 3 2 Partial Data Redaction

Figure 3 3 Regular Expression Redaction

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Random redaction The redacted data presented to the querying application user appears as randomly generated values each time it is displayed, depending on the data type of the column

No redaction: The No redaction type option enables you to test the internal operation of our redaction policies, with no effect on the results of queries against tables with policies defined on them [3]. You can use this option to test the redaction policy definitions before applying them to a production environment

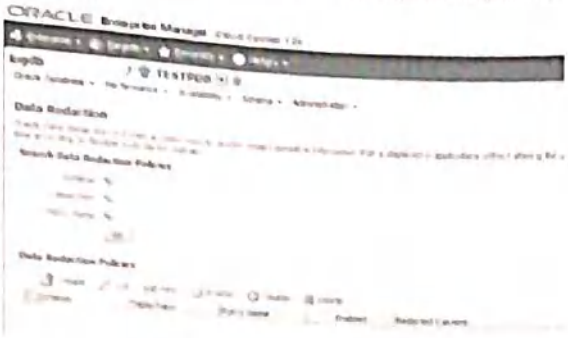

Figure 3 4 OEM for Data Redaction

Oracle Database applies the redaction at runtime, when users access the data (that is, at query-execution time). This solution works well in a production system. During the time that the data is being redacted, all of the data processing is performed normally, and the back-end referential integrity constraints are preserved [4]

Data redaction can help you to comply with industry regulations such as Payment Card Industry Data Security Standard (PCI DSS) and the Sarbanes-Oxley Act.

2.2. When to use Data Redaction

Use Oracle Data Redaction when you must disguise sensitive data that our applications and application users must access. Data Redaction enables you to easily disguise the data using several different redaction styles.

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Data Redaction is implemented in a way that minimizes performance overhead. These characteristics make Oracle Data Redaction particularly well suited for usage by a range of applications, analytics tools, reporting tools, and monitoring tools that share common production data. Although its primary target is redaction of production data for applications, Oracle Data redaction also can be used in combination with Oracle Enterprise Manager Data Masking and Sub setting Pack for protecting sensitive data in testing and development environments.

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This is different from the application-based scenarios described in "Oracle Data Redaction with Database Applications"[7], which typically generate a bounded set of SQL queries, use defined database accounts and have fixed privileges.

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Remember that the Oracle Database security tools are designed to work together to improve overall security. By deploying one or more of these tools as a complement to Oracle Data Redaction, you can significantly increase our overall security posture [9].

4. Results

SQL Script demonstrating Redaction Policy

To set up a demonstration, uses the setup.sql script, then uses the shown in below listing to set up a redaction policy on the EMP

Title of PDF Document

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```
Setup sql
create table emp
( empno number,
 ename varchar2(20),
 salary number,
 hire_date date,
 email_id varchar2(30) ) ;
insert into emp(empno,ename,salary,hire_date,email_id)
values(1,'Zaheer',1013,sysdate,'Zaheer@gmail com'),
insert into emp(empno,ename,salary,hire_date,email_id)
values(2 'Shanu',1578,sysdate-2,'shanu@gmail com'),
insert into emp(empno,ename,salary,hire_date,email_id)
values(3,'Ayaz',1398,sysdate-3,'Ayaz@gmail com'),
commit;
SQL > select * from emp;
```

EMP

NNO	ENAME	SALARY	HIRE_DATE	EMAIL_ID
1	Zaheer	1013	06-MAR-2015 02:20:42 PM	Zaheer@gmail.com
2	Shanu	1578	04-MAR-2015 02:20:42 PM	shanu@gmail.com
3	Ayaz	1398	03-MAR-2015 02:20:42 PM	Ayaz@gmail.com

3 rows selected.

When the owner of the table "EMP" selects data, the result displays the values intact - but when any other user selects data from the table, the data must be masked

Column	Description of redaction
Salary	replace with some random numbers and don't show actual values
Hire_date	show only the day and month year should be replaced with 1990
Email_id	Keep the domain name and rest others should be masked

Table 4.1 Description of Data redaction applied on Employee Database

```
SQL > grant select on emp to scott;
Grant succeeded
SQL > begin
 2  dbms_redact.add_policy
 3  (object_schema => user,
 4   object_name => 'EMP',
 5   policy_name => 'EMP_REDACT',
 6   column_name => 'SALARY',
 7   function_type => dbms_redact.random,
 8        expression => q'[sys_context('userenv','current_user')!=
'WAHEED']'
 9   ),
10 end,
11 /
PL/SQL procedure successfully completed.
SQL >
SQL > begin
 2  dbms_redact.alter_policy
 3  (object_schema => user,
 4   object_name => 'EMP',
 5   policy_name => 'EMP_REDACT',
 6   action => dbms_redact.add_column,
 7   column_name => 'HIRE_DATE',
 8   function_type => dbms_redact.partial,
 9   function_parameters => 'MDy1990').
10 end,
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PL/SQL procedure successfully completed.
SQL > begin
 2  dbms_redact.alter_policy
 3  (object_schema => user,
 4   object_name => 'EMP',
 5   policy_name => 'EMP_REDACT',
 6   action => dbms_redact.add_column,
 7   column_name => 'EMAIL_ID',
 8   function_type => dbms_redact.regexp,
 9   regexp_pattern => dbms_redact.RE_PATTERN_EMAIL_
     ADDRESS,
10   regexp_replace_string => dbms_redact.RE_REDACT_ EMAIL_
     NAME,
11   regexp_match_parameter => dbms_redact.RE_CASE_
     INSENSITIVE );
12   end,
13   /
     PL/SQL procedure successfully completed.
     SQL > select * from emp ;
```

EMP

NNO	ENAME	SALARY	HIRE_DATE	EMAIL_ID
1	Zaheer	1013	06-MAR-2015 02:20:42 PM	Zaheer@gmail.com
2	Shanu	1578	04-MAR-2015 02:20:42 PM	shanu@gmail.com
3	Ayaz	1398	03-MAR-2015 02:20:42 PM	Ayaz@gmail.com

When connected from Scott schema the redacted data look like this.

```
SQL > select * from WAHEED.emp;
```

EMP

NNO	ENAME	SALARY	HIRE_DATE	EMAIL_ID
1	Zaheer	1013	06-MAR-2015 02:20:42 PM	xxxxxx@gmail.com
2	Shanu	1578	04-MAR-2015 02:20:42 PM	xxxxx@gmail.com
3	Ayaz	1398	03-MAR-2015 02:20:42 PM	xxxx@gmail.com

Title of PDF Document

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Information's on redaction policies and policy columns are maintained in REDACTION_POLICIES and REDACTION_COLUMNS data dictionary.

```
SQL > @printtbl ' select * from redaction_policies '
OBJECT_OWNER              : "WAHEED"
OBJECT_NAME               : "EMP"
POLICY_NAME               "EMP_REDACT"
EXPRESSION                  : "sys_context('userenv','current_user')!=
'WAHEED'"
ENABLE                  : "YES  "
POLICY_DESCRIPTION          : ""
----------
SQL > PL/SQL procedure successfully completed
SQL > @printtbl ' select * from redaction_columns '
OBJECT_OWNER              : "WAHEED"
OBJECT_NAM                : "EMP"
COLUMN_NAME               : "SALARY"
FUNCTION_TYPE             : "RANDOM REDACTION"
FUNCTION_PARAMETERS       : ""
REGEXP_PATTERN            : ""
REGEXP_REPLACE_STRING     : ""
REGEXP_POSITIO            : "0"
REGEXP_OCCURRENCE         : "0"
REGEXP_MATCH_PARAMETER    : ""
COLUMN_DESCRIPTION        : ""
----------
OBJECT_OWNER              : "WAHEED"
OBJECT_NAME               : "EMP"
COLUMN_NAME               : "EMAIL_ID"
FUNCTION_TYPE             : "REGEXP REDACTION"
FUNCTION_PARAMETERS       : ""
REGEXP_PATTERN            : "([A-Za-z0-9._%+-]+)@([A-Za-z0-9.-
]+\.[A-Za-z]{2,4})"
REGEXP_REPLACE_STRING     : "xxxx@\2"
REGEXP_POSITION           : "1"
REGEXP_OCCURRENCE         : "0"
REGEXP_MATCH_PARAMETER    : "i"
COLUMN_DESCRIPTION        : ""
----------
OBJECT_OWNER              : "WAHEED"
OBJECT_NAME               : "EMP"
COLUMN_NAME               : "HIRE_DATE"
FUNCTION_TYPE             : "PARTIAL REDACTION"
FUNCTION_PARAMETERS       : "MDy1990"
REGEXP_PATTERN            : ""
REGEXP_REPLACE_STRING     : ""
REGEXP_POSITION           : "0"
REGEXP_OCCURRENCE         : "0"
REGEXP_MATCH_PARAMETER    : ""
COLUMN_DESCRIPTION        : ""
----------
SQL > PL/SQL procedure successfully completed
```

However if the querying user has the EXEMPT REDACTION POLICY system privilege redaction will not be performed

```
SQL > select * from WAHEED.emp;
```

EMP NNO	ENAME	SALARY	HIRE_DATE	EMAIL_ID
1	Zaheer	1013	06-MAR-2015 02:20:42 PM	Zaheer@gmail.com
2	Shanu	1578	04-MAR-2015 02:20:42 PM	shanu@gmail.com
3	Ayaz	1398	03-MAR-2015 02:20:42 PM	Ayaz@gmail.com

5. Conclusions

Redaction technique is applied to the tables for masking the sensitive d here. I have used 3 types of masking i) full redaction ii) partial redac and iii) regular expression. These actions can be applied either by m of Oracle Enterprise Manager Wizard and by writing SQL/PL S procedures. Both I have shown in the paper.

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CSE & IT - 5

ADVANCE SECURITY IN DATABASE BY USING REDACTION TECHNIQUES

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Abstract- *As organizations increase their trust on perhaps distributed information systems for day to day business, they have become more exposed to security breaches even as they increase their productivity and efficiency advantages. Though a number of techniques, such as many encryption techniques and electronic signatures are presently available to protect data when it gets transmitted across sites, an actually broad approach for protection of data must also include some mechanism for enforcing access control policies based on qualifications and characteristics.*

Keywords:, *Data Redaction, PII, SQL, Oracle Database kernel, Oracle Advance Security, Oracle Enterprise Manager, PCI,DSS*

I.INTRODUCTION

In the present day scenario, ever increasing security threats, diversifying compliance requirements and cloud computing technology are just a few of the reasons to establish the fact that data security has become critical. Advanced Security option delivers two essential preventive controls covering encryption of data-at-rest and redaction of sensitive data displayed by applications.[1] These controls help, protect sensitive data from being exposed directly from storage or through applications.

The sensitive data in the database can be protected from the malicious users by means of data redaction technique which is the recent innovative feature available in Oracle 12c version. Data redaction suppresses the sensitive data such as any personally identifiable information (PII). PII can be used on its own or with other information to identify or locate a single person, or to identify an individual in context.

2 LITERATURE SURVEY

Traditional approaches to redacting sensitive data typically relied on application coding or installing third-party software on the database server to modify its behavior. These alternatives have important drawbacks compared to Data Redaction. Approaches that require coding new application logic, modifying existing SQL statements, or authoring custom application scripts are likely to result in disparate solutions that are inconsistent across the enterprise and costly to maintain over their lifetime. In addition, strict controls must be placed on new application development to make sure that custom application code and new objects are properly accessed.

The code also needs to take into consideration multiple factors under which the redaction policies are enforced, while maintaining the performance and semantics of the application. Approaches that add new components to the Oracle Database, overwrite existing components, establish proxies, and modify basic behavior of the database also are fraught with problems [2] Not only does the new component introduce new attack surfaces, but they also can create performance overhead, impact operational activities of the database, and may fail when attempting to transform complex database queries that are generated by applications.

Approaches that add new components to the Oracle Database, overwrite existing components, establish proxies, and modify basic behavior of the database also are fraught with In contrast, redacting directly in the Oracle Database kernel using Data Redaction has tighter security, superior performance, and better compatibility with a range of database configurations, use cases, and workloads.

3 PROPOSED SYSTEM

Data Redaction enables you to mask (redact) data that is returned from queries issued by applications. You can redact column data by using one of the following methods.

Full redaction: You redact all of the contents of the column data. The redacted value returned to the querying application user depends on the data type of the column. For example, columns of the NUMBER data type are redacted with a zero (0), and character data types are redacted with a single space.

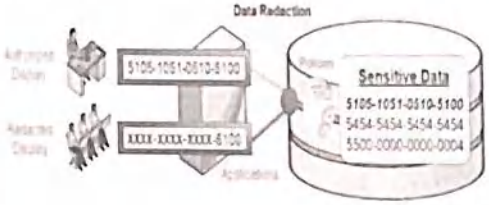

Figure 3 1 Full Data Redaction

Partial redaction: You redact a portion of the column data. For example, you can redact a Social Security number with asterisks (*), except for the last 4 digits.

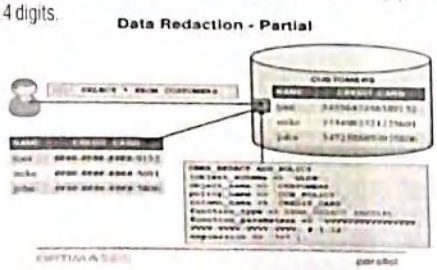

Figure 3 2 Partial Data Redaction

Figure 3 3 Regular Expression Redaction

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Random redaction The redacted data presented to the querying application user appears as randomly generated values each time it is displayed, depending on the data type of the column

No redaction: The No redaction type option enables you to test the internal operation of our redaction policies, with no effect on the results of queries against tables with policies defined on them [3]. You can use this option to test the redaction policy definitions before applying them to a production environment

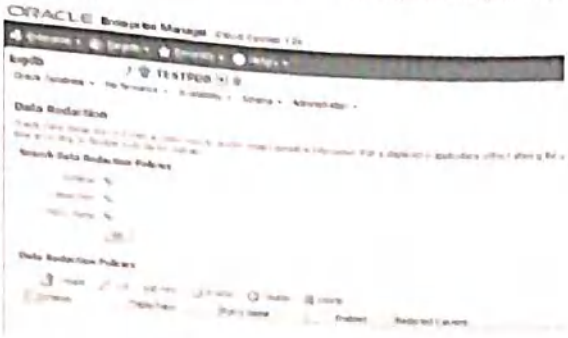

Figure 3 4 OEM for Data Redaction

Oracle Database applies the redaction at runtime, when users access the data (that is, at query-execution time). This solution works well in a production system. During the time that the data is being redacted, all of the data processing is performed normally, and the back-end referential integrity constraints are preserved [4]

Data redaction can help you to comply with industry regulations such as Payment Card Industry Data Security Standard (PCI DSS) and the Sarbanes-Oxley Act.

2.2. When to use Data Redaction

Use Oracle Data Redaction when you must disguise sensitive data that our applications and application users must access. Data Redaction enables you to easily disguise the data using several different redaction styles.

Oracle Data Redaction is ideal for situations in which you must redact specific characters out of the result set of queries of Personally Identifiable Information (PII) returned to certain application users. For example, you may want to present a U.S. Social Security number that ends with the numbers 4320 as ***-**-4320 [5]. Oracle Data Redaction is particularly suited for call center applications and other applications that are read-only. Take care when using Oracle Data Redaction with applications that perform updates back to the database, because redacted data can be written back to this database.

2.3. Benefits of Using Data Redaction

Oracle Data Redaction provides several benefits when you use it to protect our data

These benefits are as follows:

- You have different styles of redaction from which to choose.
- Because the data is redacted at runtime, Data Redaction is well suited to environments in which data is constantly changing.
- You can create the Data Redaction policies in one central location and easily manage them from there.
- The Data Redaction policies enable you to create a wide variety of function conditions based on SYS_CONTEXT values, which can be used at runtime to decide when the Data Redaction policies will apply to the results of the application user's query.

2.4. Target Use Cases for Data Redaction

Oracle Data Redaction protects sensitive data that is displayed in

applications.

Oracle Data Redaction fulfils common use case scenarios

2.4.1. Using Oracle Data Redaction with Database Applications

Data Redaction is transparent to application users because it preserves original data type and (optionally) the formatting. It is highly transparent the database because the data remains the same in buffers, cache storage only being changed at the last minute just before SQL query are returned to the caller. The redaction is enforced consistently across of the applications that use the same underlying database. You can which application users should see only redacted data by using application user information that is passed into the database through SYS_CONTEXT function; you can redact data based on attributes current database or application user, and you can implement logical conditions within a given redaction policy.

Data Redaction is implemented in a way that minimizes performance overhead. These characteristics make Oracle Data Redaction particularly well suited for usage by a range of applications, analytics tools, reporting tools, and monitoring tools that share common production data. Although its primary target is redaction of production data for applications, Oracle Data redaction also can be used in combination with Oracle Enterprise Manager Data Masking and Sub setting Pack for protecting sensitive data in testing and development environments.

2.4.2. Oracle Data Redaction with Ad Hoc Database Queries

You may encounter situations where it is convenient to redact sensitive data for ad hoc queries that are performed by database users.

For example, in the course of supporting a production application, you may need to run ad hoc database queries to troubleshoot and fix any problem with the application [6]

This is different from the application-based scenarios described in "Oracle Data Redaction with Database Applications"[7], which typically generate a bounded set of SQL queries, use defined database accounts and have fixed privileges.

Even though Oracle Data Redaction is not designed to prevent exposure to database users who run ad hoc queries directly against the database, it can provide an additional layer to reduce the chance of accidental data exposure [8]. Because such users may have the ability to change data, alter the database schema, and circumvent the SQL interface entirely, it is possible for a malicious user to bypass Oracle Data Redaction policies in certain circumstances.

Remember that the Oracle Database security tools are designed to work together to improve overall security. By deploying one or more of these tools as a complement to Oracle Data Redaction, you can significantly increase our overall security posture [9].

4. Results

SQL Script demonstrating Redaction Policy

To set up a demonstration, uses the setup.sql script, then uses the shown in below listing to set up a redaction policy on the EMP

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```
Setup sql
create table emp
( empno number,
 ename varchar2(20),
 salary number,
 hire_date date,
 email_id varchar2(30) ) ;
insert into emp(empno,ename,salary,hire_date,email_id)
values(1,'Zaheer',1013,sysdate,'Zaheer@gmail com'),
insert into emp(empno,ename,salary,hire_date,email_id)
values(2 'Shanu',1578,sysdate-2,'shanu@gmail com'),
insert into emp(empno,ename,salary,hire_date,email_id)
values(3,'Ayaz',1398,sysdate-3,'Ayaz@gmail com'),
commit;
SQL > select * from emp;
```

EMP

NNO	ENAME	SALARY	HIRE_DATE	EMAIL_ID
1	Zaheer	1013	06-MAR-2015 02:20:42 PM	Zaheer@gmail.com
2	Shanu	1578	04-MAR-2015 02:20:42 PM	shanu@gmail.com
3	Ayaz	1398	03-MAR-2015 02:20:42 PM	Ayaz@gmail.com

3 rows selected.

When the owner of the table "EMP" selects data, the result displays the values intact - but when any other user selects data from the table, the data must be masked

Column	Description of redaction
Salary	replace with some random numbers and don't show actual values
Hire_date	show only the day and month year should be replaced with 1990
Email_id	Keep the domain name and rest others should be masked

Table 4.1 Description of Data redaction applied on Employee Database

```
SQL > grant select on emp to scott;
Grant succeeded
SQL > begin
 2  dbms_redact.add_policy
 3  (object_schema => user,
 4   object_name => 'EMP',
 5   policy_name => 'EMP_REDACT',
 6   column_name => 'SALARY',
 7   function_type => dbms_redact.random,
 8        expression => q'[sys_context('userenv','current_user')!=
'WAHEED']'
 9   ),
10 end,
11 /
PL/SQL procedure successfully completed.
SQL >
SQL > begin
 2  dbms_redact.alter_policy
 3  (object_schema => user,
 4   object_name => 'EMP',
 5   policy_name => 'EMP_REDACT',
 6   action => dbms_redact.add_column,
 7   column_name => 'HIRE_DATE',
 8   function_type => dbms_redact.partial,
 9   function_parameters => 'MDy1990').
10 end,
11 /
PL/SQL procedure successfully completed.
SQL > begin
 2  dbms_redact.alter_policy
 3  (object_schema => user,
 4   object_name => 'EMP',
 5   policy_name => 'EMP_REDACT',
 6   action => dbms_redact.add_column,
 7   column_name => 'EMAIL_ID',
 8   function_type => dbms_redact.regexp,
 9   regexp_pattern => dbms_redact.RE_PATTERN_EMAIL_
     ADDRESS,
10   regexp_replace_string => dbms_redact.RE_REDACT_ EMAIL_
     NAME,
11   regexp_match_parameter => dbms_redact.RE_CASE_
     INSENSITIVE );
12   end,
13   /
     PL/SQL procedure successfully completed.
     SQL > select * from emp ;
```

EMP

NNO	ENAME	SALARY	HIRE_DATE	EMAIL_ID
1	Zaheer	1013	06-MAR-2015 02:20:42 PM	Zaheer@gmail.com
2	Shanu	1578	04-MAR-2015 02:20:42 PM	shanu@gmail.com
3	Ayaz	1398	03-MAR-2015 02:20:42 PM	Ayaz@gmail.com

When connected from Scott schema the redacted data look like this.

```
SQL > select * from WAHEED.emp;
```

EMP

NNO	ENAME	SALARY	HIRE_DATE	EMAIL_ID
1	Zaheer	1013	06-MAR-2015 02:20:42 PM	xxxxxx@gmail.com
2	Shanu	1578	04-MAR-2015 02:20:42 PM	xxxxx@gmail.com
3	Ayaz	1398	03-MAR-2015 02:20:42 PM	xxxx@gmail.com

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Information's on redaction policies and policy columns are maintained in REDACTION_POLICIES and REDACTION_COLUMNS data dictionary.

```
SQL > @printtbl ' select * from redaction_policies '
OBJECT_OWNER              : "WAHEED"
OBJECT_NAME               : "EMP"
POLICY_NAME               "EMP_REDACT"
EXPRESSION                  : "sys_context('userenv','current_user')!=
'WAHEED'"
ENABLE                  : "YES  "
POLICY_DESCRIPTION          : ""
----------
SQL > PL/SQL procedure successfully completed
SQL > @printtbl ' select * from redaction_columns '
OBJECT_OWNER              : "WAHEED"
OBJECT_NAM                : "EMP"
COLUMN_NAME               : "SALARY"
FUNCTION_TYPE             : "RANDOM REDACTION"
FUNCTION_PARAMETERS       : ""
REGEXP_PATTERN            : ""
REGEXP_REPLACE_STRING     : ""
REGEXP_POSITIO            : "0"
REGEXP_OCCURRENCE         : "0"
REGEXP_MATCH_PARAMETER    : ""
COLUMN_DESCRIPTION        : ""
----------
OBJECT_OWNER              : "WAHEED"
OBJECT_NAME               : "EMP"
COLUMN_NAME               : "EMAIL_ID"
FUNCTION_TYPE             : "REGEXP REDACTION"
FUNCTION_PARAMETERS       : ""
REGEXP_PATTERN            : "([A-Za-z0-9._%+-]+)@([A-Za-z0-9.-
]+\.[A-Za-z]{2,4})"
REGEXP_REPLACE_STRING     : "xxxx@\2"
REGEXP_POSITION           : "1"
REGEXP_OCCURRENCE         : "0"
REGEXP_MATCH_PARAMETER    : "i"
COLUMN_DESCRIPTION        : ""
----------
OBJECT_OWNER              : "WAHEED"
OBJECT_NAME               : "EMP"
COLUMN_NAME               : "HIRE_DATE"
FUNCTION_TYPE             : "PARTIAL REDACTION"
FUNCTION_PARAMETERS       : "MDy1990"
REGEXP_PATTERN            : ""
REGEXP_REPLACE_STRING     : ""
REGEXP_POSITION           : "0"
REGEXP_OCCURRENCE         : "0"
REGEXP_MATCH_PARAMETER    : ""
COLUMN_DESCRIPTION        : ""
----------
SQL > PL/SQL procedure successfully completed
```

However if the querying user has the EXEMPT REDACTION POLICY system privilege redaction will not be performed

```
SQL > select * from WAHEED.emp;
```

EMP NNO	ENAME	SALARY	HIRE_DATE	EMAIL_ID
1	Zaheer	1013	06-MAR-2015 02:20:42 PM	Zaheer@gmail.com
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NATIONAL CONFERENCE ON EMERGING TRENDS IN ENGINEERING & TECHNOLOGY (ETET-2016)

CSE & IT - 6

JPEG IMAGE COMPRESSION USING FPGA WITH FUZZY NEURAL NETWORKS

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Abstract- *Image and video compression is one of the major components used in video-telephony, videoconferencing and multimedia-related applications where digital pixel information can comprise considerably large amounts of data. Management of such data can involve significant overhead in computational complexity and data processing. Compression allows efficient utilization of channel bandwidth and storage size. Typical access speeds for storage mediums are inversely proportional to capacity. Through data compression, such tasks can be optimized. One of the commonly used methods for image and video compression is JPEG (an image compression standard) Image and video compressors and decompressors (codecs) are implemented mainly in software as digital signal processors. Hardware-specific codecs can be integrated into digital systems fairly easily, requiring work only in the areas of interface and overall integration. Using an FPGA (Field Programmable Gate Array) to implement a codec combines the best of two worlds. The implementation of this work is carried out with JPEG algorithm with Fuzzy Neural Networks (FNN). The core compression design was created using the Verilog hardware description language. The supporting software was written in matlab, developed for a DSP and the PC. The implementation of this work was successful on achieving significant compression ratios. The sample images chosen showed different degrees of contrast and fine detail to show how the compression affected high frequency components within the images.*

Index Terms *- Bandwidth, Compression, FNN, FPGA, JPEG.*

I.INTRODUCTION

Data compression is the technique to reduce the redundancies in data representation in order to decrease data storage requirements and hence communication costs. Reducing the storage requirement is equivalent to increasing the capacity of the storage medium and hence communication bandwidth. Thus the development of efficient compression techniques will continue to be a design challenge for future communication systems and advanced multimedia applications.

Typically image and video compressors and decompressors (CODECS) are performed mainly in software as signal processors can manage these operations without incurring too much overhead in computation. However, the complexity of these operations can be efficiently implemented in hardware. Hardware specific CODECS can be integrated into digital systems fairly easily. Improvements in speed occur primarily because the hardware is tailored to the compression algorithm rather than to handle a broad range of operations like a digital signal processor.

For improving the ANN efficiency for image compression various works were suggested in past. In [1] the author expounds the principle of BP neural network with applications to image compression and the neural network models. Then an image compressing algorithm based on improved BP network is developed. Feedforward networks using backpropagation algorithm [2] adopting the method of steepest descent for error minimization is popular and widely adopted and is directly applied to image compression. Image data compression using Vector Quantization (VQ) has received a lot of attention because of its simplicity and adaptability. VQ requires the input image to be processed as vectors or blocks of image pixels. The Finite-state vector quantization (FSVQ) is known to give better performance than the memory less vector quantization (VQ). The author in [3] presents a novel combining technique for image compression based on the Hierarchical Finite State Vector Quantization (HFSVQ).

The fully functional JPEG decoder prototype [4] is capable of decompressing compressed data to achieve a frame rate of 30 frames per second. In [5] the architecture and the VHDL design of a Two Dimensional Discrete Cosine Transform (2-D DCT) for JPEG image compression. This architecture is used as the core of a JPEG compressor and is the critical path in JPEG compression hardware. An efficient architecture to implement a JPEG encoder on FPGA trying to use as less resources as possible without compromising much speed or quality is discussed by author in [6].

A novel fuzzy learning vector quantization algorithm [11] for image compression was developed and consists of two basic issues. Firstly, a modified objective function of the fuzzy c-means algorithm is reformulated and then is minimized by means of an iterative gradient-descent procedure. Secondly, the training procedure is equipped with a systematic strategy to accomplish a smooth transition from fuzzy mode, where each training vector is assigned to more than one codebook vectors, to crisp mode, where each training vector is assigned to only one codebook vector. A method of fuzzy optimization design based on neural networks [12] is presented as a new method of image processing. The combination system adopts a new fuzzy neuron network (FNN) which can appropriately adjust input and output, and increase robustness, stability and working speed of the network. When compared to earlier JPEG this work with JPEG with FNN shows better performances (in terms of PSNR) for compression rates higher than 25.

II. IMAGE COMPRESSION

Image compression is the application of Data compression on digital images. The objective of image compression is to reduce redundancy of the image data in order to be able to store or transmit data in an efficient form. Image compression can be lossy or lossless. Lossy compression though gives more compression compared to lossless compression, the accuracy in retrievation is less in case of lossy compression as compared to lossless compression.

JPEG compression is defined as a lossy coding system which is based on the discrete cosine transform. However, there are several extensions to the JPEG algorithm to provide greater compression, higher precision, and can be tailored to specific applications.

A. Discrete Cosine Transform

The discrete cosine transform is the basis for the JPEG compression standard. Ahmed, Natarajan, and Rao originally proposed use of the DCT in 1974, and it has become the most popular transform for image and video

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coding [7] Many compression techniques take advantage of transform coding as it decorrelates adjacent pixels from the source image For JPEG this allows for efficient compression by allowing quantization on elements that are less sensitive The DCT algorithm is completely reversible making this useful for both lossless and lossy compression techniques

The DCT is a special case of the well known Fourier transform Essentially the Fourier transform in theory can represent a given input signal with a series of sine and cosine terms The discrete cosine transform is a special case of the Fourier transform in which the sine components are eliminated [8] For JPEG, a two-dimensional DCT algorithm is used, which is essentially the one-dimensional version evaluated twice By this property there are numerous ways to efficiently implement a software or hardware based DCT module [7] The DCT is operated two dimensionally taking into account an 8 by 8 block of pixels The resulting data set is an 8 by 8 block of frequency space components, the coefficients scaling the series cosine terms, known as basis functions The first element at row 0 and column 0 is known as the DC term, the average frequency value of the entire block The other 63 terms are AC components which represent the spatial frequencies that compose the input pixel block, by scaling the cosine terms within the series

There are two useful products of the DCT algorithm First it has the ability to concentrate image energy into a small number of coefficients Second, it minimizes the interdependencies between coefficients [7] These two points essentially state why this form of transform is used for the standard JPEG compression technique By compacting the energy within an image, more coefficients are left to be quantized coarsely, impacting compression positively, but not losing quality in the resulting image after decompression Taking away inter-pixel relations allows quantization to be non-linear, also affecting quantization positively DCT has been effective in producing great pictures at low bit rates and is fairly easy to implement with fast hardware based algorithms [9]

B. Quantization

Quantization is an extremely important step in the JPEG compression algorithm, as it removes a considerable amount of information, thus reducing the entropy in the input data stream [10] Quantization alone, is essentially a lossy compression technique However, quantization does benefit the compression process regardless of the lossy artifacts that are produced The high frequency AC coefficients typically will become zero, which aids in entropy coding Quantization is intended to remove the less important components to the visual reproduction of the image However, quantization is most effective when less important elements are quantized more coarsely Larger quantization values will result in visual artifacts Nonzero AC coefficients after quantization are worse for compression, but will suppress blocking artifacts in the reconstructed image Blocking artifacts indicate high spatial frequencies caused by an absence of AC coefficients In [10] Essentially, quantization, when used effectively will result in high compression, with minimal loss in quality.

C. Entropy Encoding

Entropy is a measure of disorder and unpredictability. The degree of entropy can be used as a measure of the information carried by the message In [8] Up to this point the input image has run through the DCT process, followed by zigzag ging to approximately organize the data stream with more entropy toward the beginning of the stream Then this stream was quantized, and run through the DC differencing in an effect to reduce entropy in the data stream All of these processes both add to compression, and more importantly, make the data stream ready for entropy coding Various coding techniques like Run Length Coding, Huffman Coding are used for entropy encoding

III. SYSTEM OVERVIEW

The system architecture for this work has been divided into the areas, which can be seen in the high level block diagram in figure major portions of this design are easily divided into three sections DSP, and FPGA

The DSP and FPGA both reside on the PLogic PCI card, whereas interfaces to the PLogic PCI card over the PCI bus. Although these are fairly separable, they interact heavily and are dependent on to fulfill the JPEG compression algorithm. The FPGA is the heart input image data into a compressed output used to create a JPG file The DSP handles transactions between the PC and providing the interface to take raw pixel inputs from an image command the FPGA to encode the input data. The DSP is also to collect the output and assemble an entropy encoded bitstream the JPEG file structure The PC is responsible for collecting grabbing the output data stream, and assembling the output file

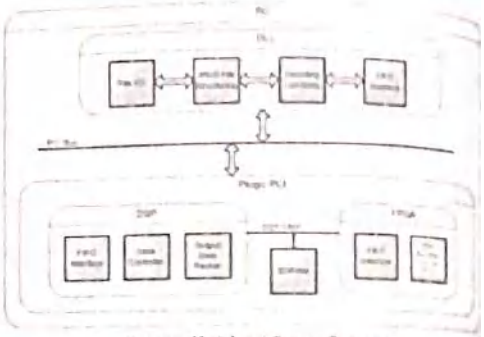

Figure 1 High Level System Overview

A. FPGA Overview

The FPGA is composed of two main systems as shown in figure the FIFO interface to the DSP The FIFO interface is designed to high speed data transactions in an asynchronous environment Additionally an interrupt source state machine is associated with interface to assist in a sort of handshaking between the DSP and The second portion of the design is the JPEG encoding core. encoder core runs on a 25 MHz clock and is fully synchronous pipelined stages, and employs parallel computation to help increase throughput

B. JPEG Encoder Core

The JPEG encoder core consists of four main modules which are separable, are all necessary to work together to comply with the encoding specification The units employed are for discrete transform, quantization and entropy coding Some of these modules are pipelined and some are comprised of parallel data paths Each module is fully synchronous, and is designed to have a common interface output of the final stage of JPEG encoding is a data stream which takes two variable length outputs from the entropy encoder combines them in a common format understood by the DSP

The JPEG compression algorithm requires an 8 bit pixel resolution data input The other requirement is that the DCT based algorithm produce an entropy coded output consisting of two variable length This data output must fit the JPEG file stream requirement, it is necessary to alter this stream into a form ready for use with the DSP is prepared where these set of values are written into two separate to form a fuzzy backpropagation training pair In other words, the vector would be the input vector and the second vector would be the desired output As many of the images tested were extremely similar were many similar training pairs. The fuzzy backpropagation algorithm

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then applied as shown in section 4 for image compression to eliminate the redundant information which also reduces the transmission time of FNN. Finally, the output produced by the FNN in the form of decompressed vectors or windows, is reconstructed and then given as input to FIFO interface.

E. DMA Interface

The DSP has a DMA controller in parallel with its core. The DMA unit can operate on the external memory interface bus, to transfer data elements to and from the DSP internal memory, or between external memory devices. Each of the four DMA channels have nine level FIFOs associated to buffer memory transfers. These channels can be configured to operate on a wide number of interrupts. This works well for this design, allowing the external memory interrupts driven by the FPGA to trigger memory transfers between the DSP and FPGA. Each of these DMA channels labeled zero through three. These channels operate where channel zero is highest priority for transfers, and channel three is lowest priority. The DMA channels can be configured to increment the source and or destination address, within its configuration registers. These addresses can be configured to increment based upon an element size for 8-bits to 32-bits. Otherwise the address can be configured to remain static.

The DMA unit also has a transfer count register which keeps track of the number of elements, and frames of elements transferred. The transfer register gives 16-bits for frames, and 16-bits for elements. Once the element count reaches 0, the frame count is decremented, and the element count is reloaded by one of the global reload registers, which specifies how many elements are within a frame. Each individual DMA channel can be setup to transfer an element or a frame on a synchronizing event. These elements can be an interrupt generated by another DMA channel, an external interrupt, a timer interrupt, as well as other sources. This is particularly helpful in transferring elements based on interrupts generated on the external interrupt line from the FPGA. These synchronization events can be tied to the DMA transfer operating between the FPGA and SDRAM. The DMA channels can also be configured to generate an interrupt based upon different events. For instance, the last transfer in a frame, defined in the transfer counter register, can generate a DMA channel interrupt. There can be an interrupt generated on the completion of the second to last frame. The ability to use different conditions to trigger interrupts gives a higher level of configurability for these DMA channels.

The general approach taken for this DMA strategy is to give the reads from the FPGA higher priority than writes, as writes will happen much more frequently and we do not want to risk overfilling the output FIFO. The interrupt state machines associated with the input and output FIFOs generate external interrupts that trigger the DMA channels for data transfers.

IV. FUZZY BACKPROPAGATION TRAINING

Let the configuration of fuzzy Backpropagation be l-m-n.

Step 1: Generate the initial weight sets $\tilde{W}$ for the input-hidden layer where each $\tilde{W}_{ji} = \left(W_{\eta ji}, W_{\alpha ji}, W_{\beta ji}\right)$ is an LR-type fuzzy number.

Also generate the weight set $\tilde{W}'$ for the hidden-output layer where $\tilde{W}'_{kj} = \left(W'_{\eta kj}, W'_{\alpha kj}, W'_{\beta kj}\right)$.

Step 2: Let $\left(\tilde{I}_p, D_p\right), p = 1,2,\ldots,N$ be the N input-output pattern set that fuzzy BP needs to be trained with. Here, $\tilde{I}_p = \left(\tilde{I}_{p0}, \tilde{I}_{p1}, \ldots, \tilde{I}_{pl}\right)$ where each $\tilde{I}_{pi}$ is an LR-type fuzzy number, i.e. $\tilde{I}_{pi} = \left(\tilde{I}_{p\eta i}, \tilde{I}_{p\alpha i}, \tilde{I}_{p\beta i}\right)$. D_p is a crisp output.

Step 3: Let ITRNS denote the number of iterations. Set the counters for the number of iterations and number of pattern sets to be trained to zero. i.e. COUNT_OF_ITRNS = 0, p = 1;

Step 4: Assign values for η and α

Initialize $\tilde{\Delta}W(t-1) = 0$;

$\tilde{\Delta}W'(t-1) = 0$;

Also, $W(t-1) = 0$ and $W'(t-1) = 0$

Step 5: Get next pattern set $\left(\tilde{I}_p, D_p\right)$. Assign

$\tilde{O}_{pi} = \tilde{I}_{pi}, i = 1,2,\ldots,l; \tilde{O} = (1,0,0)$ for the input neurons.

Step 6: Compute

$$O'_{pj} = f\left(NET_{pj}\right), j = 1,2,\ldots,m; O'_{p0} = 1$$

where $NET_{pj} = CE\left(\sum_{i=0}^{l} \tilde{W}_{ji} \tilde{O}_{pi}\right)$ for the hidden neurons.

Step 7: Compute

$$O''_{pk} = f\left(NET'_{pj}\right), k = 0,1,2,\ldots,n-1$$

where $NET'_{pk} = CE\left(\sum_{j=0}^{m} \tilde{W}_{kj} O'_{pj}\right)$ for the output neurons

Step 8: Compute change of weights $\tilde{\Delta}W'(t)$ for the hidden-output layer as follows:

8.1 Compute

$$\nabla E_p(t) = \left(\frac{\partial E_p}{\partial W'_{\eta kj}}, \frac{\partial E_p}{\partial W'_{\alpha kj}}, \frac{\partial E_p}{\partial W'_{\beta kj}}\right)$$

Where $\frac{\partial E_p}{\partial W'_{\eta kj}} = -\left(D_{pk} - O'_{pk}\right) O''_{pk}\left(1 - O''_{pk}\right).1.O'_{pj}$

$$\frac{\partial E_p}{\partial W'_{\alpha kj}} = -\left(D_{pk} - O'_{pk}\right) O''_{pk}\left(1 - O'_{pk}\right).\left(\frac{-1}{3}\right).O'_{pj}$$

$$\frac{\partial E_p}{\partial W'_{\beta kj}} = -\left(D_{pk} - O''_{pk}\right) O''_{pk}\left(1 - O''_{pk}\right).\left(\frac{1}{3}\right).O'_{pj}$$

8.2 Compute

$$\tilde{\Delta}W'(t) = -\eta \nabla E p(t) + \alpha \tilde{\Delta}W'(t-1).$$

Step 9: Compute change of weights $\Delta W(t)$ for the input hidden layer as follows:

9.1

Let $\delta_{p\eta k} = -\left(D_{pk} - O''_{pk}\right) O'_{pk}\left(1 - O''_{pk}\right).1$

$$\delta_{p\alpha k} = -\left(D_{pk} - O''_{pk}\right) O'_{pk}\left(1 - O''_{pk}\right).\left(\frac{-1}{3}\right)$$

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$$\delta_{pj} = -(D_{pk} - O_{pk})O_{pk}(1 - O_{pk})\left(\frac{1}{3}\right)$$

Compute

$$\nabla E_p(t) = \left(\frac{\partial E_p}{\partial W_{mj}}, \frac{\partial E_p}{\partial W_{qj}}, \frac{\partial E_p}{\partial W_{ij}}\right) \text{ where}$$

$$\frac{\partial E_p}{\partial W_{mj}} = \left(\sum_k \delta_{pk} W_{mk}\right) O_{pj}(1 - O_{pj}) 1 . \tilde{O}_{pi}$$

$$\frac{\partial E_p}{\partial W_{qj}} = \left(\sum_k \delta_{pk} W_{qk}\right) O_{pj}(1 - O_{pj})\left(\frac{-1}{3}\right) . \tilde{O}_{pi}$$

$$\frac{\partial E_p}{\partial W_{ij}} = \left(\sum_k \delta_{pk} W_{pk}\right) O_{pj}(1 - O_{pj})\left(\frac{1}{3}\right) . \tilde{O}_{pi}$$

9.2 Compute

$$\Delta \tilde{W}(t) = -\eta \nabla Ep(t) + \alpha \Delta \tilde{W}(t).$$

Step 10: Update weights for the input-hidden and hidden-output layers as

$$\tilde{W}(t) = \tilde{W}(t-1) + \Delta \tilde{W}(t)$$

$$\tilde{W}(t) = \tilde{W}(t-1) + \Delta \tilde{W}(t)$$

Step 11: p=p+1;

if $(p \le N)$ goto Step 5;

Step 12: COUNT_OF_ITRNS=COUNT_OF_ITRNS+1;
if COUNT_OF_ITRNS < ITRNS
{ Reset pointer to first pattern in the training set;
p=1;
goto Step 5;
}

Step 13: Output $\tilde{W}$ and $\tilde{W}$ the final weight sets.

V. FUZZY BACKPROPAGATION INFERENCE

Let $\tilde{F}_p, p = 1,2,\ldots,N$ be the patterns whose output values are to be inferred.

Let $\tilde{W}$ and $\tilde{W}$ be the weight sets obtained after training fuzzy backpropagation.

Step 1: p=1;

Step 2: Get next pattern $\tilde{F}_p$;

Step 3: Compute

$$\tilde{O}_{pi} = \tilde{F}_{pi}, i = 1,2,\ldots,I$$

$\tilde{O}_0 = (1,0,0)$ for the input neurons.

Step 4: Compute

$$O_{pj} = f(NET_{pj}) j = 1,2,\ldots,m,$$

$$O_{p0} = 1$$

Where $NET_{pj} = CE\left(\sum_{i=0}^{I} \tilde{W}_{ji} \tilde{O}_{pi}\right)$

for the hidden neurons.

Step 5: Compute

$$O^{*}_{pk} = f(NET^{*}_{pj}), k = 0,1,2,\ldots,n-1$$

Where $NET^{*}_{pk} = CE\left(\sum_{j=0}^{m} \tilde{W}^{*}_{kj} O_{pj}\right)$

for the output neurons.

Step 6: Output the associated output

$$O^{*}_{pk}, k = 0,1,2,\ldots,n-1$$

Step 7: p=p+1;

if $(p \le N^{*})$ goto Step 2.

VI. PC OVERVIEW

The PC level of this design can be separated into three sections as sh... in figure 3, all of which interact with each other. The lowest level user... interacts with the DSP via a FIFO interface, as well as direct addressing... DSP registers, and the DSP external memory interface. The level ab... this deals with constructing the output JPEG image file, and similarly... input file. TCL was chosen for its ability to create a simple comm... driven, or graphical interface through buttons, and response windows.

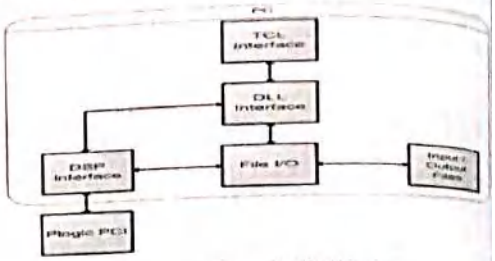

Figure 3. PC Overview

A. Imaging

There were several functions implemented to handle the understanding... the input image, sending it to the encoder, calling the encode proc... retrieving the output, assembling the JPEG headers, and producing... output file. All of these functions were fairly simple to put together as t... are high level functions within this design. The tricky part really has to... with the JPEG headers. Getting the JPEG headers correct is an impor... part of the design, as the entropy coded bit stream could be correct... incorrect headers will result in an erroneous image output stream next... decoder.

B. Input Image

The first step for the PC interface is to open a known type of input file, p... it, and send it to SDRAM. The supported input image format for this de... was chosen to be the PPM format, which stands for portable pixel... The values used for JPEG compression in this design are 8-bit, so the... in the input file here is 255, to represent 256 values starting from 0. The... two values specify the horizontal and vertical pixel resolutions. The v... for horizontal and vertical pixel ratios are stored to the DSP control reg... The grayscale images, will have one value per pixel, to specify... luminance intensity, where 0 is white, and 255 is black. When parsing... input file, a temporary output file is created to store a list of hex pixel v...

C. Encoding Process

The encoding process will read 64 pixel components in a loop, from... the files created during the parsing operation. Using one of the... transfer functions, these values are stored to SDRAM. This process... on until the file is read completely, and transferred into SDRAM. A... point, the DSP control register is updated with the pixel aspect ratio... the image component type.

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Prior to running the encoder on the FPGA the image headers are assembled. These headers are stored to an output file. After the header portion is completed, the actual encoding cycle is run, and the output bitstream is stored into the output file. The actual encode cycle on the FPGA is run once the command is given with the action code to encode the image. This is followed with a command, which will wait for a response from the DSP. The DSP response contains an integer specifying how many words must be read from SDRAM to obtain the assembled entropy encoded data stream. This integer will be used to run a loop and read SDRAM in blocks of 64 elements, until completed. After this data is written to the output file, the end of image marker is written and the file is closed.

VII. RESULTS

A. Figures and Tables

Figure 4. (a) Lena Source

Figure 4 (b) Lena Result

Figure 5. (a) Peppers Source

Figure 5 (b) Peppers Result

TABLE I
COMPARISON FOR COMPRESSION RATIO TABLE

Image	Aspect Ratio	Compression
Sample1 (Lena)	512 x 512	29.17
Sample2 (Peppers)	256 x 256	16.37

VIII. CONCLUSION

The core FPGA design had impressive results as described throughout the system overview section. In simulation on the FPGA, assuming it has streaming inputs and outputs, the encoder takes 162 cycles for the first block and as long as the data stream is constant, it will take an additional 64 cycles per block after the first. This means that a 640x480 grayscale image would take 307,298 cycles, which at 25MHz is 12.29ms. This is roughly one fourth of the time that is necessary to make motion JPEG at 24 frames per second. As this core design is fully synchronous, it should give the same result in implementation.

The results of this design in terms of compression were quite impressive. Two different test images were used to get a good range of image types from those that would expect less compression and those that would expect greater compression based upon the image details. It can be seen that JPEG image compression using FPGA with Fuzzy Backpropogation Neural Networks gives more compression ratio when compared to existing system.

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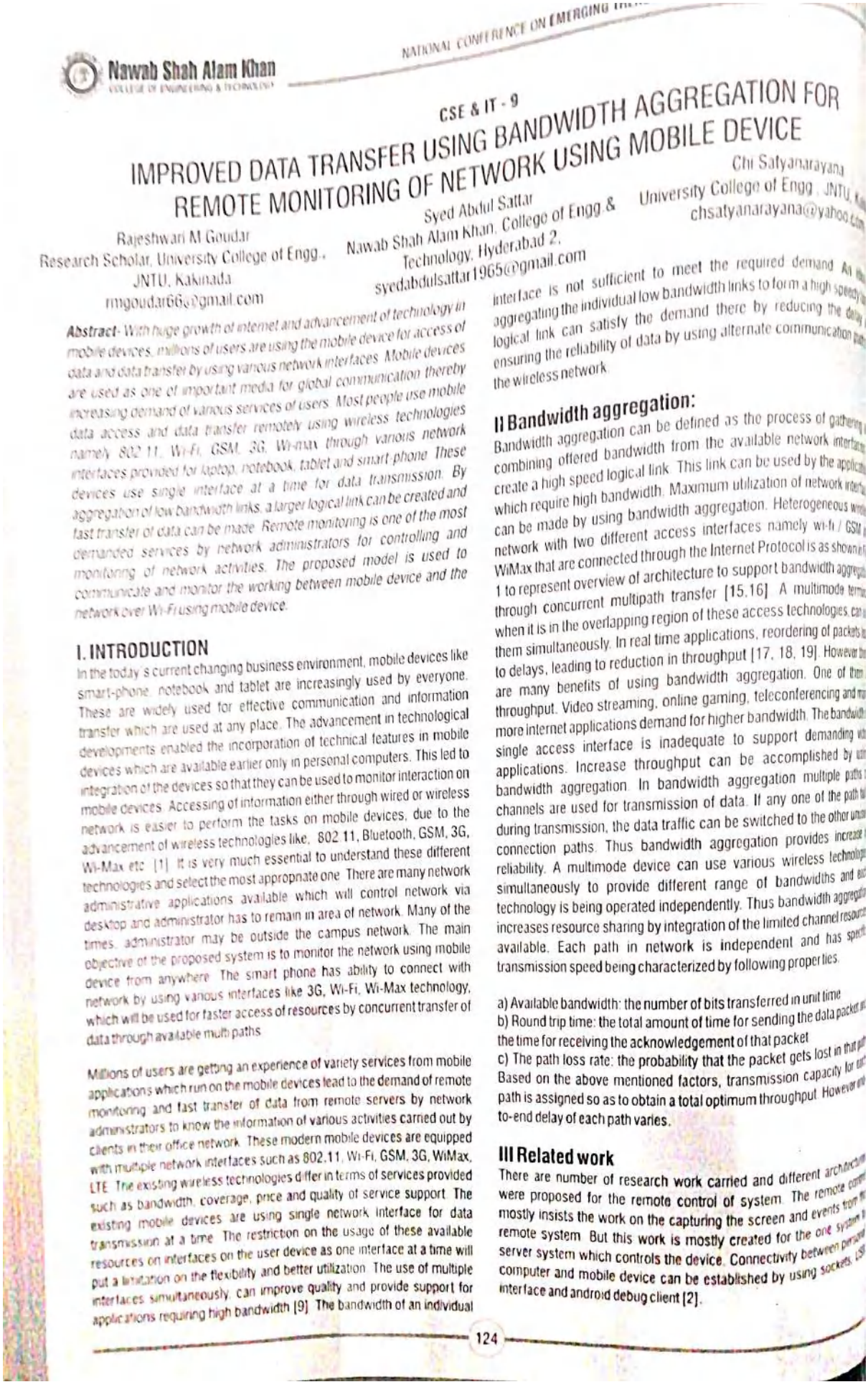

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CSE & IT - 9

IMPROVED DATA TRANSFER USING BANDWIDTH AGGREGATION FOR REMOTE MONITORING OF NETWORK USING MOBILE DEVICE

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Abstract- With huge growth of internet and advancement of technology in mobile devices, millions of users are using the mobile device for access of data and data transfer by using various network interfaces. Mobile devices are used as one of important media for global communication thereby increasing demand of various services of users. Most people use mobile data access and data transfer remotely using wireless technologies namely 802.11, Wi-Fi, GSM, 3G, Wi-max through various network interfaces provided for laptop, notebook, tablet and smart phone. These devices use single interface at a time for data transmission. By aggregation of low bandwidth links, a larger logical link can be created and fast transfer of data can be made. Remote monitoring is one of the most demanded services by network administrators for controlling and monitoring of network activities. The proposed model is used to communicate and monitor the working between mobile device and the network over Wi-Fi using mobile device.

I. INTRODUCTION

In the today's current changing business environment, mobile devices like smart-phone, notebook and tablet are increasingly used by everyone. These are widely used for effective communication and information transfer which are used at any place. The advancement in technological developments enabled the incorporation of technical features in mobile devices which are available earlier only in personal computers. This led to integration of the devices so that they can be used to monitor interaction on mobile devices. Accessing of information either through wired or wireless network is easier to perform the tasks on mobile devices, due to the advancement of wireless technologies like, 802.11, Bluetooth, GSM, 3G, Wi-Max etc [1]. It is very much essential to understand these different technologies and select the most appropriate one. There are many network administrative applications available which will control network via desktop and administrator has to remain in area of network. Many of the times, administrator may be outside the campus network. The main objective of the proposed system is to monitor the network using mobile device from anywhere. The smart phone has ability to connect with network by using various interfaces like 3G, Wi-Fi, Wi-Max technology, which will be used for faster access of resources by concurrent transfer of data through available multi paths.

Millions of users are getting an experience of variety services from mobile applications which run on the mobile devices lead to the demand of remote monitoring and fast transfer of data from remote servers by network administrators to know the information of various activities carried out by clients in their office network. These modern mobile devices are equipped with multiple network interfaces such as 802.11, Wi-Fi, GSM, 3G, WiMax, LTE. The existing wireless technologies differ in terms of services provided such as bandwidth, coverage, price and quality of service support. The existing mobile devices are using single network interface for data transmission at a time. The restriction on the usage of these available resources on interfaces on the user device as one interface at a time will put a limitation on the flexibility and better utilization. The use of multiple interfaces simultaneously, can improve quality and provide support for applications requiring high bandwidth [9]. The bandwidth of an individual interface is not sufficient to meet the required demand. An ... aggregating the individual low bandwidth links to form a high speedy ... logical link can satisfy the demand there by reducing the delay ... ensuring the reliability of data by using alternate communication ... the wireless network.

II Bandwidth aggregation:

Bandwidth aggregation can be defined as the process of gathering ... combining offered bandwidth from the available network interfaces ... create a high speed logical link. This link can be used by the applicati... which require high bandwidth. Maximum utilization of network interfa... can be made by using bandwidth aggregation. Heterogeneous wirel... network with two different access interfaces namely wi-fi / GSM ... WiMax that are connected through the Internet Protocol is as shown in F... 1 to represent overview of architecture to support bandwidth aggregat... through concurrent multipath transfer [15,16]. A multimode termi... when it is in the overlapping region of these access technologies, can ... them simultaneously. In real time applications, reordering of packets ... to delays, leading to reduction in throughput [17, 18, 19]. However the... are many benefits of using bandwidth aggregation. One of them ... throughput. Video streaming, online gaming, teleconferencing and mu... more internet applications demand for higher bandwidth. The bandwidth ... single access interface is inadequate to support demanding vi... applications. Increase throughput can be accomplished by usi... bandwidth aggregation. In bandwidth aggregation multiple paths ... channels are used for transmission of data. If any one of the path fa... during transmission, the data traffic can be switched to the other unus... connection paths. Thus bandwidth aggregation provides increase ... reliability. A multimode device can use various wireless technologi... simultaneously to provide different range of bandwidths and ass... technology is being operated independently. Thus bandwidth aggregati... increases resource sharing by integration of the limited channel resource... available. Each path in network is independent and has specif... transmission speed being characterized by following properties.

a) Available bandwidth: the number of bits transferred in unit time
b) Round trip time: the total amount of time for sending the data packet a... the time for receiving the acknowledgement of that packet
c) The path loss rate: the probability that the packet gets lost in that pa...
Based on the above mentioned factors, transmission capacity for eac... path is assigned so as to obtain a total optimum throughput. However end... to-end delay of each path varies.

III Related work

There are number of research work carried and different architectur... were proposed for the remote control of system. The remote contr... mostly insists the work on the capturing the screen and events from th... remote system. But this work is mostly created for the one system t... server system which controls the device. Connectivity between personal ... computer and mobile device can be established by using sockets, USB ... interface and android debug client [2].

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Some smart phone manufactures create their application for connecting the device for the synchronization of data from phone to desktop system. Samsung created tool as Kies which is used for synchronization of the music, video, photos and updates of firmware, but it will not help to control processes, application and services [5]. An architecture which is used to transfer files from mobile client to desktop system using database [3]. This architecture further extended to be used over local area networks node. Another aspect was considered for the remote visualization mechanisms which concentrate on achieving the remote display. The Virtual Networking Computing (VNC) which is one of the most popular system that can be used for remote control of devices. This kind of application is to be implemented in the android software stack. VNC architecture can be used to access desktop of system by use of android mobile phones [4]. VNC can be implemented with the help of Remote Frame Buffer (RFB) protocol which will used to exchange information between clients and mobile however it requires software of VNC client and server to be installed at client and server side. VNC server application for the symbian OS based devices is used to improve automate user interaction tests of the mobile devices due to the lack of resources in mobile devices [7]. There are many research work carried to remote control and monitoring of the systems. One of them is by using GSM-SMS protocol based system, in which the communication between server and administrator is made via the GSM service provider and activities among clients are monitored by administrator through SMS [14]. However in this system cost factor involved for SMS is high and sometimes the GSM modem may fail and whole communication system may collapse [11,12]. Wireless Sensor Networks can be used in monitoring and wireless monitoring is also possible by using wifi, 3G, wimax etc. These techniques are useful in many of applications like health monitoring, security systems, biomedical applications, agricultural field, home automation systems and many more [13].

Today's smart devices are equipped with multiple network interfaces which are able to communicate with other devices. Using Concurrent Multipath Transfer (CMT), we can meet the network requirements by modifying transmission layer protocol in an established network interface. Concurrent Multipath Transfer means transmitting the data through the multiple paths concurrently using multi-homing structure in the device and controls it at the transport layer. Recently, most of the hosts have multiple network interfaces and network providers have more than one link, so it has more than one path between one pair of end hosts connection. For example, laptop has wireless network adapter (Wifi) and also has wired network adapter (Ethernet). If host has multiple network interfaces then it is possible to transmit the data through multipath simultaneously. In other words, with current single path transmission, we can transmit the data through only selected one path which has one type of network interface card. But with a concurrent multi-path transfer protocol, data can be transmitted through the multiple network interfaces, two wired interface or wired with wireless interface or two different or same type of wireless interface. For example, Ethernet with Wifi or Wifi with 3G cellular networks, or more than one same interface. In this environment, we can obtain the additional bandwidth gain over multiple available path and connection robustness upon path failure. To provide concurrent multi-path transfer on transport layer more than one endpoint should be supported by multi-homing technology in one end-to-end pair. Existing transport layer protocol like TCP has no multi-homing features, but stream control transmission protocol (SCTP) has it. TCP is most popular protocol used at transport layer by many internet applications which provide end to end data transmission services however it does not meet the requirement of rigid timing reach of data and does not support for multi-homing. Stream Control Transmission Protocol (SCTP) supports for reliable multiple, independent streams of messages to be transmitted. The SCTP allows data to be transmitted through its alternate paths in case of any failure in its primary path, The concurrent transfer of new data from a source to a destination host via two or more end-to-end paths can be made using SCTP.

Hosts are often connected by multiple paths, but TCP restricts communications to a single path per transport connection. Resource usage within the network would be more efficient if these multiple paths able to be used concurrently. TCP is most popular protocol used at transport layer by many internet applications which provide end to end data transmission services however it does not meet the requirement of rigid timing reach of data and does not support for multi-homing. Stream Control Transmission Protocol (SCTP) supports for reliable multiple, independent streams of messages to be transmitted. The SCTP allows data to be transmitted through its alternate paths in case of any failure in its primary path, The concurrent transfer of new data from a source to a destination host via two or more end-to-end paths can be made using SCTP.

Remote monitoring and administration is becoming increasingly common and is often used when it is impractical to be physically near a system in order to use it, or in order to access web material that is not available in one's location. Any computer with an Internet connection, TCP/IP or on a Local Area Network (LAN) can be remotely administered. The aim is to develop an integrated software solution that allows a network administrator to remotely monitor the LAN by his mobile device. The communication between the clients and the wireless media happens through this server. Network monitoring can be useful in various applications such as college, university, mails, and offices. Network monitoring can be used to monitor the network by the administrator any time, without being dependent on third party. The administrator can control the network remotely through his mobile himself and perform activities like Kill process, Broadcast message, Screen shot , Process list, Network status , Shut down etc. The two key benefits of using multipath transport in this work are to increase the resilience of the connectivity by providing multiple paths, protecting end hosts from the failure, thereby increasing the efficiency of the resource usage and network capacity available to end hosts.

IV Architecture of system

The architecture and design of the model consists of three components namely server, client and smart-phone mobile application as shown in Fig. 2. The connectivity between smart-phone and server can be a single wireless hop, or many wired and wireless hops using the Internet infrastructure. TCP/IP is used for making communication between clients and server. Image compression module is incorporated in the client module. The flow of architecture includes running client demon on every node connected in the network. As soon as sever module started, server immediately collects all information of client nodes, connected to server. With the help of the server graphical interface, number of operations will be executed like controlling process, file operations, sending message and capturing screenshots. These all operations are handled by mobile application which will fetch information from server. Mobile should be connected through either internet connection or Wi-Fi connection. To perform operation from server module user has to first select particular client from list of clients. The operations which are performed from server module are controlling processes which start new process and kill running process on client node. To kill running process user have to select process from list of processes. File operation consists of the list of files from a particular path. By using particular path user can create and delete file from that folder. To read particular file user have to enter path of file and can accesses file. User can send the message to a particular system or to send same message to all clients broadcasting can be done.

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that folder. To read particular file user have to enter path of file and can accesses file. User can send the message to a particular system or to send same message to all clients broadcasting can be done.

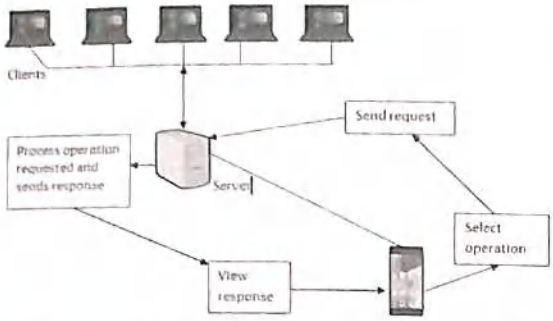

Figure 2: Architecture of remote monitoring system

V Proposed Work

The proposed system provides the facility for remote monitoring and controlling of network using mobile device. Initial authentication of users for the system is ensured by using username, password and IP address which is required for logging into the system. Services provided are displayed. Some of the services provided are viewing of client list, processes being executed of selected client and killing services, sending of message to a client, broadcast etc. and provide maximum details about the network through a mobile device remotely as shown in Fig. 3.

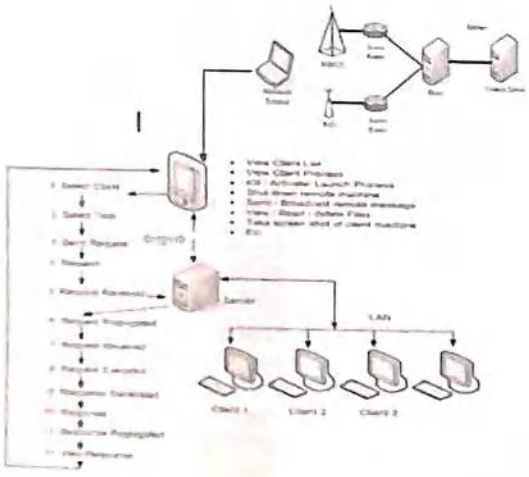

Figure 3: Block diagram for remote monitoring

The proposed system can be implemented by developing application for a mobile device using java designing the interface between a mobile device and sever using connection framework, wifi / 3G and mysql server, establishing connection between a mobile device and clients present in the network.

Server consists of the graphical user interface to provide various operations required by administrator. Server module is implemented using Java servlets and Java swing application framework. The connectivity is established by using URL class of java which connects the client to server for sending and receiving of message from client to server. Server application performs operations such as sending messages, control of process, broadcasting and client view list etc.

Client in a network consists of GUI which helps user to connect to server. The graphical interface consists of entry for IP address of the se display for commands executed by server on that client node. Mobile device is provided with an application having same fea server and connected to server using wifi connectivity. This ap verifies the user through verification of username and password successful verification will display list of client which was conn server.

As for getting screenshot of system user will be aware of curren the system. So after capturing screenshot at client node with the client module, this image is sent over network to server and then mobile application. To perform this procedure it requires lot transferred over network, hence it requires a lot of time. To reduce improve performance of system one solution is to first comp image and then transfer over the network. By compressing ima will be get reduced and it is easy and faster to transfer over the net do image compression lot of lossless algorithms proposed which size of image without losing any information. So first tried with coding algorithm for image compression, but it took lot of compress image on client side and then it will send on network algorithm which will take less time to compress image compression. So JPEG algorithm is used to compress image wi minimum time.

CONCLUSION

A remote monitoring system is developed to remotely monitor a using mobile device in order to minimize time required to transf Prototype of system can be implemented using Java. The time t capturing screenshots without using compression technique will as compared with time taken by system with implemente compression technique. It helps user to see the lot of con screenshot and look for status of network and monitor the client and helps in improving the efficiency of the resource usage. increasing the network capacity available to end hosts.

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CSE & IT - 12

A NOVEL DYNAMIC QUEUE MANAGEMENT APPROACH FOR SIP OVERLOAD CONTROL

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ABSTRACT *Session Initiation Protocol is regarded as the predominant technology platform protocol for next generation networks for facilitating application layer protocol functionalities like creation, modification and termination of sessions. Session Initiation Protocol servers are also prominent in preserving multimedia voice, data and video transactions. The simplicity of electronic data transmission in SIP servers in the next generation networks has given rise to the overload problem. This has been identified as a major problem in SIP servers. There are several approaches suggested by research scholars to reduce the overload problem for the requests and responses managed by the SIP Servers. But they could not effectively resolve the problem permanently in SIP Servers. In this paper we propose a novel dynamic queue management approach for SIP overload control. This queue management approach has effectively reduced the overload problem and nullified the erroneous rejection of requests. The proposed dynamic queue management system has improved the throughput in the event of overload in SIP servers and demonstrated the same output through the simulation experiments.*

Keywords—SIP Servers, Increased data transmission, Overload control, request rejection, Dynamic queue management.

I. INTRODUCTION

SIP servers are predominantly used to preserve the data, voice and video call transactions and to distribute the same to the different client machines. It is standardized by IETF for creating, modifying and terminating the sessions in the internet. SIP technology is predominant and effective in distributing the multimedia files, conducting video conferencing and instant messaging. The next generation networks like 3GPP, ITU-T and ETSI have relied on SIP Servers and its Internet Multimedia Subsystems architecture. SIP has provided effective services and predominantly served the Video Conferencing and Multimedia distribution requirement over next generation networks. The increased popularity and usage of SIP has given occurrences of overloading issues. The overloading problem has been identified by its emergency induced call volume, flash crowds initiated by TV Programs, special events like "free tickets to third caller" and denial of service attacks. When SIP servers are experiencing the problem of overloading it can be identified by the rejection messages and termination for the requests sent to SIP servers. The continuous transmission of rejection messages from SIP servers to the clients in a large amount will lead to throughput loss and network collapses. This is a built in mechanism of SIP servers to safeguard the server from the overloading problem with excessive calls from receiving entity to the SIP sending entities.

The main goal of this paper is to propose a novel dynamic queue management approach for SIP overload control. The novel dynamic queue management approach has initiated to investigate and resolve the causes for overloading and widespread SIP network congestion collapses. The driving factor of this investigation is the continuous hop retransmission process configured for reliability purposes. The proposed dynamic queue management approach has given throughput for transmitting various kinds of messages from the clients sending messages for processing. The queue management method has been deployed and the results evaluated on the testbed.

II. RELATED WORK

Yang Hong et al (March, 2012) has introduced a unique session initiation protocol overload control algorithm to reduce the overload in SIP servers. This mechanism has been initiated in between UAE and UAS with the help of SIP Proxy – 1 and SIP Proxy – 2 servers. This approach has focused on delay consideration, discrete time formulation, message enqueuing and dropping policy. The session initiation protocol overload control algorithm has fulfilled the derivation of retransmission process and arrival and departure process effectively.

Tadasuke Nozoe et al (2016) has introduced a priority based admission management scheme to reduce the overloads on SIP Servers. The priority based queue management scheme is developed in the network to avoid messages dropping with the probability calculation with the priority item in the SIP server request queue with the help of UAE. In the simulation the messages have been cleared with the help of SIP servers 3, 4 and 5 in between SIP UAs. This has been demonstrated in the simulation environment.

Rejecting the requests is a general phenomenon in SIP servers which are experiencing the overload problem. The rejections of the requests lead to collapse of entire system in the network. Mahdi Khazaei et al has introduced a multi-agent system in the SIP network. The system is working on the basis of controlling the holonics structure. SIP servers working with the hierarchical structure of holons. In this work, holonic structure can be changed with the end-to-end window based method. The method has been demonstrated in the simulation environment.

Another approach to overcome this problem a distributed and adaptive window based overload control algorithm is introduced to control the amount of calls forwarded to a downstream SIP server.

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...his algorithm is developed to prevent the overloading problem in SIP ...ers (Rosario G. Garroppo (2009)] In this method the queuing ...ine obtained with the combination of first in first out (FIFO) service ...cline on the basis of buffer sizes.

...harles Shen et al (2009) did explore a new mechanism to reduce the ...verloading in SIP Servers with the help of TCP flow control with the high ...evel insight. In this research work the focus was on the TCP flow through ...server instrumentation and simple overload control algorithms without any ...kernel or protocol modification. This mechanism has achieved in the ...experimental results with zero throughput to nearly full capacity [Charles Shen et al (2009)]

...Zoltair Chentouf (2011) has introduced an automatic classification ...mechanism to decrease the overloading problem in SIP servers. In this ...paper the author has focused on the utility of support vector machines to ...classify the traffic behavior when reached the saturation state of the server ...capacity. In this work, Session Initiation Protocol has been used for ...controlling the increased traffic. This paper also implemented the Adaptive ...Rate Control and support vector machines based algorithms.

...K. Guduru et al pinpointed the problem occurring because of the ...resending of failed SIP requests in a priority queuing design and proposed ...an intelligent priority queuing model to bring down the count of the ...retransmissions by assigning a higher priority to retransmitted SIP ...messages and avoiding the dispatch of unnecessary retransmissions in ...the incoming traffic of SIP server networks.

III. METHODOLOGY

...The next generation telecommunications networks rely mainly on SIP ...servers to forward the SIP messages to the corresponding clients in the ...IP networks. SIP is predominantly used as the main signaling protocol for ...multimedia sessions and also voice over IP through Internet because of its ...IMS architecture. Basically SIP protocol has an inbuilt overload control ...mechanism. But when the messages traffic is reached the saturation state ...and going beyond the messages processing capacity of SIP servers then ...the overload state is observed. If this state is continued the server enters ...into a congestion collapse. Besides the incoming network messages ...traffic, the implicit messages generated by SIP servers will create more ...and increasing traffic in the SIP networks. This state will create the escape ...route to the server's capacity and torque. Though the external messages ...are remarkably lesser than the capacity of SIP Servers processing ...capacity, the implicit messages created in SIP servers will be added ...together to pressurize the process to reach the overloading state.

...The state of overloading can be caused by the SIP servers by various ...different reasons. These are caused when many users are making VoIP ...calls at the same moment, when voting for a TV show is conducted many ...users will send the messages to the specific number in a huge quantity, ...many endpoints recover from a failure and register many users in the same ...short of time into the network and failure of SIP server farms etc. Though ...SIP servers have the capacity to withstand the overloading messages in ...normal conditions, the abnormalities mentioned above will cross the ...threshold point of the servers and leads to overloading.

A Dynamic Queue Management Approach

...The call flow between User Agent Client system UAC and User Agent ...Server UAS along with the Proxy A and Proxy B servers to initiate the ...messages are shown below in figure 1.

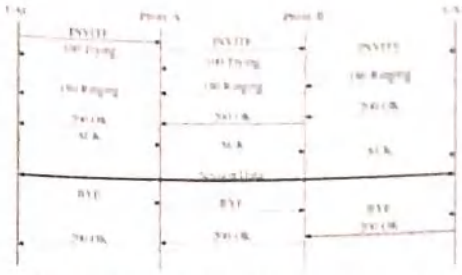

Figure 1 Invite Call flow in SIP Servers

The Dynamic Queue Management can be established to withdraw the overflow state in SIP Servers. The dynamic Queue Management will streamline the messages in accordance with the significance of the messages sending to the SIP servers. The request made from different User Agent Clients to process the requests. The requests are with the combination of multimedia content or voice messages or text messages. The queue will be arranged in accordance with the priority of messages and quality of its request's sender.

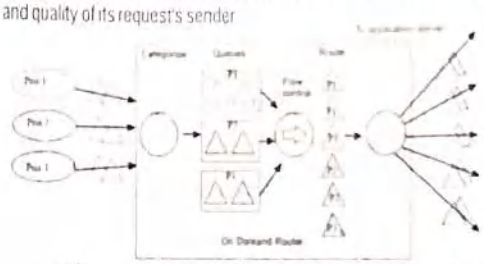

Figure 2 Dynamic Queue Management

In this mechanism the On Demand Router is playing vital role in arranging the requests and distinguish the requests whether they are prio-1, prio-2 or prio-3. Dynamic queue management technique classifies and prioritized the messages based on SIP message type. This paper proposes three priority levels namely prio-1, prio-2 and prio-3 that are used to classify different types of SIP messages. Prio-1 category includes SIP message types that terminate the SIP session such as BYE or CANCEL and ACK, 2xx status codes that may appear in later stage of SIP session. Prio-1category SIP messages are given highest priority in Overload situation since by processing these messages number of active SIP sessions will have reduced and there is a room for new SIP sessions. Prio-2 category includes light weight SIP messages such as REGISTER, PUBLISH, NOTIFY, MESSAGE, SUBSCRIBE. Prio-2 category messages given next priority since these messages are less delay sensitive and require less processing time. Retransmitted message is also categorized as Prio-2. Prio-3 category includes INVITE SIP request that establish new communication session and 1xx provisional responses. These messages are given least priority. The dynamic queue management mechanism will arrange the messages in a queue and process the requests accordingly shown in the figure 2 and 3.

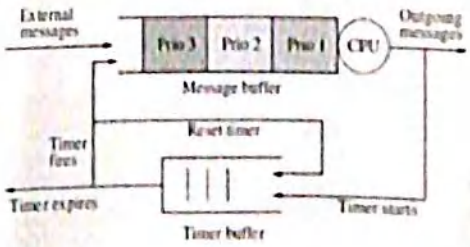

Figure 3 Dynamic Queue Management Model

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The message buffer will hold the messages according to the priority and keep them in queue. This automatic buffer management will nullify the overloading problem in the SIP Servers.

IV. RESULTS

The results have been obtained from the simulation environment. The results have demonstrated the queue management of different SIP messages have been kept in the queue with the help of dynamic queue management approach for SIP overload control. The simulation work has been incorporated in a single test bed with all out-of-the-box configurations and demonstrated the throughput specified in the following figure 4.

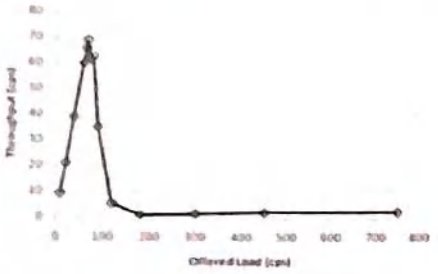

Figure 4 SIP Server Throughput for various messages

V. EVALUATION

The results have been evaluated with the messages sent to SIP server from different client systems as depicted in Figure 4. The first 100 messages have given the abrupt rise in the throughput. When the dynamic queue management approach has implemented to the SIP servers, the messages have been kept in the queue according to the priority basis. Since the total size of the experimental queues was 100, the throughput has demonstrated less than 10 cps even when the number of messages have been increased hinting at network saturation threshold.

CONCLUSION

Overloading is an inbuilt mechanism of SIP Servers when increased traffic has experienced with the emergency-induced call volume. The continuous overloading leads to collapse of SIP servers. This problem has addressed effectively in the paper by introducing a dynamic queue management mechanism to reduce the effects of overloading in SIP servers. The proposed dynamic queue management mechanism has effectively influenced the higher traffic and managed the data file transfer in keeping in the queue with priority mechanism linked with the combination of first in first out service discipline on the basis of buffer sizes. The experimental simulation results have demonstrated the efficiency of dynamic queue management approach to control overload in SIP network.

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CSE & IT - 15

HYBRID ALGORITHM FOR CONCURRENCY CONTROL IN MOBILE ENVIRONMENTS

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ABSTRACT In a mobile computing environment, multiple Mobile Hosts can access shared data from Fixed Host and update independently irrespective of their physical location. This leads to inconsistency of the data. Most of the concurrency control techniques proposed in literature to prevent data inconsistency are either pessimistic or optimistic approaches. In this paper we first analyze the existing scheme of concurrency control without locking and justify its Performance limitations. A new hybrid algorithm is proposed with reduced computation cost there by increasing overall throughput of the system. Experimental results show performance benefits and increase in commit rate of the transactions.

Key words Timestamp, Validation, Invalidation Report, Mobile Host, Fixed Host

I. INTRODUCTION

In a mobile computing environment, users can perform on-line transaction processing independent of their physical location. Due to different constraints of mobile environment like limited bandwidth, limited power supply disconnections, mobility etc., concurrency control is a challenging area in the mobile database environments etc. [6]. Several valuable techniques are proposed in literature to provide concurrency control in mobile environments, however most of them are either pessimistic or optimistic approaches towards concurrency control. Optimistic approaches minimize the computation cost but increases transaction rollbacks where as pessimistic approaches increase computation cost even though there is no data conflict thereby decreasing the overall throughput of the system.

In [9] a new concurrency control technique is proposed based on Absolute validity interval (AVI) value [3]. This scheme has a problem of needless computations to ensure serializability in pessimistic manner which leads to increased waiting time of the transactions and decreases the overall throughput of the system. In this paper we justify that pessimistic based approach may result in unnecessary delay in execution and abortion of transactions. Several performance limitations of the scheme is also mentioned. In this paper we also proposed a hybrid scheme for achieving concurrency control in mobile environments by eliminating needless computations of the existing scheme and increasing overall throughput of the system.

The rest of the paper is organized as follows. Section 2 reviews existing concurrency control schemes. Section 3 describes mobile database environment. In Section 4 we discuss performance limitations of the existing lockless scheme. Section 5 explores proposed hybrid concurrency control scheme. Section 6 specifies performance metrics. Section 7 concludes the paper.

2. Related work

In mobile database environment providing consistency of the data items is a challenging issue in case of concurrent access. Concurrency Co one of the important building blocks of Transaction Management. valuable attempts are made in providing solutions for data manage mobile environments.

The conventional two phase locking protocol is not suitable as it re clients to communicate continuously with the server to obtain loc detect the conflicts [7]. An optimistic concurrency control techniq the problem of delayed response and does not use cache invali scheme [11]. In [12] timeout based Commit Protocol has the prob time lag between local and global commit and more rollbacks transactions due to starvation.

In [5] the proposed Mobile 2PC protocol preserves the 2PC princ minimizes the impact of unreliable wireless communication.

An Optimistic Concurrency Control with Dynamic Time stamp Adju Protocol requires client side write operations. However because delay in execution of a transaction, it may never be executed [2]. In the conventional optimistic concurrency control algorithm in eri with an early termination mechanism on conflicting transactions dynamic timer management is used for achieving concurrency c This suffers from the problem of frequent rollbacks due to regulare the timer and wastage of computation. In [10] preemptive dynam adjustment strategy based on assumption of execution time scalable.

3. Mobile Database Environment

Mobile database environment (fig 1) consists of Mobile Host (MH Host (FH) and Base station. The communication of the MH with th supported by Base station. FH is connected with a wired network an Database server. MH may have DBMS module to perform d operations. A MH may be disconnected or in doze mode to save consumption. Hence disconnections are treated as normal events as failures [7].

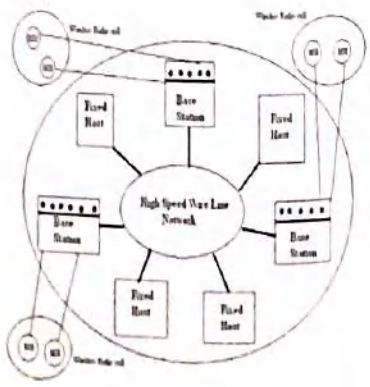

Fig.1 Mobile Database Environment [3]

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4. Performance Limitations of Existing Scheme

- All transactions are bound to execute needless computations in case of data conflicts when trying to access the data item.
- According to principle of serializability to ensure consistency of concurrently executing transactions, the transaction which accessed the data item first should also use this first among others. This principle is not followed, even though consistency is maintained by simply aborting one of the conflicting transactions.
- Increased Server computations with several data items monitoring and reporting.

5. Proposed Hybrid Concurrency Control Scheme

5.1 Proposed scheme Features

1. We incorporate a parameter called MH_TIMESTAMP (MT) which denotes the MH time of access of a data item for write operation.
2. Whenever there is a validation at FH, the transaction that has low value of MT (i.e. started first) for that data item should update first.
3. When a transaction updates the data item, transaction's MT of that data item is set to zero.
4. Invalidation Reports are used to perform implicit validation of the MH to reduce unnecessary rollbacks.

The data stored on the fixed host has the following format to control concurrent access

D_ID	DATA	M_ID[ ]	MT[ ]

Fig 2 Data Item Format on Fixed Host

1. D_ID denotes a unique-Id of the data item.
2. DATA denotes the current value of the data item.
3. M_ID[ ] denotes array of unique-Ids of the MH.
4. MT[ ] denotes array of MH timestamp, i.e. the time at which the MH copied the data item from FH.

5.2 Proposed Mobile Host (MH) algorithm

1. MH Connects to the fixed host. Checks the availability of all the data items required for execution.
2. Copy all data items to private memory.
3. Start execution locally.
4. Search data item in latest Invalidation report.

Case A: If Data Id exist, it means that the value of the data item is updated at the fixed host and the current value is invalid. Execute from step (1).

Case B: If Data Id does not exist, it means that the value of the data item is still valid.

5. Update data item on Fixed Host.
6. Repeat from step (4) for next data item until all data items are validated.
7. If execution = Success
   Then MH Commit
   Else
   MH Abort

5.3 Proposed Fixed Host (FH) Algorithm

1. Send and receive data item format.
2. Receive data item request from MH.
3. If write data item
   Assign MH timestamp (MT).
   Make a copy of data items.
   Put data items for validation.
   Check MH timestamp ordering for serializability.
   If validation = Success
   Then update data item values.
   Create Invalidation Report (I R).
4. Send I R to Mobile Hosts, which has a copy.

Else

i) Reject data item values.
ii) Set MH timestamp (MT) = 0.

The transaction execution in mobile environment for the proposed hybrid algorithm is shown with the help of a state diagram in Figure 3. A transaction in the system exists in any of the six(06) states i.e. Ready, Copy, Execute, Validate, Commit and Abort. Transition from one state to another occurs through well defined actions which transform the transaction from one consistent state to another consistent state.

5.4 Transaction State Diagram for Proposed Hybrid algorithm

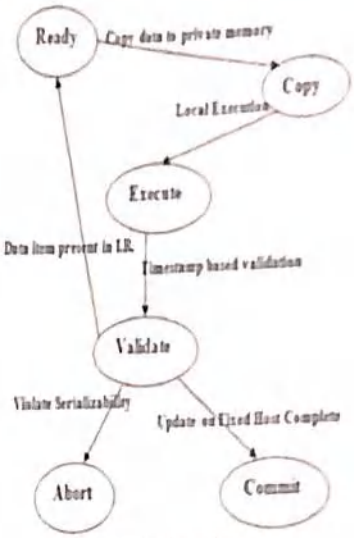

Fig. 3 Transaction State diagram

6. Performance Metrics

Same concurrent execution scenario of the transactions as presented in [9] is taken to show performance enhancement. The table 1 depicts execution steps of the transactions. X,Y,Z are the data items. Each Mobile Host (MH) requires two data items. Copy denotes the operation of copying the data item from Fixed Host (FH) to MH. Read, Write, commit are the operations of normal transaction execution.

Table 2 represents the given Mobile Host transactions execution schedule by the existing scheme [9]. The Current Access Time depicts the time of the each logical operation of transaction execution. RW (A) represents copying the data item into the private memory and performing the write operation on A. R (A) represents copying the data item into the private memory for performing read only operation. WAIT (A) specifies that the mobile host is waiting to acquire the data item A. WRITE (A) denotes write through policy for updating the data item A. A (T) denotes the time T at which the data item A is copied by the Mobile Host. Timestamp denotes the time at which the data item is copied from the Fixed Host.

Table 1 Execution Steps of transactions

MH1	MH2	MH3
Copy(X)	Copy(Y)	Copy(Z)
Copy(Y)	Copy(Z)	Copy(X)
Write(X)	Read(Y)	Write(Z)
Write(Y)	Write(Z)	Write(X)
Commit	Commit	Commit

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Table 2. Transaction Execution on MH [9]

Current Access Time	MH1	MH2	MH3	AVI			Timestamp		
				X	Y	Z	MH1	MH2	MH3
11	RW(X)	R(Y)	RW(Z)	5	6	4	X(11)	Y(11)	Z(11)
12	RW(Y)	WAIT(Z)	WAIT(X)	5	6	4	Y(12)	-	-
13	WRITE(X)	-	-	3	6	4	-	-	-
14	WRITE(Y)	Inv. Rept	RW(X)	3	5	4(exp)	-	-	X(14)
15	Commit	RW(Z)	Abort	2	5	7	-	Z(15)	-
16	-	R(Y)	-	-	5	7	-	-	-
17	-	WRITE(Z)	-	-	-	5	-	-	-
18	-	Commit	-	-	-	-	-	-	-

AVI=Absolute Validity Interval

In the above schedule MH3 aborts due to violation of serializability for a data item. Since by the time it updates 'Z' after waiting for it, transaction MH2 acquires it violating Serializability. Hence MH3 aborts execution.

Table 3. Transaction Execution on MH in proposed hybrid scheme

Current Access Time	MH1	MH2	MH3	MH_Timestamp(MT)		
				MH1	MH2	MH3
11	RW(X)	R(Y)	RW(Z)	X(11)	-	Z(11)
12	RW(Y)	RW(Z)	RW(X)	Y(12)	Z(12)	-
13	VALID(X)	VALID(Z)	VALID(Z)	-	-	-
14	VALID(Y)	Inv. Rept	Inv. Rept	-	-	-
15	Commit	RW(Z)	RW(X)	-	Z(15)	X(15)
16	-	VALID(Z)	VALID(X)	-	-	-
17	-	Commit	Commit	-	-	-

Table 3 represents Mobile Host transactions execution schedule with the proposed hybrid scheme. VALID(A) denotes the timestamp based validation and updating of the data item value on the Fixed Host. At '13' both MH2 and MH3 try to update 'Z'. Since MH3 timestamp (MT) is less than MH2 timestamp, MH3 is allowed to update whereas MH2 recopies the new 'Z' value and commits. Similarly MH3 has to recopy 'X' as MH1 updated the 'X' value and commits.

MH3 now commits due to maintaining the principle of serializability. MH3 has acquired data item 'Z' first, it should use this first to maintain serializability. With the proposed hybrid scheme the system is able to give full commit rate and overall computation cost also decreased. The results of the scheme over increased number of transactions given more commit rate.

The Fixed Host updates the values of the data item format only when some transaction uses it. Table 4 represents data item format values stored on the Fixed Host while concurrent execution of the transactions in AVI based scheme [9].

Table 4. Fixed Host data item status [9]

Current Access Time	Semaphore Value			AVI			TLU		
	X	Y	Z	X	Y	Z	X	Y	Z
10	0	0	0	0	0	0	0	0	0
11	1	0	1	5	6	4	0	0	0
12	1	1	1	5	6	4	0	0	0
13	0	1	1	3	6	4	13	0	0
14	1	0	0	3	5	4(exp)	13	14	0
15	0	0	1	2	5	7	15	14	0
16	0	0	1	3	5	7	13	14	0
17	0	0	0	-	-	5	13	14	17
18	0	0	0	-	-	-	13	14	17

TLU=Time of Last Update

Table 5. Fixed Host data item status in proposed hybrid scheme

Current Access Time	D_ID(X)				D_ID(Y)				D_ID(Z)			
	MH1		MH3		MH2		MH1		MH3		MH2	
	M_ID	MT	M_ID	MT	M_ID	MT	M_ID	MT	M_ID	MT	M_ID	MT
11	MH1	11	-	0	MH2	0	-	0	MH3	11	-	0
12	MH1	11	MH3	12	MH2	0	MH1	12	MH3	11	MH2	12
13	-	0	MH3	12	MH2	0	MH1	12	-	0	-	0
14	-	0	MH3	12	MH2	0	-	0	-	0	-	0
15	-	0	MH3	15	MH2	0	-	0	-	0	MH2	15
16	-	0	-	0	-	0	-	0	-	0	-	0
17	-	0	-	0	-	0	-	0	-	0	-	0

Table 5. represents data items monitoring and timestamp validation by Fixed Host to provide concurrent access of data items in the proposed hybrid scheme.

6.1 Advantages of proposed hybrid scheme

1. Transactions data item access order is maintained to ensure serializability without aborting the transactions.

2. The computation cost of the transactions is reduced due to optimistic approach and unnecessary rollbacks are minimized due to pessimistic approach. Hence, overall commit rate of the system is increased due to hybrid approach.

3. The transaction waiting time to acquire data time is absent thereby decreasing the load on the Fixed Host to maintain the queue of transactions data access.

4. All the transaction are given access to copy the data items whenever required thereby eliminating the starvation.

7. Conclusion

In this paper we have shown the limitations of the existing concurrency control scheme. We also justified that hybrid approach of concurrency control to ensure serializability reduces needless computations and decreases unnecessary rollback of the transactions. The proposed concurrency control scheme improves the drawbacks of the existing scheme by providing the optimistic approach. Due to very few transaction re-executions current load of Fixed Host server is reduced. It increases the overall commit rate of the system.

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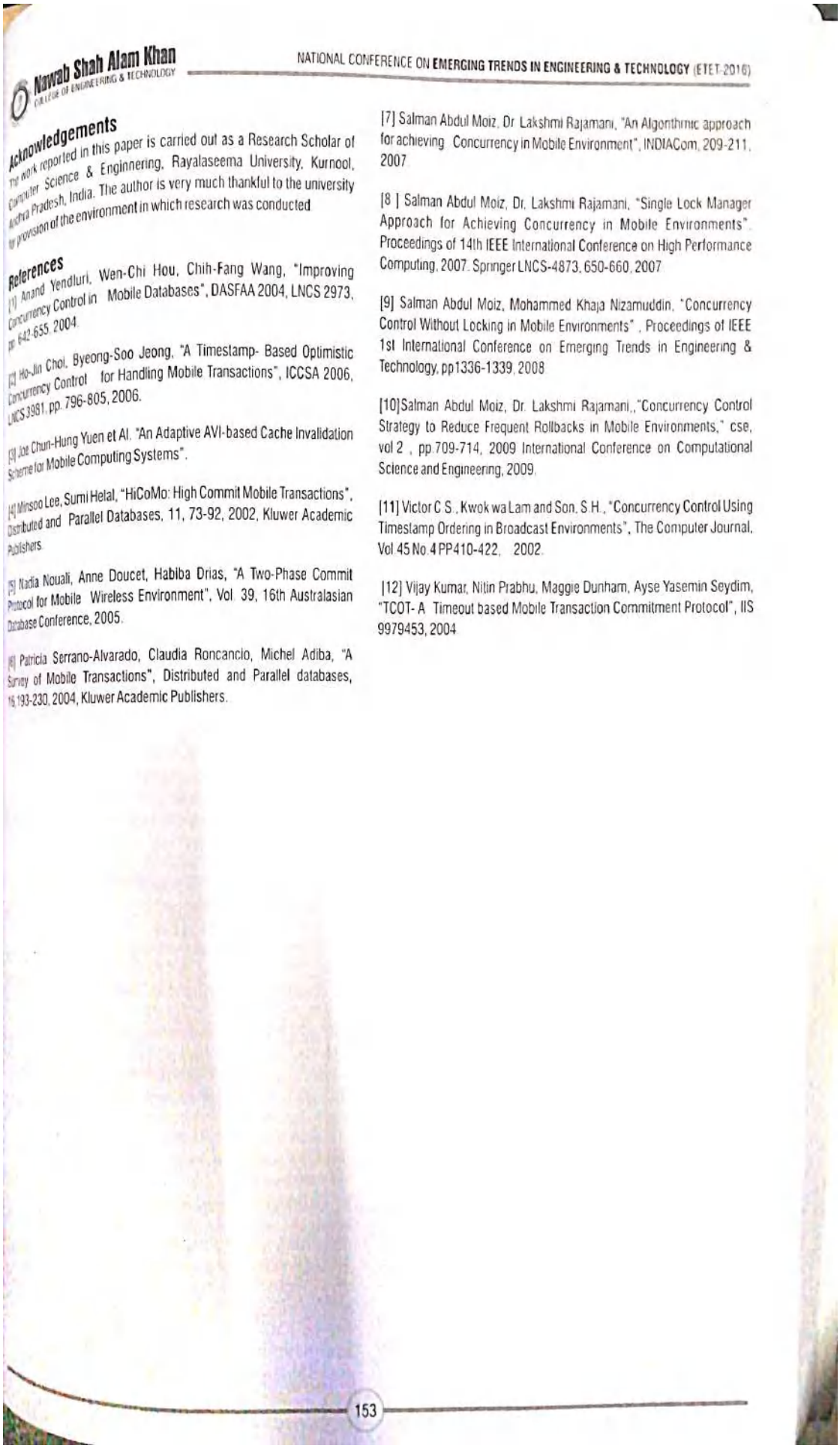

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CSE & IT - 16

APPLICATION OF DATA MINING IN RISK MANAGEMENT

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ABSTRACT *As the information technologies are widely used in construction risk management, which can bring out explosive growth of data, how to organize and analyze the data becomes a crucial problem for construction managers. There are few issues to argue about the application of data mining in construction risk management. So, it is worthwhile to experiment in this particular field to manage the risks in construction projects. The major aim of this paper was to use data mining to extract implied, unknown, uncommon and potential application valuable information or patterns, which names Knowledge Discovery in Database. Therefore, correspondent effective countermeasures may be adopted in order to control the risk in construction project. First reviewed in this paper were the concepts of data mining and construction risk management. Several steps of risk management based on data mining were then shown, such as (1) identification of data mining object, (2) data preparation, (3) establishment of data mining model, (4) data mining, (5) result analysis, (6) knowledge application. Construction risk managers can apply the new knowledge with the help of data mining, thus making appropriate decisions faster, more pinpoint, and more comprehensive. Moreover, its possible applications can be extended to find effective measures in order to improve the level of other construction management.*

Key words: *data mining, association rule, risk management.*

I. INTRODUCTION

Many construction projects have been ruined by risk and have not always been dealt with adequately, which are resulted in poor performance with increasing costs and time delays[1]. It is worthwhile to research in this particular field to manage the risk in construction project. There are many theoretic and methods on it. As the construction industry is adapting to information technologies, using data mining technology to manage risk may be a new and efficient way. Data mining can extract useful, interesting, potential, and previously unknown patterns on construction risk management from raw data. Data mining is a kind of deep analysis technology of data, which can establish a forecasting model instead of back retrospective model. Traditionally statistical analysis tools are used to test the past situation, while data mining technology is aimed at finding unexpected relationships through discoverable, predictable, pattern matching algorithms[2]. An attempt is to apply data mining to find useful relationships between risk factors, remedial measures and results in this article, to assessment the risk combination, and to help the decision makers to find effective measures to avoid the loss of construction risk.

2. DATA MINING TECHNOLOGY

The development of data mining has been powered by the desire to find meaningful, new patterns in real –world database. It is widely applied in many fields such as shopping bag analysis, insurance, fraud detection, and text categorization. Unfortunately, there were few issues to argue about the application of data mining in construction risk management. So, it is worthwhile to experiment in this particular field to manage the risk in construction project. In general, data mining process can be divided into four main parts[2]. (1) Aggregate data sets for analysis (2) Put forward the data to data mining tool(3) Analyze and interpret the result (4) Apply the result to solve the new problems and new situations.

3. RISK MANAGEMENT BASED ON DATA MINING

There are five core steps in the process of risk management. They are identification, risk assessment, risk analysis, risk handling and monitoring[3]. The main processes model of data mining on project management is depicted in Fig 1. In this figure, data mining process and risk management process are integrated. Data mining has been important tool in finding the correlation or uncertainty of risk factors. It analysis based on the hierarchical risk breakdown structure splits association between the risk factors. Relationships between risk factors may usually be consanguineous, thus a risk factor may induce another factor to strengthen or weaken. In this paper, association rule is used data mining tool to manage the construction project risk. Using this mining tool, the association rule between risk factors combination and result can be found, and then these rules can be applied in target project risk management.

3.1 Identification of Data Mining Object The first step of data mining implementation is the identification of data mining object. Although the final result of data mining could not be predicted, the problem to solve could be predicted and aimed. It would always be no longer successful without objectives. In this step, several questions should be confirmed such as, where to start with, which and how many data to be collected, which extent to be reached by data mining. Maybe proved knowledge needs to be provided in the stage. New questions may be brought forward in data mining process, which means that data mining is a process. The main task of this step is to understand the target of data mining, define the corresponding measurement criterion, and then to implement stratagem.

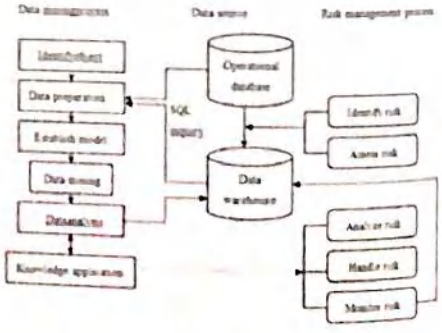

Fig 1 the mainprocess of Data mining on process risk management

3.2 Data Preparation Data preparation is a very important process because data may have been collected in an ad hoc manner, unfilled fields in records may be found, or mistakes in data entry may have been made. As a result, the data mining process cannot succeed without a significant effort to prepare the data. Cabena et al.(1998) presents that 60% of the time goes into preparing the data for mining, thus highlighting the critical dependency on clean, relevant data[5]. Proper data preparation can make preparation time enormously, depending on the quality of the original data, allowing the analyst to produce better models in less time.

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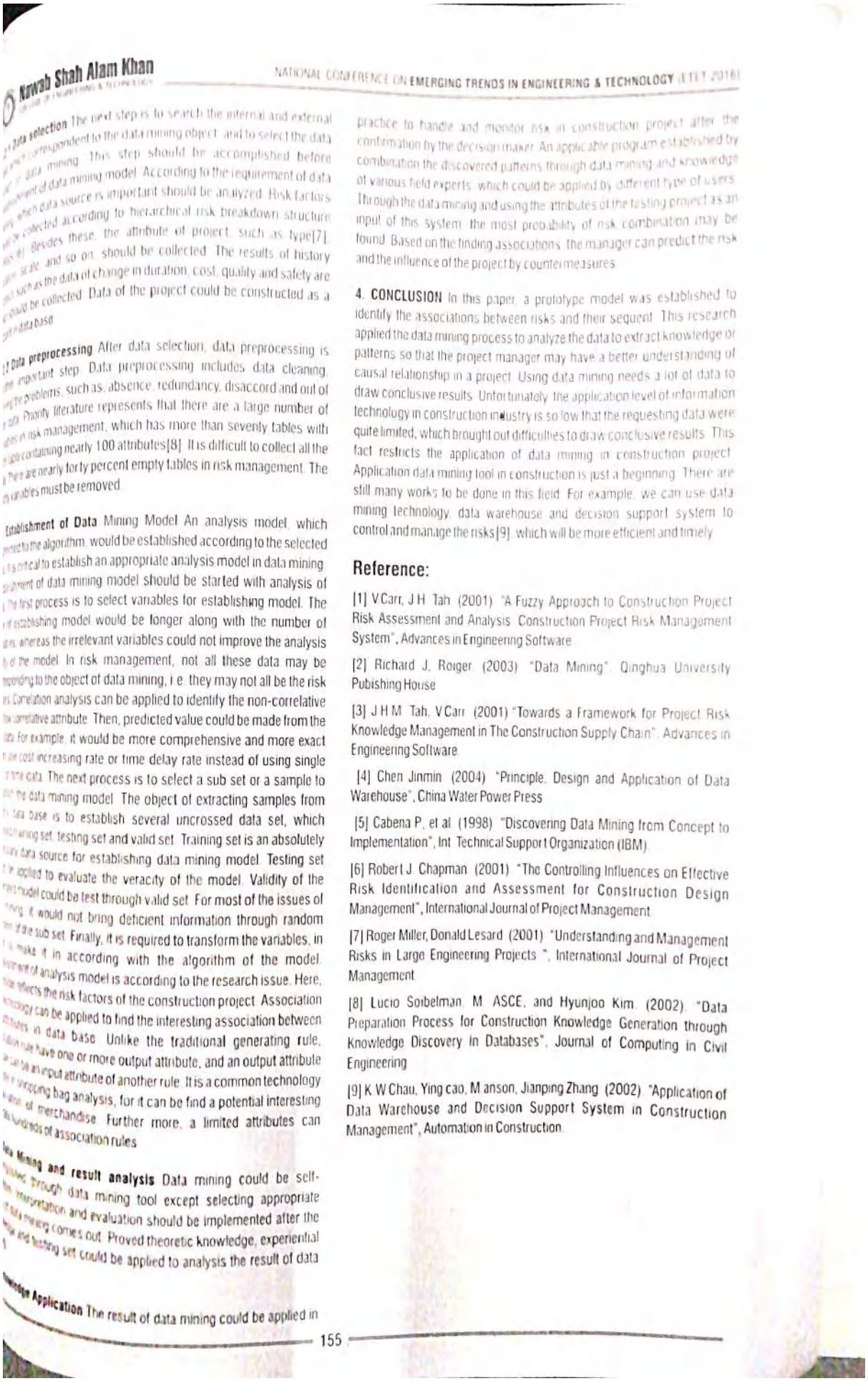

Data selection The next step is to search the internal and external ... correspondent to the data mining object, and to select the data ... data mining. This step should be accomplished before ... of data mining model. According to the requirement of data ... which data source is important should be analyzed. Risk factors ... collected according to hierarchical risk breakdown structure ... Besides these, the attribute of project, such as type[7], ... scale, and so on, should be collected. The results of history ... such as the data of change in duration, cost, quality and safety are ... should be collected. Data of the project could be constructed as a ... data base.

Data preprocessing After data selection, data preprocessing is ... important step. Data preprocessing includes data cleaning, ... the problems, such as: absence, redundancy, disaccord and out of ... data. Priority literature represents that there are a large number of ... on risk management, which has more than seventy tables with ... table containing nearly 100 attributes[8]. It is difficult to collect all the ... There are nearly forty percent empty tables in risk management. The ... variables must be removed.

Establishment of Data Mining Model An analysis model, which ... to the algorithm, would be established according to the selected ... It is critical to establish an appropriate analysis model in data mining. ... of data mining model should be started with analysis of ... The first process is to select variables for establishing model. The ... establishing model would be longer along with the number of ..., whereas the irrelevant variables could not improve the analysis ... of the model. In risk management, not all these data may be ... corresponding to the object of data mining, i.e. they may not all be the risk ... Correlation analysis can be applied to identify the non-correlative ... correlative attribute. Then, predicted value could be made from the ... For example, it would be more comprehensive and more exact ... the cost increasing rate or time delay rate instead of using single ... time data. The next process is to select a sub set or a sample to ... the data mining model. The object of extracting samples from ... data base is to establish several uncrossed data set, which ... training set, testing set and valid set. Training set is an absolutely ... data source for establishing data mining model. Testing set ... be applied to evaluate the veracity of the model. Validity of the ... model could be test through valid set. For most of the issues of ..., it would not bring deficient information through random ... of the sub set. Finally, it is required to transform the variables, in ... make it in according with the algorithm of the model. ... of analysis model is according to the research issue. Here, ... reflects the risk factors of the construction project. Association ... can be applied to find the interesting association between ... in data base. Unlike the traditional generating rule, ... rule have one or more output attribute, and an output attribute ... be an input attribute of another rule. It is a common technology ... shopping bag analysis, for it can be find a potential interesting ... of merchandise. Further more, a limited attributes can ... hundreds of association rules.

Data Mining and result analysis Data mining could be self-... through data mining tool except selecting appropriate ... interpretation and evaluation should be implemented after the ... data mining comes out. Proved theoretic knowledge, experiential ... and testing set could be applied to analysis the result of data ...

Knowledge Application The result of data mining could be applied in practice to handle and monitor risk in construction project after the conformation by the decision maker. An applicable program established by combination the discovered patterns through data mining and knowledge of various field experts, which could be applied by different type of users. Through the data mining and using the attributes of the testing project as an input of this system, the most probability of risk combination may be found. Based on the finding associations, the manager can predict the risk and the influence of the project by countermeasures.

4. CONCLUSION In this paper, a prototype model was established to identify the associations between risks and their sequent. This research applied the data mining process to analyze the data to extract knowledge or patterns, so that the project manager may have a better understanding of causal relationship in a project. Using data mining needs a lot of data to draw conclusive results. Unfortunately, the application level of information technology in construction industry is so low that the requesting data were quite limited, which brought out difficulties to draw conclusive results. This fact restricts the application of data mining in construction project. Application data mining tool in construction is just a beginning. There are still many works to be done in this field. For example, we can use data mining technology, data warehouse and decision support system to control and manage the risks[9], which will be more efficient and timely.

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EEE - 2

COMPARISON OF POWER STABILITY ENHANCEMENT BY VARYING ROTOR ANGLE OF GENERATOR USING VARIOUS FACTS DEVICES

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In recent years power demand has been continuously increasing but the expansion of power generation is limited due to many reasons, the most important of them being the aspects of transient stability. Transient stability control ensures a stable operation of power system during large disturbances and faults. FACTS devices are series and shunt compensating devices which are most prominently used for transient stability improvement. This paper gives a comparative study of various facts devices to improve the transient stability of a two area system by varying rotor angle of generator. It emphasizes in particular the comparison of performance and cost of UPFC with other FACTS devices such as Static Synchronous Series Compensator (SSSC), Thyristor Controlled Series Capacitor (TCSC) and Static VAR Compensator (SVC) respectively. The simulation results demonstrate the effectiveness of the UPFC in the proposed system.

Index Terms - FACTS, SSSC, SVC, TCSC, UPFC, Transient Stability, Cost

I. INTRODUCTION

Initially the solutions provided to improve the quality of power supply in electrical networks involved power semiconductor devices and static power converters that acted like ideal switch and were controllable [1]. Later the development of power electronic devices introduced the concept of FACTS controllers in power system. FACTS devices can be used to improve voltage, steady state and transient stabilities of power system [2]. Due to continuous increase of power demand, the existing transmission lines are more loaded than was planned. Increased load on long transmission lines causes transient stability problem whenever a major disturbance occurs which may even cause a black out. Transient stability in power system refers to the capability of a system to maintain synchronous operation in the event of large disturbances [3]. Stability depends on initial operating conditions as well as the severity of the fault or disturbance. Use of FACTS controllers allows increased utilization of existing networks close to their thermal loading capacity and hence avoiding the need to construct new transmission lines.

Different FACTS controllers such as SVC, TCSC, SSSC, and UPFC are compared here in regard of cost, power stability enhancement and the variation of generator rotor angle of two area power system [4].

Static VAR Compensator SVC is the first generation of FACTS devices that can control voltage at the required bus, thereby improving the voltage profile of the system [5]. Thyristor Controlled Series Capacitor (TCSC) is one of the important members of FACTS family. It has various roles in the flow and control of power system, such as scheduling power flow, balancing unsymmetrical components, reducing net loss, providing voltage support, limiting short circuit currents and enhancing transient stability [6-8]. A SSSC is a device which is connected in series with a power system. Its primary purpose is to control flow in steady state and to improve transient stability of a power system [9]. UPFC is the most versatile of all the devises. It is used to improve steady state, dynamic and transient stability of a system. UPFC can independently control many parameters, since it is the combination of STATCOM & SSSC [10-11]. This paper compares the cost, power stability enhancement and performance of UPFC in a two area power system with other FACTS devices [1].

II. FACTS DEVICES

FACTS devices are used for reactive power compensation. FACTS devices are controllers based on either thyristor devices with no gate turn off or power devices with gate turn off capability. These devices are used for dynamic control of voltage and phase angle of high voltage AC transmission lines [5]. Basic principles of FACTS controllers which are used in two area power system model under study are discussed briefly.

A. Static Var Compensator (SVC)

Static var systems are applied in transmission applications for rapid control of voltage at weak points in a network. Installations may be at the midpoint of transmission interconnections or at the line ends[5]. Static Var Compensators are shunt connected static generators / absorbers whose outputs are varied so as to control voltage of the electric power systems. In its simple form, as shown in Fig.1, the SVC is connected to a coupling transformer that is connected directly to the AC bus whose voltage is to be regulated. The effective reactance is varied by varying firing angle control of the anti-parallel thyristors. The firing angle can be controlled through a PI (Proportional + Integral) controller such that the voltage of the bus, where the SVC is connected, is maintained at the reference value.

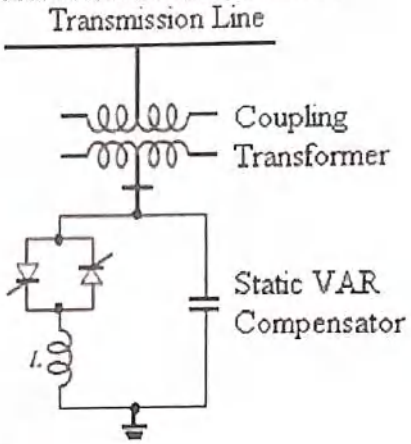

Fig. 1 Configuration of SVC

B. Thyristor Controlled Series Capacitor (TCSC)

TCSC is one of the most important and best known FACTS devices, which is used to increase the power transfer and to enhance system stability [5]. The main circuit of a TCSC is shown in Fig. 2. The TCSC consists of three main components: capacitor bank C, bypass inductor L and bidirectional thyristors SCR1 and SCR2. The firing angles of the thyristors are controlled to adjust the TCSC reactance. According to the variation of the thyristor firing angle or conduction angle, TCSC can be modelled as a fast switch between corresponding reactances.

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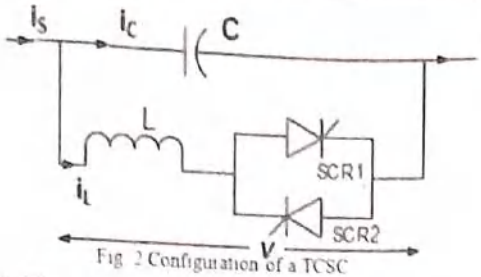


Fig. 2 Configuration of a TCSC

C. Static Synchronous Series Compensator (SSSC)

The SSSC is the recent development of FACTS devices for power transmission series compensation. It can be considered as a synchronous voltage source as it can inject a sinusoidal voltage of variable and controllable amplitude and phase angle in series with a transmission line[5]. The injected voltage is in quadrature with the line current. A small part of the injected voltage that is in phase with the line current provides the losses in the inverter. Most of the injected voltage, which is in quadrature with the line current, provides the effect same as that of inserting an inductive or capacitive reactance in series with the transmission line. The variable reactance influences the electric power flow in the transmission

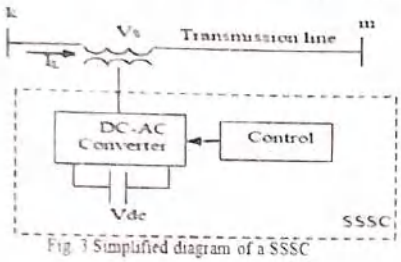


Fig. 3 Simplified diagram of a SSSC

C. Unified Power Flow Controller (UPFC)

Among all the available FACTS devices, the Unified Power Flow Controller (UPFC) is the most versatile one that can be used to enhance steady state stability, dynamic stability and transient stability [3]. The basic configuration of a UPFC is shown in Fig. 4. The UPFC is capable of both supplying and absorbing real and reactive power and it consists of two AC/DC converters. One of the two converters is connected in series with the transmission line through a series transformer and the other in parallel with the line through a shunt transformer. The DC side of the two converters is connected through a common capacitor. The power balance between the series and shunt converters is required to maintain a constant voltage across the DC capacitor. As the series branch of the UPFC injects a voltage of variable magnitude and phase angle, and thus improves the power flow capability of the line as well as its transient stability limit. The shunt converter exchanges a current of controllable magnitude and power factor angle with the power system. It is normally controlled to balance the real power absorbed from or injected into the power system by the series converter plus the losses by regulating the DC bus voltage.

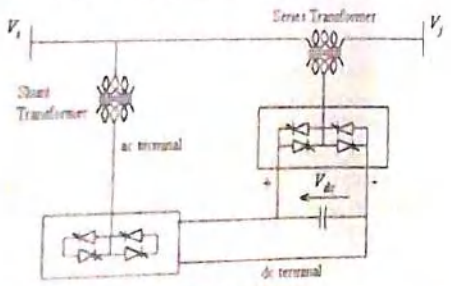


Fig. 4 Configuration of UPFC

III. COST COMPARISONS OF VARIOUS FACTS DEVICES

Table I gives an idea about the approximate cost of FACTS devices. The main disadvantage of FACTS devices is expensive cost to provide smooth and fast response to secure power system during normal and steady state operations.

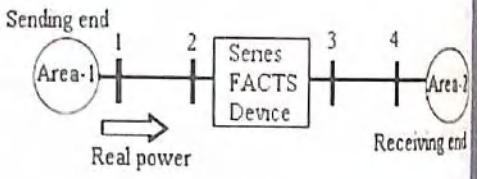
TABLE I
COST COMPARISON OF VARIOUS FACTS DEVICE [13]

Sl. No	FACTS Device	Cost (Rs/kVar)
1	Shunt Capacitor	432
2	Series Capacitor	1080
3	SVC	2160(controlled portions)
4	TCSC	2160(controlled portions)
5	STATCOM	2700
6	UPFC Series Portions	2700 (Through power)
7	UPFC Shunt Portions	2700(controlled portions)

IV. TWO AREA POWER SYSTEM MODEL

Consider a two-area power system (Area-1 & Area-2) with series FACTS devices, connected by a single long transmission line as shown in Fig. 5. Here, the series FACTS devices such as UPFC (combination of STATCOM and SSSC), SSSC, and TCSC are equipped between bus-2 and bus-3. The direction of real power flow is from Area-1 to Area-2. In the two-area power system model, the Area-1 consists of Generator 1 (G1) and Generator 2 (G2) and the Area-2 consists of Generator 3 (G3) and Generator 4 (G4). The system data are given in [12].

During normal operation of generator stator magnetic field and rotor magnetic field rotate at same speeds but there is angular difference between the two, this difference is called generator rotor angle. It depends on power operation. In the above mentioned system a UPFC and TCSC are installed one at a time and a 3-phase symmetrical short circuit fault is considered to occur at bus 3. In this paper we compare the system performance of two area system model with and without UPFC and with TCSC. The simulated result of the case is discussed below.



V. SIMULATION RESULTS AND DISCUSSION

A. Two-area Power System with UPFC

The two-area system shown in Fig. 5 is considered in this study. The system has a UPFC installed between bus-2 and bus-3. It is considered that a 3-phase symmetrical short-circuit fault of 300 milli-seconds duration occurs at bus-3. The system is simulated in Matlab/Simulink environment and the corresponding graphs are shown in Fig. 7 and Fig. 8. From the Fig. 7, it is inferred that without a UPFC, the oscillations in generator rotor angle of Area-1 (Generator 1 and Generator 2) and Area-2 (Generator 3 and Generator 4) increase and the settling time for the oscillations is found to be high. However, from the Fig. 8, it can be seen that with a UPFC, the oscillations in generator rotor angle of Area-1 and Area-2 decrease and the settling time for the oscillations is found to be slightly low. Hence, the transient stability of the two-area power system is improved with UPFC.

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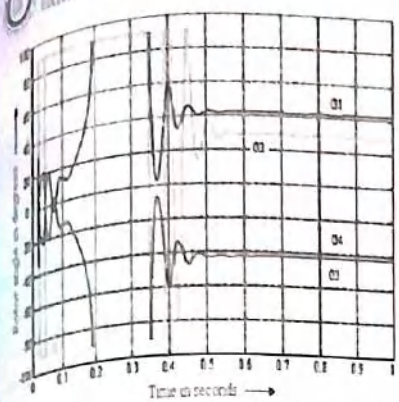

Fig 6 Variation of generator rotor angle of the two-area power system without UPFC

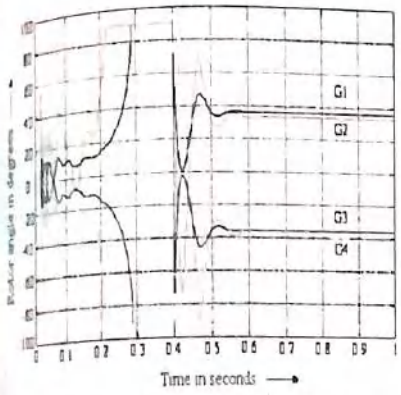

Fig. 7 Variation of generator rotor angle of the two-area power system with UPFC

B. Two-area Power System with TCSC

The two-area system shown in Fig. 5 is considered in this study. The system has a TCSC installed between bus-2 and bus-3. A 3-phase symmetrical short-circuit fault of 300 milli-seconds duration occurs at bus-3. The system is simulated in Matlab/Simulink environment and the variation of line power transmitted is shown in Fig. 10. From the Fig. 10, it is clear that the power system stability of the system is improved with TCSC.

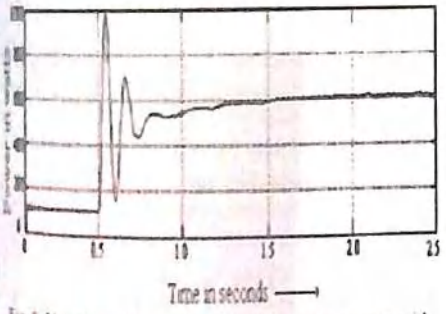

Fig. 8. Variation of line power of two-area power system with TCSC

C. Comparison between UPFC, and TCSC for Power System Stability Enhancement

From the simulation results shown in Figs. 6 - 8, a comparison is made between the above FACTS devices for stability enhancement of two-area power system under study as shown in Table II. From the Table II, it is investigated that the UPFC is the effective FACTS device for stability enhancement of inter-area power system.

TABLE II
COMPARISON BETWEEN UPFC & TCSC FOR POWER SYSTEM STABILITY ENHANCEMENT

Facts device	Power System Stability Enhancement	Load flow	Transient stability	Time (sec)
UPFC	YES	High	Medium	0.6
TCSC	YES	Medium	High	1.5

VI. CONCLUSION

In this paper the power system stability enhancement of two area power system by TCSC & UPFC is discussed. The variation of rotor angle of generator is compared with and without the presence of UPFC. Then performance of UPFC for transient stability improvement is compared with that of TCSC. It is seen that with the presence of UPFC the settling time in post fault period is found to be 0.6 sec approx and that with the presence of TCSC is 1.5 approx.

The cost of UPFC with other FACTS devices is also compared. From the above comparisons it can be concluded that even though the cost of UPFC is more compared to other devices it is generally preferred over other devices keeping in view the improvement in system performance being higher in case with UPFC.

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NATIONAL CONFERENCE ON EMERGING TRENDS IN ENGINEERING & TECHNOLOGY (ETET-2016)

EEE - 4

VOLTAGE ESCALATION DUE TO CIRCUIT BREAKER RE-IGNITIONS IN LARGE INDUSTRIAL MOTORS

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ABSTRACT Industrial motors are high voltage motors utilized as drives in power stations, fans, and water pumps. Motors are operated by vacuum circuit breakers during switching on/off duties. The operation of circuit breakers gives rise to multiple re-ignitions with high surge voltage generated at its terminal. The surge voltage propagates through connected cables. These motors are affected by a number of re-ignitions caused due to switching operations of vacuum circuit breaker. It results in high over voltage across the terminal of the motor leading to failure. The present paper aims at an investigating the transient over voltage due to vacuum circuit breaker switching, by means of Electromagnetic Transient Program (EMTP). To calculate the re-ignition voltages, an electrical model has been developed for the purpose, and implemented in the EMTP environment.

Keywords—Circuit breaker, switching operations, abort start, EMTP.

I. INTRODUCTION

Large industries such as Petro Chemicals Edifices, Paper mills and pulp industries as well as cement plants utilize huge size motors for their operations. Based on the requirement, turning on and turning off operation is carried out using circuit breaker. As per load requirement, use of circuit breakers is different. Amongst all, vacuum and SF6 circuit breakers are the modern techniques for medium and high voltage applications. During closing and opening operation of circuit breaker, transient over voltages are generated. Dielectric breakdown between breaker contacts causes production of high frequency transients. This phenomena occurs either during switching on, when the gap between contacts becomes very small, or during switching off, when a high TRV causes a re-ignition. This again depends upon type of circuit breaker used. SF6 has improved dielectric strength than vacuum circuit breaker. But it has labeled as one of the major global warming gases. Consequently vacuum circuit breakers are used as it does not have any risk to the environment. Several authors reported that generated transient over voltages have large amplitudes and may be a steep rise time. W.Z Gandhare [1] reported that steep fronted surges can stress the inter turn and node to ground insulation beyond its basic insulation level. Authors found that impulse voltage at breaker terminal is more than motor terminal. Group of coils [2] are selected to apply voltage endurance test. It is found that coils having pencil-thin insulation have failed at 20 kV. Publications [3-4] show stator winding faults account for a large percentage of the failure of machine. These transient over voltages propagate along the cable and achieve the motor terminal. It is observed that multi break switch [5] has high dielectric strength during opening and restrike operations. For waves with short rise time, the withstand voltages [6], are of the order of 5 p.u. and more. It is therefore a matter of growing concern to motor designer to know the severity of transient voltage distributing in the winding. For surge fronts below 1 μs, voltage distribution [7-8] becomes distinctly non-linear. Voltage stress is not distributed uniformly [9] among the coil. Distribution is depends on parameters of the coil and the rise time of the surge. Multiple re-ignitions [10] are proportional to the arc angle. However, multiple re-ignitions may be observed in breaker after opening operations due to their ability to interrupt currents at high frequency. This requires further investigations of switching transients and its influence on motor winding insulation.

In this paper an equivalent electrical network is modeled to calculate the re-ignition voltages of electrical switch. The model parameters like L, C and R are taken from a industrial motor. The fundamental target of this paper is to assess transient over voltages as an element of cable length and suggest suitable surge arrester to ensure the motor stator winding protection. The paper also discusses the re-ignition surge in the event of abort start of the motor.

II. GENERATION OF TRANSIENT OVER VOLTAGES

The generations of transient over voltages are mainly due to current chopping, virtual current chopping, multiple re-ignitions and prestrike.

2.1 Current Chopping

Current chopping refers to premature interruption of the power frequency currents before natural zero current. The amplitude of chopping current depends on the movement of the breaker contacts separation, type of circuit breaker used for switching operations. Figure 1 shows the equivalent circuit representation for current chopping phenomena.

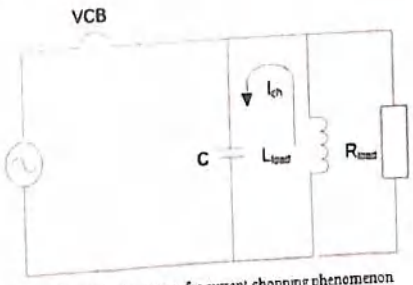

Figure.1. Circuit representation for current chopping phenomenon

Assume I_{ch} is the chopping current, thus the stored electromagnetic energy is $\frac{1}{2}LI^2$

This energy is transferred in the form of electrostatic energy in the capacitance $\frac{1}{2}CV^2$. The resulting voltage increase on the load side

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stresses the contact gap. This transient overvoltage is depends on the surge impedance of the load as well as peak value of the chopped current. It is noticed that after current chopping, the transient recovery voltage (TRV) across the contact gap rises. If the rate of rise of recovery voltage is higher than the rate of rise of dielectric strength, the arc is reestablished. This leads to over voltages. However, current chopping does not affected high power applications.

2.2 Voltage Escalation Due To Re-Ignition

If reignition occurs, then arc reestablishes. Due to this phenomenon there is a flow of high frequency current. This current can be extinguished at one of its natural current zeros. If this interruption does happen, the process described in above section repeats, i.e., the voltage escalation continues till either

- The separation contact is enough to withstand the transient recovery voltage
- The current magnitude at power frequency is high enough to prevent zero crossing of aggregate of high frequency and power frequency current. In this case there is no interruption and current continues for one more half cycle.

III. CALCULATION OF RE-IGNITION VOLTAGE USING EMTP

The equivalent circuit consists of a three phase 6.6 kV motor, connected to a power supply through a step down 132/6.6 kV transformer. Length of the cable which is connected in the system is 750 meters. A vacuum circuit breaker is connected for switching operations. Figure 2 shows a schematic diagram of motor system. Although several other motors are also connected to the same supply they are assumed to be permanently switched on. Only single motor is considered for switching on and off duty.

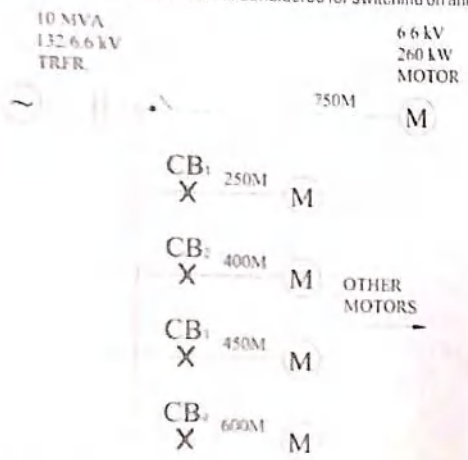

Figure 2, Schematic diagram of motor system

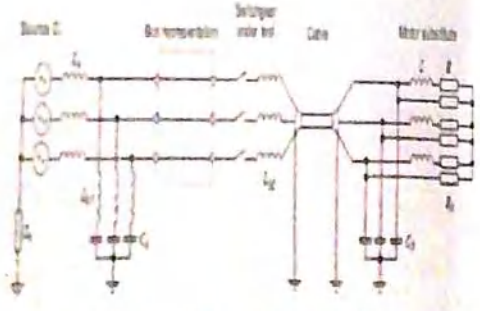

Figure 3, Three phase equivalent circuit diagram of a 6.6 KV motor system

Ls = 1.45 mH
R = 1.22 Ω
Cp = 0.013 μF
Rp = 15 kΩ

Table 1 Sequence parameters per Km of cable length

Sequence parameter	R(ohm)	L(mH)	C(uF)
Zero sequence	2.85	0.33	0.18
Positive sequence	0.31	0.26	0.34
Negative sequence	0.31	0.28	0.34

Equivalent electrical circuit representation of the above system in Figure 3. Circuit breaker is represented by a normal switch for and closing operation. Cable is specified with values equivalent to positive and negative sequence parameters. Motor is represented and L_m in series along with parallel resistance R_p and capacitance

Where,
C_p is capacitance between winding and core.
R_p is resistance between winding and core.
The equivalent electric circuit is solved by Electro Magnetic Program (EMTP) to calculate re-ignition voltage.

IV. IMPLEMENTATION OF EMTP TO SIMULAT IGNTION VOLTAGES

Parameters of three phase system, shown in Figure 3 are entered to EMTP data sheet. The short circuit impedance of transformer parameters of cable, inductance, capacitance and resistance of entered in different cells using proper node definition. Connect breaker is represented by switch with time to open and close. high voltage motors in the system operate without neutral ground neutral end of the motor is kept open. During simulation it is assu motor is in off condition and that switching is done at a given pha The re-ignition voltages generated due to switching in open calculated. The closing time of the switch is changed in such motor closes at different phase angle to calculate re-ignition voltage

V. RESULTS AND DISCUSSIONS

In EMTP simulation the breaker contacts are closed at pre specifie The switch is closed at most onerous condition to determine the magnitude of voltage distribution in the motor winding. In first case pole contact is closed at 2 ms and opened at 2.4 msec. Switch closed at 7.5 ms. The generated surge due to first re-ignition is Table 2 shows the voltage escalation due to multiple re-ignitions.

Table 2 Voltage escalation due to multiple re-ignitions

Re-ignition	Voltage escalation at motor terminal	Breaker clos time (ms)
First re-ignition	17.33 kV	7.5
Second re-ignition	29.12 kV	8.23
Third re-ignition	39.01 kV	8.7
Fourth re-ignition	65 kV	9.4

Figure 4 shows the voltage escalation due to multiple re-ignition closing time of the switch is changed in such a way that motor different phase angle to study the multiple re-ignitions. The magnitude and rise time are depends on the frequency of oscilla three phase circuit and the magnitude of voltage at the instant of The time interval between two adjacent re-ignitions depends on the parameters of the circuit. Nevertheless, repeated re-ignitions and escalation is also determined in vacuum switching devices dur operations because of their potential to interrupt excessive inst currents.

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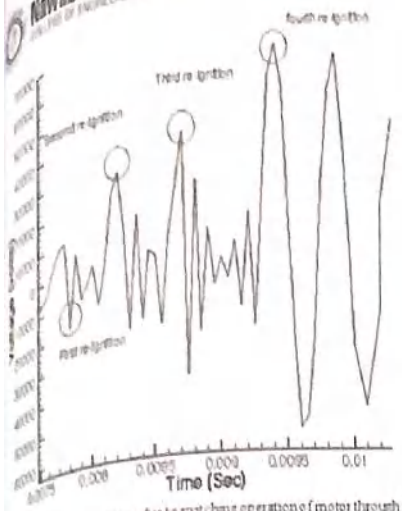

Figure 4. Voltage escalation due to restriking operation of motor through circuit breaker

The simulated result of abort start with single re-ignition is shown in Figure

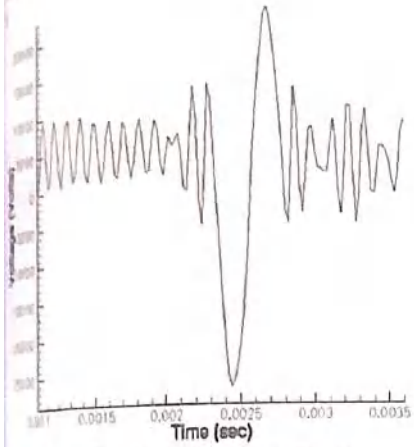

Figure 5. Re-ignition voltage due to abort start

The sequence of operation of closing and opening in abort start event is as follows

Closing time of switch is at 1ms.
Opening time of switch is at 2.25 ms
Closing time of switch is at 2.8ms

V. CONCLUSION

The present paper describes the result of voltage surge generated during three phase switching operation of a circuit breaker in 6.6 kV high power system connected through HV cable. In this paper voltage escalation due to multiple re-ignitions of circuit breaker have been investigated. It shows that abort start yields higher first re-ignition surge compared to normal first re-ignition. EMTP can be effectively used for simulation of re-ignition phenomena. Due to multiple re-ignitions voltage at motor terminal reached 9.85 kV. This transient over voltage exceeds basic insulation limit of the 6.6 kV motor and may damage the winding insulation. To avoid this phenomena it is advisable to use suitable surge arresters at motor side.

1. Acknowledgements

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CIVIL - 7

A STUDY OF SIMPLIFIED TECHNIQUES FOR SEISMIC SAFETY EVALUATION OF RCC BUILDINGS

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SYNOPSIS - *Most of the existing RCC buildings particularly the older ones are lacking adequate earthquake resistivity. If such buildings are identified they can be retrofitted so as to withstand the future earthquakes. Seismic vulnerability assessment of existing buildings is a costly, time consuming process. Use of simplified techniques can be justified for most of the structures. The purpose of this paper is to review such simplified methods for the seismic safety evaluation of existing buildings. The available methods are either qualitative or analytical or a combination of both. These methods rely on conditional assessment, visual inspection and non-destructive testing. The analytical methods include Capacity/Demand method, Push over analysis, Inelastic time-history analysis etc. Another way of classification divides the methods into 3 categories - Level-1 procedure consisting of Rapid visual screening. Level 2 procedures involving simplified vulnerability assessment based on the information obtained from level-1 and structural drawings or site measurements. Level-3 procedure involves detailed vulnerability assessments, making use of computer. Lot of work in this area has been done in U.S, Japan and Europe.*

INTRODUCTION

A number of great earthquakes have occurred in several parts of the world including the 4 in India. During the past 30 years about half a dozen major and moderate earthquakes which have occurred in India caused loss of life and severe damage to structures. In 1986, [ATC-40] specified the seismic evaluation and retrofit of concrete buildings. [ATC-14] covered the evaluation of seismic resistance of existing buildings in 1987. In 1988 Federal Emergency Management Agency (FEMA-154) came out with the handbook on Rapid Visual Screening for potential seismic hazards. Seismic demands are estimated by four analytical procedures which are linear & non- linear static/dynamic analysis. [FEMA-178] included the NEHRP handbook for seismic Evaluation of Existing buildings by Seismic Safety Council in 1992. In 1998, the Handbook for Seismic Evaluation of Buildings was brought out (FEMA-310). [FEMA-356] (Old 273) brought out the commentary on Seismic Rehabilitation of Buildings in 2000. In addition to the UBC provisions, the seismic evaluation of RC Moment Resisting Frame Buildings presented by Durgesh C Rai of IIT Kanpur and [GSDMA] (2005) document are also briefly reviewed. ATC-55 project brought out [FEMA 440] which summarizes the results of studies to assess the ability of Displacement Coefficient method to estimate the maximum displacement of inelastic structural models.

SEISMIC VULNERABILITY

The seismic vulnerability of a structure can be described as its condition to get damaged by ground shaking of a given intensity due to earthquake. The aim of a vulnerability assessment is to get the likelihood of a given level of damage to a given building type as a result of a severe earthquake. The different strategies for vulnerability assessment that are projected within the past to be used in loss estimation will be divided into two main categories: empirical or analytical, each of which might be utilized in hybrid strategies. A vulnerability assessment has to be created for a ... characterization of the ground motion, which is able to represent ... seismic demand of the earthquake on the building. The chosen para... ought to be able to correlate the ground motion with the damage ... buildings. Historically, macro seismic intensity and peak ... acceleration (PGA) are used, while more modern proposals ... connected the seismic vulnerability of the buildings to response sp... obtained from the ground motions. Every vulnerability assess... technique models the damage on a discrete damage scale; frequently ... examples include the MSK scale [Medvedev and Sponheuer, 1969] ... Modified Mercalli Scale [Wood and Frank Neumann, 1931]16 and ... EMS98 scale [Grunthal, 1998]17. In empirical vulnerability proced... the damage scale is employed in reconnaissance efforts to provide ... earthquake damage statistics, whilst in analytical procedures this s... associated with limit-state mechanical properties of the building... interstorey drift capacity. Seismic vulnerability assessment of struc... has been administrated by researchers in numerous parts of the glo... In 2007 Alam et al performed earthquake vulnerability analysis of bu... in sylhet (Bangladesh) using rapid Visual Screening methodology a... structural scoring system. Arya in 2008 mentioned the ... assessment of masonry buildings. Srikanth et al (2010) perfo... earthquake vulnerability assessment of existing buildings in Gandh... and Adipur Cities in Kachchh, Gujarat (India). Sadat et al (2010) asse... the seismic vulnerability of reinforced cement concrete structure... selected area in Dhaka national capital) city in Bangladesh using ... Visual Screening methodology and Turkish methodology. Agrawal ... Chourasia(2011) explained the method of seismic analysis ... representative buildings in 134 zones /wards of Delhi using questionn... framed based on Indian seismic codes. Both qualitative and quantita... ways were used. There exist no hard and fast rules concerning ... magnitude of earthquake up to which a specific structure is safe. Kama... et al (2011) reviewed the various methodologies accessible for seis... vulnerability assessment of buildings. Earthquake vulnerabi... assessment may be carried out primarily in 2 steps - (i) a prelimi... analysis using Rapid Visual Screening (RVS) and (ii) an in depth analysi...

Screening Methods

The rapid assessment of the seismic performance of existing reinforc... concrete buildings has received particular attention in Turkey in re... years. Several preliminary assessment methods have been propos... that require the dimensions of the lateral load resisting elements to ... defined. In 1997 Hassan and Sozen have proposed a procedure to deri... "Priority Index" for each building, which is a function of a wall index (... walls and infill panels divided by total floor area) and a column index (... of columns divided by total floor area). Damage data can be used ... calibrate the "Priority Index" and define the level of vulnerability of ... building. In 2004 Yakut11 has recently proposed a "Capacity Index" whi... considers the orientation, size and material properties of the lateral lo... resisting structural system as well as the quality of workmanship and ... materials and architectural features such as short columns and ...

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...mplications. Buildings are classified as either at low risk (and thus should ...d suffer severe damage) or at high risk (and thus would probably not ...eet the life safety performance level of recent seismic codes). These ...ast vulnerability assessment methods are of particular use for ...creening buildings for further more detailed assessments that would be ...equired to design a rehabilitation scheme. In 2005 the Seismic Safety ...creening Method (SSSM) has recently been proposed by Ozdemir et al. ...hich is an adaptation of the Japanese Seismic Index Method (JBDPA ...). This rapid seismic safety evaluation method can be applied to ...all buildings with 8 storeys or less and with reinforced concrete frame. To ...valuate the buildings of the surveyed area two methodologies were mainly ...sed: Rapid Visual Screening (RVS) suggested by FEMA and Turkish ...ethod.

Rapid Visual Screening (RVS)

...apid visual screening (RVS) of buildings for potential seismic hazards ...as initiated in 1988 with the publication of the FEMA 154 Report on (Rapid ...isual Screening of Buildings for Potential Seismic Hazards a Handbook) ...hich provides a procedure to identify, record and rank buildings that are ...reliminary seismically hazardous. This screening methodology is ...mplemented in a one page form, which combines a description of a ...uilding its layout and occupancy, and a rapid structural evaluation related ...o its seismic hazard. Although RVS is applicable to all buildings its ...rimary purpose is to identify (1) older buildings designed and ...onstructed before the adoption of adequate seismic design and detailing ...equirements (2) buildings on soft or poor soils or (3) buildings having ...erformance characteristics that negatively influence their seismic ...esponse. Once identified as potentially hazardous such buildings should ...e further evaluated by a design professional experienced in seismic ...esign to determine if, in fact, they are seismically hazardous.

...e rapid visual screening method is designed to be implemented without ...erforming any structural calculations. The procedure utilizes a scoring ...ystem that requires the evaluator to (1) identify the primary structural ...eismic load-resisting system and (2) identify building attributes that ...odify the seismic performance expected for this lateral load-resisting ...ystem. The inspection, data collection and decision-making process ...hich occurs at the building site, and is expected to take around 30 ...inutes for each building. The screening is based on numerical seismic ...azard and vulnerability score. Basic Structural hazard scores for various ...uilding types are provided on the RVS form. The screener modifies the ...basic structural hazard score by identifying and circling score modifiers ...hich are then added (or subtracted) to the basic structural hazard score ...o arrive at a final structural score, S. The basic structural hazard score ...and modifiers, the final structural score S, all relate to the probability of ...building collapse. The result of the screening procedure is a final score that ...may range above 10 or below 0, with a high score indicating good ...expected seismic performance and a low score indicating a potentially ...hazardous structure. While the score is related to the estimated probability ...of damage, it is not intended to be a final engineering judgment of the ...building, but merely to identify buildings that may be hazardous and require ...detailed seismic evaluation. If the score is 2 or less, a detailed evaluation is ...recommended. On the basis of detailed evaluation, engineering analysis ...or other detailed procedures, a final determination of seismic adequacy ...or need for rehabilitations can be made.

GSDMA METHOD

...Most times, after the 1999 earthquake in the cities of Kocaeli and ...Duzce, the Government of Turkey and Japan International Cooperation Agency ...came forward for implementing a regional seismic assessment and ...evaluation program. Researchers from various universities were involved in this program supported by the Government of Turkey and JICA. A sample two level Seismic Assessment Procedure for a building stock was proposed by Sucuoglu and Yazgan13 in 2003. In this most vulnerable buildings that may undergo severe damage in a future Earthquakes are identified. A survey of 472 damaged buildings (1-7 storey) affected by Duzce earthquake (November 1999) was carried out. This was then compiled to form a database of damaged buildings to be used for future research work.

GSDMA METHOD

Durgesh C. Rai has present the following method for evaluation of seismic vulnerability of existing RCC buildings. The first step consists of a preliminary evaluation involving the following checks: 1. Load Path 2. Geometry 3. Weak Storey 4. Soft Storey 5. Vertical Discontinuities 6. Mass 7. Torsion 8. Adjacent Buildings 9. Short Columns.

The next step consists of Strength Related Checks. The procedure is as follows:

(a)Design Seismic Base Shear

As per the draft code on seismic evaluation & strengthening the design seismic base shear is modified considering the existing conditions of the building.

Sa/g value is taken from Fig 2 of IS code & seismic zone factor Z from table 2. Importance factor I from table 6 & Response reduction factor R from table 7 of IS code. Calculation of seismic weight: Average dead load of roof, floor and live load intensity are considered. As per clause 7.3.1 of IS code imposed load to be considered in seismic weight may be 25% imposed load.

b) Shear Stress in RC Frame Columns

As per clause 6.5.1 of the draft code, an estimation of the average shearing stress in columns is given as

$\tau col = \{nc/(nc-nf)\}(V_j/Ac)$

nc = total no. of columns resisting lateral forces in the direction of loading

nf = total no. of frames in the direction of loading

Ac = Summation of the cross-section area of all columns in the storey under consideration

V_j = maximum storey shear at storey level j

$(\tau col)all$ < min. of 0.4MPa and 0.1 x fck < 0.4MPa

If $\tau col > (\tau col)all$ NG, the check is not satisfied a more detailed evaluation of the structure should be performed.

(c) Axial Stress in Moment Frames

Axial force in columns of moment frames at base due to overturning forces.

$F_a = 2/3 (VB \cdot nf)(H/L)$

VB = Base shear x Load factor

nf = No. of frames in the direction of loading

H = total height

L = length of the building

If the axial stress σ_a & $\sigma all = 0.25 fck$

Are such that $\sigma < \sigma_{all}$ then Ok

If the check is satisfied depending on DCR value it is OK, otherwise more detailed evaluation of the structure should be performed.

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EMPIRICAL METHODS

The seismic vulnerability assessment of buildings at large geographical scales has been first carried out in the early 70s' through the empirical methods initially developed and calibrated as a function of macro seismic intensities. There are 2 kinds of these methods based on the damage determined after the earthquakes, each of which may be called 'damage motion relationships'

Vulnerability Index Method

This method has been extensively used in Italy in the past few decades, and is predicted on an over sized quantity of damage survey data , this technique is 'indirect' as a result of a relationship between the seismic action and also the response is established through a ' vulnerability index'. The method uses a field survey form to gather data on the vital parameters of the building that may influence its vulnerability. There are 11 parameters in total, each having one of 4 qualificationents iK, in accordance with the standard conditions – from A (optimal) to D (unfavorable) - and are weighted to account for their relative importance. The VI ranges from 0 to 382 5, however is rationalized from 0 to 100, where 0 represents the least vulnerable building and 100 the foremost vulnerable. The information from past earthquakes is employed to calibrate vulnerability functions to relate the VI to a global damage factor 'd' of buildings with similar typology, for a similar macro seismic intensity or PGA

CONCLUSIONS

A brief review of some of the techniques used for the seismic safety evaluation was presented. It is unlikely that a single methodology can be produced which fulfils all of the requirements e.g. many analytical/mechanical models, though theoretically superior require a large amount of detailed data, but the benefit of collecting such data is often not proven through validation of the methodology models with empirical models based on the observed damage data. Characteristics of the building stock and the influence of incorrectly modeling the seismic demand experienced by the buildings in the damaged region is normally accounted for. Furthermore, many methodologies do not explicitly mod the various sources of uncertainty. Thus, it appears that the ideal approac for the future needs to be a combination of the positive aspects of differe vulnerability assessment methodologies. In other words, reliabl vulnerability assessment of a given region is likely to call for th employment of at least two to three different approaches which shoul complement and/or verify each other. The latest recent developmen within the field of seismic hazard assessment ought to be incorporated

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MECH - 1

ANALYSIS OF HYPERSONIC SCRAMJET ENGINE WITH A STARTING MACH NUMBER OF 4

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ABSTRACT *Scramjet Engine works at the hypersonic speeds generally at mach no 5. To achieve this speed turbojet engine following ramjet engines are used. To reduced the number of engines used, the starting mach no. is decreased such that scramjet engine is operable. The design for such a scramjet engine is carried out three dimensionally in this project considering only the inlet designs and the flow analysis is carried out in ANSYS & CFD.*

I. INTRODUCTION

In order to provide the definition of a scramjet engine, the definition of a ramjet engine is first necessary, as a scramjet engine is a direct descendant of a ramjet engine. Ramjet engines have no moving parts, instead operating on compression to slow free stream supersonic air to subsonic speeds, thereby increasing temperature and pressure, and then combusting the compressed air with fuel. Lastly, a nozzle accelerates the exhaust to supersonic speeds, resulting in thrust. In a ramjet engine due to the deceleration of the free stream air, the pressure, temperature and density of the flow entering the burner are "considerably higher than in the free stream". At flight Mach numbers of around Mach 6, these

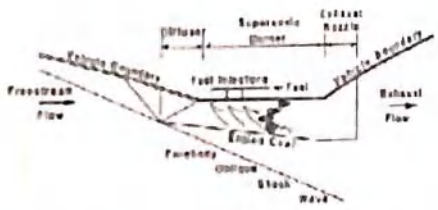

Fig-1 Two-dimensional schematic diagram of scramjet engine

increases make it inefficient to continue to slow the flow to subsonic speeds. Thus, if the flow is no longer slowed to subsonic speeds, but rather only slowed to acceptable supersonic speeds, the ramjet is then termed a 'supersonic combustion ramjet,' resulting in the acronym scramjet. Fig-1 shows the schematic two-dimensional scramjet engine.

II. SCRAMJET ENGINE HISTORICAL TIMELINE

It is the intention of this section to provide a brief introduction to the historical timeline of the scramjet, so as to provide a knowledge base for the current project. There have been many authors that have provided more thorough historical accounts of both the ramjet and scramjet this section only seeks to list the highlights of the scramjet's development here. As mentioned previously, the scramjet is a direct descendent of the ramjet. Therefore, in an attempt to provide a brief historical timeline of the modern-day scramjet, we must first begin with the invention of the ramjet. The first patent for a subsonic ramjet device, specifically for what is now known as an ejector ramjet, was issued to Lake in the United States in 1909. Simultaneously, René Lorin of France was working on ejector ramjets, publishing the first treatise on subsonic ramjets in 1913. According to Fry, the ramjet engine reached a relative peak of interest during the 1950s in terms of the number of operational systems being deployed, with a subsequent international resurgence of attention beginning in the 1980s. Development on the scramjet, on the other hand, did not begin until the mid 1950s through early 1960s. The basis for its development came about due to an interest in "burning fuels in external streams to either reduce the base drag of supersonic projectiles or to produce lift and/or thrust on supersonic and hypersonic airfoils in the early 1950s". Additionally, the findings of the 1960 study by Dugger on the relative performance of a kerosene-fueled conventional ramjet engine (CRJ) and a scramjet engine showed that the scramjet's performance would exceed the performance of the CRJ in the speed range of Mach 6 to 8. The first scramjet demonstration also took place in 1960 by Ferri. Following this demonstration, many major scramjet development programs were started in the United States, the most extensive of these being the NASA Hypersonic Research Engine or Hypersonic Ramjet Experiment (HRE) program in 1964. The core goal for the HRE project was to test a "complete, regeneratively cooled, flight weight scramjet on the X-15A-2 rocket research airplane". Unfortunately, this program was not able to be flight tested as the cost to repair the X-15 A-2 was too high and the entire X-15 program was cancelled in 1968.

In summary, the major propulsion systems of the modern era have a direct correlation between the year of their first flight and their current prevalence of application: Turbojet-1939, Ramjet-1940, High-Performance Large Liquid-Fueled Rocket Engine-1943, Practical Man-Rated Reusable Throttleable Rocket Engine-1960, and the Scramjet-2002. However, despite the fact that no operational and readily available scramjet engine currently exists, this is not due to a lack of potential applications which would benefit greatly from the use of the scramjet.

III. PRELIMINARY CALCULATION OF CYCLE STATIC TEMPERATURE RATIO T3/T0 NECESSARY FOR STARTING MACH NUMBER OF 4

Due to the impact of T_3/T_0 on the design, this section will present the theory and governing equations that the preliminary investigation of this parameter requires. The largest factor in changing the freestream Mach number at which supersonic combustion begins is the cycle static

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temperature ratio T_3/T_0. As T_3/T_0 increases for a given freestream Mach number (M0), the Mach number of the flow entering the combustor increases. Thus T_3/T_0 directly affects the M at which the flow entering the burner (M_3) becomes supersonic. So with a range of freestream Mach numbers, the necessary T_3/T_0 can be determined based on M_3 and the ratio of specific heats at compression (yc) where $M_3 = 1$ by the following equation.

$$M_3 = \sqrt{\frac{2}{\gamma_c - 1}\left\{\frac{T_0}{T_3}\left(1 + \frac{\gamma_c - 1}{2}M_0^2\right) - 1\right\}} \qquad 1$$

A. ANALYSIS VARIATION OF CYCLE STATIC TEMPERATURE RATIO

The cycle static temperature ratio (T3/T0) has a powerful impact on the starting Mach number of a scramjet. As Equation 1 shows, T3/T0, the ratio of specific heats during compression ([]c), and the free stream Mach number (M0) are the only variables which determine the burner entry Mach number (M3). The specific heat ratio can be considered constant in the compression component. With the requirement that M3 > 1 to ensure supersonic combustion, lowering M0 can apparently be achieved by lowering T3/T0. Therefore, T3/T0 has perhaps the greatest impact on whether it is possible to lower the scramjet starting Mach number. Thus, it is necessary to determine what the required value of T3/T0 is to achieve a starting scramjet Mach number of 3.50. Using Equation 1 with a range of free stream Mach numbers, and []c = 1.36, the necessary T3/T0 for each free stream starting Mach number can be determined where M3 ≥ 1. According to the calculations in the reference papers, with generic values chosen for the fuel properties and the fuel-to-air ratio, the maximum T3/T0 for a scramjet with a starting Mach number of 3.50 to maintain supersonic combustion is 1.25 (with no available margin), which hardly requires any compression at all. Although a T3/T0 value exists for lowering the starting scramjet Mach number to 3.50, the overall performance values are quite low. Though scramjet overall efficiencies are commonly around 50%, and are often as low as 30%, the overall efficiency here is only 9%. This is a very low efficiency and one that severely impedes any possible benefits for starting the scramjet at M0 = 3.50. Also, the values of specific impulse and specific thrust are significantly reduced with a value of T3/T0 this low. Therefore, this section has shown that further investigation of the remaining design parameters is needed to aid in lowering the scramjet starting Mach number, so that the T3/T0 value may be selected at a higher value closer to the value of 2.75. On the other hand, it is found out that a Mach no. of 4.00 is both feasible and practicable. Hence we take Mach 4.00 as the free stream Mach no. and carry out our analysis. The design of compression systems is characterized by the cardinal number of oblique shock waves available to produce a specified cycle static temperature ratio at a specified Mach number and in the cases when more than one shock wave is specified, all oblique shock waves must provide equal amounts of geometric turning of the flow. The compression sequence is assumed to begin at the leading edge of the vehicle. The input values are M0, T3/T0, [], and the number of desired oblique shock waves. The number of oblique shock waves has a direct impact on the compression efficiency ([]c). It is from these values and plotting the graph that an educated guess can be made as to how many shock waves are necessary based on the M0, T3/T0, and the desired compression efficiency. It should be noted that the higher the number of oblique shock waves, the longer the compression system will be. Also, with more oblique shocks, more off-design complications will exist.

IV. DESIGN OF SCRAMJET WITH STARTING MACH NUMBER OF 4

By using hypersonic airbreathing propulsion (HAP) gas tables the parameters of each component of scramjet engine is determined with starting mach number 4

Co-ordinates for

Upper Body		Lower Body	
X	Y	X	Y
0	1.119	1.1118	0.5
2.534	0.619	3.5199	0.5
4.017	0.417	4.4671	0.8
5.149	0.2206	5.167	0.5
5.199	0.152		
4.164	0.152		
4.167	0.252		
3.019	0.781		
1.1169	2.8171		

Four different models can be created in the analysis, namely Single Ramp, Double Ramp, Tri Ramp and Four Ramps. The ramp angles were obtained in the analysis part in earlier and the ramps are varied in the following way. For a Single ramp engine model, all inlet values will not be considered. Inlet values (upper body) of 1 and 5 will directly be joined and values 2, 3 and 4 are not taken into account. 1 and 5 points are directly joined and the line joining points 1 and 5 is the single ramp of the engine model. For Double ramp engine model, inlet values (upper body) of 1, 2 and 5 are joined and values 3 and 4 are not taken into account. Lines joining points 1-2, 2-5 form two ramps of the engine model. For a Tri ramp engine model, inlet values (upper body) of 1, 2, 3 and 5 are joined and 4th value is not considered. Lines joining the points 1-2, 2-3, 3-5 form three ramps of the engine model. For Four ramp engine model, all inlet values (upper body) are joined. Lines joining 1-2, 2-3, 3-4 and 4-5 form four ramps of engine model. Finally the scramjet is extruding to 8mm thickness and placed in between the control volume. The 3D model of single and four ramps are shown below

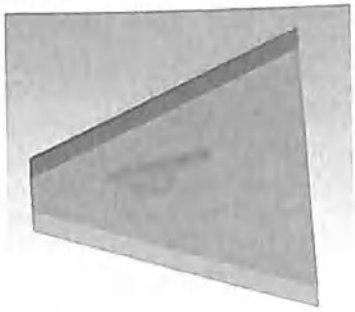

Fig:2 3D Scramjet engine with single ramp

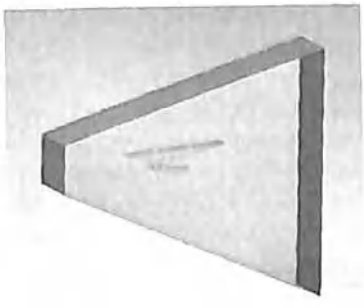

Fig:3 3D Scramjet engine with four ramp

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The meshing is done with tetrahedron cells, the single ramp scramjet model is divided into 200809 cells and four ramp scramjet models is divided into 446212 cells

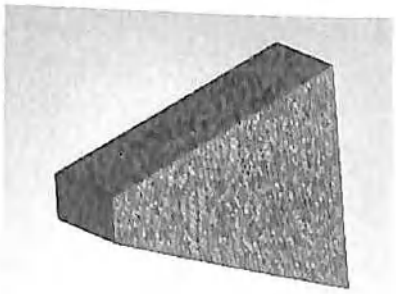

Fig4 3D Meshed model of Scramjet engine with single ramp

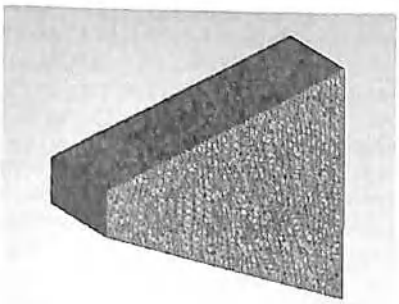

Fig: 5 3D Meshed model of Scramjet engine with four ramp

V. CFD METHOD

Initially analysis was done with less dense mesh in ansys and the results were not in any way closer to the analytical values. Therefore in order to get more precise values, we mesh the model more densely

A. FLUENT ANALYSIS

After the mesh file is imported the mesh check and reordering of domain and zones are done. As the free stream velocity is in supersonic Density-based model should be taken. The energy equation should be ON and the model is k-omega SST. The fluid is ideal gas with viscosity as Sutherland. The operating pressure should be Zero.

B. BOUNDARY CONDITIONS

i Inlet - pressure far field – guage pressure(4275 Pa) – mach number(4) - temp (216.16 K)
ii Outlet - Pressure Outlet - temp(K)
iii Wall - pressure far field - guage pressure (4275 Pa) – mach number(4) - temp (216.16 K)

C. SOLUTION METHOD

Implicit methods is used because it is a time saving process and get the approximate results where as explicit method is a time taking process because in this process the initial values changes for each and every cell. Courant number is the time stepping scheme it can increase so as to get the solution early

VI. RESULTS AND DISCUSSION

The analysis of single and four ramp scramjet engine with the help of ANSYS Workbench. The pressure, temperature and Mach number contours of single and four ramp are shown below

A CONTOURS OF SINGLE RAMP

Fig:4Contour of Pressure

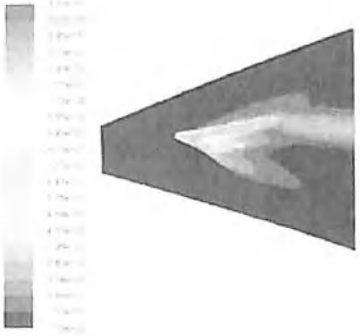

Fig:5 Contour of Temperature

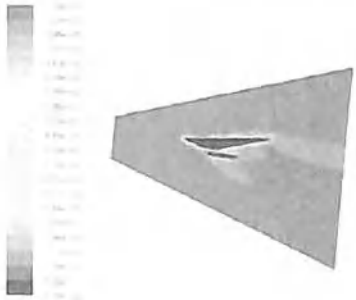

Fig:6 Contour of velocity

B CONTOURS OF FOUR RAMP

Fig:7 Contour of Pressure

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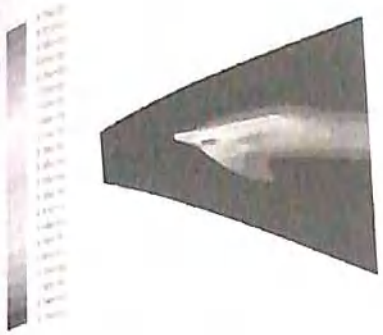

Fig:8 Contour of Temperature

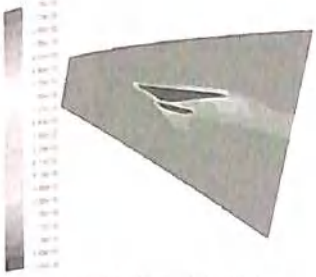

Fig:9 Contour of velocity

C. COMPARISON OF THEORETICAL AND CFD VALUES OF SINGLE AND FOUR RAMP SCRAMJET ENGINE

	RAMPS	
	Single	Four
Mach no theoretical	3.1	1.518
Mach no CFD	2.26	1.545
P_2/P_0 theoretical	8.3	34.86
P_2/P_0 CFD	8.02	36.1
T_2/T_0 theoretical	1.41	2.8
T_2/T_0 CFD	2.66	2.76

The above comparison concludes that the pressure ratio and the temperature ratios of theoretical and CFD analysis are in acceptable limit for four ramp scramjet engine. As for supersonic combustion the mach number should be in the range of 1-2 mach clearly from the above comparison the mach numbers are also in acceptable limits.

VII. CONCLUSION

The purpose of this project is to determine whether the free stream starting Mach number of a scramjet can be lowered to mach 4. The purposes of this project has been accomplished, by successively analyzing the driving parameters influencing the starting Mach number and applying the necessary theory and equations. Hence a Scramjet engine is then modeled and analysis carried out in FLUENT for the same with different design models. It was found out that a model with starting Mach number of 4.00 was feasible as it matched the theoretical values with CFD values. Among the single and four ramp designs, a design with four ramps yielded better results than single ramp. The present analysis shows that the design Starting Mach number of Scramjet can be reduced to Mach number 4 but with the same design Scramjet cannot be used above mach 10 as the fuel used in this analysis is JP-7 which is a hydrocarbon fuel. The scramjet can be used above mach 10 if the fuel is hydrogen fuel for that there should be a detail study on the different parameters.

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MECH - 2

DESIGN OF HVAC SYSTEM FOR A COMMERCIAL BUILDING

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ABSTRACT *In current practice, HVAC designing based on standardized procedures that were mostly developed by ASHRAE (IAQ) 62.1 2001 Handbook. In any HVAC design, Engineers are faced difficulties with the challenge of trying to capture all the information that completes a system. The difficulty in this process can be that there is limited information available, using previous study work as a template helps to approach to the work orderly. The key idea behind this HVAC Design System is to improve the indoor quality of air in commercial as well as residential buildings. It includes information and advice on overall building design system to minimize the loads during all seasons. This HVAC system involves ducts as a path which used in buildings to carry air from all parts of the building. It is designed in such a way that, it helps to reduce the loads occur on the building. Cooling load is calculated through the Hourly Analysis Program which recorded the valves for every hour and provides us the better outcome.*

There are three major HVAC components that make up a system complete. These include equipment, piping, and ductwork. These three items will be discussed in detail on how their design and layout can impact the building and how to implement what is actually needed to complete the system. All the work is done with the use of ASHRAE standards. The results show that the total cooling load for the required rooms is 80 tons. For the chilled water piping I have used PEX (crossed linked polyethylene) piping. I would bold to say that PEX shouldn't have any fragility problems. All this pipes have light insulating characteristics.

I. INTRODUCTION

In present days the environmental problem is one of the most serious problems. Energy consumption by industries and buildings are responsible for this problem. About 72% of world energy is consumed by infrastructure, industry, commercial buildings, residential houses, and markets. In a large building or complex, which is air conditioned, about 60% of the total energy requirement in the building is allocated for the air conditioning plant installed to use the cooling purpose. Exact prediction of the cooling and heating load, proper sizing of the heat ventilation air-conditioning (HVAC) system and optimal control of the HVAC systems are important to minimize energy consumption. Root factors that affect cooling loads are the external climates such as outdoor temperature, solar radiation and humidity. Local climatic conditions are important parameters for the energy efficiency of buildings. Because the energy consumption in buildings depends on the climatic conditions and the performance of heating ventilating and air conditioning (HVAC) systems changes with them as well. better design in building HVAC applications that take account of the right climatic conditions will result in better comfort and more energy efficient buildings. Heating, Ventilating and Air Conditioning, HVAC, is a huge field. A HVAC system is used for comfort heating, to the extremely reliable total air-conditioning systems found in sub-marines and space shuttles. Cooling equipment varies from the small domestic unit to refrigeration machines that are 10,000 times the size, which are used in industrial processes.

Calculating the thermal load of building is very essential to find exact air-conditioning equipment and air handling unit, to achieve comfort operation and good air distribution in the air conditioned zone.

LITERATURE REVIEW

In present days the environmental problem is one of the most serious problems. Energy consumption by industries and buildings are responsible for this problem. About 72% of world energy is consumed by infrastructure, industry, commercial buildings, residential houses, and markets. In a large building or complex, which is air conditioned, about 60% of the total energy requirement in the building is allocated for the air conditioning plant installed to use the cooling purpose. Exact prediction of the cooling and heating load, proper sizing of the heat ventilation air-conditioning (HVAC) system and optimal control of the HVAC systems are important to minimize energy consumption. Modern air conditioning is critical to almost every facet of advancing human activity. Although there have been great advances in HVAC, there are several areas where active research and debate continue. Indoor air quality is one that directly affects us. In many countries of the world there is a rapid rise in asthmatics and increasing dissatisfaction with indoor-air-quality in buildings and planes. The causes and effects are extremely complex. A significant scientific and engineering field has developed to investigate and address these issues.

HVAC system components may be grouped into three functional categories: source components, distribution components, and delivery components. Source components provide or remove heat or moisture. Distribution components convey a heating or cooling medium from a source location to portions of a building that require conditioning. Delivery components serve as an interface between the distribution system and occupied spaces. Compact systems that serve only one space or zone of a building (local systems) often incorporate all three functions in a single piece of equipment. Systems that are intended to condition multiple spaces in a building (central systems) usually have distinctly different equipment elements for each function.

OBJECTIVE

The objective of this project is to calculate cooling load to find exact air-conditioning equipment and air handling unit, to achieve comfort operation and good air distribution in the air-conditioned zone.

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HVAC System Design

The main objectives of HVAC system design are as follows

- Control of temperature, humidity, air purity and correct pressurization
- Avoid contamination
- Provide comfort and healthy indoor environment of office buildings, educational buildings, cinemas, libraries, auditoriums, multiplex, shopping centers, hotel, public place
- Provide special air filtration to remove bacteria, high indoor quality, and cross contamination

Cooling Load Calculation

The objectives of cooling load calculation are as follows

- To determine be the optimum rate at which heat needs to be removed from space to establish thermal equilibrium & maintain a pre-determined space conditions
- To calculate peak design loads (cooling/heating)
- To estimate capacity or size of plant/equipment.
- To provide info for HVAC designs e.g. load profiles
- To form the basis for building energy analysis

DATA COLLECTION

Basic Information

Before estimating cooling load of any building there are some basic information are necessary to design an exact HVAC systems, like building orientation, weather condition, building spacing, buildings materials etc. The more exact the information the more accurate will be the load estimated.

Building Location

The commercial building considered in this study is situated in Hyderabad district Telangana, India and at an elevation of about 1,657 ft above mean sea level.

Weather Conditions: According to ASHRAE 62.1 - 2004

- Summer conditions:
  - Dry bulb temp = 42 °C
  - Wet bulb temp = 26 °C
- Winter conditions:
  - Dry bulb temp = 13 °C
  - Wet bulb temp = 9 °C

Building Structures

It has three floors included the ground floor. The exterior walls of building consists of 230 mm common bricks + air space + with 13 mm cement mortar and 26 mm (13 mm both side) sand cement plaster. The interior walls of building are consist of 230 mm common bricks with 26 (13 mm both side) inch sand cement plaster. The roofs consist of 152 mm concrete poured in a metal sheet with 13 mm plaster. The windows consist of single glass materials of 12.7mm thick with frame panel.

CALCULATING HEAT LOAD CALCULATION

Heat load is calculated through Hourly Analysis Program (HAP) which gives the precise result. HAP is a computer tool which assists engineers in designing HVAC systems for commercial buildings. HAP is two tools in one. First it is a tool for estimating loads and designing systems. Second, it is a tool for simulating building energy use and calculating energy costs. HAP uses the ASHRAE-endorsed transfer function method for load calculations, and detailed hour by-hour simulation techniques for the energy analysis.

HAP System Design Features

HAP estimates design cooling and heating loads for commercial buildings in order to determine required sizes for HVAC system components. Ultimately, the program provides information needed for selecting and specifying equipment. Specifically, the program performs the following tasks.

- Calculates design cooling and heating loads for spaces, zones, and coils in the HVAC system
- Determines required air flow rates for spaces, zones and the system
- Sizes cooling and heating coils
- Sizes air circulation fans
- Sizes chillers and boilers.

Gather Data

Before design calculations can be performed, information about the building, its environment and its HVAC equipment must be gathered. This step involves extracting data from building plans, evaluating building usage and studying HVAC system needs. Specific types of information needed include

- Climate data for the building site
- Construction material data for walls, roofs, windows, doors, exterior shading devices and floors, and for interior partitions between conditioned and non-conditioned regions
- Building size and layout data including wall, roof, window, door and floor areas, exposure orientations and external shading features
- Internal load characteristics determined by levels and schedules for occupancy, lighting systems, office equipment, appliances and machinery within the building
- Data concerning HVAC equipment, controls and components to be used.

Enter Weather Data

Weather data defines the temperature, humidity and solar radiation conditions the building encounters during the course of a year.

These conditions play an important role in influencing loads and system operation. To define weather data, a city can be chosen from the program's weather database, or weather parameters can be directly entered. Weather data is entered using the weather input form.

Enter Space Data

A space is a region of the building comprised of one or more heat flow elements and served by one or more air distribution terminals. Usually a space represents a single room. However, the definition of a space is flexible. For some applications, it is more efficient for a space to represent a group of rooms or even an entire building. To define a space, all elements which affect heat flow in the space must be described. Elements include

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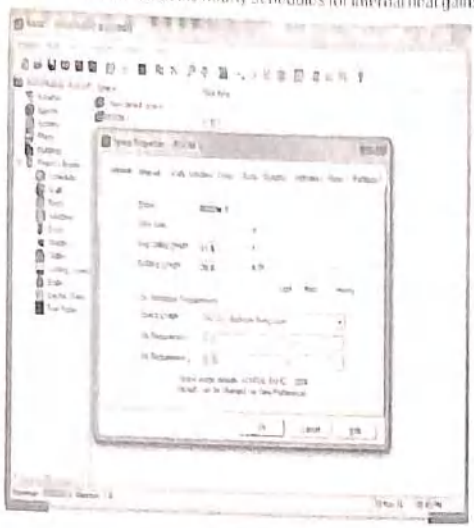
walls windows doors roofs skylights floors occupants lighting electrical equipment, miscellaneous heat sources, infiltration, and partitions. While defining a space information about the construction of walls roofs windows doors and external shading devices is needed as well as information about the hourly schedules for internal heat gains.



This construction and schedule data can be specified directly from the space input form (via links to the construction and schedule forms), or alternately can be defined prior to entering space data. Space information is stored in the project database and is later linked to zones in an air system.

Enter Air System Data

An Air System is the equipment and controls used to provide cooling and heating to a region of a building. An air system serves one or more zones. Zones are groups of spaces having a single thermostatic control. Examples of systems include central station air handlers, packaged rooftop units, packaged vertical units, split systems, packaged DX fan coils, fan coils and water source heat pumps. In all cases, the air system also includes associated ductwork, supply terminals and controls. To define an air system the components, controls and zones associated with the system must be defined as well as the system sizing criteria. This data is entered on the air system input form.

Select Equipment

Finally use data from the reports you generated to select the appropriate cooling and heating equipment from product catalogs or electronic catalog software. System and plant design reports provide information necessary to select all the components of your HVAC system including air handler packaged equipment, supply terminals, duct systems, piping systems an plant equipment.

DISCUSSION

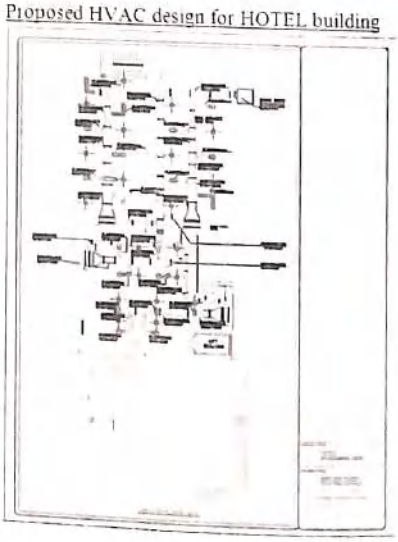
In any building, heat is transmitted through external walls, top roof, floor the ground floor, windows and doors. Heat transfer takes place b conduction, convection and radiation. The cooling load of the building dependent on local climate, thermal characteristics of material and type building. For cooling load calculation, there are many types of softwa such as DOE 2.1E, BLAST OR Elite available which use the transf functions method and heat balance method. These methods require complex and lengthy data input. Therefore, most of the designers do n use these methods. They prefer a more compact and easy method fo calculating the cooling load of a building. A more basic version fo calculating a cooling load using the transfer function method is to use th one step procedure. This method is called the Hourly Analysis Prograr version (HAP) 4.5. In this method, software automatically calculated th cooling load.

Hand calculations were done for a small portion of the building using the a equations mentioned in the Hotel building there are total 28 rooms of thre floors where air conditioning is required including general rooms, meetin rooms and etc. Each one of them is treated as separate system. A equations required for heat transfer through the building and for th inside's load were used to get the thermal load. Then, all the equation were inserted in a particular program MS Excel, to get the results. For th chilled water piping I have used PEX (crossed linked polyethylene) piping would bold to say that PEX shouldn't have any fragility problems. All th pipes have light insulating characteristics.

The general step by step procedures for calculating the total heat load ar as follows

- Select inside design condition (Temperature, relative humidity).
- Select outside design condition (Temperature, relative humidity)
- Determine the overall heat transfer coefficient Uo for wall, ceiling floor, door, windows, below grade.
- Calculate area of wall, ceiling, floor, door, windows and Calculate TR.

Proposed HVAC design for HOTEL building



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CONCLUSION

In this study, a hotel building an integrated part of a research institution located in Hyderabad was considered for calculating cooling loads. Hourly analysis Program (HAP) method was used to find the cooling load. Cooling load items such as people light infiltration and ventilation can easily be plotted to the MS-Excel program. The program can also be used to calculate cooling load due to walls and roofs.

- The results show that the total cooling load for the AC required rooms is 88 tons.
- 3 Air cooled Chiller is used (2 working & 1 stand by) each of 40 ton.
- Provided Exhaust system for (Kitchen, Car parking & toilet ventilation)
- Ducts, Diffusers & Fan coil units are used as a medium to provide conditioned air to the unconditioned spaces.
- Designing & Drafting is prepared for hotel building. Hence site engineer needs to be execute according to the results and drawing.

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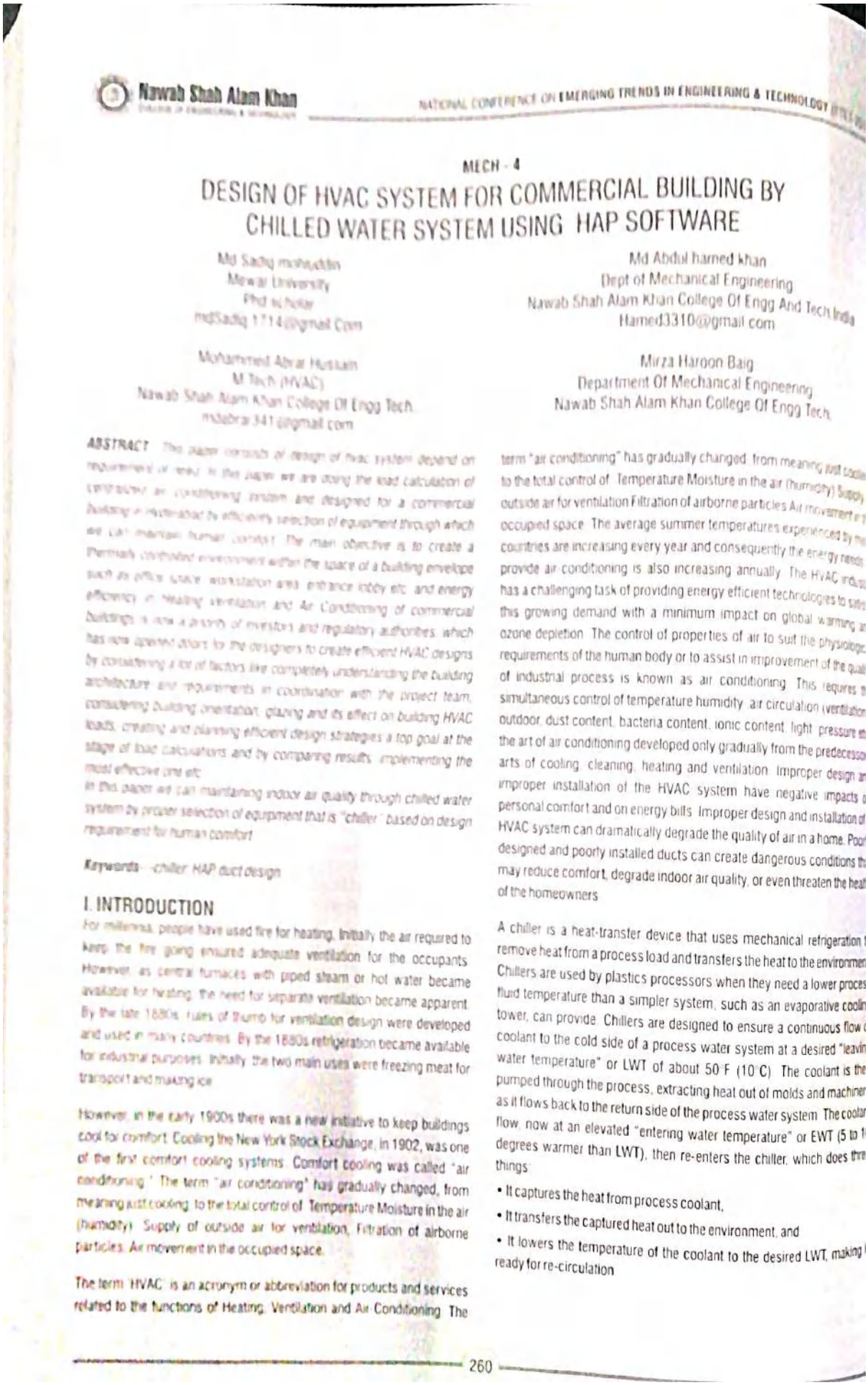

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NATIONAL CONFERENCE ON EMERGING TRENDS IN ENGINEERING & TECHNOLOGY

MECH - 4

DESIGN OF HVAC SYSTEM FOR COMMERCIAL BUILDING BY CHILLED WATER SYSTEM USING HAP SOFTWARE

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ABSTRACT This paper consists of design of hvac system depend on requirement of area. In this paper we are doing the load calculation of centralized air conditioning system and designed for a commercial building is illustrated by efficiently selection of equipment through which we can maintain human comfort. The main objective is to create a thermally controlled environment within the space of a building envelope such as office space, workstation area, entrance lobby etc. and energy efficiency in Heating, Ventilation and Air Conditioning of commercial buildings is now a priority of investors and regulatory authorities, which has now opened doors for the designers to create efficient HVAC designs by considering a lot of factors like completely understanding the building architecture and requirements in coordination with the project team, considering building orientation, glazing and its effect on building HVAC loads, creating and planning efficient design strategies a top goal at the stage of load calculations and by comparing results, implementing the most effective one etc.
In this paper we can maintaining indoor air quality through chilled water system by proper selection of equipment that is "chiller" based on design requirement for human comfort.

Keywords -chiller, HAP, duct design

I. INTRODUCTION

For millennia, people have used fire for heating. Initially the air required to keep the fire going ensured adequate ventilation for the occupants. However, as central furnaces with piped steam or hot water became available for heating, the need for separate ventilation became apparent. By the late 1800s, rules of thumb for ventilation design were developed and used in many countries. By the 1880s refrigeration became available for industrial purposes. Initially, the two main uses were freezing meat for transport and making ice.

However, in the early 1900s there was a new initiative to keep buildings cool for comfort. Cooling the New York Stock Exchange, in 1902, was one of the first comfort cooling systems. Comfort cooling was called "air conditioning." The term "air conditioning" has gradually changed, from meaning just cooling, to the total control of Temperature Moisture in the air (humidity). Supply of outside air for ventilation, Filtration of airborne particles, Air movement in the occupied space.

The term 'HVAC' is an acronym or abbreviation for products and services related to the functions of Heating, Ventilation and Air Conditioning. The term "air conditioning" has gradually changed, from meaning just cooling, to the total control of Temperature Moisture in the air (humidity). Supply of outside air for ventilation Filtration of airborne particles Air movement in the occupied space. The average summer temperatures experienced by many countries are increasing every year and consequently the energy needs to provide air conditioning is also increasing annually. The HVAC industry has a challenging task of providing energy efficient technologies to satisfy this growing demand with a minimum impact on global warming and ozone depletion. The control of properties of air to suit the physiological requirements of the human body or to assist in improvement of the quality of industrial process is known as air conditioning. This requires the simultaneous control of temperature humidity, air circulation (ventilation), outdoor, dust content, bacteria content, ionic content, light, pressure etc. the art of air conditioning developed only gradually from the predecessor arts of cooling, cleaning, heating and ventilation. Improper design and improper installation of the HVAC system have negative impacts on personal comfort and on energy bills. Improper design and installation of HVAC system can dramatically degrade the quality of air in a home. Poorly designed and poorly installed ducts can create dangerous conditions that may reduce comfort, degrade indoor air quality, or even threaten the health of the homeowners.

A chiller is a heat-transfer device that uses mechanical refrigeration to remove heat from a process load and transfers the heat to the environment. Chillers are used by plastics processors when they need a lower process fluid temperature than a simpler system, such as an evaporative cooling tower, can provide. Chillers are designed to ensure a continuous flow of coolant to the cold side of a process water system at a desired "leaving water temperature" or LWT of about 50°F (10°C). The coolant is then pumped through the process, extracting heat out of molds and machinery as it flows back to the return side of the process water system. The coolant flow, now at an elevated "entering water temperature" or EWT (5 to 10 degrees warmer than LWT), then re-enters the chiller, which does three things:

- It captures the heat from process coolant,
- It transfers the captured heat out to the environment, and
- It lowers the temperature of the coolant to the desired LWT, making it ready for re-circulation.

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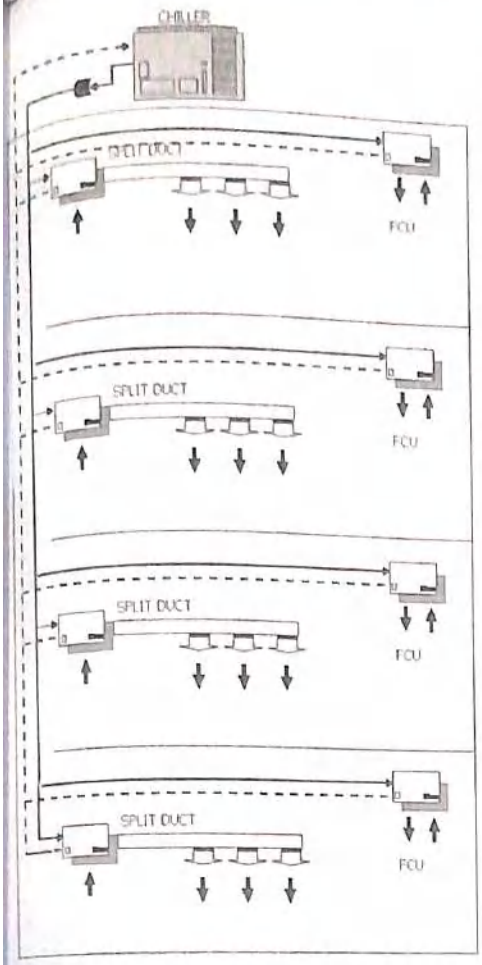


HOW DOES A CHILLER WORK?

A chiller is a vapor compression mechanical refrigeration system that connects to the process water system through a device called an evaporator. The evaporator is a heat exchanger in which heat captured by the process coolant flow is transferred to the flow of refrigerant fluid. As the heat-transfer takes place, the refrigerant evaporates, changing from a low-pressure liquid into vapor, while the temperature of the process coolant is reduced down the desired LWT. Next, the refrigerant flows to a compressor, which performs two functions. First, it removes refrigerant vapor from the evaporator and ensures that the pressure in the evaporator refrigerant line (vapor pressure) remains low enough to absorb process heat at the correct rate. Second, it raises the pressure in outgoing refrigerant vapor to ensure that its temperature is high enough to release its heat when it reaches the condenser, where the refrigerant returns to a liquid state.

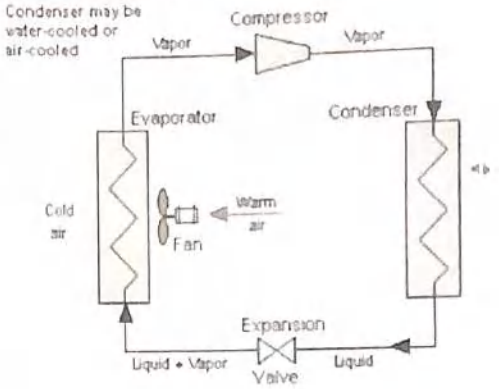
The latent heat given up as the refrigerant changes from vapor to liquid is carried away to the environment by a cooling medium (air or water). Thus, there are two types of condensers: air-cooled and water-cooled.

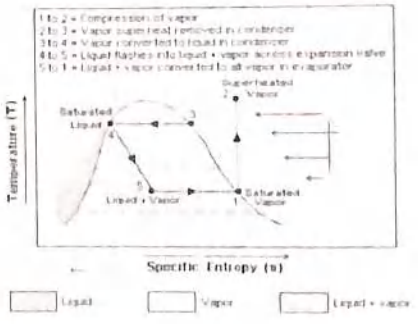
- Air-cooled condensers resemble the "radiators" that cool automobile engines. They use a motorized blower to force air across a grid of refrigerant lines. Unless they are specially 14
Design for high-ambient conditions, air-cooled condensers require ambient temperatures of 95°F (35°C) or below to operate effectively.
- Water-cooled condensers perform the same function as air-cooled condensers, but require two steps, rather than one, to complete heat transfer. First, heat moves from refrigerant vapor into the condenser water. Then the warm condenser water is pumped to a cooling tower where the process heat is ultimately discharged to the atmosphere.

Literature review:

2.1 Air Conditioning

In summer, air conditioners work in such a way to provide cooling and dehumidification. They extract heat from inside the home and transfer it outside. This system typically use a "vapour compression cycle". This cycle circulates a refrigerant, a material that increases in temperature significantly when compressed and cools rapidly when expanded. The exterior portion of a typical air conditioner is called the condensing unit and houses the compressor, the noisy part that uses most of the energy, and the condensing coil. An air-cooled condensing unit should be kept free from plants and debris that might block the flow of air through the coil or damage the thin fins of the coil. Ideally, the condensing unit should be located in the shade. The inside mechanical equipment, called the air-handling unit, houses the evaporator coil, the indoor blower, and the expansion, or throttling valve. The controls and ductwork for circulating cooled air to the house complete the system. Air conditioners use the vapour compression cycle, a 4-step process which illustrate in above figure, the four processes are





1. The compressor which compresses refrigerant vapour to a high pressure, making it hot in the process.
2. Condenser in which air or water cooling reduces the temperature of the refrigerant sufficiently to cause it to condense into liquid refrigerant and give up its latent heat of evaporation. Latent heat of evaporation is the heat required to convert a liquid to a vapor at a particular temperature and pressure and is the heat released when a vapor condenses at a particular temperature and pressure.
3. Expansion valve which allows a controlled amount of the liquid refrigerant to flow through into the low-pressure section of the circuit.

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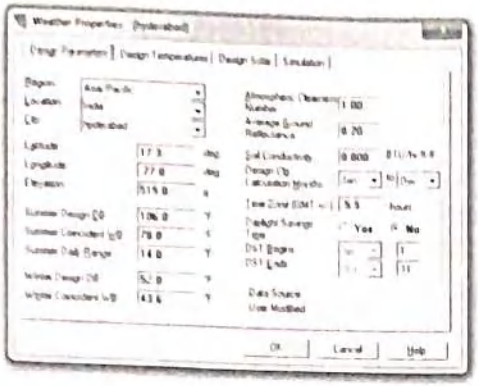
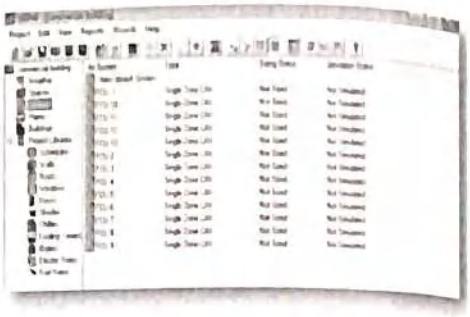
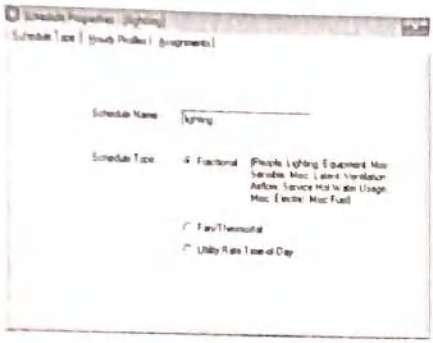
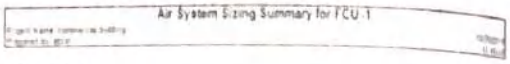
4 The cold liquid circulates through evaporator coils. Inside air is blown across the coils and cooled while the refrigerant warms and evaporates. The cooled air is blown through the ductwork. The refrigerant, now a gas, returns to the outdoor unit where the process repeats.

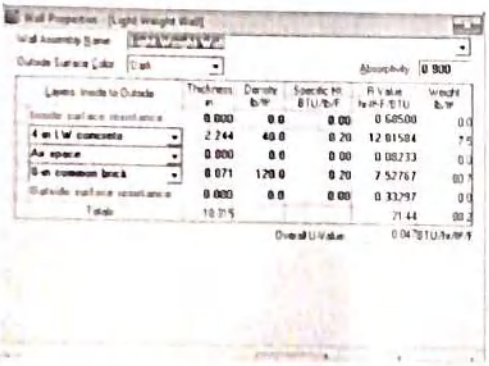
CALCULATION BY HAP SOFTWAR:

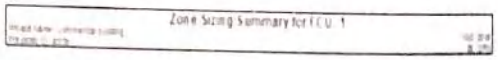












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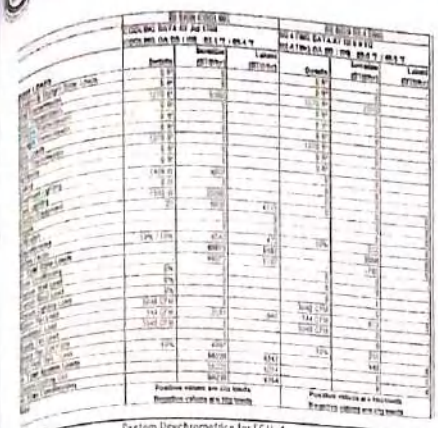
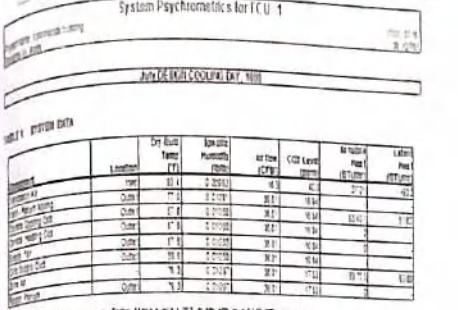
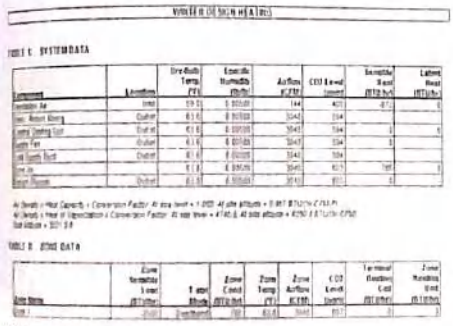


System Psychrometrics for FCU-1



System Psychrometrics for FCU-1



Chiller selection

A chiller is a compressor based cooling system that is similar to an air conditioner except it cools and controls the temperature of a liquid instead of air. The other main components to a chiller are a temperature controller, a recalculating pump and a reservoir. Operation and setup is simple. Fill the reservoir with fluid to be recalculated, typically water or an ethylene glycol/water mix. Install plumbing between the chiller and the application and provide power to the chiller. The controller regulates the chiller's functions. The chiller will provide a stable temperature, flow and pressure once it has been programmed by a user for their individual needs. Harmful particles are kept out of the system by an internal strainer.
The sizing of chiller is done by the following procedure.

General sizing formula is:

1 Calculate Temperature Differential (?T°F) ?T°F = Incoming Water Temperature (°F) - Required Chill Water Temperature
2 Calculate BTU/hr BTU/hr = Gallons per hr x 8.33 x ?T°F
3 Calculate tons of cooling capacity Tons = BTU/hr ÷ 12,000
4 Oversize the chiller by 20% Ideal Size in Tons = Tons x 1.2

In this project, the chiller is required to cool 288GPM from 55°F to 45°F
1 ?T°F = 55°F - 45°F = 10°F
2 BTU/hr = 288gpm x 60 x 8.33 x 10°F = 1,439,424 BTU/hr
3 Ton Capacity = 1,439,424 BTU/hr ÷ 12,000 = 119.95 Tons 89
4 Oversize the chiller = 119.95 x 1.2 = 143.94
5 A 143.94 or 150-Ton chiller is required

Therefore in this project Air-cooled Scroll chillers are used and the total tonnage is 150TR
So we need to install 150TR Air-cooled Scroll chiller. Air-Cooled Scroll Chillers are Efficient, Sustainable & Flexible at 55-200 TR (195-700 kW)

Results

1 Air balancing is done measuring the velocity of air using digital anemometer thus by arriving volume of the flow (flow = area x velocity)
2 Regulating the VCD (volume control dampers) in the ducts and controlling collar dampers provided in the air terminal
3 Water balancing is done as per designed flow rate using double regulating balancing valve by taking differential pressures across the valve to ensure water flow as per the design

4 Temperature and relative humidity is measured is all the conditioned area and recorded that 23 Degree Celsius temp and 55to 58 RH, using digital temperature & RH indicator
5 Variable air volume thermostat is set for 23Deg c and observed that air volume is getting reduced as the VAV actuator will close the damper proportionately on achieving set temperature of 23c. Similarly VAV actuator opens the damper proportionately on increase of inside the cabin temperature

CONCLUSION

Decreasing the energy consumption of heating, ventilation and air conditioning (HVAC) systems is becoming increasingly important due to rising cost of fossil fuels and environmental concerns. Therefore, finding novel ways to reduce energy consumption in buildings without compromising comfort and indoor air quality is an ongoing research challenge.
The use of thermostat setback, compared to using constant settings, achieved more energy savings in this project.
Where water shortage is concerned, air-cooled chillers are typically installed to provide cooling energy in commercial buildings with significant electricity consumption. In this project using the Air cooled scroll chiller Which consists the following features;

- Highly efficient and Quiet operation at an affordable price with sound pressure ratings as low as 60 dBA, without any optional acoustic treatment
- Due to few moving parts and slider valve, these compressors have minimal wear and tear, thereby, resulting in longer life of the compressor compared to screw compressor
- Ideal for retrofit since compact unit footprint can save installation space and costs.
- Responsible refrigerants for 75 to 190 ton chillers use R-410A, which has no ozone depletion potential and no phase-out schedule
- Easy to integrate because our Open Choices feature allows the unit controls to easily integrate with your choice of building automation system

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MECH - 5

Increasing the Performance of Automobile Engine by Feeding Hydrogen and Oxygen Generated by Electrolysis Process

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STRACT . Past few years automobile companies have been earching for technological advantages to increase fuel millage in order protect the environment. Also with gas prices on the rise, the average nsumer wants an automobile that can go miles while using the least ount of fuel possible. Customers are demanding for better gas millage the present scenario the growing concern of the people living in every of al society is the ever increasing price of fuel and the harmful effects used due to higher level of pollutants in the atmosphere. One of the best solution to control the above two concern is the evolution of the brid vehicle. Any vehicle that combines one or more sources of on board power that can directly or indirectly provide propulsion power is a brid vehicle. The hybrid vehicle attempts to significantly increasing the leage and reduce the emission levels of a fuel powered engine and nal Engines. The water hybrid vehicle uses an HHO (Oxy Hydrogen) nerator to supply hydrogen on demand by Electrolysis. The water hybrid stem is an attempt to provide an affordable low emission fuel efficient icle with performance standards better than most of the conventional gines. In this work, try to address this issue by designing an HHO nerator. This generator uses the principle of electrolysis to split water o its two hydrogen and oxygen in gas form. Hydrogen has introduced o the combustion chamber of an engine to increase its power burn less el and exhaust less gas out to the environment. Its gives a clear rview of how this technology works and the economic potential that uld have especially in a modern society dominated by fossil fuels. ostract)

ywords - Engine Hydrogen, Oxygen, Comburtion

INTRODUCTION

verage annual rate of transportation have been growing at a nificantly greater rate in worldwide. This will enhance the problems of pollution, energy shortage, slow economic growth and energy security. growth without due attention to the environment will have very rimental long- term consequences [1]. Coal was the raw material ring the industrial revolution, oil replaced it by creating the second volution and all the experts speak about the hydrogen as the protagonist the third revolution. Hydrogen is an important synthetic fuel of the future, sidering its physical and chemical properties. It is abundant and newable, because is possible to extract it by water electrolysis, using a mary energy source. Hydrogen has the potential to end the world's pendence on oil imported and its tragic consequences. Furthermore, as it is so plentiful and exists in all parts of the world, all human beings uld have power, becoming the first truly democratic energy system [2-

Hydrogen Association (AaH2) in strategic vision of June 2005 mentioned that the use of hydrogen can significantly contribute to achieve public policy objectives of European energy security, air quality, reduction of greenhouse gases and industrial competitiveness. Also in the same report, the AeH2 imagines the year 2050, with the hydrogen functioning not only as fuel for transportation, it will be used as a complement to the power generation system based on renewable energy sources, in order to adjust the generation energy demand[5, 6]

The water hybrid system plans essentially to convert a vehicle to use water as a source of supplemental or even primary fuel. The engine derives fuel from Hydrogen gas generated by the electrolysis of water and petrol (primary fuel). Although petroleum derived fuel and an external electrical generating system is not theoretically required, in most circumstances it is a practical necessity. The only by-product resulting from the combustion of Hydrogen gas within the engine is water vapor. Therefore, emissions are usually cleaner, emitting fewer polluting particles. In short, the Water hybrid system is a cleaner system, one that derives supplemental fuel from a free and inexhaustible resource, water. It has the unique advantage of being able to remove pollutants from the air during combustion, and even reduces the carbon residue within the engine [7, 8]

Water electrolysis is simply the breaking down of water into its basic hydrogen and oxygen atoms by passing an electronic current through it. HHO, referred to as Hydrogen gas, water gas, and brown gas (in automotive applications) is a weekly bonded water molecule which exists in gaseous state. It is 2:1 molar mixtures of hydrogen and oxygen. it gives information about HHO production and it was produced by electrolysis process of different electrolytes (KOH), NaOh, NaCl, with various electrode designs in a leak proof reactor [9]

Although the technology has been around for over a century, progress has been slow to develop an Alternative fuel from this planet's most abundant commodity known as water. With the increased dependence on fossil fuels from oil, the costs of this vital resource are escalating along with damage caused by air pollution. Global warming is a very important and real threat issue that can reduce our chances for survival in the future. Water may just save us, if we use it wisely and keep it from becoming polluted also. The most abundant element in the known universe is hydrogen. Water is composed of two atoms of hydrogen (H) and one atom of oxygen (O). Thus H2O Water. There is a device called a Hydrogen generator that uses a process known as electrolysis to separate and extract both hydrogen and oxygen out of water. Earlier developments for hydrogen generators were designed to extract HHO or sometimes referred to as Browns Gas. They were originally designed for welding and cutting purposes, but HHO can be used as a supplemental fuel for internal combustion engines, even diesel motors. we developed a patented pending design that is compact and can fit into almost any vehicles motor compartment [10]

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With such high demand for more efficient engines, our mission is to design and create a device that will increase engine efficiency without jeopardizing its performance. Such device is an HHO gas Generator. This generator uses electric current (electrolysis) to produce hydrogen from water, the hydrogen will be introduced into the combustion chamber of an engine through the intake manifold. We will attempt to make it compact and affordable, in order for it to be appealing to customers.

Building this generator comes with some challenges. We need to make sure that the amount of energy put into the cell to split the water molecules is less than the amount of output energy of the generator. In order to overcome this challenge we will need to make it as efficient as possible. This includes coming up with a creative design to get as much hydrogen out with the least amount of current running through the jar. More concerns include implementing very conductive wires and plates into our system. Taking these aspects into consideration will make the HHO generator a productive addition to any internal combustion engine.

II. EXPERIMENTAL PROCEDURE

In the electrolysis of water, electricity is used to split water into its elemental components hydrogen and oxygen. Electrolysis of water is often considered the preferred method to produce hydrogen, and it does not need any fossil fuels. Using this method can get a final product of high purity and feasible both at small and large scales. Here implemented Wet Cell System as shown in Figure 1. Stainless steel plates with a negative charge will be connected to the negative terminal of the battery and the positive will be connected to a relay, this will give an on/off control of the system while drive.

For these connections used 2 cables. To avoid all possible losses the generator placed close to the battery. This is transparent to see the level of water inside it as shown in the figure 2. For safety reasons use an air filter between the HHO generator and the intake of the engine. The air filter is small container with 3 way passage that will help us avoid any back fire from the engine to enter the generator. In order to quantitate the process of electrolysis, it has found some equations that relate the current needed to obtain a certain volume for a gas. The process for this calculation at room temperature and at 1 atm.

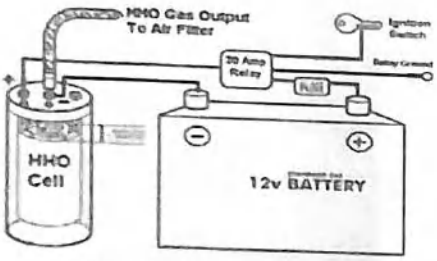

Figure 1. Block diagram of Wet Cell

Figure 2. HHO gas generator

The block diagram of the HHO dry cell consist a battery of 12 volts, ammeter can be used to measure the readings of the current flowing fr the battery to the HHO dry cell. The positive wire from the ammeter connected to the HHO dry cell and the negative is connected to the v wheeler grounding. When the process starts HHO is produced and the g from the outlet is sent directly to the carburetor with the help of a pipe. Fa hydrogen desorption kinetics- facilitates quick hydrogen release to m the transient driving requirement.

Low enthalpy of desorption – Can release hydrogen at ambie temperature and at pressures suitable for hydrogen injection at lo pressures. It also facilitates direct hydrogen absorption from commercia available medium pressure electrolyze, without any further compressio Transition metals based alloys with reversible hydrogen storage capacity between 1.8-3.0 wt% have been developed. These alloys relea hydrogen at temperatures ranging from 25°C to 150°C. Additionally

Storage of hydrogen offers superior safety and volumetric attribut versus gaseous or liquid storage. In addition, the high production volum of metal hydride alloys associated with the nickel metal-hydride batte industry already provide the economies of scale. ECD's storage alloys a mass- produced and packaged in specially engineered containers. provide maximum volumetric and gravimetric energy densities, whi simultaneously optimizing heat transfer properties. Prototype hydrog ICE two-wheeler shown in Figure. 3.

Figure 3. HHO kit with ICE two-wheeler

III. RESULTS AND DISCUSSIONS

Converted a 110cc gasoline ICE bike for hydrogen fuel. The conversio was achieved by making changes to the fuel delivery system and th ignition system . The hydrogen ICE bike uses a fuel injector controlled b an Engine Control Unit (ECU). The carburetor was injected with the outl pipe of our "HHO" kit. The hydrogen ICE bike was field-tested to study th acceleration and the range. There were two tests conducted. The ambie temperature during test- driving varied between 38 – 55 ° F and th barometric pressure was approximately 30" Hg. The fuel consumptio was determined to be approximately 4km/100ml under the above drivin conditions. Approximately 129 grams of hydrogen was drawn from th storage system during the test. Top speed during the road testing was 4 kmph with one person on the vehicle.

Table 1. Results of the testing

Amount of fuel (ml)	vehicle Speed (km)	Test I without "HHO" Kit	Test II with "HHO" Kit
100ml	0	9.6 km	17 km
100ml	20	6.7 km	12 km
100ml	40	4.8 km	7.2 km

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In the combustion chamber the fuel which comes from the fuel injector gets mixed up with the mixture of air and hydrogen gas coming from the hydrogen dry cell. The hydrogen gas mixed with air enriches the fuel. As the hydrogen gas is highly flammable it helps in efficient burning of the fuel and removes the carbon deposits inside the cylinder and helps in running a cleaner engine.

The process is as follows: start with water and an electrolyte, and there are many different types. DC current breaks H2O into H2 & O. This introduce it into the engine by one of the engines six liter. The H2 combines with air and is burnt together in the combustion chamber. Once burnt, it converts back to H2O. It is now going to absorb the inner heat from the engine normally and turn into water-heated dry steam. Then it is pushed out during the exhaust stroke and out the tail pipe. There it condenses back into its water vapor and eventually collects back into water. The most amazing part of the process is that the emissions are reduced to exceptionally clean low levels.

This covers final hydrogen diesel experiments that have several similarities to our experimental setup in this research. Conditions for commonality include naturally aspirated diesel engine, constant engine speeds at or near 1500 revolutions per minute driving a generator, small rates of hydrogen injection into the air intake with fuel consumption and NOx emissions analysis. Throughout this research, all gas mass flow rates are converted to volumetric flow rate at standard temperature and pressure - 298.15K and 101.325kPa. Firstly it takes 7.79kJ to produce 1L of HHO, and secondly the net efficiency of converting the equivalent diesel energy. HHO energy was between 11.4% and 16%. 4.4Wh of electrical energy was required make 1L of HHO with the experimental setup. This includes losses from the switch mode power supply. Taking an arbitrary 25% HHO conversion efficiency of 15%.

The constraints of this project were that had to overcome at least 3 times the limit established by Faraday in his laws of electrolysis current, inefficient process that has been used by industry since the early 20th century. HHO generators that can find in the market today, work with the system and the limits established in the mid 1800 by Faraday and stated that about 1,200 watts (12 volts x 100 amperes) can produce 360 liters of gas per hour (LPH).

This project is a challenge that others had already tried before with varying success, so the technical team used some knowledge of the work of other worldwide reference researchers like Paul Zigouras, Stanley Meyer and Daniel Dingel, plus of course many own ideas. The circuit diagram shows fuse is connected to battery then to HHO Dry Fuel cell. The most abundant element in the known Universe is Hydrogen, which is the volatile part of this amazing fuel. Oxygen does not burn, but it does support combustion. The technology that is used to extract the two elements from water is known as Electrolysis. Electrolysis of water has been used for experimentation and other industrial processes for over a hundred years. The HHO fuel systems used today are used primarily as a supplemental fuel rather than a replacement for gasoline. The design is considered an on demand system, meaning that HHO fuel is produced only as is needed, having no storage tank, and stopping when the ignition key is turned off. Fuel mileage is increased because the gasoline burns more completely, producing cleaner exhaust emissions, and can save money on fuel costs and help the environment by reducing air pollution.

IV. CONCLUSION

As the load increases Brake power increases. The brake power developed by the engine operated on HHO gas is more as compared with pure petrol. Mechanical Efficiency of the engine increases, for engine operated with HHO gas is more as compared with pure petrol. Brake thermal efficiency, indicated thermal efficiency of the engine increases, for engine operated with it as compared with pure petrol. Total fuel consumption of the engine decreases, for engine operated with HHO gas. Emissions like carbon monoxide (CO), hydro carbons (HC), carbon dioxide (CO_2), NOx are greatly reduced for the engine operated with HHO gas compared to pure diesel engine.

Demonstrated the viability of hydrogen ICE bike with hydrogen storage as a near-term application of hydrogen technology for transportation. The proof-of-concept prototype was converted for hydrogen fuel at ECD. It improve the performance of the hydrogen ICE bike. In the design of hydrogen generator tried to increase fuel efficiency while providing additional power. The hydrogen cell produces oxygen and hydrogen from water through electrolysis. Minimize the cost by using wildly available materials. However, the cost may go up based on the results of different tests and the goal that we want to reach. It benefit the environment and society. Since implementing the hydrogen generator will produce less carbon dioxide to the atmosphere. Therefore it will reduce greenhouse gasses. Hence less effect on global warming on the long run. Implementing a hydrogen generator will provide more fuel efficiency. It will save money for people who will use this product. It provide maximum fuel efficiency while maintaining minimum cost.

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Appendix

1. Brake power developed by the engine (B.P):

B.P = (πDNW) K.W

D = 0.3 + 0.015 = 0.315 m

d_1 = 0.3----m, d_2 = 0.015-----m N = 1484 rpm = 24.7 rps

W_1 = 8 kg W_2 = 0.8 kg

W = net load on the dynamometer = (W_1-W_2) = (8-0.8) = 7.2 kg = 70.6 KN

B.P = (π*0.315*24.7*70.6)/1000 = 1.726 KW

2 Total fuel consumed T.F.C (M_f):

T.F.C (M_f) = (Q*SP GRAVITY)/1000 ---Kg/sec Where

Q = 10/t

t = time of collecting n cc fuel consumption in —sec[] t = 48 Sec

= T.F.C (M_f) = (Q*sp)/1000(10*0.8275)/(1000*48)

= $1.72*10^{-3}$ Kg/Sec

3 Heat input to the engine (Q_{in}):

Q_{in} = T.F.C (M_f)*C.V ---K.W

C.V = calorific value of the fuel = 10833 kcal/kg = 45368 kj/kg

Q_{in} = T.F.C (M_f)*C.V = $1.72*10^{-3}$*10833*4.188 = 7.764 K.W

4Indicated power (IP):

I.P = B.P + F.P K.W = B.P + F.P = 1.726 + 0.2 = 1.926 KW

Where B.P = brake power = 1.726 K.W

F.P = frictional power graph = 0.2 K.W

5 Brake thermal efficiency (η_{bth}):

η_{bth} = (B.P/ heat input)*100

= (1.726/7.764)*100 = 22%

6 Indicated thermal efficiency (η_{ith}):

η_{ith} = (I.P/heat input)*100

= (1.926/7.764)*100 = 24.7%

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Nawab Shah Alam Khan

NATIONAL CONFERENCE ON EMERGING TRENDS IN ENGINEERING & TECHNOLOGY (ETET-201

MECH - 7

COMPARATIVE STUDY OF VRF SYSTEM IN HEATING MODE COMBINED OUTDOOR AIR PROCESSING UNIT WITH CENTRAL AIR CONDITIONING SYSTEM

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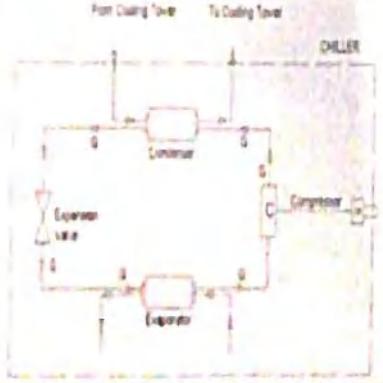
ABSTRACT This paper describes a new VRF with outdoor air processing unit combined air conditioning system in heating mode is proposed and simulated VRF or variable refrigerant flow is an air conditioning system in which there is one outdoor condensing unit and multiple indoor units the term variable refrigerant flow refers to the ability of system to control the amount of refrigerant flowing to the multiple evaporators (indoor units) enabling the use of many evaporators of different capacities and configurations connected to a single condensing unit. The arrangement provides an individualized comfort control and simultaneously heating and cooling in different zones. With a higher efficiency and increased controllability the VRF system can help achieve a sustainable design.

KEYWORDS air conditioning, VRF system, inverter compressor, simulation, heating mode

I. INTRODUCTION

VRF systems are similar to the multi-split systems which connect one outdoor section to several evaporators. However, multi-split systems turn OFF or ON completely in response to one master controller Where as VRF system continuously varying the flow of refrigerant through a pulse modulating valve. The control is achieved by continually varying the flow of refrigerant through a pulse modulating valve thermostat sensors in each indoor unit the indoor units are linked by a control wire to the outdoor unit which responds to the demand from the indoor units by varying its compressor speed to match the total cooling and/or heating requirements.

Air conditioning is the process of removing heat from a confined space, thus cooling the air and removing humidity. This process is used to achieve a more comfortable interior environment. however air conditioners are also used to control rooms filled with heat producing devices such as computers and amplifiers. Air conditioners often use a fan to distribute the conditioned air to an occupied space such as a building or a car to improve thermal comfort and indoor air quality Working of a AC system



II. LITERATURE REVIEW

In VRF system basically one outdoor unit and multiple indoor units Conventional heating, ventilating and air-conditioning systems, such as the all-air variable air volume (VAV) systems, are widely used in many types of buildings in spite of the fact that these common systems have several significant deficiencies, which yet have triggered the HVAC engineers to develop new types of air conditioning systems to reduce energy use and to improve comfort performance. From the last two to three decades there is a wide application of VRF system have been seen in various commercial buildings for the purpose of energy saving and the demand of an air conditioning system possessing independent units serving separate zones.

In spite of that VRF system has greater energy saving potentials than other HVAC systems such as central air conditioning system and fan-coil unit plus fresh air systems. The multi-split VRF system has high energy efficiency under part load condition. In addition, duct losses in the multi-split VRF systems can be almost eliminated due to the in-space location of the indoor units. However, the multi split VRF system can hardly ensure the indoor air quality (IAQ) because it does not induce outdoor air (OA) into the air conditioning zone(s) in most cases an energy recovery ventilator (ERV) will be installed accompanying with the multi-split VRF system for inducing efficient amount of ventilation air as required by ASHRAE.

Here a new system of VRF combined with outdoor air processing unit is designed in heating mode is investigated and simulate that combined system in terms of energy performance and compare that combined system with some other conventional system (such as central air conditioning system)

Here a new office building is designed with combined system with following specifications as shown in fig

Items	Description
Building location	India
Building type and storeys	Office building, 6-story above ground
Gross floor area (air conditioned area)	4700 m2
Typical floor area and height	28 m × 28 m, floor-to-floor
Height	3.5 m
Zone height (m)	2.7 m
Solid wood door size width × height	1.0 m × 2.0 m
Windows and shading	Low-e double pane glazing. Window width × height 1.8 m × 1.5 m, sill height = 0.80 m, no shading device

Table 1 Central information of building

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III EXPERIMENTAL PROCEDURE

...ce building of frame structure is designed to accommodate the ...conditioning system. The building has two floors in total ...ground. Each floor of the building is divided into six conditioned ...zones corresponding to four outdoor exposures, an interior zone ...a centre zone. The typical floor section in fig 1 and a summary of the ...parameters of the building is given in table above

...conditioning zones in one typical floor are numbered from zone 1 to ...5 for conveniently identifying their positions. As is determined by the ...of the building internal heat gains are mainly from the sources of ...lighting and equipment. Table 2 describes the methodology of ...calculation. The real time occupants of each zone is detected and ...by a dynamic occupant detecting module originally developed ...and Jin based on the variation of the CO2 concentration

...calculation methodology for this typical office building is shown in ...here heat gain in the building is due to the lighting, occupant, and ...used in the zones. And the calculation methodology is shown in ...below the typical floor plan is shown below of total area of

Item	Description
Lighting	Light max = 20 W/m²
Occupant	Sensible heat = 65 W, latent heat= 55 W
Equipment	Equipment max =120 W/m²

TYPICAL FLOOR PLAN

Typical floor plan of the building

VRF SELECTION

...heating and cooling capacity of the building is calculated as 25.6 HP ...51.68 HP respectively by using software called HAP. Complete report ...this software is shown below

...Capacity of system is 51.68 HP

...BTU/hr 1 ton = 12000 BTU/hr

...lation = 64.6 x 12000

= 775200 BTU/hr

Gallons per minute = TR x 24/ΔT

Where TR = ton of refrigeration

ΔT = temperature difference in °F T_1-T_2 = 10 °F

64.6 x 24/55-45 = 155.04 GPM

3 Chiller capacity (KW)

Q = m x Cp x ΔT

Where m = mass flow rate in kg/sec

ΔT = Temperature difference in °C

Comp Outlet Temp = T_1 and Comp Inlet Temp = T_2

T_1 = 12°C and T_2 = 7°C

Cp = Specific heat in KJ/kg °C

Q = capacity in KW

M = 155.04 x 272.77

= 42290.26 kg/hr

= 42290.26/3600

= 11.74 kg/sec

Q = 11.74 x 4.18 X (12-7)

Q = 245.51 KW

IV COMINED SYSTEM DESCRIPTION

A schematic diagram of the proposed combined system is shown in fig The system can be divided into two parts structurally VRF part and OA processing part. A multi-split VRF unit consists of one outdoor unit and multiple indoor units (IDU), varying the refrigerant flow rate with the help of the variable speed compressor in the outdoor unit and the electronic expansion valve (EEV) located in each IDU to match the heating load in order to maintain the zone air temperature at the indoor set-point

The OA processing part consists of a DX rooftop unit and the VAV OA supplying system. In each branch supply duct, there is a VAV box to regulate the OA flow in response to the zones' demand. There is an enthalpy wheel between the exhausted air and the OA to recover energy. The control designing of the combined system are also shown in Fig The demand-controlled ventilation (DCV) and economizer cycle techniques which have been proved that they can provide extensive energy conservation in modern HVAC applications are adopted for regulating the OA flow

For VRF part, two control loops are set. The overall superheated degree of the suction vapour is used for the VRF capacity control to regulate the speed of the compressor. The zone return temperature is used for the zone temperature control to regulate opening of EEV in each IDU. For OA processing part, four control loops are set. OA flow rate control is accomplished through modulating the air damper opening (damper opening control) installed in each branch supply duct to responding to contaminant concentration of the zone accompanying with adjusting the frequency of the supply fan (supply fan control). When dampers of the zones are adjusted, supply air static pressure in the air duct may change.

A static pressure sensor located in the supply air duct senses the static pressure signals, and the frequency of supply fan will be modulated accordingly concentration of the zone accompanying with adjusting the frequency of the supply fan (supply fan control). When dampers of the zones are adjusted, supply air static pressure in the air duct may change. A static pressure sensor located in the supply air duct senses the static pressure signals, and the frequency of supply air.

The required OA flow of the conditioning zone is determined by CO2 concentration and the DCV control. OA supply temperature is maintained by EEV opening control despite of the OA mass flow rate changing with the occupancy variation. The refrigerant also should be superheated before flowing into the compressor, and the superheat degree is controlled by DX capacity control with adjusting the compressor speed

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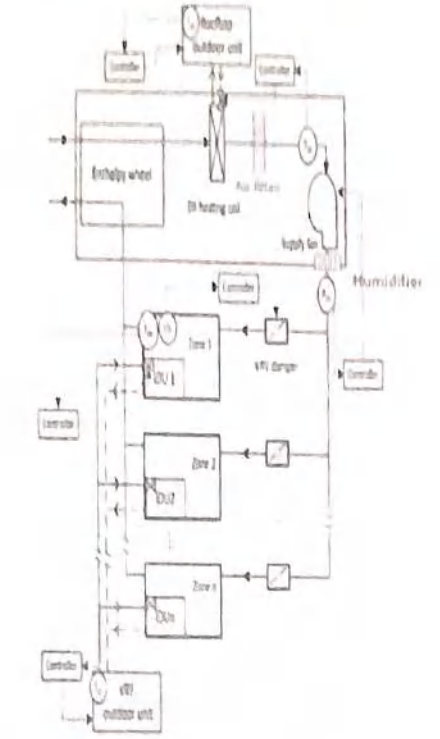
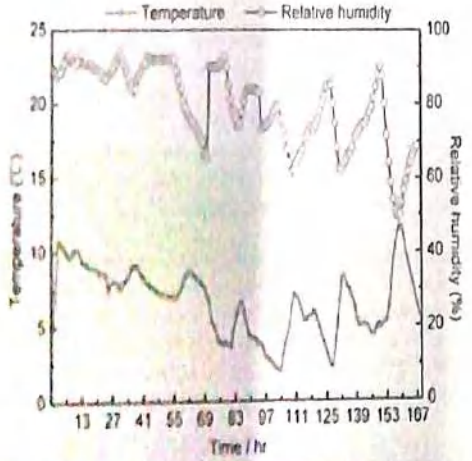


Fig.3.Combined system description

VII VALIDATION OF THE SIMULATION MODEL ON ENERGY PERFORMANCE

The simulation model is validated by the data report A typical VRF-HP with two condensers is used for the validation system The rated heating capacities for the outdoor and indoor units of the VRF system are 250 kW and 125 kW (2 sets) respectively The conditions of the two rooms including the light, equipment and occupants are treated the same just as the experimental set Heat gains of all the spaces are supposed to happen during 10 00--17 00 The temperature set point is 22 C for both the two rooms Weather data are got from India Weather Bureau (SWB), which include air dry bulb temperature, air relative humidity, solar radiation, atmospheric pressure, wind speed, etc But the ambient dry bulb temperature and the relative humidity are replaced with actual data collected during the experiment days as shown in fig



7.1. Air dry bulb temperature and relative humidity

By VRF, average daily calculated results, including total heating capaci and input power, and the coefficient of performance (COP) are report and compared against the monitored data as shown in fig and respectiv The COP is calculated by dividing the cooling capacity by the input pow of the compressor

It can be seen from Figs 7 2 and 7 3 that the simulation results includi heating capacity, input power and COP generally own similar trends to t experimental data But their error scales are different among the tes days The relative differences between the VRF and central air conditioni system data are listed in Table The average and the maximum deviatio between calculated and measured heating capacity are 7 87% and 11 8 respectively The average and the maximum deviations of the input pow are 12 45% and 23 51% respectively And the average and the maximu deviations of COP are 6 19% and 15 24% respectively

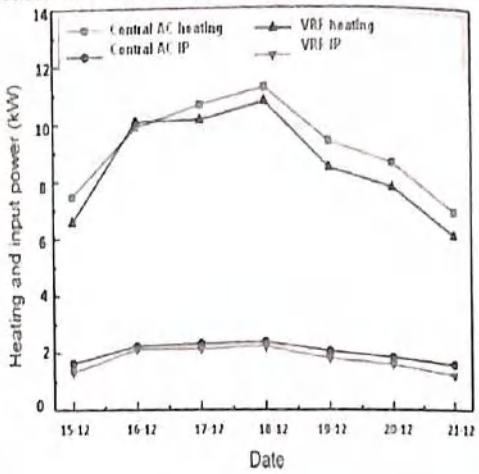


Fig 7 2 Comparison between central air conditioning and VRF system of heating capacity and Input power

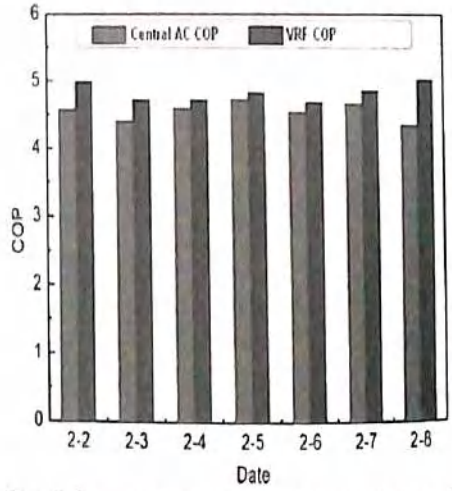


Fig 7 3. Comparison between central air conditioning and VRF simulation COP

The combined system is simulated in a software for better en performance in a software called energy plus Here two cases, the s and different set-points of the zones temperature, are carried ou studying the performances of the combined system

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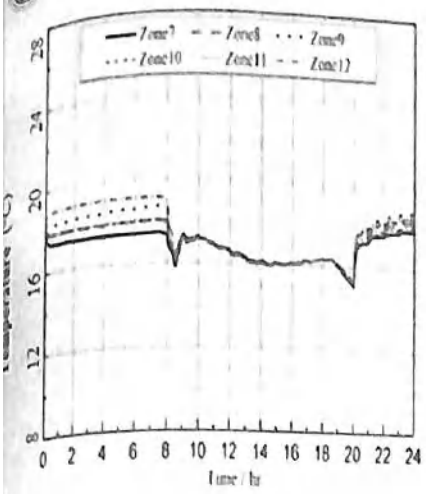
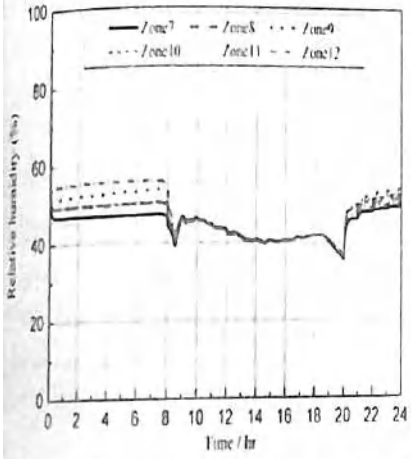
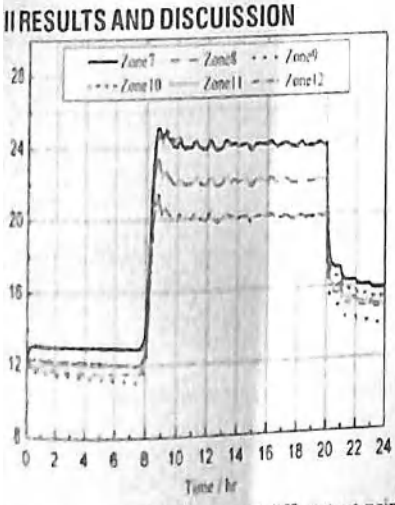


Zone temperature result in the case of the same set-point

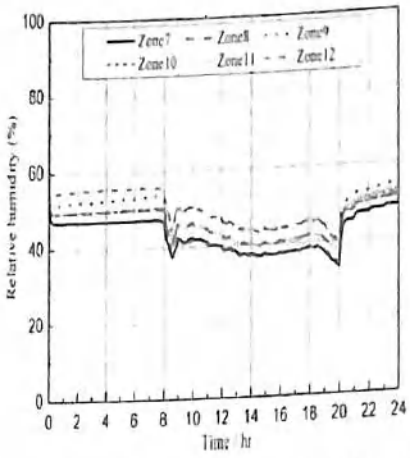


Relative humidity of the zones in the case of the same set point

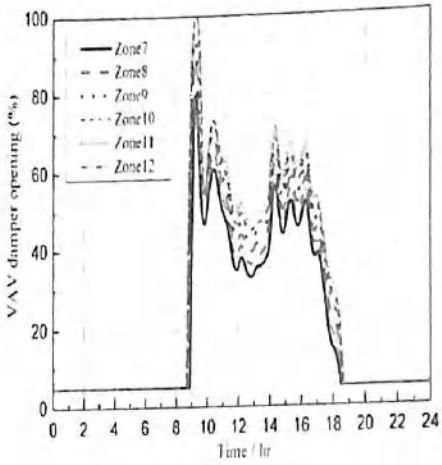
II RESULTS AND DISCUISSION



e temperature result in the case of different set-points



Relative humidity of the zones in the case of different set-points



. Opening of the VAV damper °C

Zone temperature and humidity

For the case of the same set-points of the zones temperature, the set-points of the 6 zones are all 22oC

The OA supply temperature set-point is 22oC as well Figs 10 and 11 show the simulation results of the temperature and relative humidity of the zones respectively

As shown in Figs 10 and 11, all the zone temperatures are well controlled that the deviations are all smaller than 0 5 C except the start-up periods In one hand, it indicates that the heating capacity meets the heating load in this condition In the other hand, it also shows that very good control performances of the system are obtained

For each zone, the temperature increases while the relative humidity decreases quickly after the combined system starts working at 8 a m There are tiny peaks and valleys in both the temperature and the relative humidity pro les, due to the continuously varying state of the OA flow, including flow rate and supply air condition, which on the other hand indicates that the state of the OA flow affects indoor environment to some extent

The control lag at 8 a m is caused by the start-up respectively It can be reduced by increasing the controller parameter (proportional term), but it will increase the risk of unstable control of the temperature and relative humidity after they reach the set-points For the case of different set-points

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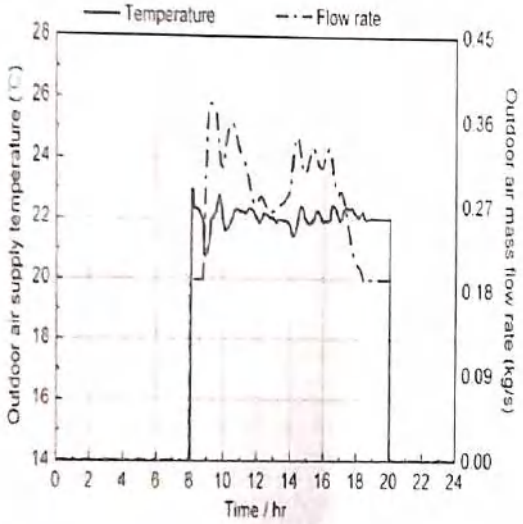
of the zones temperature, zones 7 and 12 are set 24oC, zones 8 and 11 are set 22 C and zones 9 and 10 are set 20 C However, the OA supply temperature set point remains 22oC

Figs 12 and 13 show the simulation results of the temperature and relative humidity of the zones in this case respectively

It can be found in Fig 12 that the temperature of each zone can also be maintained at its specific set-point within an acceptable deviation

It is indicated that good performances of the conditioning system and control strategies are obtained In addition, the demand of an air conditioning system possessing independent units serving separate zones in the same building could also be met by applying this combined system

The OA flow is regulated according to CO2 concentration, which is used as the indicator of the IAQ of the zones The CO2 concentration upper limit, called IAQ-limit here, is 1000 ppm The OA mass flow rate, as well as the CO2 concentration, mainly depending on the variation of occupants in this paper, is independent of the zone temperature and the relative humidity Therefore, the OA mass flow rate of the combined system under the case of either the same or different set-points is the same neglecting the calculation error The OA mass flow rate and supply air temperature are shown in Fig 14



The flow rate of the return air (i e the exhausted air) for the enthalpy wheel is simply treated to be proportional to that of the supply air for maintaining a positive pressure in the building. The variation of the CO2 concentration of each zone is plotted in Fig 9 5, while the corresponding opening of each VAV damper of each zone is depicted in Fig 9.6

As is shown in Fig 14 the OA mass flow rate of the combined system varies with the time, which rejects the variation of the occupants. In addition the valley in early afternoon rejects rational absence of the occupants for lunch rest etc The OA supply temperature varies in a very similar way in both the cases of the same and different set-points, thus only the OA supply temperature in the former case is plotted, as shown in Fig 9 5 The OA supply temperature is properly controlled at the set-point

IX CONCLUSION

This paper presents a simulation of a new air conditioning system combining VRF with OA processing unit in heating mode After the illustration of the combined system and its control strategies, simulation models are developed and validated

The simulation model is validated using the experimental data The simulation model accuracy to predict daily heating capacity, energy consumption and COP are about 7 87%, 12 45%, 6 19% respectively Moreover, it is found that when the accuracy of heating capacity is increased or decreased, the accuracy of simulated energy consumption is also increased or decreased following, which indicates that more attention should be paid on the relative error difference between the heating capacity and energy consumption, rather than the relative error itself

The simulation test results show that all the zones of the combined system can be maintained at their specific set-points, and the controls are also stable no matter the set-points change or not Meanwhile, the indoor CO2 concentration of all zones can be well controlled below the limit to maintain acceptable IAQ As the OA proportions are continuously monitored and controlled according to the demand, over ventilation is avoided and eventually the energy can be saved in the combined system

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Nawab Shah Alam Khan
NATIONAL CONFERENCE ON EMERGING TRENDS IN ENGINEERING & TECHNOLOGY (ETET-2016)

MECH - 8

STRUTURAL AND THERMAL ANALYSIS OF GAS TURBINE ROTOR BLADES

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ABSTRACT In the present work the first stage rotor blade of a two stage gas turbine has been analyzed to structural, thermal using ANSYS 12. which is a powerful Finite Element Software. In the process of getting the thermal stresses. The temperature distribution in the rotor blade has been evaluated using this software.

The design features of the turbine segment of the gas turbine have been taken from the preliminary design of a power turbine for maximization of an existing turbojet engine. It was observed that in the above design the rotor blades after being designed were analyzed only for the mechanical stresses but no evaluation of thermal stress was carried out. As the temperature has a significant effect on the overall stress on the rotor blades, it has been felt that a detail study can be carried out on the temperature effects to have a clear understanding of the combined mechanical and thermal stresses.

In this work, the first stage rotor blade of the gas turbine has been analyzed using ANSYS 12 for the mechanical and radial elongations resulting from the tangential, axial and centrifugal forces. The gas forces namely tangential, axial were determined by constructing velocity triangles at inlet and exist of rotor blades. For obtaining temperature distribution the convective heat transfer coefficients on the blade surface exposed to the gas flow to feed to the software. The convective heat transfer coefficients were calculated using the heat transfer empirical relations taken from the heat transfer design data book. After containing the temperature distribution, the rotor blade was then analyzed using ANSYS 12 for the combined mechanical and thermal stresses. The radial elongations in the blade were also evaluated.

Titanium Alloy and silicon carbide materials used for analysis. The turbine blade along with the groove is considered for the static, thermal, modal analysis. The blade is modeled with the 3D-Solid Brick element. The geometric model of the blade profile is generated with splines and extruded to get a solid model.

I INTRODUCTION

The finite element method (FEM) has now become a very important tool of engineering analysis. Its versatility is reflected in its popularity among engineers and designers belonging to nearly all the engineering disciplines.

Traditional methods of engineering analysis, while attempting to solve an engineering problem mathematically, always try for simplified formulation in order to overcome the various complexities involved in exact mathematical formulation.

The turbine escapes energy from the exhaust gas. Like the compressor, turbine can be centrifugal or axial. In each type the fast moving exhaust gas is used to spin the turbine, since the turbine is attached to the same shaft as the compressor at the front of the engine, and the compressor will turn together. The turbine may extract just enough energy to turn the compressor. The rest of the exhaust gas is left to exit the rear of the engine to provide thrust as in a pure jet engine.

In this paper comparison between conventional method and computer aided engineering is done. It is essential to incorporate the Computer Aided Engineering in the turbocharger development and design process. Structural analysis of their component parts has been made so far mainly on the automotive and marine turbochargers centrifugal compressors. Aero engine turbine and compressor blades operate at speed range 5000 to 15000 r.p.m. With temperature ranging from 50 to 900 degree centigrade. Hence depending on the stage of operation blading material is usually an Al alloy stainless steels titanium alloys and nickel-based alloys. The tolerances on the blades are usually in the range of 0.05 mm to 0.15 mm on the aerofoil. The blades have a complex aerofoil structure and with varying aerofoil shape at different sections along the length of blade. There is always twist in the aerofoil sometimes of the order 60 degrees. These complex configurations are required as the gases are to be smoothly guided along the different stages of the compressor and turbine without turbulence to achieve maximum thrust from the engine.

Blade operating and service conditions are taken into consideration. The factors are inspection results, coating stripping and cracks due to thermo mechanical stresses during operation likely to be located on airfoil and on fillet radius, mechanical deformation modifications of design profile mainly on trailing edge, corrosion, erosion, coating and surface degradation due to high temperature on airfoil. The heart of these new machines is made by the blades and vanes which are subjected during operation due to very high thermal and mechanical stresses (combined effect of centrifugal force and thermal gradient) in aggressive environment the blades suffer during operation of several damages which limit the component overall life, life cycle fatigue, hot corrosion.

This paper compares the accuracy of elastic and elastoplastic solid continuum finite element analyses modeled with all hexahedral or all tetrahedral meshes. Eigen values of element stiffness matrices, linear static displacements and stresses, dynamic modal frequencies and plastic flow values are compared. Elements with both linear and quadratic functions are evaluated. A simple bar with a rectangular cross section fixed at one end is modeled and results are compared to known analytical solutions wherever possible. The evaluation substantiates a strong preface for linear displacement hexagonal finite elements when compared to linear tetrahedral finite elements. The use of quadratic displacements formulated finite elements improves the performance of tetrahedral as well as hexahedral elements. The nonlinear elastoplastic comparison indicates

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that linear hexahedral elements may be superior even to quadratic tetrahedrons. In this paper Eigen values of a square geometrical volume meshed with a single hexahedron is compared to the same geometrical volume meshed with five tetrahedrons. Next, results of a linear elastic, fixed end bar meshed with either all hexahedrons or all tetrahedrons are compared.

Computer Aided Analysis of Gas Turbine Rotor Blade:

The model is created and analyzed using CATIA and ANSYS. For automatic mesh generation and node selection is used. The structural, thermal modal modules of ANSYS 12.1 are used for the analysis of the rotor blade. The rotor blade was analyzed for mechanical stresses, temperature distribution, combined mechanical and thermal stresses and radial elongations, natural frequencies and mode shapes. The blade is then analyzed sequentially with thermal analysis preceding structural analysis. The model is discretised using 8-noded plane element (plane 82) & solid 95 3D 20-nodes structural solid element.

Advancements in gas turbine materials have always played a prime role – higher the capability of the materials to withstand elevated temperature service, more the engine efficiency, materials with high elevated temperature strength to weight ratio help in weight reduction. A wide spectrum of high performance materials - special steels, titanium alloys and super alloys - is used for construction of gas turbines. The material available limits the turbine entry temperature (TET).

Titanium Alloy:

These titanium alloys are mainly used for substituting materials for hard tissues. Fracture of the alloys is, therefore, one of the big problems for their reliable use in the body. The fracture characteristics of the alloys are affected by changes in microstructure. Therefore, their fracture characteristics, including tensile and fatigue characteristics should be clearly understood with respect to microstructures. The fracture characteristics in the simulated body environment also be identified because the alloys are used as biomedical materials. The effect of living body environment on the mechanical properties is also very important to understand.

Although "commercially pure" titanium alloy has acceptable mechanical properties and has been used for orthopedic and dental implants, for most applications titanium alloy is alloyed with small amounts of aluminium and vanadium, typically 6% and 4% respectively, by weight. This mixture has a solid solubility which varies dramatically with temperature, allowing it to undergo precipitation strengthening. This heat treatment process is carried out after the alloy has been worked into its final shape but before it is put to use, allowing much easier fabrication of a high-strength product.

Silicon Carbide:

Silicon Carbide (SiC), is also known as Carborundum , is a compound of silicon and carbon with chemical formula (SiC). It occurs in nature as the extremely rare mineral moissanite. Silicon carbide powder has been mass-produced since 1893 for use as an abrasive. Grains of silicon carbide can be bonded together by sintering to form very hard ceramics that are widely used in applications requiring high endurance, such as car brakes, car clutches and ceramic plates in bulletproof vests. Electronic applications of silicon carbide such as light-emitting diodes (LEDs) and detectors in early radios were first demonstrated around 1907. SiC is used in semiconductor electronics devices that operate at high temperatures or high voltages, or both. Large single crystals of silicon carbide can be grown by the Lely method; they can be cut into gems known as synthetic moissanite. Silicon carbide with high surface area can be produced from SiO2 contained in plant material.

I PLANE 82 2-D 8-NODE STRUCTURAL SOLID ELEMENT

Plane 82 is a higher order version of the two dimensional four-node element. It provides more accurate results for mixed (quadratic-triangular) automatic meshes and can tolerate irregular shapes without as much loss of accuracy. The 8-node elements have compatible shapes and are well suited to model curved boundaries. The 8-node element is defined by 8 nodes having two degrees of freedom at each node-translations in the nodal x and y directions. As shown below the element may be used as a plane element or as an axissyymetric element. The element has plastically creep, stress stiffening, large deflection, and large strain capabilities. The following table provides the summary of element input.

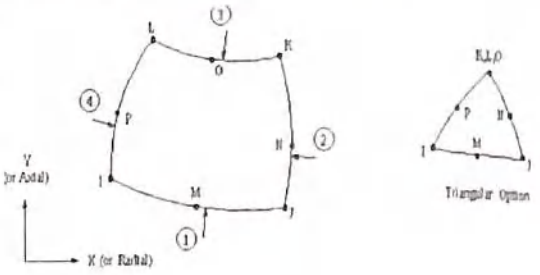

Figure 1. plane 82 2-d structural solid

SOLID 95 3D 20-NODE STRUCTURAL SOLID ELEMENT

Solid 95 is higher order version of the 3-D 8-node solid element. It can tolerate irregular shapes without as much loss of accuracy. Solid 95 elements have compatible displacement shapes and are well suited to model curved boundaries as shown. The element is defined by 20 nodes having three degrees of freedom per node: translations in the nodal x, y and z directions. The element may have any spatial orientation. The element has plastically creep, stress stiffing, large deflection and large strain capabilities. The following table provides the summary of ele

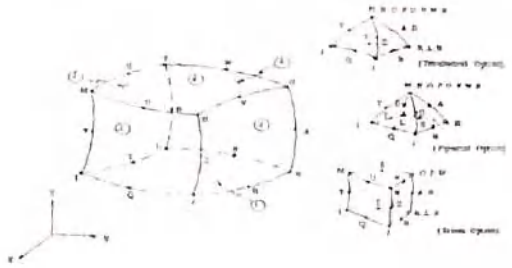

Figure 2 Solid 95 3-D structural solid

EVALUATION OF GAS FORCES ON THE ROTOR BLADES

Gas forces acting on the blades of the rotor in general have two components namely tangential (Ft) and axial (Fa). These forces result from the gas momentum changes and from pressure differences across the blades. These gas forces are evaluated by constructing velocity triangles at inlet and outlet of the rotor blades. The rotor blades considered for analysis are untwisted and same profile is taken throughout the length of the blade. If the gas forces are assumed to be distributed evenly then the resultant acts through the centroid of the area.

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...CULATION OF GAS FORCES ON THE FIRST STAGE ROTOR BLADE
...inlet of the first stage rotor blades,

...flow angle $\alpha_1 = 23.85^0$
...velocity $V_1 = 462.21$ m/s
...velocity triangles at inlet of first stage rotor blades were constructed as ...

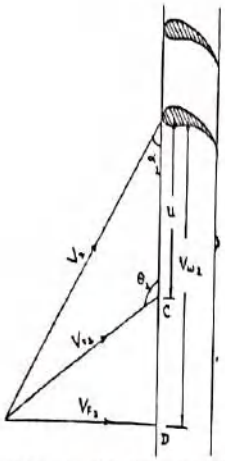

Figure 3 Inlet velocity triangles of I-stage rotor blades

...meter of blade mid span D = 1.3085 mt.
...speed of turbine N = 3426 r.p.m.

...ferential speed of rotor blade at its mid span
... = πDN/60 ---------- (1)
...the velocity triangles in figure we get,
...velocity $Vw_2 = 422.74$ m/s
...velocity Vf2 = 186.89 m/s
...velocity Vr2 = 265.09 m/s
...angle at inlet θ2 = 135.017 0

...the exit of first stage rotor blades,
...velocity Vr3 = 180 42 m/s
...flow angle θ2 = 37.88 0

...velocity triangles were constructed at the exit of the first stage rotor ...as shown in figure 3.11.

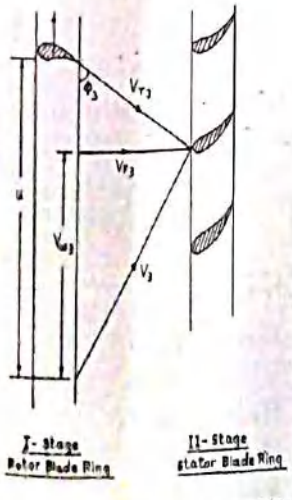

Figure 4 Exit velocity triangles of I-stage rotor blades

From the velocity triangles (Figure), we get
Whirl velocity Vw3 = 2 805 m/s
Relative velocity Vr3 = 293 83 m/s

A. Finding tangential Force (Fr) and Axial force (Fa) on each rotor
Tangential force
In Newtons
Ft = M (Vw2 – (+ Vw3)] (2)
Axial Force
In Newtons
FA = M (Vf2 – (+ Vf3)] ..... (3)

Where m represents mass flow rate of gases through the turbine in kgs / sec

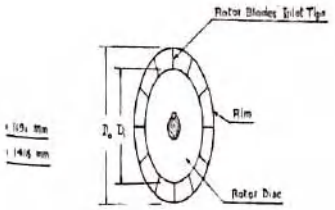

Figure 5 First stage rotor

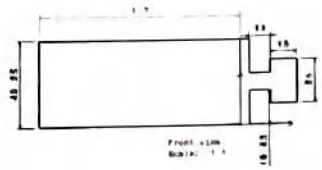

Figure 69. dimension of turbine blade

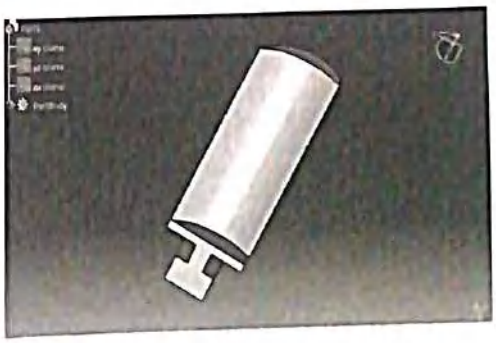

Figure 3.20. Geometric model of turbine blade using CATIA

ANALYSIS OF STRESSES AND ELONGATIONS

The ANSYS software then analyzed the mechanical stresses and elongations experienced by the rotor blade. The results were viewed in the post processor part of ansys. The geometry, loads and results were stored in a file named 'X'.

THERMAL BOUNDARY CONDITIONS APPLIED ON THE ROTOR BLADE MODEL

A new file was opened in ANSYS and the thermal module of ANSYS was activated. The rotor blade model was copied into this file from which the previous structural analysis file 'X'. The structural boundary conditions that were applied previously on the rotor blade model were deleted.

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The element type was stitched from structural to its equivalent thermal element type. The material properties were same as those in the previous file of structural analysis.

Two boundary conditions namely Heat flux and Convection were applied on the rotor blade model

The solution part of ANSYS was opened and Heat flux = 0 was applied on the areas shaded and numbered in figure
Heat flux = 0 fro areas 1,2 to 16

Areas 1,2,3 and 8,9,10 come in contact with similar areas on the adjacent rotor blades. Hence due to symmetry boundary conditions, these areas are assumed to be insulated.

Areas 4,5,6 and 11,12,13,15 on account of their small dimensions are assumed to be insulated. In the convective boundary condition, the convective heat transfer coefficient (h) and temperature of surrounding gases (T) have to be specified on the areas subjected to convection.

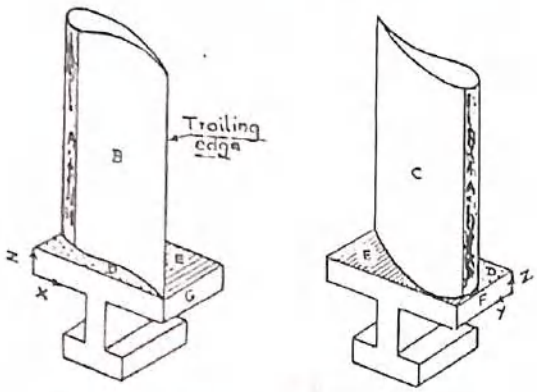

Figure 3.26 Thermal Boundary conditions

The following have been the convective boundary conditions for the areas
For area A h = (hs + hp)/2 = 332.43 w/m²K and T = 839.22° c
For area B h = hp = 248.95 w/m²K and T = 786° c
For area C h = hs = 379.92 w/m²K and T = 786° c
For area D h = 248.95 w/m²K and T = 786° c
For area E h = 379.92 w/m²K and T = 786° c
For area F h = 231.19 w/m²K and T = 733° c

Fig 7 Geometric Model of rotor blade

PARAMETERS	TITANIUM ALLOY	SILICON CARBIDE
NODAL TEMPERATURE	838.974	786.537
DEFORMATION	0.144E-6	0.144E-6
VONMISES STRESS	424	410

Modal Analysis Results of gas turbine rotor blade

S.no	Mode Shapes	TITANIUM Alloy Natural Frequencys(Hz)	SILICON CARBIDE Natural Frequencys(Hz)
1	Mode	31.76	57.042
2	Mode	86.194	154.808
3	Mode	141.276	253.739
4	Mode	184.776	331.868
5	Mode	366.005	657.365
6	Mode	433.485	778.561

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ONCLUSION

The finite element analysis of gas turbine rotor blade is carried out ng 20 noded brick element. The static and thermal analysis is carried

The temperature has a significant effect on the overall stresses in the ine blades.

Maximum elongations and temperatures are observed at the blade tip ation and minimum elongation and temperature variations at the root of ades.

Temperature distribution is almost uniform at the maximum curvature ion along blade profile.

Temperature is linearly decreasing from the tip of the blade to the root the blade section.

By using Titanium Alloy and silicon carbide analyzed couple field ation.

Maximum stress induced is within safe limit.

Maximum thermal stresses are setup when the temperature difference imum from outside to inside.

Maximum stresses and strains are observed at the root of the turbine ion and upper surface along the blade roots.

Elongations in X-direction are observed only at the blade region in the ng the blade length and elongation in Y-direction are gradually varying on different sections along the rotor axis.

It could be concluded that these contour maps and profiles enables us ascertain the areas of rotor blades that are vulnerable for failure.

From Couple Field Analysis and Modal Analysis, we conclude that Silicon Carbide is better than the Titanium Alloy.

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Preface

The First International Conference on Data Engineering and Communication Technology (ICDECT 2016) was successfully organized by Aspire Research Foundation, Pune during March 10–11, 2016 at Lavasa City, Pune. The conference has technical collaboration with Div-V (Education and Research) of Computer Society of India. The objective of this international conference was to provide opportunities for the researchers, academicians, industry persons, and students to interact and exchange ideas, experience and gain expertise in the current trends and strategies for information and intelligent techniques. Research submissions in various advanced technology areas were received and after a rigorous peer-review process with the help of program committee members and external reviewer, 160 papers in separate two volumes (Vol-I: 80, Vol-II: 80) were accepted. All the papers are published in Springer AISC series. The conference featured seven special sessions on various cutting-edge technologies which were conducted by eminent professors. Many distinguished personalities like Dr. Ashok Deshpande, Founding Chair: Berkeley Initiative in Soft Computing (BISC)—UC Berkeley CA; Guest Faculty: University of California Berkeley; Visiting Professor: New South Wales University, Canberra and Indian Institute of Technology Bombay, Mumbai, India; Dr. Parag Kulkarni, Pune; Prof. Amit Joshi, Sabar Institute, Gujarat; Dr. Swagatam Das, ISI, Kolkata, graced the event and delivered talks on cutting-edge technologies.

Our sincere thanks to all Special Session Chairs (Dr. Vinayak K. Bairagi, Prof. Hardeep Singh, Dr. Divakar Yadav, Dr. V. Suma), Track Manager (Prof. Steven Lawrence Fernandes) and distinguished reviewers for their timely technical support. Thanks are due to ASP and its dynamic team members for organizing the event in a smooth manner. We are indebted to Christ Institute of Management for hosting the conference in their campus. Our entire organizing committee, staff of CIM, student volunteers deserve a big pat for their tireless efforts to make the event a grand success. Special thanks to our Program Chairs for carrying out an immaculate job. We would like to extend our special thanks here to our publication chairs doing a great job in making the conference widely visible.

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Lastly, our heartfelt thanks to all authors without whom the conference would never have happened. Their technical contributions to make our proceedings rich are praiseworthy. We sincerely expect readers will find the chapters very useful and interesting.

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Experimental Analysis on Big Data in IOT-Based Architecture

Anupam Bera, Anirban Kundu, Nivedita Ray De Sarkar and De Mou

Abstract In this paper, we are going to discuss about big data processing for Internet of Things (IOT) based data. Our system extracts information within specified time frame. Data tracker or interface tracks information directly from big data sources. Data tracker transfers data clusters to data controller. Data controller processes each data cluster and makes them smaller after removing possible redundancies. Big data processing is a challenge to maintain data privacy-related protections. Data controller processes big data clusters and sends them through secure and/or hidden channels maintaining data privacy.

Keywords Big data (BD) · Distributed file system (DFS) · Hadoop · Distributed network (DN) · Internet of things (IOT)

1 Introduction

Internet is a great source for information sharing through hypertext documents, applications on World Wide Web (WWW), electronic mail, telephony and peer-to-peer networks. Internet is the framework of cooking massive information. Nowadays, a large number of smart devices are connected to Internet, and con-

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tinuously transmit massive amount of heterogeneous data. It is a challenging job of processing such huge amount of data in real time. Data should be processed in distributed environment in real time. Data could be stored in offline. Size of data is too large and distributed, that it requires use of BD analytical tools for processing [1]. There is number of different application domains widely used for data streaming, storing and processing. These application domains are difficult to maintain due to size of data and nature of network [2, 3]. User could interact with databases to modify, insert, delete, manage information using modern database software or database management system (DBMS) [4]. BD database activities are included in capture, data noise removal, search, sharing, storage, transfer, visualization, and information privacy [5].

2 Related Works

BD is a collection of large, multidimensional, heterogeneous datasets that becomes difficult to manage on typical database management systems. BD refers to data bundles whose volumes are beyond the scope of traditional database software tools [5, 6]. It is a useful tool to use predictive analytics or certain advanced methodology to extract value from data [7]. Typical database management systems failed to provide storage volumes and efficient data processing due to tremendous growth and massive data volume [5]. In 2012, a researcher "Gartner" has described BD as high volume, high velocity and/or high variety information assets which require new forms of processing for enhanced decision-making, insight discovery, and process optimization [8]. In Hadoop [9] mechanism, JobTrackers [10] have processed a block of data (δx) from distributed storage followed by analysis of data blocks to generate final results for storing into a data file. Hadoop has executed MapReduce algorithms for data processing in parallel fashion on distinct CPU nodes. Hadoop works as follows: (i) Place job to Hadoop for required process; (ii) Hadoop job client submits job to JobTracker; (iii) JobTracker executes task as per MapReduce implementation; (iv) JobTracker stores data into data file.

3 Proposed Work

Our proposed model has two segments as follows: (i) one side actively receives all signals from sensors, and forward it to BD database servers; (ii) other side serves request from enterprise personnel for data analysis.

System receives query from end-user and system coverts them to smaller size. After conversion of queries, system interface controller has plugged the information with minimum loaded interface to fetch data from BD server. Fetched records are subdivided into multiple data cubes, and further received at controller side for data analysis. Data analyzer is used to extract all necessary data from data cubes using

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two levels of data analyses. Finally, data cubes are received at user end through secure data path.

Proposed architecture is shown in Fig. 1. This model has four sections as follows: (i) dynamic query generator; (ii) data retrieval through multiple interface; (iii) two levels of data analyzer; (iv) data transmission through secure channels.

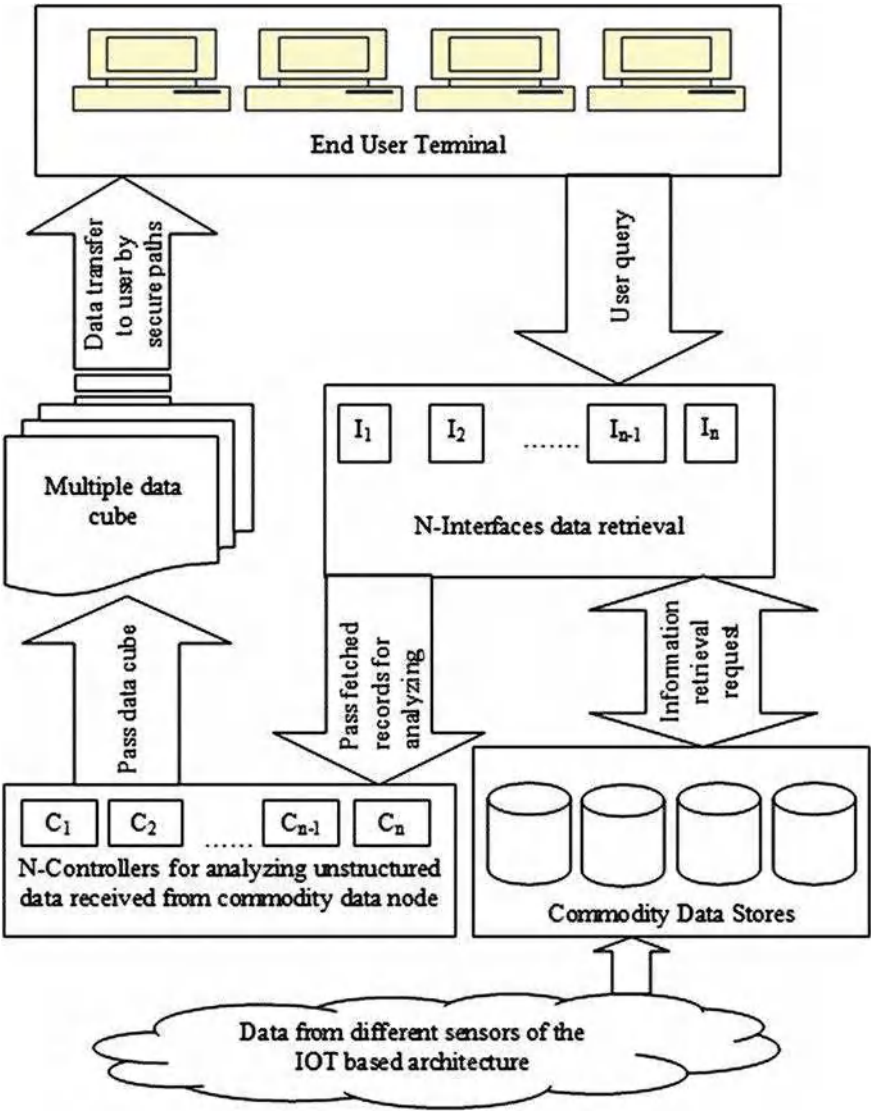

Fig. 1 Proposed architecture of our approach

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Dynamic query generator has received user's key string as input. System has splitted the string into multiple single word key values. These single word key values are being passed to minimum loaded interface. Interfaces are linked with backend BD database server, which are large-scale distributed datasets, distributed file system, e.g. NoSQL database. Structured data as well as unstructured data are available in BD system. Data retrieval time using load tracker has been reduced.

Controllers have received large datasets from interface. Controller has started analyzing for reducing redundancies after received unstructured datasets from BD system. Controllers have worked in two phases such as initially it reduces first-level redundancies, and then controller applies reduction procedure, as per user request having stringent data analysis when most of the key values are matched with record sets. Finally, controller breaks these datasets into smaller data cubes to transform into specific structure for database storage.

These smaller data cubes are passed through secure paths as it is difficult to apply encryption due to large volume of datasets. Few hidden channels have been introduced for sending data to end-users. These hidden channels and datacube sequence number are chosen randomly.

Formation of dynamic query generator is one of the most cost effective mechanisms for selecting datasets from BD system. This is introduced to minimize time complexity of total procedure. In this phase, we break user query into number of meaningful single word key values. Each user query has been broken, and then key values are sent to minimum loaded interface for retrieving required datasets.

Data analyzer is used to reduce redundancy of datasets and further processes comparatively less error-prone data to send it back to specific user. Two phases of data analyses have been performed in our system.

In this model, we have introduced secure transmission of final record sets. It is the most effective way to enforce data security on BD tools. One of the biggest challenges in BD industry is to enforce security. Information transmission is assured to users through secured hidden channels. In BD environment, data are being floated within distributed network in an unsecured manner. We have introduced security measures in BD transmission.

Proposed IOT-based BD model has two application segments. First part receives data streams from different synchronous and asynchronous sensors. It is responsible for transforming data and storing it into respective BD database servers. The other part searches information from BD database.

First segment of proposed IOT-based BD model has three algorithms as follows: (i) Synchronous_Data_Feed_Timer(); (ii) Asynchronous_Data_Feed_Timer(); (iii) storeRecord().

Algorithm 1 is a synchronous data stream feeder from different synchronous sensor devices. Each synchronous sensor produces continuous stream. Our algorithm has captured continuous stream for transforming into appropriate analytical formats as mentioned in algorithm (i.e. {timestamp, device id, data stream, alarm type, remarks}).

```
Algorithm 1: Synchronous_Data_Feed_Timer ()
Input: Device ID, Real time data
```

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```
  Output: Time Stamp, Device ID, Data, Alarm type

Step 1:Read devID, data
Step 2:l_thr : = call Find_Lower_Thresold (devID)

       /*to get lower threshold of the said device*/

Step 3:h_thr : = call Find_Higher_Thresold (devID)

       /*to get higher threshold of the said device*/

Step 4:if l_thr > data; then alarmType = low

       /*data to be checked for alarm selection*/

Step 5:else if h_thr < data; then alarmType = high
Step 6:else alarmType = withinRange
Step 7:Call storeRecord ({timestamp, devID, data, alarm-
Type, remarks})
Step 8:Stop
```

Algorithm 2 scans and collects data stream from asynchronous devices. It is executed periodically, either when sensor queue is full or after specified time intervals. Finally, it passes all received information for processing by data server.

```
  Algorithm 2: Asynchronous_Data_Feed_Timer ()
  Input: Device ID, data
  Output: Time Stamp, Device ID, Data, Alarm type.

Step 1:if (data < threshold or data > threshold);

       then alarmType: = OFR/*OFR-Out Of Range*/

Step 2:else alarmType: = WIR/*WIR-With In Range*/
Step 3:Call storeRecord ({timestamp, devID, data, alarm-
Type, remarks})
Step 4:Stop
```

Algorithm 3 receives information packs from Algorithm 1 or Algorithm 2, then converts all data items into single data string. This string is stored in a data file. Database writer periodically updates string information to database server.

```
  Algorithm 3: storeRecord ()
  Input: Record set
  Output: Output file

Step 1:For each data: record set
Step 2:Call concate (recordString, dataItem)
Step 3:printfile recordString #file
Step 4:Stop
```

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Second segment of our proposed IOT-based BD model has three algorithms as follows: (i) Fetch_record(); (ii) First_Level_Query_Analysis(); (iii) Second_Level_Query_Analysis().

Algorithm 4 acts as dynamic query generator and raw data retriever from BD system. System finds raw data (unstructured data) from distributed datasets in this phase of processing. It receives query string as input and generates output extracting large datasets from BD database.

```
Algorithm 4: Fetch_Record()
Input: Query, level of analysis
Output: Interface id, key value

Step 1:Read query_string, query_level
Step 2:key_values[]: = split_Query_String()
Step 3:For each key_values : key_val
Step 4:interfaceID : = call minimum_Loaded_Interface()
Step 5:record_set[]: = call Find_Record (key_val, interfaceID)
Step 6:End For loop
Step 7:Return {record_set, query_stringm query_level}
Step 8:Stop
```

Algorithm 5 works for first-level data redundancy minimization. It takes large datasets as input from Fetch_Record algorithm. Based on user's query level, either data is transferred for further analysis to BD analyzer, or, transferred for second level reduction.

```
Algorithm 5: First_Level_Query_Analysis ()
Input: Record sets, query string, query level
Output: Less redundant data

Step 1:For each record_set: record
Step 2:if record (common); then delete record
Step 3:End For
Step 4:if query_level : = high then
Step 5:Call Second_Level_Query_Analysis(record_set, query_
string)
Step 6:Call Big_Data_Ananlyzer(record_set)
Step 7:Stop
```

Algorithm 6 exhibits final-level reduction before calling BD analyzer. It receives data from Algorithm 5 for further reduction.

```
Algorithm 6: Second_Level_Query_Analysis ()
Input: record_set, query_string
Output: reduced datasets

Step 1:len: = no_of_keyvalues (query_string)
Step 2:if count (key_val, record_set) < len/2; then delete
record
```

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```
Step 3:Call Big_Data_Analyzer (record_set)
Step 4:Stop
```

4 Experimental Results

Following diagrams are exhibited to understand behaviour of our system framework in real time. It also shows that our system has a cost effective and time efficient structure.

In Fig. 2, CPU load has been shown with good performance for executing proposed framework. CPU load is less than 50 % in most of the time. It is an important part to identify how our model works.

Figure 3 represents real-time performance of proposed BD model with an effect on CPU temperature around 45 °C. Most of the time CPU temperature is near to 40 °C.

Figure 4 shows a graph of memory load with respect to time. Primary memory occupancy is quite high due to large raw record sets. It is around 90 % of total memory available. Less temporary space at run time is occupied by our model.

Our system works in two phases, such as data tracker and controller.

In Phase 1, there is '*I*' number of data trackers responsible for data retrieval and each successive request has '*K*' number of key-value pairs. So, we have drawn time equations of data tracker algorithms as follows:

$$\mathrm{T(K)} = \mathrm{O}(\log_I K), \tag{1}$$

where I = number of data trackers; K = number of key-value pairs;

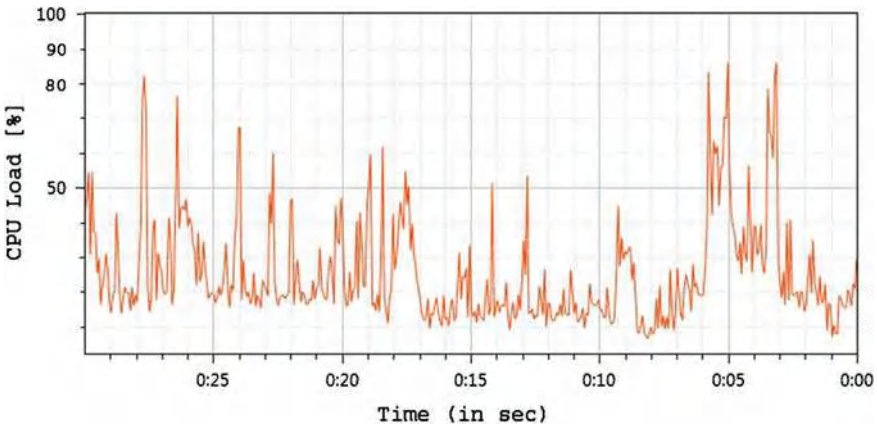

Fig. 2 CPU load distribution in real time

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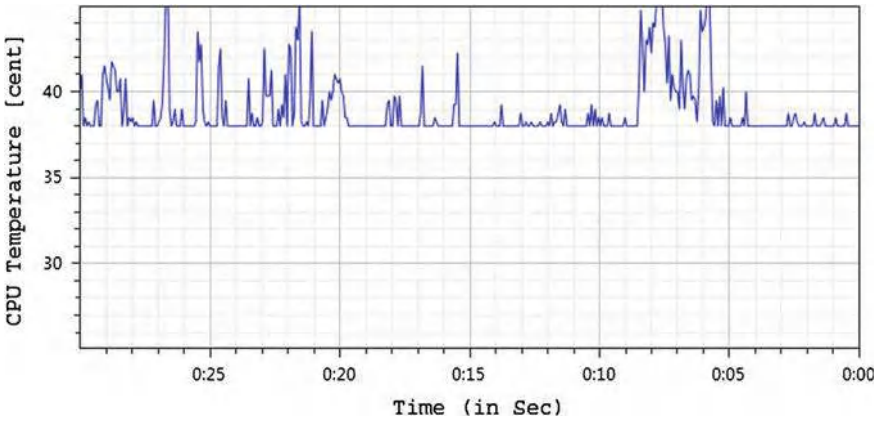

Fig. 3 CPU temperature performance with respect to time

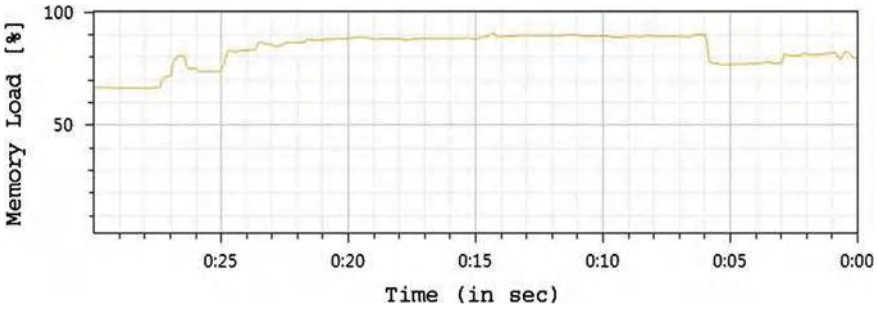

Fig. 4 Primary memory load versus time

In Phase 2, there is '*C*' number of controllers responsible for reducing data blocks and each controller receives '*N*' data blocks from data trackers. Following equation is the representation of time complexity in controller's part:

$$\mathrm{T(N)} = \mathrm{O}(\log_C N), \tag{2}$$

where C = number of controllers; N = number of data blocks;

5 Conclusion

Information from BD sources has been tracked by data tracker, and subsequently data controller has processed the confined information avoiding redundancies. Experimental results have shown CPU load, CPU temperature, and primary memory load in real time to exhibit characteristics of our proposed system. Cost

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analysis of our system framework is depicted with an aim of achieving better efficiency.

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Morphology Based Approach for Number Plate Extraction

Chetan Pardeshi and Priti Rege

Abstract Number Plate Recognition identifies vehicle number without human intervention. It is a computer vision application and it has many important applications. The proposed system consists of two parts: number plate area extraction and character identification. In this paper, morphological operation-based approach is presented for number plate area extraction. Effective segmentation of characters is done after plate area extraction. Histogram-based character segmentation is a simple and efficient technique used for segmentation. Template matching approach is used for character extraction. Number plate with variable character length poses limitation on number identification in earlier reported literature. This is taken care of using histogram-based character segmentation method.

Keywords Histogram · Morphological operations · Number plate extraction · Template matching · Thresholding

1 Introduction

Every country has specific vehicle identification system. These systems are used in the traffic control and surveillance systems, security systems, toll collection at toll plaza and parking assistance system, etc. Human eye can easily recognize these number plates, but designing automated system for this task has many challenges. Blur, unequal illumination, background and foreground color and also many natural phenomena like rain fall, dust in air may create problem in number extraction. Also number plate standards are different for each country, therefore large number of variations are obtained in parameters like, location of number plate, area of number plate and characters, font and size used for numbers and characters (standard font is

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Arial Black), background color (white, yellow or black) and foreground color (black or red), etc., which make the task of number plate extraction difficult.

Number of applications of license plate identification can be listed as parking assistance facility during ticket collection, unmanned toll collection at toll booths, traffic surveillance system, tracking vehicles during signal violation, vehicle's marketing research.

Aim of this paper is to implement an efficient method for number plate extraction. Algorithm proposed in this paper identifies characters present on single line number plate with variable character length.

Rege and Chandrakar [1] has separated text image in document images using run length searing algorithm and boundary perimeter detection. Morphological operation and bounding box analysis are used by Patel et al. [2]. Owamoyo et al. [3] used Sobel filter along with morphological operations. Algorithm presented by Gilly and Raimond [4] stresses on connected component analysis. Bulugu [5] used edge finding method to locate the plate in the scene. Kate [6] proposed morphological operation based on area for searching number plate. Kolour [7] has reviewed a number of license plate detection algorithms and compared their performances in his paper. His experimentation gives a basis for selection of the most appropriate technique for their applications. Parasuraman and Kumar [8] extracted the plate region using edge detection followed by vertical projection. Proposed algorithm has four stages: (i) Acquisition of vehicle image and preprocessing includes conversion of image to gray format, resizing of image, etc. (ii) Marking of area covering the number plate in the vehicle image, (iii) Segmentation of characters from the number plate extracted, and (iv) Recognizing and displaying the segmented characters.

2 Proposed Method for Identification of Letters/Numbers from License Plates

This section elucidates the number plate extraction method for single line number plate. Input to the system is a vehicle image (with clear view of number plate in it) which is captured by digital camera and output is the actual characters present in that vehicle image. Each character present on input number plate image should at least have minimum resolution of 24 × 42 pixels and distance of number plate from camera should be such that it guarantees clear view of numbers present on the number plate.

Proposed algorithm consists of following steps:

- Image Preprocessing
- Number plate area extraction
- Segmentation of each character area in image
- Image matching for each character
- Output extracted characters in text format

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2.1 Image Preprocessing

Preprocessing is used to enhance the contrast of the image and for resizing of the image. RGB image is converted to grayscale image which carries intensity information. RGB values are converted to grayscale values by forming a weighted sum of the R, G, and B components:

$$\text{Gray} = 0.2989 * \text{R} + 0.587 * \text{G} + 0.114 * \text{B}$$

2.1.1 Contrast Enhancement

Captured image may have unevenly distributed lighting or darkness. During edge detection fine edge details in dark region of the image are eliminated. Also feature edges in bright regions need to be preserved. Top-hat transformation is used to preserve these edge details as well as prominent ones. The main property of top-hat operator can be applied to contrast enhancement. After applying top-hat filtering, image is converted to binary image from gray scale using Otsu's algorithm. Figure 1a–d shows various stages of image preprocessing.

2.2 Number Plate Area Detection

System's speed and accuracy is enhanced using precise number plate area extraction. At this stage, number plate area is extracted from entire preprocessed image. This step reduces processing burden on next stage of identification of numbers from license plate area.

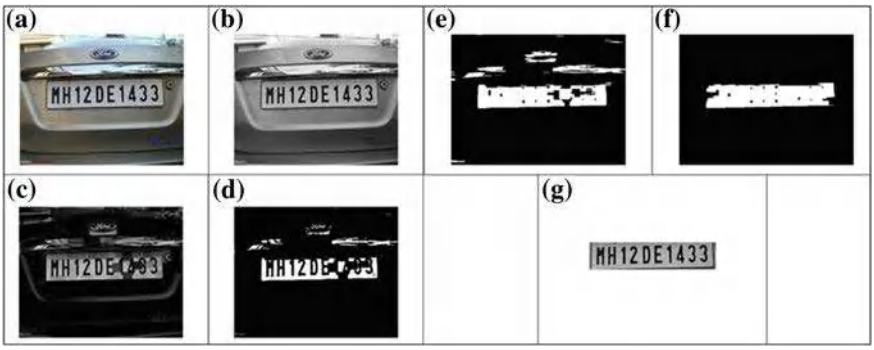

Fig. 1 **a** Original image, **b** Gray image, **c** Top-hat filtered image, **d** Binary image, **e** Dilated image, **f** Selected object, **g** Extracted plate

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2.2.1 Plate Area Detection

A morphological operator is employed to the preprocessed image for extracting the plate area. Morphological operator that suits the rectangular shape of number plate is used for this purpose. Binary image is dilated with rectangular box as structuring element.

After dilation operation, horizontal object with Aspect Ratio(R) > 3 is filtered out from dilated image. As number plate generally have larger lengths as compared to its width. Aspect Ratio = width/height and R defines the region of interest.

Upon detection of plate area, top left and bottom right coordinates are extracted and further these coefficients are used for selecting plate area from original image. Figure 1e–g shows various stages involved in plate area extraction. Figure 1e shows dilated image. Filtered region (selected object) from unwanted region is shown in Fig. 1f. Figure 1g shows extracted plate area.

2.3 Character Segmentation

In this step, number plate is segmented to obtain characters present in it.

Morphological operations are used in segmentation process. Dilation of an image I by the structure element H is given by the set operation

$$I \oplus H = \{(p+q) \mid p \in I, q \in H\}$$

Erosion of an image I by the structure element H is given by the set operation

$$I \Theta H = \{(p \in Z^2) \mid (p+q) \in I, \text{for every } q \in H\}$$

Algorithm for segmentation process is as follows:

- Convert extracted plate image is into gray scale image (Fig. 2a).

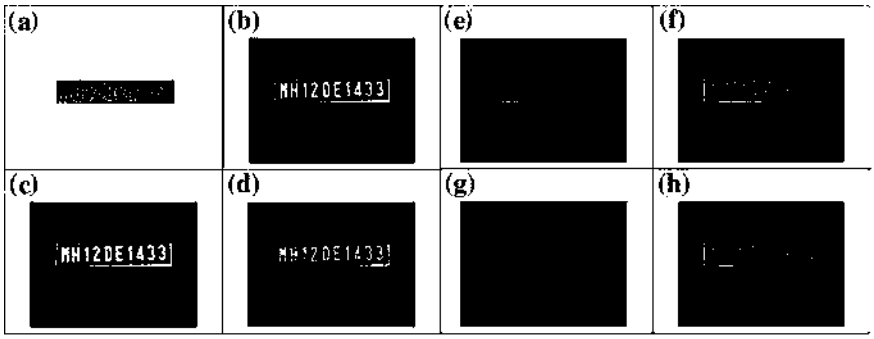

Fig. 2 **a** Gray image, **b** Inverted binary image, **c** Dilated image, **d** Eroded image, **e** Subtracted image, **f** Convolved Image, **g** Erosion with horizontal structuring element, **h** Subtracted after erosion

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- Binarized image is using Ostu's algorithm. Invert pixel values of binarized image, i.e., make 0 to 1 and 1 to 0 for further processing. Result of binarization is shown in Fig. 2b.
- Apply morphological gradient for edges enhancement. Figure 2c shows dilated image with disk as structuring element. Figure 2d shows results of erosion on binary image Fig. 2b, e shows result of image subtraction of eroded image from dilated image.
- Convolve subtracted image with [1 1; 1 1] for brightening the edges (Fig. 2f).
- Erode with horizontal line as structuring element to eliminate the possible horizontal lines from the output image after subtraction operation (Fig. 2g).
- Subtract eroded image from convolved image (Fig. 2h).
- Fill all the regions of the image (Fig. 3a).
- Do thinning on the image to ensure character isolation (Fig. 3b).
- Calculated properties of connected components, i.e., objects present in image using 4 and 8 neighborhood labeling algorithms. Following properties of each object are calculated, (i) [x y] which specifies the upper left corner of the object. (ii) [x_width y_width] which specifies the width of the object along each dimension.
- Calculate histogram of all objects based on y-dimensions and y-width. Find intersection of number of objects in histogram based on y-dimensions and histogram based on y-width, to know exact number of characters present in image. Use 4, 8 neighborhood connectivity algorithms to find out bounding box for individual objects in image. Using result of histogram analysis, only those objects which have been identified in intersection of histogram are proposed for further processing. The result of object segmentation is as shown in Fig. 3c.

Results for two more samples are shown in Figs. 4 and 5.

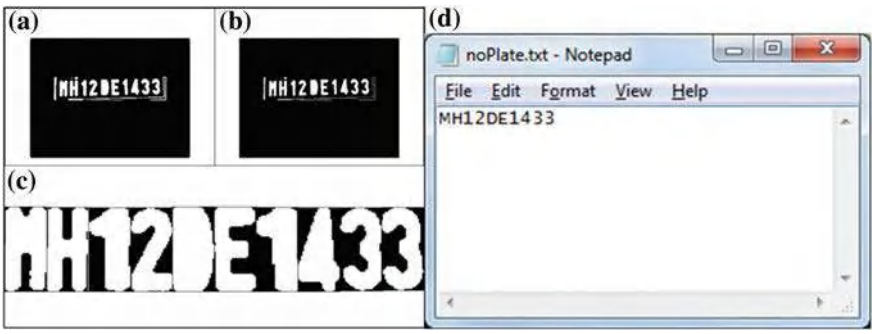

Fig. 3 **a** Holes filled, **b** Thinning, **c** Segmented characters, **d** Extracted characters stored in text file

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Fig. 4 **a** Sample image Fig. 2, **b** Extracted plate, **c** Processed image, **d** Extracted letters, **e** Extracted characters in text file

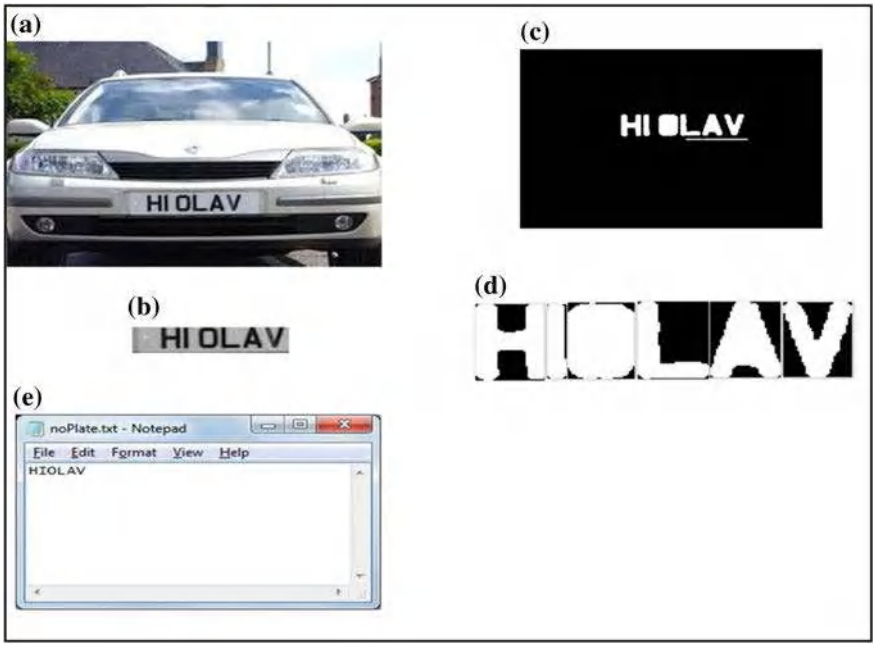

Fig. 5 **a** Sample image Fig. 3, **b** Extracted plate, **c** Processed image, **d** Extracted letters, **e** Extracted characters in text file

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2.4 Image Matching

Each segmented character image is then compared against database image (database is set of few samples of character images of different fonts and different style of holes fillings in them) and correlation between test character image and database images is found.

Correlation coefficient between image A and image B can be calculated using

$$r = \frac{\sum_m \sum_n (A_{mn} - \overline{A})(B_{mn} - \overline{B})}{\sqrt{\left(\sum_m \sum_n (A_{mn} - \overline{A})^2\right)\left(\sum_m \sum_n (B_{mn} - \overline{B})^2\right)}},$$

where $\bar{A} = \text{mean}(A)$, and $\bar{B} = \text{mean}(B)$.

The database image for which maximum correlation is obtained is the identified character. This identified character is then stored in text file as shown in Fig. 3(d).

3 Conclusion and Future Works

Algorithm proposed in this paper identifies characters present on single line number plate with variable character length. In future, the extraction of number plate can be integrated with video-based surveillance system for automatic detection of various objects from video sequences.

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NeSeDroid—Android Malware Detection Based on Network Traffic and Sensitive Resource Accessing

Nguyen Tan Cam and Nguyen Cam Hong Phuoc

Abstract The Android operating system has a large market share. The number of new malware on Android is increasing much recently. Android malware analysis includes static analysis and dynamic analysis. Limitations of static analysis are the difficulty in analyzing the malware using encryption techniques, to confuse the source, and to change behavior itself. In this paper, we proposed a hybrid analysis method, named NeSeDroid. This method used static analysis to detect the sensitive resource accessing. It also used dynamic analysis to detect sensitive resource leakage, through Internet connection. The method is tested on the list of applications which are downloaded from Android Apps Market, Genome Malware Project dataset and our additional samples in DroidBench dataset. The evaluation results show that the NeSeDroid has the high accuracy and it reduces the rate of fail positive detection.

Keywords Android malware analysis · Network behavior · Network traffic monitoring · Sensitive resource · Hybrid analysis · Mobile device security

1 Introduction

According to the International Data Corporation's statistic [1], the Android operating system always has the highest market share recently. In the second quarter of the year 2015, the Android operating system accounted for 82.8 % market share. According to F-secure's statistic [2], the number of new malware on Android is 99 % when compared with others. Analyzing and detecting malware on Android

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Table 1 Malicious behavior categories in 2014

Behavior category	2014 (%)	Behavior category	2014 (%)
Steals device data	36	Modifies settings	20
Spies on user	36	Spam	7
Sends premium SMS	16	Elevates privileges	7
Downloader	18	Banking trojan	7
Back door	18	Adware/annoyance	13
Tracks location	9		

operating system become very necessary. There are three methods of analyzing malware: they are static analysis, dynamic analysis, and hybrid analysis. Static analysis is not necessary to run the application and opposite with dynamic analysis. Many researches used the static analysis [3–10]. Dynamic analysis [11–16] will solve the problem of static analysis as encryption, confusing the source. Meanwhile, hybrid analysis [17, 18] combines both static analysis and dynamic analysis. Hybrid analysis technique inherits the advantages of static analysis and dynamic analysis but it needs more cost.

The report of Symantec [19] shows that "steals device data" and "spies on user" are two malicious behaviors that were the most common used behaviors, which mean a study performing on this behaviors is necessary (Table 1).

Based on the network accessing behavior of application to detect malware, dynamic analysis method has many advantages and a lot of research interest [15, 18, 20–22].

Feizollah et al. [20] analyzed malware on Android operating system based on network packet analysis. They used two classification algorithms: K-means and Mini batch K-means to detect anomalies from network packets of the applications. Besides, they compare the performance of each algorithm. In this article, the authors focused subclass of applications compared to the set of known malware, and it had difficulty in analyzing new malware families (zero-day malware). This approach does not care about the semantics of the packet. Needs to expand the content analysis of network connectivity requirements of the application to be able to detect malicious behavior instead of matching network data collected by the application are considered for data collection network from the sample application in practice.

Zaman et al. [15] proposed a method to detect malware based on information of network access requirements from applications. Their system collects the domain which is accessed by application; if the domain name in the list of blacklist domains is defined before, this is malware. Thus, this approach depends on blacklist domains. The same difficulty in detecting malware using the domain name (Command and Control—C&C server) new is not belong to blacklist domains. Consider to find out a method of analyzing the network access behavior of application with this solution to able to detect the malware using new C&C server.

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Jun et al. [21] proposed an Android malware analysis method using SVM classifier algorithm on network accessing information. The authors run benign applications for a long time and collect network packet information. Next, they run malware applications to collect network information. The classification is based on two information collected. This approach only detects a comparison with the available malware that have difficulty in detecting the new malware, new behaviors.

Shabtai et al. [22] proposed an approach to analyze malware which updated itself by collecting network information. This approach also allows to distinguish changes in the network access behavior of applications in one of three kinds: changing of user habit, self-update new version, and insert malicious malware from the Internet. This approach only concerned with network access behavior but do not consider the dangerous of stolen information in device, which is then sent to the network via network connection.

Feldman et al. [18] also proposed a solution which allows to detect malware by grouping network information and machine techniques. This method is not only interested in stealing sensitive information but also interested in the behavior of network access, which leads to false alarm applications; normal Internet access application is the malware.

Arzt et al. [9] proposed FlowDroid. FlowDroid is an approach that is used to detect a sensitive flow from sensitive sources to critical sinks. Because FlowDroid uses a static analysis technique, it cannot detect some malicious behaviors that are performed when the application is running. So, an approach based on hybrid analysis technique is necessary to study.

In this paper, we propose a malware analysis method based on network information and behavior of sensitive resources accessing in order to reduce the rate of false positive detection. This mean to reduce case which detects that a benign application is a malware.

The contributions of this study included the following:

- Make a dynamic malware analyzing system based on network information and sensitive resources with low FP.
- Compare with the existing relevant works.
- Add some samples into the existing dataset.

The rest of this paper is organized as follows. Part objective is presented in Sect. 2. Section 3 is a detailed description of malware detection system that is proposed, NeSeDroid. The test results and discussed assessment are presented in Sect. 4, and conclusion in Sect. 5.

2 Objectives

In this section, we present some motivation examples and related research questions. Besides, we outlined the objectives of this study.

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```
<uses-permission android:name="android.permission.INTERNET" />
```

Fig. 1 An example of AndroidManifest.xml

The first research question: If an application access to a website on the Internet does not have behavior of leak user's information, can we conclude that it is a malware or not?

Consider the AccessInternet application which wrote to make an experiment in this study. This application just accesses the Internet but does not leak information of devices on the Internet. Applications are the granted permissions that are shown in Fig. 1:

More detail of Java code is shown in Fig. 2.

This application just only access and download the website's content. However, based on the solution of Zaman et al. [15], if the URL is detected in the predefined blacklist, this application is called a malware, even though this site is just a normal website (such as a news website, a education website…). In this case, increase the False Positive of method which is proposed by Zaman et al. and thus need to distinguish between normal access and dangerous access to decrease rate of false detection. An application has the risk of information leakage when this application is accessed to sensitive resources on device, and to the Internet to steal this sensitive information.

Second research question: When analyzing an application's code using static analysis techniques, there are several functions that can access to sensitive resources (e.g., getDeviceId ()) with Internet connection to leak information. Is it a case of malware? Do we have any application that has a malicious signal if it is analyzed by static analysis techniques although it never access the Internet when the application is executed in the real?

We wrote an application, named NeverClick, for sensitive resources access testing using getDeviceId() function, such as strDeviceID = telephonyManager. getDeviceId(); Although source code of this application has functions that are used to send values of strDeviceID to a web server, these functions should never be done because btnNeverClick button is disabled so the onClick event will not be called during running the application. More detail of NeverClick is shown in Fig. 3.

According to FlowDroid [9], this is a malicious application because it has both sensitive source and critical sink. However, the fact is that behavior of AccessInternet cannot happen. Therefore, this is caused False Positive of FlowDroid.

```
URL url = new URL("http://www [redacted]");
HttpURLConnection con = (HttpURLConnection) url.openConnection();
String readStream = readStream(con.getInputStream());
System.out.println(readStream);
```

Fig. 2 Java code of AccessInternet application

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```
    TelephonyManager telephonyManager = (TelephonyManager)
            getSystemService(Context.TELEPHONY_SERVICE);
    strDevice = telephonyManager.getDeviceId();
    Button btnNeverClick = (Button) findViewById(R.id.btnNeverClick);
    btnNeverClick.setEnabled(false);
    btnNeverClick.setOnClickListener((view) -> { fncPOST(); });
}
public void fncPOST() {
    if (android.os.Build.VERSION.SDK_INT > 9) {
        StrictMode.ThreadPolicy policy = new
                StrictMode.ThreadPolicy.Builder().permitAll().build();
        StrictMode.setThreadPolicy(policy);
    }
    HttpClient httpclient = new DefaultHttpClient();
    HttpPost httppost = new HttpPost("http://[redacted]/default.php");
    List<NameValuePair> sendValue = new ArrayList<~>(1);
    sendValue.add(new BasicNameValuePair("DeviceID:",strDevice));
    try {
        UrlEncodedFormEntity entity = new UrlEncodedFormEntity(sendValue);
        httppost.setEntity(entity);
        ResponseHandler<String> handler = new BasicResponseHandler();
        String content = httpclient.execute(httppost, handler);
```

Fig. 3 Java code of NeverClick application

```
Button btnConnect = (Button) findViewById(R.id.btnConnect);
btnConnect.setEnabled(true);
```

Fig. 4 Java code of SensitiveResource application

We wrote other application, named SensitiveResource. This application is like NeverClick but the difference is that enabled attribution of button btnConnect is True (such as, btnConnect.setEnabled (true)). This application either gets device ID or sends it to a webserver (Fig. 4).

In this case, the sensitive resource access and network access are detected not only in the case of static analysis but also in dynamic analysis. This application is a specific example for the case of information leakage of devices via the Internet.

Through the examples above, this paper sets out specific objectives:

- Reduce the false detection rate in detecting the risk of leaking sensitive information via the Internet by combining static analysis with dynamic analysis.
- Add the sample to the dataset used for the evaluation of malware analysis solutions based on network traffic and sensitive resource accessing.

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3 System Design

To achieve the goals set out in Sect. 2, we propose the malware analysis system based on the analysis behavior of sensitive resource accessing and Internet accessing to steal information, named NeSeDroid. NeSeDroid system is operated with three phases:

Phase 1: Create a list of dangerous domains (BlackListDB) and the list of sensitive sources (SensitiveSourceDB). Step (1) transfers the malicious domain information from Virustotal [23] to BlackListDB. Step (2) runs the samples in Genome Dataset [24] to obtain network access information. This information is also included in BlackListDB. Thus, compared to the other, NeSeDroid created backlist from more sources, such as Virustotal and other applications from dataset of Android Malware Genome Project. This makes the list of domains in this blacklist more accurate (Fig. 5).

Step (3) extracts the sensitive sources from source–sink list provided by SuSi [25]. SuSi provide source–sink list maybe included in an Android application. We proceed to extract the sensitive sources which maybe included from this list to make an evidence for detecting sensitive resource and accessing of applications was analyzed.

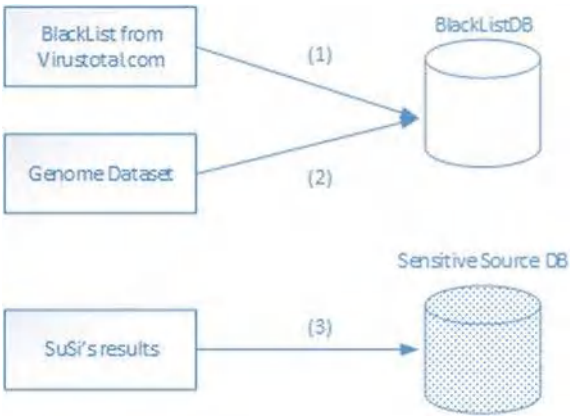

Fig. 5 Three steps in the first phase of NeSeDroid

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Fig. 6 Extract the used sensitive sources list from apk file

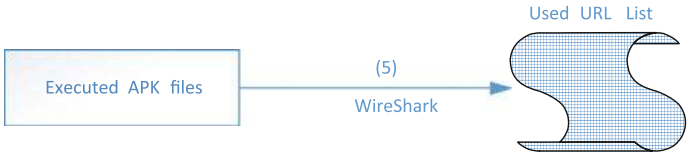

Fig. 7 Capture the used URL list using WireShark

Phase 2: The system extracts the sensitive sources (if any) by analyzing apk file. This information is stored in a list (Used sensitive source list). If there is any sensitive source in the application, turn isSource flat into 1, if not turn isSource into 0. In step (4), we use apkTool [26] and dex2jar [27] to reverse the apk file. Extract the functions related to sensitive resource accession using AndroidManifest.xml file and classes_dex2jar.jar file (Fig. 6).

Phase 3: The system executes a tested application on the Android virtual machine. In this phase, the network accessing information is logged. The gathering of network information was conducted by the Wireshark [28]. Network information will be compared to the black list in Phase 1. If this information is contained in the black list, the system turns isURL flag into 1, and 0 in opposite case (Fig. 7).

If both iSource and isURL are equal to 1, this is a malware. In opposite situation, this is a benign application. Using the information that relate to network accessing and sensitive resource accessing, our system can detect malicious applications with low of false detection rate. However, this system needs more than cost to perform two analysis techniques: static analysis method is used to extract BlackListDB, sensitive source DB, used sensitive source list; and dynamic analysis method is used to create used URL list.

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Details of pseudocode of this approach is as follows:

```
Input: Used URL list, Used Sensitive Source list
Output: false: Benign App OR true: Malicious App
Begin
          If Used URL list IN BlacklistDB
            Then  isURL = 1
            Else  isURL = 0
          If Used Sensitive Source List IN Sensitive
          Source DB
            Then  isSource = 1
            Else  isSource = 0
          If isURL==1 AND isSource==1
            Then  isMalware = True
            Else isMalware = False
          Return isMalware
End.
```

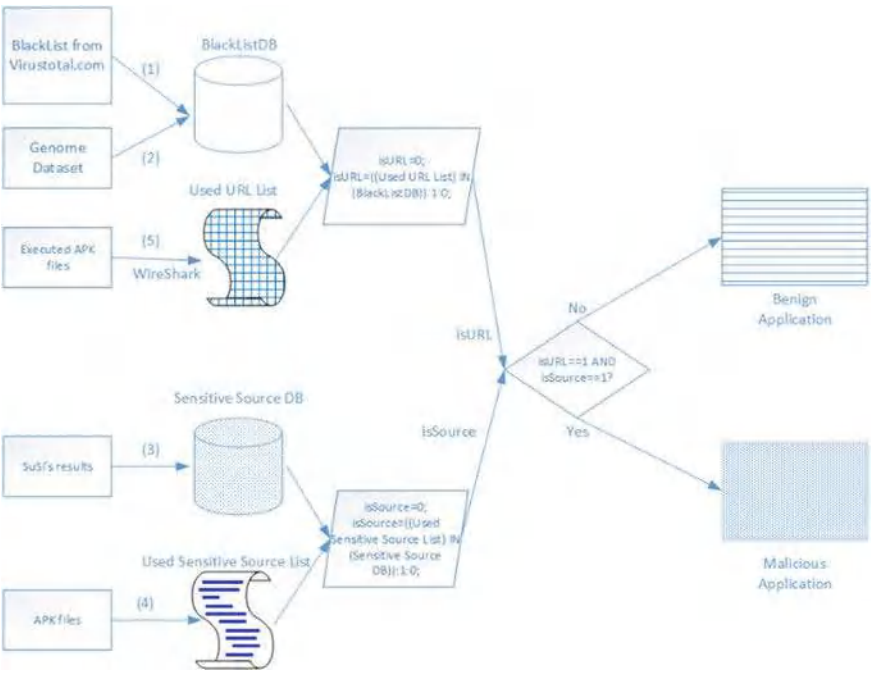

Fig. 8 The NeSeDroid system

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In this pseudocode, the return value is isMalware. If isMalware is True, this application is a malicious software, whereas it is a benign software.

The system diagram of NeSeDroid is shown in Fig. 8.

4 Evaluation

NeSeDroid is a hybrid analysis system. NeSeDroid was implemented on the experimental model which is shown in Fig. 9.

In this model, the Android device is a virtual machine running Android 4.4 (KitKat) [29]. This virtual machine connected to the Internet via a gateway machine. Gateway is a computer running Ubuntu 12.04 [30]. Wireshark software is installed on the gateway machine. Internet accessing information from Android Device saved into a file by Wireshark. This file content is used by NeSeDroid in phase 3 of the analysis.

Dataset in this test included the dataset from Android Malware Genome Project [24] and the free applications from Google Play. Moreover, we added some samples (NeverClick, AccessInternet, and SensitiveResource) to the DroidBench dataset.

To compare NeSeDroid with other approaches, we tested two samples which wrote in this study to supplement the DroidBench dataset for malware analysis by analyzing sensitive source accessing and network traffic. AccessInternet is a normal Internet accessing application group without sensitive resources accessing.

NerverClick is an application group having the behavior of access to sensitive sources, but the behavior of Internet access just have in code of application which did not active when this program was executed. This mean the NeverClick application group is not a dangerous application group which is leak information. The last application group is Exploit sensitive resource via Internet. This group includes applications which have behavior of access to sensitive sources and Internet access to steal this sensitive information. Thus, a good malware detecting system needs to detect three of this case with results: the first group is not malware, the second group is not malware, and the third group is malware.

Thus, the experimental results showed that NeSeDroid detected three of application groups accurately when FlowDroid and Zaman et al's solution just have two out of three cases. Table 2 shows that FlowDroid and NeSeDroid detect AccessInternet (a benign application) as a benign application. This means that two methods are successful in this case. Meanwhile, AccessInternet is seen as a malware

Fig. 9 The experimental of NeSeDroid

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Table 2 The experimental results

Sample	Type of application	FlowDroid	Zaman et al's solution	NeSeDroid
Access internet	Benign	True	False	True
Never click	Benign	False	True	True
Exploit sensitive resource via internet	Malicious	True	True	True

if we use Zaman et al's solution. In NeverClick case, FlowDroid has the fail detection, because NeverClick is really a benign application while it is seen as a malicious software by FlowDroid. In the last case, SensitiveResource is seen as a malware by all of three methods. In short, the test result shows that the rate of positive false of NeSeDroid is lower than the two remaining studies.

5 Conclusion

In this paper, we propose the Android malware analysis system through the analyzing network information and sensitive resources accessing (NeSeDroid). This static analysis is used to detect sensitive resources accessing and dynamic analysis to detect information leakage via the Internet. The test result shows that this approach has higher accuracy and lower false positive detection. Moreover, we added some samples to the DroidBench dataset that are used to compare difference approaches. Studying a method to shorten time detect malware by this method should be studied in the future, such as the used URL is collected on Android device instead of on the gateway.

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RiCoBiT—Ring Connected Binary Tree: A Structured and Scalable Architecture for Network-on-Chip Based Systems: an Exclusive Summary

V. Sanju and Niranjan Chiplunkar

Abstract High-performance computing systems consist of many modules of high complexity with billion transistors on a small silicon die. To design these mega functional systems, the common bus architecture poses a serious problem in terms of latency and throughput. To overcome the disadvantages of the common bus architecture, a new paradigm in ASIC design called the Network-on-Chip (NoC) was proposed. Several topologies like 2D mesh, torus, etc., were used to interconnect the different modules of the design using this novel idea. These topologies underperformed when scaled. This paper proposes a new architecture RiCoBiT: Ring Connected Binary Tree. It is a new scalable, structured architecture for Network-on-Chip based systems. An optimal routing algorithm for it has been designed. The paper discusses the different properties and performance parameters like maximum hop count, average hop count, number of wire segments, and wire length used to interconnect the nodes of RiCoBiT. These parameters are compared with that of 2D mesh and torus. The paper also discusses and bounds real-time parameters like latency and throughput.

Keywords Network-on-chip · Topology · Architecture

1 Introduction

The advances in semiconductor physics and successful research outcome in fabrication and lithography processes have enabled integration of more and more logic on a small silicon area. This prompted designs for high-performing mega functional

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modules. Initially, these designs were realized using the common bus architecture. As the system complexity increased, several new techniques like parallel bus architecture, arbitration, and polling were incorporated. As year passed by, these also caused problems in high performance.

To overcome these, a new paradigm in ASIC design called Network-on-Chip (NoC) [1–3] was introduced wherein the concepts of networking were implanted on silicon. The processing modules are placed in different nodes of the direct and indirect network like 2D mesh, torus, tree, octagon, and omega [1, 4] which were proposed to implement this concept. The nodes communicated through packets transferred from one node to the other. These innovations proved advantageous in terms of performance with a small increase in area which allowed the designs to swell further. This continued for sometime. As the designs scaled up, there was a small dip in expected performance because of the latency in packet transmission and reception. This was due to the diameter of the network/length of the path to be traversed by the packet to reach from the source to destination node. The problem of performance dip may be overcome by a design of the solution using a new architecture which has a smaller diameter. This architecture should be structured, scalable, and modular which should not increase the area or wire length substantially [5–10].

This paper proposes a new scalable and structured architecture for Network-on-Chip based systems. An optimal routing algorithm for the same is also presented. Its performance in terms of maximum hop, average hop, number of wire segments, and wire length is studied and compared with that of 2D mesh and torus. During the analysis, it is found that the proposed architecture performs better without any substantial increase in area. Proposed architecture performs better without any substantial increase in area.

2 Proposed Architecture

A new architecture for Network-on-Chip based system called RiCoBit—Ring Connected Binary Tree—is presented in this section.

2.1 RiCoBiT Topology

The proposed RiCoBiT topology resembles the spider's cob web as shown in Fig. 1. The topology consists of growing interconnected concentric rings. The rings are numbered from 1 to K, where K is the number of rings in the configuration. The number of nodes in ring L is 2^L numbered from 0 to 2^L–1. Therefore, the number of nodes Nr in the configuration with K rings is

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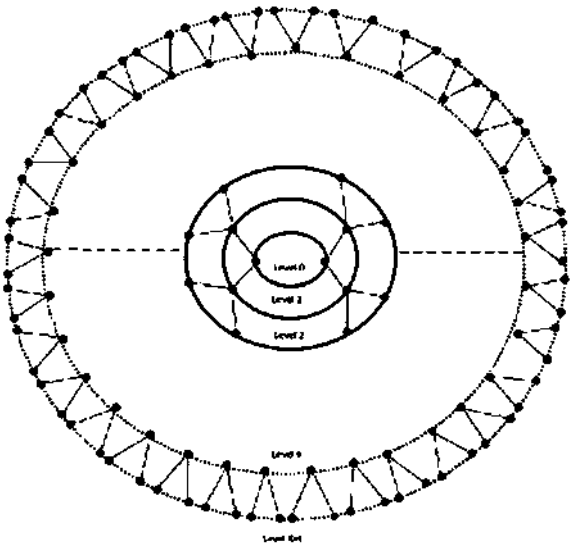

Fig. 1 Proposed architecture with $K + 1$ rings

$$Nr = \sum_{L=1}^{k} 2^L$$

The node n in ring L is connected to its neighboring nodes $2n$ and $2n + 1$ in ring $L + 1$. The number of wire segments to connect the nodes in ring L to those in ring $L + 1$ is therefore 2^{L+1}. Similarly, the nodes within each ring are also interconnected by wire segments. The number of such wire segments in ring L is 2^L.

The proposed topology has several advantageous properties. The topology is symmetric and regular in nature. It is structured, modular, and scalable limited only by the fabrication technology. The scalability property is well complemented with high performance with marginal increase in chip area. The performance study is presented in section three.

2.2 RiCoBiT Addressing

The processing nodes are placed and addressed relative to the ring to which they belong and the position within the ring. The rings are numbered starting from one and the nodes within the ring are numbered starting from zero.

It is observed that node addressing scheme plays an important role in performance of the system. The transmission time of a packet between the interfaces depends on the number of bits the packet contains. This implies that if the transmission time would increase as the packet size grows thereby decreasing the performance.

Let us consider two addressing schemes for RiCoBiT.

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Table 1 Packet size in RiCoBiT

Number of nodes/level	Packet size	
	Ring and node number	Only node number
2/1	10	10
6/2	14	14
14/3	18	16
30/4	20	18
62/5	24	20
126/6	26	22
254/7	28	24
510/8	30	26
1022/9	34	28
2046/10	36	30

- Using Ring Node Number: In this case, the node is referred by the ring number to which it belongs and the position within the ring. This is as shown in figure. In this case the size of a packet with source, destination addresses, and K bits data can be expressed as $2*(\log_2 R + R) + K$, where R is the maximum number of rings in the topology.
- Using Only Node Number: In this case, the nodes are addressed using continuous numbers starting from the inner ring as shown in figure. In this case the size of a packet with source, destination addresses, and K bits data can be expressed as $2*(\log_2 N) + K$, where N is the number of nodes in the topology.

It is observed that the packet size is reduced when using only node numbers. Table 1 illustrates the same for a byte data. This trend increases as the topology grows.

2.3 RiCoBiT Routing Algorithm

This section presents an optimal routing algorithm for RiCoBiT. The proposed algorithm to route the packet from the source to the destination is presented below.

Step 0: Check destination address. Initialize current_src as node address and current_dest as destination address.

Case 1: current_src and current_dest in same ring.

1. Compute the minimum hop count between current_src and current_dest. If it is greater than 3, set current_src and current_dest as their parent nodes, respectively, in the adjacent ring below.
2. Repeat Step 1 till shorter hop count is greater than 3.
3. Move to the next node from current_src toward current_dest along the minimum hop count path. Set the current_src as the next node.

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4. Repeat Step 3 until current_src is equal to current_dest.
5. Consider a complete binary tree with top right node of the current_src as root. If destination node lies in the tree, mark the right node as set current_src else mark the sibling of the left node as current_src. Move to the current_src.
6. Repeat Step 5 until current_src is equal to destination address.

Case 2: When destination node is in a ring above that of the source node

1. Move one step at a time from the current_dest to the ring below until ring of the current_src is reached. Set current_dest as the node obtained in the ring of the source.
2. Repeat the steps as in Case 1.
3. Repeat Step 5 and 6 of Case 1.

Case 3: when destination node is in a ring below that of the source node

1. Move one step at a time from current_src to the ring below until the ring of current_dest is reached. Set current_src as the node obtained.
2. Repeat the procedure as in case 1.

A packet when received by a node is checked by the routing logic of the interface. The logic is built around three cases based on the ring to which the current source node and the destination of the packet, respectively, belong. If the current source node and the destination of the packet are in the same ring, the packet is routed to the parent node on the adjacent ring until the node difference is greater than three. Then the node traverses the lateral path along the shortest route to current destination. After reaching the current destination, the packet travels up the ring toward the destination.

Whenever the destination is above the current node, the packet is initially routed along the same ring to the parent node of the destination. Then the packet moves up toward the destination.

Whenever the destination node is below the current node, the packet moves toward the ring of the destination along the parent node of current node. Then the routing logic routes the packet toward the destination.

From the above, it is evident that the packet uses binary tree traversal which is known for its optimal routing and a lateral traversal through the shortest path to reach the destination. This proves that the packet is routed through the shortest path. Therefore, the proposed algorithm is optimal.

Statement: The proposed algorithm is optimal, i.e., the routing algorithm would route the packet from the source to the destination for any configuration with K rings through the shortest path.

The statement is proved by mathematical induction.

Case 1: $K = 1$

Let us consider the algorithm for the smallest case, i.e., for ring $K = 1$ with $N = \sum_{L=1}^{k} 2^L = 2$ nodes. The source and destination being adjacent to each other,

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there are two alternate paths each consisting of single hop. Note that this is the shortest possible.

Case 2: $K = 2$

1. If source and destination are both in ring 1, then it is same as case 1.
2. If the source and destination are both in ring two, then the shortest path consists of one hop in case source and destination are adjacent to each other. Otherwise, the shortest path consists of two hops.
3. If the source and destination are in two different rings, then the shortest path consists of one hop in case they are adjacent. Otherwise, the shortest path consists of two hops. It is noted that such a path has an intermediate node in ring one which is adjacent to source and destination both. Therefore, it is of length two hops and is shortest. When the intermediate node is in ring one, it is concluded that if a configuration with a single ring others shortest path between adjacent nodes in ring one then a configuration with two rings also others shortest path for any source destination pair in two different rings.

From this we infer that there is a shortest path between any source destination pair when the configuration has two rings.

Case 3: $K = 3$

1. If source and destination are confined to ring one and ring two, then it is same as Case 2.
2. If the source and destination both are in ring three, then the shortest path consists of one hop in case these are adjacent to each other. Otherwise, there is a shortest path along the ring three consisting of two hops or three hops or four hops if there are one or two or three intermediate nodes between source and destination pair, respectively. In case of three intermediate nodes, there are alternate shortest paths of four hops each which pass through ring two.
3. If one of the nodes is in ring three and the other one in ring two, then the shortest path is of one hop when the source and destination are adjacent to each other. Else there exists an intermediate node in ring two which is adjacent to the node in ring three.

According to the Case 2, it is known that there exists a shortest path for any source destination pair for configuration of two rings. Hence, there exists a shortest path between a node in ring three and any node either in ring one or two. From this we infer that there exists a shortest path between any source destination pair when the configuration has three rings.

Case 4: $K = 4$

1. If source and destination are confined to ring one, ring two, and ring three, then it is same as Case 3.
2. If the source and destination both are in ring four, then the shortest path consists of one hop in case these are adjacent to each other. Otherwise, there is a shortest path along ring four, consisting of two hops or three hops or four hops if there

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are one or two or three intermediate nodes between source and destination pair, respectively. In case of three intermediate nodes, there are alternate shortest paths of four hops each which pass through ring three. When the source and destination are separated by more than four hops in ring four, then the shortest path passes through ring three to the destination at ring four. The number of hops in such shortest path varies from four to six on case to case basis.

3. If one of the nodes is in ring four and the other node in ring three, then the shortest path is of one hop when the source and destination are adjacent to each other. Else there exists an intermediate node in ring three which is adjacent to the node in ring four. According to the case of ring three, there is a shortest path for any source destination pair for configuration of three rings. Hence, there is a shortest path between a node in ring four and any node in other rings.

From this we infer that there exists a shortest path between any source destination pair when the configuration has four rings.

Case $K - 1$:
Assume that there are shortest paths between any source destination pair in a configuration consisting of $K - 1$ rings.

Case K:

1. If the source and destination both are in ring K, then the shortest path consists of one hop in case these are adjacent to each other. Otherwise, there is a shortest path along the same ring consisting of two hops or three hops or four hops if there are one or two or three intermediate nodes between source and destination pair, respectively. When the source and destination are separated by more than four hops in ring K, then the shortest path passes through ring $K - 1$ to the destination at ring K.
2. If one of the nodes is in ring K and the other node in ring $K - 1$, then the shortest path is of one hop when the source and destination are adjacent to each other. Else there exists an intermediate node in ring $K - 1$ which is adjacent to the node in ring K. In view of the assumption for the Case $K - 1$ above, there is a shortest path between any source destination pair for configuration of K rings passing through the adjacent intermediate node between ring K and $K - 1$.

From the above discussion it is evident that the routing algorithm routes the packets from any source to any destination through the shortest route. Thus the proof.

3 Performance Parameters and Comparison

In this section, the performance of RiCoBiT is studied and compared with two of the most popularly used architectures in Network-on-Chip based systems namely 2D mesh and torus. In this comparison, some important parameters like the

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maximum hop for a given order (size/no of nodes), the number of wire segments, and the wire length used for the interconnection are considered. These are the major factors governing the system performance in terms of latency, throughput, and area of a given design (which in turn are decisive factors for power consumption and dissipation).

3.1 Maximum Hop Count

Consider the set of shortest path(s) between all possible source–destination pair of nodes for a given configuration. The largest element in the set is referred to as maximum hop count. As the number of hops traversed by a packet from the source to the destination increases, the latency of the system also increases and the performance dips. Hence, this is one of the most important parameters which determine the performance and throughput of a system.

In case of RiCoBiT, the packet travels from the source to the destination with a maximum hop count

$$\text{Max Hop} = 2\log_2(N_r + 2) - 4\,;\ N_r \text{ is the no of nodes}$$

Proof In a complete binary tree of *Nr* nodes, the maximum distance from the root to the leaf node is expressed as

$$\text{Max Distance} = \log_2(N_r + 1) - 1$$

Therefore, the distance from the extreme left to the extreme right would be twice of the above expression

$$\text{Max Distance} = 2 \times \log_2(N_r + 1) - 2$$

By construction, complete the figure to form a balanced complete binary tree with $N_r + 1$ nodes as

$$\text{Max Distance} = \log_2(N_r + 2) - 1$$

Therefore, the distance from the extreme left or the extreme right would be twice of the above expression:

$$\begin{aligned}\text{Max Distance} &= 2 \times (\log_2(N_r + 2) - 1) \\ &= 2 \times \log_2(N_r + 2) - 2\end{aligned}$$

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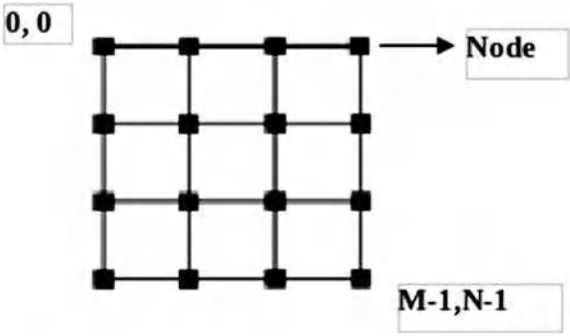

Fig. 2 A 2D mesh of *M* rows and *N* columns showing the modules at the intersections with the addressing

Now removing the two extra edges from the construction, we get

$$\begin{aligned}\text{Max Distance} &= 2 \times \log_2(N_r + 2) - 2 - 2 \\ &= 2 \times \log_2(N_r + 2) - 4\end{aligned}$$

Thus the proof.

Now let us consider a 2D mesh. It is one of the most popular, simplest, and widely used topologies in Network-on-Chip based systems. In this topology, the processing modules are placed at the intersection of the row and column as shown in Fig. 2.

In the comparison of the parameter maximum hop, we consider the proposed architecture of L rings with $N_r = \sum_{i=1}^{L} 2^i$ nodes. This is compared with a 2D mesh with M nodes along its row and N nodes along its column having total MN nodes. The equation below shows the relation between the number of nodes of 2D mesh and RiCoBiT:

$$N_r = MN - 2$$

where N_r is the number of nodes in RiCoBiT and MN is the number of nodes in 2D mesh. Whenever $MN \gg 2$, N_r tends to MN or $N_r \approx MN$. For example, in 2D mesh of 32 rows and 32 columns we have $MN = 1024$ nodes, which is compared to $Nr = MN - 2 = 1024 - 2 = 1022$ nodes of RiCoBiT.

Extending the above equation for a square mesh, the equation reduces to

$$\begin{aligned}N_r &= N^2 - 2 \\ &\approx N^2 \\ N &= \sqrt{Nr}\end{aligned}$$

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In case of a 2D mesh, the maximum hop would be when a packet can travels from the corner node to its diagonally opposite corner. This is expressed as

$$\text{Max Hop} = M + N - 2$$

where M and N are the order of the mesh and MN is the number of nodes.

In case of a regular 2D mesh of equal rows and columns, the expression reduces to

$$\text{Max Hop} = 2N - 2$$

where N is the order of the mesh and N^2 is the number of nodes.

Taking number of nodes N_r into consideration, we can rewrite the above equation as

$$\begin{aligned}\text{Max Hop} &= 2\sqrt{N_r} - 2 \\ &\approx 2\sqrt{N_r}\end{aligned}$$

Torus is another popular, simple, and widely used topology in Network-on-Chip based systems. The topology is evolved from 2D mesh by adding an extra edge between the end points of the mesh topology. Like 2D mesh, the processing modules are placed at the intersection of the row and column as shown in Fig. 3 below.

The discussion on the number of nodes of torus and its comparison with RiCoBiT remains the same as in the previous case. The maximum hop parameter in the case of torus is when the packet travels from the corner node to the middle of the system and is given by

$$\text{Max Hop} = \llcorner M/2 \lrcorner + \llcorner N/2 \lrcorner$$

where M and N are the order of the mesh and MN is the number of nodes.

Reducing the equation for same dimension of rows and columns,

$$\text{Max Hop} = 2 \text{ X } \llcorner N/2 \lrcorner$$

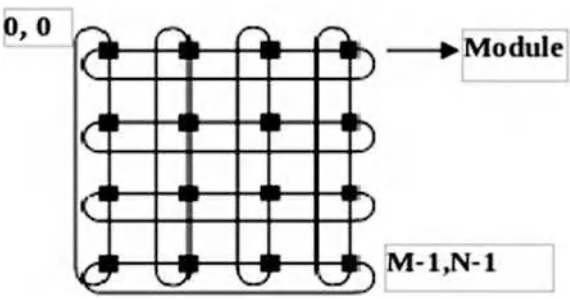

Fig. 3 A 2D torus of M rows and N columns showing the modules at the intersections with the addressing

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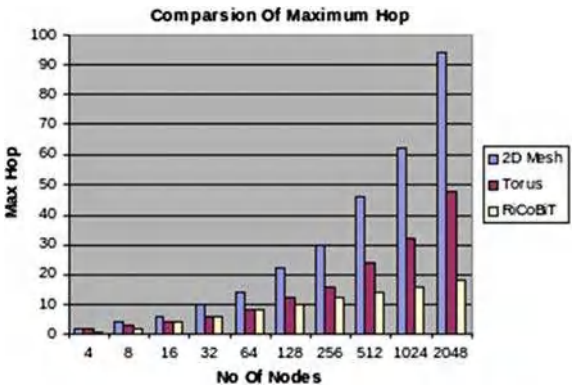

Fig. 4 Graph plotting the maximum hop of all the topologies

where N are the order of the mesh and N^2 is the number of nodes.

Taking number of nodes N_r into consideration, we can rewrite the above equation as

$$\text{Max Hop} \approx \sqrt{N_r}\,; \text{Where } N_r \text{is the number of nodes}$$

The graph (Fig. 4) below compares the maximum hop of the mesh and torus with RiCoBiT. From the graph and equations, it is quite evident that the maximum hop is highest in mesh. The parameter is half for torus as compared to mesh and the maximum hop is lowest in the proposed architecture. The maximum hop is almost the same when the number of modules is less. As the number of modules scales up, the parameter rises substantially in both mesh and torus but the growth is very slow in case of our proposed architecture. This implies that the performance is not compromised when design is scaled. All the other parameters are compared in the same manner.

3.2 Maximum Hop (Average Case)

As a part of the comparison we also compute an average value of the maximum hop. This parameter helps us to compare the overall performance of the packet transfer in the system. This parameter is calculated by taking the arithmetic mean of the maximum hop for all possible node pairs. From the graph (Fig. 5) below, it is evident that the average hop is substantially less when compared to the other architectures. This also proves that the proposed architecture performs well when compared to other architectures.

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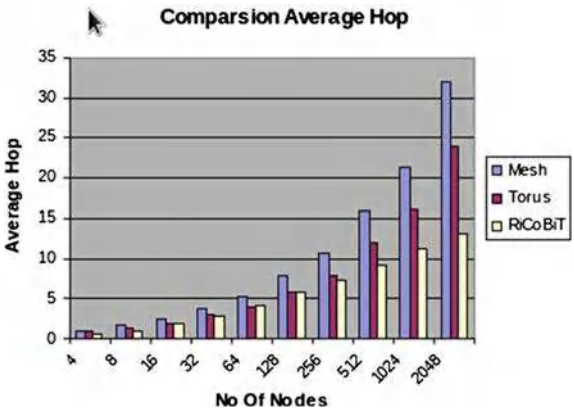

Fig. 5 Graph plotting the average hop of all the topologies

3.3 Number of Wire Segments

This is another important parameter which would govern the area and routing complexity of the design.

If the design has more wire segments, it would increase the area, power consumption, and also pose difficulty for CAD tool to place and route the wire segments. The parameter expressed in terms of number of nodes Nr for the proposed architecture is

$$\text{No. of Segments } W = 2 * N_r - 2$$
$$\approx 2 * Nr$$

Proof Let us prove the above equation by method of induction.

Consider the equation for the base case with 2 nodes at ring 1:

$$\text{No Of segments} = W = 2 * 2 - 2 = 2$$

The statement is true for $N = 2$.

Now let us express the number of nodes N in terms of ring L:

$$N = \sum_{i=1}^{L} 2^i$$

Let the equation for some ring K be true:

$$W = 2 * \sum_{i=1}^{k} 2^i - 2$$

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Now let us prove for ring $K + 1$

$$\mathrm{W} = 2 * \sum_{i=1}^{k} 2^i - 2 + 2^{k+1} + 2 \sqcap 2^k$$

where the term 2^{K+1} represents the number of links to interconnect nodes at $K + 1$ ring and the term $2 * 2^K$ is for the number of links to interconnect the nodes at ring K and $K + 1$. Reducing the above equation,

$$\begin{aligned}
\mathrm{W} &= 2* \sum_{i=1}^{k} 2^i - 2 + 2^{k+1} + 2^{k+1} \\
&= 2* \sum_{i=1}^{k} 2^i + 2 \sqcap 2^{k+1} - 2 \\
&= 2* \left\{ \sum_{i=1}^{k} 2^i + 2^{k+1} \right\} - 2 \\
&= 2* \left\{ \sum_{i=1}^{k+1} 2^i \right\} - 2 \\
&= 2*\mathrm{N} - 2
\end{aligned}$$

where the number of nodes at ring $K + 1 = \sum_{i=1}^{k+1} 2^i$ Thus the proof.

The number of wire segments for an $M \times N$ order 2D mesh is given as

$$W = 2\,M \times N - M - N$$

where M and N are the order of the mesh and MN is the number of nodes.

Reducing the equations for equal rows and columns,

$$\begin{aligned}
W &= 2 * N^2 - 2N \\
&= 2N(N - 1)
\end{aligned}$$

where N is the order of the mesh and N^2 is the number of nodes.

Considering the number of nodes N_r, we can express the relation as

$$\text{No. of Segments } W \approx 2N_r$$

In the case of torus, the number of wire segments would increase due to the addition of extra wire segments to join the end points. This would give rise to an expression as given below:

$$W = 2\,M \times N$$

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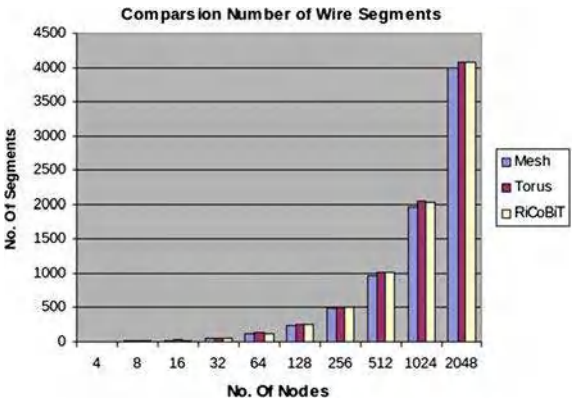

Fig. 6 Graph plotting the number of segments for all the topologies

Reducing the equations for equal rows and columns,

$$W = 2N^2$$

Expressing the above expression in terms of number of nodes *Nr*,

$$\text{No. of Segments } W \approx 2N_r$$

From the graph (Fig. 6) below, we could observe that the number of segments is almost the same as other architectures. This implies that the area requirement of RiCoBiT for a given number of nodes would remain the same with advantage of performance over the others.

3.4 Wire Length

This is also an important parameter affecting the performance and area of the design. The same effects of number of wire segments hold good even in this parameter. For considering the wire length of the proposed architecture, we consider unit length for interconnects between the modules with an additional wire of length equal to the number of nodes to connect the ends. The parameter for the proposed architecture is calculated as

$$WL = 3N_r - 4$$
$$\approx 3N_r$$

Proof Let us prove the above equation by method of induction.

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Consider the equation for the base case with 2 nodes at ring 1:

$$\text{Wirelength} = WL = 3 * 2 - 4 = 2$$

The statement is true for $N = 2$.

Now let us express the number of nodes N in terms of ring L:

$$\mathrm{N} = \sum_{i=1}^{L} 2^i$$

Let the equation for some ring K be true:

$$WL = 3 * \sum_{i=1}^{K} 2^i - 4$$

Now let us prove for ring K + 1:

$$WL = 3 * \sum_{i=1}^{K} 2^i - 4 + \left\{2^{K+1} - 1\right\} + 2 * 2^K + \left\{\left(2^{K+1} - 1\right) + 2\right\}$$

where the term $2^{K+1} - 1$ represents the number of links to interconnect nodes at $K + 1$ ring and the term $2 * 2^K$ is for the number of links to interconnect the nodes at ring K and $K + 1$. Considering a unit length for each link, the number of links would be equal to the wire length. Also, we would require $(2^{K+1} - 1) + 2$ units for interconnecting the two end points.

Reducing the above equation,

$$\begin{aligned} WL &= 3 * \sum_{i=1}^{K} 2^i - 4 + 2^{K+1} + 2^{K+1} + 2^{K+1} \\ &= 3 * \sum_{i=1}^{K} 2^i + 3 * 2^{K+1} - 4 \\ &= 3 * \left\{\sum_{i=1}^{K} 2^i + 2^{K+1}\right\} - 4 \\ &= 3 * \sum_{i=1}^{K+1} 2^i - 4 \\ &= 3 * N - 4 \end{aligned}$$

where the number of nodes at ring is $K + 1 = \sum_{i=1}^{K+1} 2^i$. Thus the proof.

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Similarly, considering a unit and equal length for all the interconnects, the wire length for 2D mesh of order $M \times N$ can be computed as

$$WL = 2\,M \times N - M - N$$

Reducing the equations for equal rows and columns,

$$\begin{aligned} WL &= 2N^2 - 2N \\ &= 2N(N-1) \end{aligned}$$

Expressing the above in terms of number of nodes N_r,

$$\begin{aligned} WL &\approx 2N_r - 2\sqrt{N_r} \\ &\approx 2N_r \end{aligned}$$

In case of torus, considering a unit and equal length for all the interconnects between internal nodes and the length of the end points wires to be approximately equal to the order of the torus, the wire length can be computed as

$$WL = 4M \times N - 2M - 2N$$

Reducing the equations for equal rows and columns,

$$\begin{aligned} WL &= 4N^2 - 4N \\ &= 4N(N-1) \end{aligned}$$

Expressing the above in terms of number of nodes *Nr*,

$$\begin{aligned} WL &\approx 4N_r - 4\sqrt{N_r} \\ &\approx 4N_r \end{aligned}$$

It may be noted from the graph (Fig. 7) that the wire length of the proposed architecture is more than mesh but is lesser than torus. We could take this marginal hike in the wire length for the performance that it would deliver.

Summarizing the discussion above, the proposed architecture is better in terms of maximum hop and average hop which is a parameter indicating performance. It is also comparable in terms of number of wire segments and wire length which represents area. From the above two parameters it is evident that the proposed architecture fairs better than the existing popular ones. The section below discusses performance analysis of the proposed architecture deducing bounds for parameters like latency and throughput.

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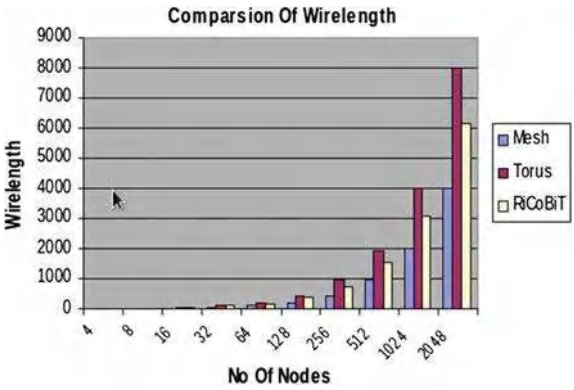

Fig. 7 Graph plotting the wire length for all the topologies

4 Performance Analysis

Various performance analyses were carried out on the above-discussed topologies using analytical deductions and verified using simulation. The topologies during simulation were subjected to various operating conditions and the performance parameters were recorded. The operating condition includes loading the topology with packets of different sizes under varying buffer size and varying buffer load to study different parameters like overall packet delivery time, packet latency, throughput, etc.

Let us first understand the assumption and context under which these analyses are carried out. A node communicates with each other through their interface using simple request acknowledgment protocol. The communication between the nodes starts with rising of the request signal when there is a packet of size p bits present in the send buffer of N_b size and waits T_{ack} time for acknowledgment. The adjacent node issues an acknowledgment only if its N_b size received buffer is not full after which the data is serially transferred. The packet in the receive register is processed to find the next transit node by the routing logic in T_p amount of time. Now the packet is placed in the send buffer of the interface along the destination if there is a space in it else its own receive buffer.

Consider a system realized using the above topologies for store and forward strategy with n nodes. The packet (p bits) contains source, destination addresses, and the data bits. Assuming the number of data bits and number of buffers per node to be equal, the number of cycles (T) required to transfer a packet between any two nodes can be modeled as follows:

$$T = T_p + T_w + T_{ack} + T_t$$

where T_p is the constant processing time, T_w is the waiting time in the buffers, T_{ack} is the time for receiving the acknowledgment after the request signal, and T_t is the

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transmission time. The waiting time T_w is the time spent by the packet in both receive and send buffers which can be expressed as

$$T_w = T_{\text{receive}} + T_{\text{send}}$$

The parameter T_{receive} is bounded within limits $N_b * (T_t + T_{ack})$ when the packet is placed in the last location of the buffer and is zero when it placed directly in the send buffer after processing. The same explanation holds good for send buffer wherein the bounds are 1 to $N_b * (T_t + T_{ack})$. Therefore,

$$T_w = 2 * N_b * (T_t + T_{ack})$$

The parameter T_t is the time taken for transmission of the packet of p bits including the request/acknowledgment which is expressed as $T_t = 2 + p$. Now let us estimate the time T_{ack}. The best case is when there is a free space and the acknowledgement is given without any delay, i.e., $T_{ack} = 0$. In the worst case, in a deadlock free scenario the parameter is bounded by $T_{ack} = (n–1) * T_t$. This can be explained as follows.

Consider a source node S1 sends a request to its adjacent node $T1$. Since the receive register of $T1$ is not free it cannot generate an acknowledgment. To generate an acknowledgement the packet in the receive register of *T1* should be placed in one of the send buffers which in turn is full. The send buffer of the link for which the packet in the receive register is meant for should create a space by sending a request signal and the cycle continues over other nodes. This can be modeled as a graph problem where the path traced by the congested bu_ers now forms a Hamilton path which can be of length n −1 for n nodes at the worst case.

Summing the above set of equations

$$\begin{aligned} T &= T_p + T_w + Ta_{ck} \\ &= 2 * N_b * (T_t + (n-1) * T_t) + (n-1) * T_t + T_t \\ &= T_p + 2 * N_b * T_t * n + (n-1) * T_t + T_t \\ &= T_p + T_t * n(2 * N_b + 1) \end{aligned}$$

Applying bounds on the parameter T,

$$T_p + T_t \leq T \leq T_p + T_t * n(2 * N_b + 1)$$

4.1 Packet Consumption Rate

This parameter refers to the time taken by the system to consume all the generated packets. Consider a system with n nodes and the longest path between any nodes in

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the system. The time taken for a packet to reach from source to destination can be expressed as

$$T_{\text{long}} = T * \text{Maxhop}$$

Now consider a node sends one packet to all other nodes. This implies that the node would generate n–1 packet. The time taken for all the packets to be consumed by the systems can be expressed as

$$\begin{aligned} T_{1;All} &= (n-1) * T + T * \text{Maxhop} \\ &= T * (\text{Maxhop} + n - 1) \end{aligned}$$

Similarly, consider a system where X nodes generate one packet each to other nodes. By keeping the parameters same, the expression for time taken for all the packets to be consumed by the system can be expressed as

$$T_{All} = T * (\text{Maxhop} * (n - X))$$

We have already proved that the maximum hop is very less in RiCoBiT when compared to mesh and torus. Also, the time taken for transfer of packet from one node to another node is equal in all the cases. Hence the above equations, it is quite evident that the system using RiCoBiT topology absorbs the entire packet in a time which is much lower than when compared to mesh and torus.

4.2 Throughput

Considering the construction of the topology, it could be observed that the node in RiCoBiT is connected to five other nodes as compared four that of mesh and torus. This means that node of RiCoBiT can send or receive more packets, and hence process more data. Also from the above equations, it is clear that the time taken for packet to reach the destination is also less to the other compared topologies. This implies that the more packets can be processed per unit time using the proposed topologies thereby providing increased throughput. The throughput of a system depends on the amount of output it can generate per unit time. This implies that the node interface in topology should be able to get more packets to generate more results which are a function of the waiting time of the packets. So for a given number of nodes, the throughput is minimum when the delay is high and worst case is when the delay at the node is minimum. Considering the above equations derived for time bounds, we can bound the throughput as given below:

$$\frac{1}{Tp + Tt \sqcap n(2 \sqcap Nb + 1)} \leq Th \leq \frac{1}{Tp + Tt}$$

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From the delay estimation it is proved that the proposed architecture performs well for all the cases. Hence, the throughput is all better for the proposed architecture.

The above-mentioned topologies are subjected to experimental setup using simulation. All the above-discussed cases were simulated with varying buffer size, packet size, and traffic loads. It was observed that proposed topology performs better than mesh and torus.

5 Conclusion

A new architecture for Network-on-Chip based systems namely RiCoBiT—Ring Connected binary Tree—is proposed in this paper. The proposed architecture is scalable and structured and is limited only by the fabrication technology. The paper also proposes with proof, an optimal routing algorithm which routes the packet from the source to the destination though the shortest path. The comparative study of the performance parameters namely maximum hop count, average hop count, number of wire segments, and wire length is also presented. It also discusses and bounds latency and throughput parameters. An expression for these parameters is analytically deduced and the validity is computationally verified. These performance parameters are compared with that in 2D mesh and torus. It is observed that the length of the shortest path is much lower when compared to 2D mesh and torus of the same order. This enables the packets to reach the destination much faster thereby improving the performance and throughput. Also, the requirement in terms of area is almost the same as others. This implies that the proposed architecture performs better without increase in the area. These parameters were also verified using simulation experimental setup.

The proposed architecture is being implemented using a FPGA. This is to enable the study of performance and area factors under real-time conditions.

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Application of Compressed Sensing (CS) for ECG Signal Compression: A Review

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Abstract Compressed Sensing (CS) is a fast growing signal processing technique that compresses the signal while sensing and enables exact reconstruction of the signal if the signal is sparse with a few numbers of measurements only. This scheme results in reduction of storage requirement and low power consumption of system compared to Nyquist sampling theorem, where the sampling frequency must be at least double the maximum frequency present in the signal for the exact reconstruction of the signal. This paper presents an in-depth study on recent trends in CS focused on ECG compression. Compression Ratio (CR), % Root-mean-squared Difference (% PRD), Signal-to-Noise Ratio (SNR), Root-Mean Square Error (RMSE), Sparsity and power consumption are used as the performance evaluation parameters. Finally, we have presented the conclusions based on the literature review and discussed the major challenges in CS ECG implementation.

Keywords Compressed sensing (CS) · ECG compression · SPIHT · Sparsity

1 Introduction

Electrocardiogram (ECG) is an important and advanced diagnostic tool used for various heart diseases diagnosis, such as arrhythmia, myocardial ischemia, and cardiac infarction. The detail interpretation provides information about patient's health. The different heart activities are represented by different waves. A normal ECG includes a P wave followed with QRS complex wave and lasts with T wave.

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Figure 1 shows the normal ECG waveform. The P wave is caused produced by the depolarization of the atria muscles and associated with their contraction, while the QRS complex wave is initiated by the depolarization of ventricles before to their contraction. The detection of the QRS complex is an important step in automated ECG analysis. Because of their distinctive shape, the QRS complex used as the reference tip for automated heart rate monitoring and as the initial point for additional evaluation.

Therefore, the long-term ECG data records become an important aspect to perceive information from these heart signals, resulting in increase in memory size of data. Hence, the ECG data compression becomes an essential for decreasing the data storage and the transmission times. ECG compression methods are categorized into two main groups: (i) Direct compression methods (ii) Transform compression methods. In the transform methods, the discrete wavelet transform-based techniques are simple to implement and provides good localization in both time and frequency scale.

The further best work in this area is described by embedded zero tree wavelet (EZW) [1] and a set partitioning in hierarchical tree (SPIHT) [2, 3] protocols, which work on the self similarity basis of the wavelet transform.

Compared to traditional ECG compression scheme, CS [4, 5, 6] transfers the computational load from the encoder side to the decoder side, and thus provides simple encoder hardware implementations. Also, there is no need to encode locations of the significant wavelet coefficients. This paper presents the detailed review of different aspects of CS-based ECG compression. The paper is outlined as: Sect. 2 describes the CS acquisition and recovery model. Section 3 presents different performance measures of signal. In Sect. 4, we have presented the detailed literature reviews on current CS-based ECG compression followed by conclusions in Sect. 5.

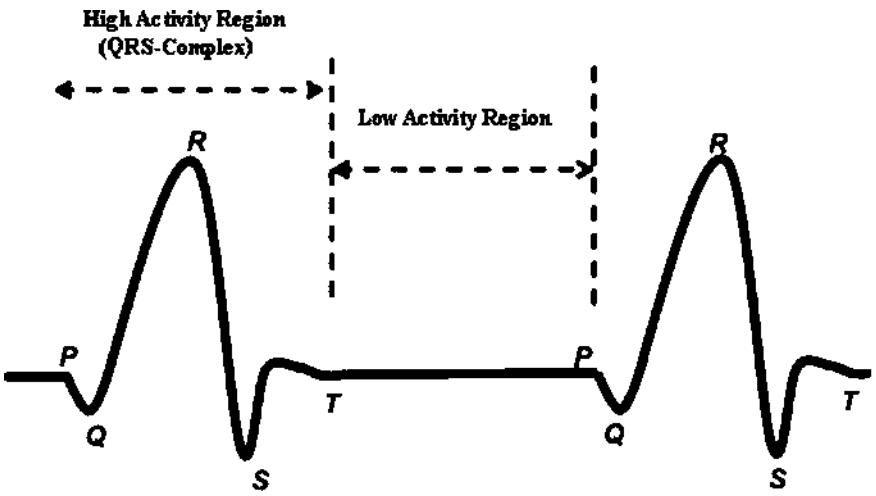

Fig. 1 Normal ECG waveform

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2 Compressed Sensing (CS) Framework

2.1 Background

CS is a fast developing signal compression technique that acquires the signal and exactly recovers with few numbers of samples than Shannon–Nyquist sampling. CS takes advantage of signal sparsity property in some domain like wavelet transform. Nyquist sampling depends on the greatest amount of rate of alteration of a signal, whereas CS depends on the greatest amount of rate of knowledge in a signal. The CS executes two main operations: compression and recovery of signal.

2.2 CS Sensing Model

Compressed sensing scheme is represented as follows:

$$y = \Phi f \tag{1}$$

where, f is the original input signal of length $N \times 1$, y is the compressed output signal of length $M \times 1$, and Φ is the $M \times N$ sensing matrix. Here, as Φ is always constant, CS is nonadaptive scheme.

The input signal x is further defined as

$$f = \Psi_x \tag{2}$$

where, x is the nonsparse input signal with length N and Ψ is the $N \times N$ sparsifying basis. Combined form of Eqs. (1) and (2) as follows:

$$y = \Theta_x \tag{3}$$

where, $\Theta = \Phi\Psi$ is commonly referred to as the sensing matrix. CS acquires $M << N$ observations from N samples utilizing random linear estimate. In order to implement a CS algorithm correctly, there are three key requirements:

(a) The input signal f must be a sparse in some domain.
(b) The Ψ and Φ must be incoherent.
(c) The Φ should satisfy the Restricted Isometric Property (RIP) [7] and defined as

$$(1 - \delta_s) \|f\|_2^2 \leq \|\Theta f\|_2^2 \leq (1 + \delta_s) \|f\|_2^2 \tag{4}$$

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For exact and stable compression, and signal recovery, Candes et al. [8, 9] recommends a minimum number of compressed measurements (m) based on the sparsity and coherence constraints outlined.

$$m \geq c.\mu^2(\Psi, \Phi)s.\log(N) \tag{5}$$

where, s is number of nonzero elements and c is a small fixed value. The sensing matrix can be designed with random distribution [10] values from Bernoulli, Gaussian, and uniform probability density functions.

2.3 CS Signal Reconstruction Model

Because Φ is not a square matrix, this CS problem becomes under determined problem with many possible solutions. These CS recovery algorithms require information of a representation basis where the signal is compressible or sparse for approximate or accurate recovery of signal. Reconstruction algorithms in CS exploit the sparse solution by minimizing L0, L1, L2 norm over solution space. L0-norm minimization will accurately reconstruct the original signal under the sparse condition, with slow speed and is NP (Non-Polynomial) hard. The L2-norm minimization is fast but it does not find the sparse solution resulting in error. The L1-norm gives exact sparse solution with efficient reconstruction speed. Hence, L1-norm is the good alternative to L0-norm and L2-norm minimization to find the accurately sparse solution. Finally, original signal can be reconstructed by calculating x using L1 norm minimization as given by equation below:

$$\min \|\hat{x}\|_1 \text{ Subject to } y = \Theta\hat{x} = \Psi\Phi\hat{x} \tag{6}$$

The sparsity and incoherence conditions guarantee the high probability of sparse exact solution using Eq. (6).There are different CS reconstruction algorithms available based on convex optimization method for e.g. Basis Pursuit (BP) [11], BP denoising (BPDN) [11], M-BPDN [12], LASSO [13] and greedy methods like OMP [14, 15], CoSaMP [16].

3 Performance Evaluation Parameters

There are different distortion measures used for performance evaluation of signal like % root-mean squared difference (PRD), Compression ratio (CR), Root-mean square error (RMS), Signal-to-noise ratio (SNR), and sparsity.

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3.1 Percentage Root-Mean Squared Difference (PRD)

PRD is the measure of the difference between the input signal and recovered signal and given as:

$$PRD(\%) = \frac{\sum_{n=1}^{N} (f(n) - \hat{f}(n))^2}{\sum_{n=1}^{N} f^2(n)} \tag{7}$$

Measurement of PRD without the DC level in the input signal is given as

$$PRD(\%) = \frac{\sum_{n=1}^{N} (f(n) - \hat{f}(n))^2}{\sum_{n=1}^{N} (f(n) - \bar{f})^2} \times 100 \tag{8}$$

Here, $f(n)$ is the input signal, $\hat{f}(n)$ is the recovered signal, $\bar{f}$ is the mean of the signal, and N is the length of signal.

3.2 Compression Ratio (CR)

CR is used to measure the reduction in the dimensionality of the signal and given as:

$$CR = \frac{M}{N} \tag{9}$$

where the input signal is of the length N and M *is* the number of measurements taken from sensing matrix.

3.3 Root-Mean Square Error (RMSE)

RMSE is given as:

$$RMS = \sqrt{\frac{\sum_{n=1}^{N} (f(n) - \hat{f}(n))^2}{N}} \tag{10}$$

where, $f(n)$ is the original signal and $\hat{f}(n)$ is the recovered output signal and N is the length of input signal.

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3.4 Signal-to-Noise Ratio (SNR)

SNR is given as

$$SNR = 10 \times \log\left(\frac{\sum_{n=1}^{N}(f(n)-\bar{f})^2}{\sum_{n=1}^{N}(f(n)-\hat{f}(n))^2}\right) \tag{11}$$

where $f(n)$ is the original input signal, $\hat{f}(n)$ is the recovered output signal, $\bar{f}$ is the average of the signal, and N is the length of input signal.

3.5 Sparsity

When a given signal contains only few no. of nonzero (K) coefficients, it is called as sparse signal and given as

$$\text{Sparsity}(\%) = \frac{(N-K)}{N} \times 100 \tag{12}$$

where, N is the signal length, K is the number of nonzero coefficients of the signal and *(N-K)* is the number of discarded coefficients of the signal.

4 Application of Compressed Sensing (CS) for ECG Signal Compression

An extensive literature survey have been performed on CS-based ECG compression papers. Table 1 shows the comparative summary of literature papers for CS-based ECG signal compression.

Pooyan et al. [2] tested wavelet transform on the ECG signal and SPIHT technique is used to encode the coefficients. SPIHT achieves CR = 21.4, PRD = 3. 1 with a very good reconstruction quality and outperforms all others compression algorithm. SPIHT has a low computational complexity and easy to implement. Polania et al. [17] proposed a 1-lead compression method. In this, the ECG signal's quasi periodic nature is exploited in between adjacent beats of samples. The author utilized the distributed compressed sensing to explore the common support between samples of adjacent beats. The drawback of the scheme is increase in the computational complexity at encoder. Experimentation is performed using the MIT-BIH Arrhythmia Database. The proposed CS-based scheme accomplishes a good CR for low PRDs and also out performs SPIHT. Polania et al. [18] incorporate two properties of signal structure; in the first property the wavelet scale dependencies are included into the recovery methods and second used the great common support

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Table 1 Comparative summary of literature for CS-based ECG signal compression

Author	Sparsity basis, sensing matrix, reconstruction algorithm used	PRD (%)	CR	Strengths/Findings
Pooyan [3]	Set partitioning in hierarchical trees (SPIHT) algorithm	3.1	21.4	High efficiency, easy to implement, computationally simple
Polania [17]	Daubechies wavelets (db4), random gaussian matrix, SOMP	2.57	7.23	Achieves a good compression ratio, outperforms SPIHT as the PRD increases, offers a low complexity encoder
Polania [18]	Wavelet transform-based tree-structure model, bernoulli matrices, MMB-CoSaMP and MMB-IHT (Record no.100)	IHT = 3.65, CoSaMP = 3.86	6.4	Simple hardware design, less data size, and small computational need
Daniel [22]	Wavelet bases, random bernoulli matrix, BP	9	2.5	Simple encoder design
Ansari-Ram [23]	Biorothogonal4.4, nonuniform binary matrix, convex optimization	8.58	5	Increases the overall PRD
Akanks-ha Mishra [19–21]	29 different wavelet families like coiflets, daubichies, symlets, biorthogonal, reverse biorthogonal, random gaussian matrix and KLT sensing matrix, BP	0.01 0.01	2 2	rbio3.9 shows best sparsity. KLT sensing matrix superior than gaussian matrix
Anna Dixon [24, 25]	Random gaussian matrix, convex optimization, OMP, CoSaMP, ROLS, NIHT	–	–	CoSaMP and L1-norm convex gives best accuracy, CoSaMP preferred in noisy conditions, OMP is best for low computational complexity
Mamaghanian [33, 36]	Wavelet basis, random gaussian matrix, BP	<9	3.44	PRD = 0–9 % is “good or very good” ECG signal quality

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of wavelet domain coefficients. The two model-based algorithms namely modified model-based MMB-CoSaMP and MMB–IHT are evaluated. For compression ratio CR = 4, the PRD of MMB–IHT is 3.65 and for MMB-CoSaMP is 3.86. For nearly all the ECG records, MMB-IHT shows superior execution than MMB-CoSaMP.

- *Selection of Best Sparsity Basis for CS ECG Compression*

One of the primary research areas for ECG compression is the choice of sparsity basis. Mishra et al. [19, 20, 21] evaluated a best wavelet basis for ECG Signal compression using Compressed Sensing approach by comparing several wavelet families like Haar, Daubechies, Reverse Biorthogonal, and biorthogonal etc. These families were evaluated using the performance metrics such as MSE, PSNR, PRD, and Correlation Coefficient (CoC). Here, L1 optimization is used as the signal reconstruction method. The result analysis is performed for five different compression ratios, like 2:1, 4:1, 6:1, 8:1, 10:1 and from each CR the best fit wavelet family was identified. From reverse biorthogonal wavelet family, rbio3.7 and rbio3.9 shows the best results. Finally, the best Daubechies wavelet (db) is selected for specific CR. For CR 2:1, db4 is chosen. Similarly, for CR 4:1, db8 is selected. For CR 6:1, db4 is most suitable Daubechies wavelet.

- *Different Sensing Matrices for ECG Signal Compression*

Polania et al. [17] used Random Gaussian Matrix with zero mean and 1/m variance achieves a good compression ratio. Polania et al. [18] and Chae et al. [22] tested Bernoulli matrices results in small data storage, less computational complexity, and simple encoder hardware design. Mishra et al. [19, 20, 21] compared the random Gaussian matrix and KLT sensing matrix performance for different compression ratios: for Random Gaussian matrix with CR = 2, PSNR = 57.57, PRD (%) = 0.01, MSE = 1.57, COC = 0.9994 where for KLT sensing matrix with CR = 2, PSNR = 59.92, PRD (%) = 0.01, MSE = 1.20, COC = 0.9996. This result shows that KLT sensing matrix shows better performance than random Gaussian matrix. Ansari-Ram and Hosseini-Khayat [23] proposed a nonuniform measurement matrix. This matrix acquires the QRS complex, i.e., region of interest and increases the total PRD value. This method has a weakness since it is also required to transmit sensing matrix to decoder end.

- *CS Reconstruction Algorithms for ECG Compression*

Dixon et al. [24, 25] evaluated comparative analysis on state-of-the-art CS recovery algorithms: BP, convex optimization, OMP, CoSaMP, ROLS and NIHT based on metrics like computational time, accuracy and noise tolerance. When accuracy is needed CoSaMP and L1 based convex are the natural choices. In noisy conditions CoSaMP outperforms L1-norm convex. OMP is preferable where computational complexity is important like real-time implementation with low power consumption.

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- *Performance of CS ECG with Different Sparsity and Noisy Conditions*

Chae et al. [22] evaluated the CS ECG compression performance under the noisy ECG signal acquisition and with varied heartbeat rate because of body movements. From results, we can conclude that the CS with noise is quite difficult to minimize because of nonlinear nature of the recovered noise. The CS performance is compared to TH-DWT for ECG compression, where TH-DWT outperforms CS in the sense of CR. Care should be taken while applying CS for ECG compression as the CS is very susceptible to noise and sparseness of the signal. The TH-DWT method attains a PRD of 9 % at a CR = 5 whereas for the same PRD the CS attains a CR = 1.67. With noisy signals, the TH-DWT shows a flat SNR up to a CR = 2.5 after which have a slight fall in SNR, while the CS performance sharply decreased from a CR = 1.25.

- *Application of Dictionary Approach for ECG Compression*

Polania and Barner [26] proposed the multiscale dictionary learning approach for the recovery of ECG signals and evaluated the results with wavelet and single scale dictionary approach. Results show that these dictionary learning-based schemes provide better performance than the CS scheme using standard wavelet dictionaries. A multiscale dictionary in CS schemes improves the quality of the recovered ECG signal when compared to single scale methods. The proposed method utilizes the different wavelet subbands information at various scales to efficiently learn sparse and redundant dictionaries for representation of the ECG. Pant and Sridhar Krishnan [27] proposed the dictionary learning algorithms which produce a dictionary which can be used with L_p^{2d}–RLS method. This approach significantly improves signal recovery performance of L_p^{2d}–RLS method for ECG signals.

Fira et al. [28, 29] obtained the best results for the CPCS method using optimized projection matrix and patient-specific dictionary. The optimized dictionaries show the excellent results for all the records. The great extent of quality score achieved, for a 15:1 CR, 0.97 PRD and 15.46 QS is 50 % with CPCS technique with patient-specific heart beats (PRD = 0.51, QS = 29.13) without preprocessing. Singh and Dandapat [30] proposed distributed CS (DCS) for multichannel ECG signals with sparse learned dictionary, which are suitable for sparsity control of a signal. Pathology-specific and normal overcomplete dictionaries are used as the sparsifying basis and learnt using K-SVD algorithm. This improves the efficiency of the conventional CS in views of data size and reconstruction time.

- *Bayesian Learning Approach for ECG Compression*

Zhang et al. [31] proposed the Bayesian learning approach for the reconstruction of ECG signal which is sparser than existing compressed sensing solutions and it is also faster due to the improved sparsity. However, Bayesian approach has a drawback such as lack of theoretical foundation between the Bayesian approach, RIP, and incoherence. Some of the approaches fulfill the condition of RIP and incoherence, but in case of the full rank Fourier matrix, the BCS is failed. Zhang et al. [32] successfully applied the block sparse Bayesian learning (BSBL) structure to

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compress as well as recover non-sparse FECG signal and improved the performance using the correlation structure of signals. Experiments are performed on the DaISy Dataset and the OSET Dataset. Same sensing matrix is used with every experiment for all the CS methods used to compress FECG recordings. Two categories CS algorithms are tested. First category of recovery methods do not utilize block structure of signals includes CoSaMP, BP, SL0, Elastic-Net, and EM-GM-AMP which are from the class of greedy algorithms. The Basis Pursuit algorithm is used to reconstruct adult ECG recordings. The second group of algorithms utilized the structure of signals which includes, Block Basis Pursuit, Block-OMP, StructOMP, BM-MAP-OMP, and CluSS-MCMC. Block Basis Pursuit and Block-OMP requires a priori information of the block division. The result of comparison shows satisfactory quality with BSBL-BO algorithm. The BSBL-BO is evaluated for various factors such as impact of, the block partition effects, effect of compression ratio, and the impact of number of nonzero column entries of the sensing matrix. The proposed framework can be employed to many other telemedicine applications, such as wireless electroencephalogram, and electromyography.

- *On Quality of the Recovered ECG in the Views of Clinical usage*

Mamaghanian et al. [33] evaluated the PRD values for NIHT, EIHT, and FLIHT using the wavelet tree model. Among all, EIHT shows the great degrees of performance for S-Sparse signals. For model-based reconstruction methods MB-NIHT accomplish 95 % and more successful recoveries for M = 160 number of measurements. The same is achieved for M = 224 with EIHT and M = 192 with MB-FLIHT. Hence, NIHT and FLIHT results in a improved signal recovery performance in view of the probability of signal reconstruction and the output recovered PRD. This research shows that PRD values from 0–9 % are considered as "good or very good" ECG signal quality for clinical diagnosis. Zigel et al. [34] suggested a novel distortion metric named weighted diagnostic distortion (WDD) for ECG signal compression. The result shows that the suggested WDD metric is most appropriate for evaluating ECG recovered signals compared to the PRD metric. Drawback of WDD is that it is expensive to calculate compared to inexpensive measure of PRD.

- *Real-Time CS Hardware Implementation for ECG Signal Compression*

In the recent years significant research focus and efforts are made on the design, development and implementation of real-time CS hardware for different applications. Duarte et al. [35] proposed the one pixel imaging using CS. Body area network (BAN) is one of the recent application which is explored by many publications. Mamaghanian et al. [36] evaluated the performance of CS for wireless BAN on shimmer embedded platform which outperform DWT based lossy compression technique. Mishali et al. [37] designed "analog-domain CS system—a modulated wideband converter (MWC)". Chen et al. [38, 39] presented digital based CS for ECG and EEG signals. Dixon et al. [25] evaluated the performance of bio-medical signal sensors for BAN application on real time hardware.

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5 Conclusion

In this review paper, we have presented a complete survey of the CS area for 1-dimensional biomedical application focused on CS-based ECG signal compression. We have investigated the basic of CS technique and discussed theoretical and mathematical basis of the important concepts. We have presented the reviews on some of important areas of CS-based ECG compression like choice of most excellent wavelet basis function for maximum sparsity of ECG signal, different sensing matrices for ECG signal compression, evaluation of CS reconstruction algorithms for ECG signal recovery with good accuracy and less reconstruction time, performance of CS ECG signal in different sparseness and noisy conditions, application of dictionary approach for ECG compression, Bayesian learning approach for ECG signal compression or recovery and real-time CS hardware implementation for ECG signal compression. Research on CS has demonstrated that CS is suitable alternative compared to the state of the art ECG compression techniques like SPIHT. From the review summary we can conclude that biorthogonal wavelet family rbio3.7 and rbio3.9 gives best sparsity, Bernoulli's matrices results in simple encoder design, OMP is the best choice for real time implementation. Dictionary learning approach will improve the CS reconstruction performance, while recently emerged Bayesian learning approach will even outperform CS-based approaches. Low power consumption and reconstruction quality of signal are the major challenges faced by real-time CS hardware implementation.

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Tracking Pointer Based Approach for Iceberg Query Evaluation

Kale Sarika Prakash and P.M.J. Pratap

Abstract Extracting small set of data from large or huge database is a challenge in front of data warehouse system. The queries executed on data warehouse are of the nature aggregation function followed by having clause. This type of query is called as iceberg query. Present database system executes it just like normal query so it takes more time to execute. To increase execution speed of iceberg query on large database is the challenge in front of researchers. Previous research uses tuple scan approach and bitmap index pruning strategy to execute query which is time-consuming and it faces the problem of fruitless bitwise AND-XOR operation. They focus on only COUNT and SUM aggregate functions. To address these problems and improve efficiency of iceberg query the proposed research makes use of tracking pointer concept. It avoids fruitless bitwise AND-XOR operations and also it minimizes the futile queue pushing problem that occurs in previous research. Along with COUNT and SUM function this study creates framework for MIN, MAX, COUNT, and SUM aggregate functions. This proposed work uniquely distinguishes the MIN, MAX, and SUM operations which is not found in existing systems.

Keywords Data warehouse (DW) · Iceberg queries (IBQ) · Aggregate functions—COUNT · SUM · MIN · MAX · Bitwise AND-XOR operation

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1 Introduction

The users of the data warehouse are the decision makers, business analyst and knowledge workers of respective organization. They make use of data from data warehouse to predict some issues about their business. Accordingly they take decisions about business. Once they have taken decision they concentrate on implementation of the same. As they make use of data for planning means they do not use data warehouse frequently. The information which they collect from data warehouse is small information from huge data set. To extract such a type of data the query executed is of the nature aggregation of some value on some specified condition or threshold. This type of query is called as iceberg query. Iceberg queries were first studied by scientist named Fang et al. [1]. According to him, iceberg query is defined as the type of query which performs aggregation function on some set of attributes followed by having clause on some condition or on threshold value. The output of iceberg query is small set of data from huge data set as input. Because of this type of nature it is called as iceberg query. Syntax of an iceberg queries on a relational table T (Col1, Col2… Coln) is stated below:

SELECT Col1, Col2, …, Coln AGG (*) FROM T GROUP BY Col1, Col2…, Coln, HAVING AGG (*) > = Threshold, where Col1, Col2,…, Coln represents a subset of attributes in R which are aggregate attributes. AGG is aggregate functions used in iceberg query like MIN, MAX, SUM, AVG, and COUNT. The greater than equal to (>=), less than or equal to (<=), or is equal to (= =) are special symbols used as a comparison predicate in having clause.

Due to threshold condition iceberg query returns very small distinct data set as output which looks like the tip of an iceberg. The output of iceberg query is very small that is on the tip of the iceberg compared to the input so such a type of query must answer quickly even it executes on huge data set. But current database systems do not take advantage of this feature of iceberg query. The relational database systems like Oracle, SQL server, Sybase, MySQL, and PostgreSQL are all using general aggregation algorithms [2–4] to execute iceberg query. They did not consider it as special query so the time required to execute such queries on these databases are more. Existing optimization techniques for processing iceberg queries [1, 5] can be categorized as the tuple-scan-based method, which requires minimum one table scan to read data from disk. They focus on reducing the number of passes when the data size is large. They did not make use of iceberg query property for efficient query processing. Due to this a tuple-scan-based method generally takes a long time to answer iceberg queries on large database. Besides these tuple-scan-based approaches, Ferro et al. [6] designed a two-level bitmap index which can be used for processing iceberg queries. However, it suffers from the massive empty bitwise AND results problem.

The research proposed in [7] provides dynamic pruning and vector alignment strategy tries to overcome empty bitwise AND operation problem. But empty bitwise XOR operation issue is occurred in this research. This empty bitwise XOR operation problem is overcome by [8, 9] but it faces the problem of futile queue

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pushing which degrades the performance of query. Proposed research concentrates on preprocessing of bitmap index. Due to this futile queue pushing cost is reduced. If the number of attributes in bitmap vector is increased the maintenance of number of queues is also increased. The preprocessing of bitmap vector reduces the queue maintenance cost. To achieve this proposed research makes use of tracking pointer concept along with making array of 1 bit position in each vector prior to perform followed operations. Existing research [7–11] only concentrate on COUNT aggregate function which is not sufficient to execute generalized iceberg query so to address this problem in our proposed research along with COUNT function MIN, MAX, and SUM operation worked out.

The remaining sections of this paper are structured as follows: Sect. 2 discusses related work. Section 3 discusses proposed tracking pointer strategy and in Sect. 4 comparative study of different iceberg query evaluation algorithm is discussed followed by conclusion in Sect. 5.

2 Related Work

Due to involvement of Internet there is rapid increase in input sources to form a data warehouse. So to build a data warehouse for large data set has become easier but extracting knowledge from it is a challenging task for researchers in the area of data mining, decision support system, and OLAP systems. The queries to be executed on the data warehouse are of the nature of iceberg query. In this section, we are highlighting the iceberg query execution strategies developed by different researchers and application of bitmap index to execute iceberg query.

The iceberg query processing is first described by Fang et al. [1] in 1998. In this study author proposed Hybrid and Multi-bucket algorithms by extending probabilistic technique used in [12]. In this research sampling and multi-hash functions are combined to improve the performance of iceberg query and reduce memory requirement. But these algorithms do not scale to large data sets.

To overcome this problem [1] suggests algorithms which consist of sampling and bucket counting mechanism. This mechanism generates false positive values which are candidates for the final result but it does not exceed the threshold limit. It also generates false negative values which are in the final result but it is not in the candidate list. The focus of this research is to minimize false positive. Different optimization methods are used which consist of hashing, multiple hashing, combination of multiple hash functions and multiple scan over relation. These methods reduce number of false positive values but it takes more time to execute query as it requires multiple scan of relation.

Iceberg query processing is also proposed by [5], focus of this study is to reduce number of table scans so that time required to execute the query will get reduced. It introduces methods to select candidate values using partitioning and POP (Postpone Partitioning) algorithms. This overcomes the problem of multiple scan over relation occurs in sampling and bucket counting mechanism [1]. The result of this study

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shows that performance of these algorithms degraded due to data order and memory size. If database is sorted then performance is excellent without regard to memory size.

A comparison was presented for Collective Iceberg Query Evaluation (CIQE) [13] using three standard methods like Sort Merge Aggregate (SMA), Hybrid Hash Aggregate (HHA), and ORACLE. CIQE indicates that performance of SMA is better on data sets with low to moderate number of targets than moderate to high skew. HHA performance was not robust and quite bad when the number of targets was high. There was a considerable performance gap between the online algorithms and ORACLE, indicating a scope for designing better iceberg query processing algorithms.

Above-mentioned approaches come under the group of tuple scan based method, which requires one physical table scan to read data from disk. These algorithms focus on reducing number of tuple scan but no one of them uses property of iceberg query.

Bitmap index is usually a better choice for querying the massive, high-dimensional scientific data sets. It supports fastest data accesses and reduced the query response time on both high-and low-cardinality values with a number of techniques [14]. Generating the bit map index of attribute will not affect on the performance of query because generated bitmap by database system is in compressed mode [15]. Therefore, use of bitmap index to execute iceberg query avoids the complete table scan.

However, [6] tries to make use of this property of iceberg query and uses bitmap index but it suffers from empty bitwise AND results problem. This problem is minimized by [7] using dynamic pruning and vector alignment approaches. This work leverages the antimonotone property of iceberg query and develops dynamic pruning algorithm using bitmap indexing. However, they notice that there is problem of massively empty bitwise AND results. To overcome this challenge they develop vector alignment algorithm which uses priority queue handling. The problem with this technique is that all vectors may not have 1 bit at same position and if it is not at same position then all AND as well as XOR operations are fruitless and time-consuming.

In this way both the above approaches suffer from fruitless AND as well as XOR operations. Research [8] try to handle empty XOR operation problem but did not able to solve fruitless bitwise AND operation problem. Both the research [7, 8] use priority queue concept for all vectors and faces the problem of futile queue pushing. In proposed research by making use of tracking pointer we are trying to minimize the number of fruitless bitwise XOR and AND operation. It will help to minimize futile queue pushing problem.

None of the above research [7–11] works on other aggregate functions like MIN, MAX, SUM. In proposed research we are developing framework for aggregate functions like MIN, MAX, SUM, and COUNT, only our strategy is not applicable for AVERAGE function.

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3 Details About Proposed Tracking Pointer Strategy

This section highlights the methodology used in tracking pointer to improve the efficiency of iceberg query. The block diagram and pseudocode of proposed methods are included in this section.

3.1 Description of Tracking Pointer-Based IBQ Evaluation Method

Figure 1 shows the working flow of tracking pointer-based IBQ evaluation method. This model is used to interface with any data warehouse/large database system. Iceberg query is executed through this model. As per query attributes bitmap index is prepared. The preprocessing of bitmap index is important part. In this part the analysis of bitmap vector as per query attribute will be done. With this analysis we can directly prune the vector which reduces fruitless bitwise AND and XOR operation. Bitwise AND operation is performed to find probability of tuples to be subset of final answer and XOR operation is performed to generate new vector. In this strategy tracking pointer keeps track on POP out element list from priority

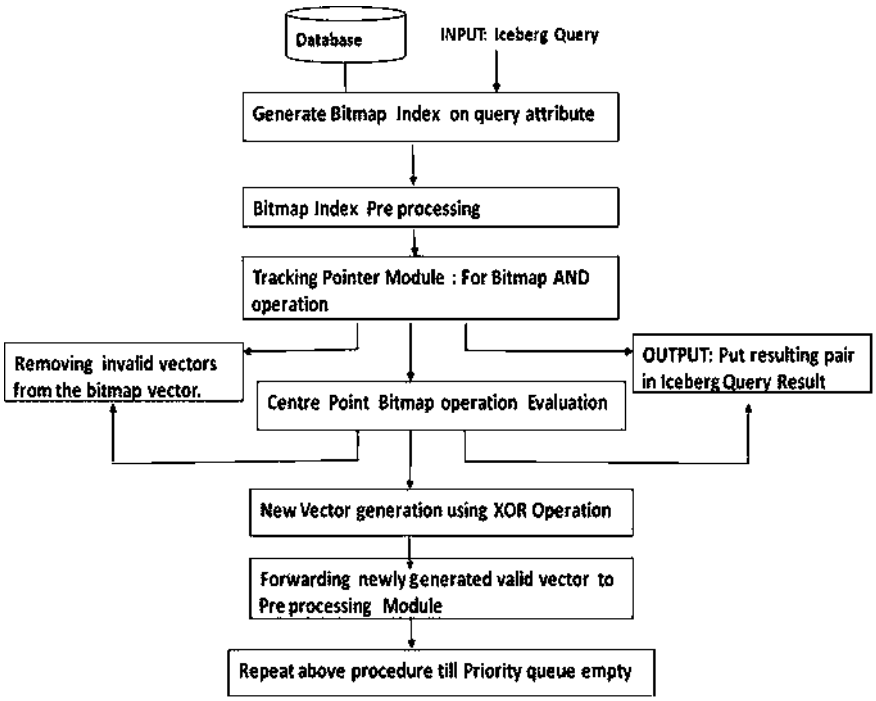

Fig. 1 Tracking pointer methodology

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queue. Then check for longest first 1 bit of both the list has to be done. Tracking pointer points to first 1 bit of vectors and compares it with second vectors bits. This will repeat until both vectors have 1 bit on same position. As shown in Fig. 1 center point bitmap operation evaluation logic declares to prune vector and to perform complete operation to generate iceberg result.

3.2 *Pseudocode for Iceberg Query Evaluation Using Tracking Pointer Concept*

Input: Iceberg Query
Iceberg Result(attribute X, attribute Y, threshold T)
Output: iceberg results
Algorithm

```
1. PriorityQueueX.clear, PriorityQueueY.clear
2. for each vector x of attribute X do
3. if x.count > = T then
4. x.next1 = FirstOneBitPosition(x,0)
5. PriorityQueueX.Push(x)
6. Same logic is applied to push the highest priority vector in PriorityQueueY
7. Result = Null
8. x,y = NextAlignedVector(PriorityQueueX.clear, PriorityQueueY,T)
9. Here concentration is on NextAlignedVector function.
10. While x! = NULL &y! = NULL do
11. PriorityQueueX.Pop
12. PriorityQueueX.Pop
13. Result = BitwiseAnd(x,y)
14. If(Result.count >=T) then
15. Add IcebergResult(x.value,y.value,result.count)
16. x.count = x.count-result.count
17. y.count = y.count-result.count
18. If x.count >=T then
19. X.next1 = FirstOneBitPosition(x,x.next + 1)
20. If x.next1! = NULL then
21. PriorityQueueX.Push(x)
22. If y.count >=T then
23. y.next1 = FirstOneBitPosition(y,y.next + 1)
24. If y.next1! = NULL then
25. PriorityQueueY.Push(y)
26. x,y = NextAlignedVector(PriorityQueueX, PriorityQueueY,T)
27. Return Result
```

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Same logic is applicable whenever new vector is generated after XOR operation. The fruitless XOR operations are reduced by assuming A1 AND B1 = R1 then New A1 = A1-R1 but before performing this XOR operation count number of 1 bits of A1 and R1. If A1-R1 or R1-A1 is greater than threshold then only perform New A1 = A1 XOR R1. After getting new vector apply above NextAlignedVector (PriorityQueueX, PriorityQueueY,T) function and repeat the procedure till both the queue will be empty.

4 Comparative Study Between Different Algorithms

In this section, we are showing the analysis of solving some iceberg query on given tables using different iceberg query processing strategies. The examples considered here are from [7, 8] and number of bitwise AND operation, XOR operations and number of iterations required to solve query are summarized.

Example: Select Month, category, COUNT (*) from R group by Month, category having COUNT (*) > 2.

Month	Category
July	Milk
June	Veg
July	Fruit
July	Milk
June	Veg
July	Fruit
July	Milk
July	Fruit
June	Veg
July	Milk
Aug	Fruit
Aug	Fruit

Table R

June	July	Aug	Fruit	Milk	Veg
0	1	0	0	1	0
1	0	0	0	0	1
0	1	0	1	0	0
0	1	0	0	1	0
1	0	0	0	0	1
0	1	0	1	0	0
0	1	0	0	1	0
0	1	0	1	0	0
1	0	0	0	0	1
0	1	0	0	1	0
0	0	1	1	0	0
0	0	1	1	0	0

Bitmap Indices for Month, category

This work solves above query using Bitmap Indexing, Dynamic Pruning, Vector Alignment, and Tracking pointer strategy. From this we collected the count of number of AND and XOR operations required to solve query. Similarly, number of iterations required for query execution is calculated through implemented module of proposed strategy. Table 1 shows the summary of results obtained from above-mentioned methods and implemented module. Experimental result shows that number of AND operation, XOR operation, and iteration count get reduced in case of tracking pointer strategy. This increases the execution speed of query and reduces I/O access.

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Table 1 Comparative analysis

Iceberg query evaluation strategy	Bitwise AND operation	Bitwise XOR operations	Number of iterations required
Query1:			
Bitmap indexing	9	0	108
Dynamic pruning strategy	5	6	60
Vector alignment strategy	5	6	66
Tracking pointer strategy	3	1	51
Query2:			
Bitmap indexing	9	0	98
Dynamic pruning strategy	5	2	56
Vector alignment strategy	3	2	47
Tracking pointer strategy	3	0	39

5 Conclusion

Generally, knowledge discovery systems (KDS) and decision support systems (DSS) compute aggregate values of interesting attributes by processing it on large databases. In particular, iceberg query is a special type of aggregation query that computes aggregate values above threshold values provided in query. Normally, only a small number of results will satisfy the threshold constraint. The results are on the tip of iceberg means we are extracting small information from large database. Proposed research makes use of the antimontone property to speed up iceberg query execution by tracking pointer concept. With our analysis and experimental results we found that tracking pointer requires less number of AND operation, XOR operations, and number of iteration. Along with COUNT function proposed research is also concentrating on Aggregate functions like MIN, MAX, and SUM. To support AVERAGE function proposed strategy is not appropriate. AVERAGE function does not support antimontone property. Our research makes use of antimontone property of iceberg query which supports only COUNT, MIN, MAX, and SUM aggregate function. The challenge in front of current research is to develop framework for AVERAGE aggregate function.

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Performance Evaluation of Shortest Path Routing Algorithms in Real Road Networks

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Abstract Dijkstra's algorithm is one of the established algorithms that is used widely for shortest path calculation. The algorithm finds the shortest path from the source node to every other node in the network. Several variants of the Dijkstra's algorithm have been proposed by the researchers. This paper focusses on Multi-parameter Dijkstra's algorithm that uses multiple parameters for shortest path calculation in real road networks. The major contributions of this paper include (1) Comparison of the Dijkstra's algorithm to Multi-parameter Dijkstra's algorithm with special focus on real road networks, (2) Performance evaluation of Multi-parameter Dijkstra's algorithm, (3) Time complexity analysis of Different modifications of Dijkstra's algorithm.

Keywords Shortest path · Fastest path · Multi-parameter Dijkstra's algorithm

1 Introduction

Due to its capability of solving single-source shortest path problem, Dijkstra's algorithm is widely used. For instance, given a set of cities, representing the vertices V in a graph and the edges in the graph are represented by E, weight of the edges w representing the distance between the cities, Dijsktra's algorithm can be used for calculating the shortest route between any two cities. The graph representing the network can be represented as follows:

$$G = \langle V, E \rangle$$

Dijkstra's algorithm relaxes the vertices continuously until the shortest path is obtained. Though in real road networks, using the weight w or the distance between the edges may not be sufficient. Multi-parameter Dijkstra's algorithm proposed in [1]

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uses multiple parameters like real-time congestion and time taken to travel from source to destination into consideration. This paper compares Dijkstra's algorithm to Multi-parameter Dijkstra's (MPD) algorithm [1] and validates its use in real road networks.

Section 2 provides an overview of the original Dijkstra's algorithm and various other shortest path algorithms. Section 3 provides a comparative analysis of Dijkstra's algorithm and Multi-parameter Dijkstra's algorithm. Section 4 analyzes the time complexity of various algorithms. Conclusions and Future directions are given in Sect. 5.

2 Shortest Path Algorithms

The popularity of shortest path algorithms is due to their application in varied scenarios. The shortest path algorithms are also used for routing problems. Many algorithms have been suggested to compute the single-source shortest path or all pairs shortest path problems [2, 3]. While Dijkstra's algorithm solves the single-source shortest path problem, Bellman–Ford algorithm solves the single-source shortest path problem with negative edge weights. Algorithms such as Floyd–Warshall and Johnson's algorithm solve the all-pairs shortest path problem.

There are several approaches proposed in the literature. Some of them include privacy preserving shortest path calculation [4] using Private Information Retrieval in which the authors have proposed the involvement of third party in shortest path calculation and thus ensuring location privacy.

A framework for road networks has been suggested in [5]. The authors have devised highway-based labeling and an algorithm for the road networks.

Several modifications of the Dijkstra's algorithm have also been suggested in [3]. These include Dijkstra's algorithm with Double buckets (DKD), Dijkstra's algorithm with overflow bag implementation (DKM), and Dijkstra's algorithm with approximate buckets implementation (DKA). A comparison of various implementations of Dijkstra's algorithm has been given in [1].

Dijkstra's algorithm has also been extended to solve bi-objective shortest path problem in [6]. The authors have proposed an algorithm that runs in $O(N(m + n\log n))$ time to solve one-to-one and one-to-all bi-objective shortest path problems.

Next section compares Dijkstra's algorithm to its modified version, Multi-parameter Dijkstra's algorithm [1].

3 Multi-parameter Dijkstra's Algorithm Versus Dijkstra's Algorithm

Given a set of Edges E and a set of vertices V, the cities can be represented as Vertices and edges represent the distance between any two cities. The technique that has been suggested by Dijkstra's algorithm is to update the distances as soon as

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a shorter path is found between any two nodes. The existing path is updated with the newly discovered shorter path. This process is continued until all the neighboring nodes are visited. In this manner the shortest distance between any two nodes is calculated.

A shortest path algorithm can be used to find the fastest way to get from a node *A* to node *B* or find the least expensive route from *A* to *B* or it may be used to find the shortest possible distance from *A* to *B* [7]. Though Dijkstra's algorithm is able to calculate the shortest possible distance, but this might not necessarily be the fastest route or the least expensive one. In real road networks, users may want to calculate the route that fulfills other criteria as well.

Though distance between two nodes is an important factor while computing the shortest path between any two nodes, there are several other factors that can be taken into consideration while calculating the shortest path for real road networks. Apart from distance, Multi-parameter Dijkstra's algorithm [1] takes other factors such as the time taken to travel form one node to another and real-time congestion factor into consideration. As in real road networks, it would be difficult if only distance is taken into consideration. Since the time taken to travel from one city to another may be affected by other factors like congestion and blockage or ongoing construction on the road. It makes sense if the users are provided a large number of choices and according to the preference, the algorithm adapts. In Multi-parameter Dijkstra's algorithm, if the user gives the preference of distance as a basis of shortest path calculation then this algorithm functions as the original Dijkstra's algorithm. But, if the user chooses time or congestion as a deciding factor then the distance is weighted as per the time factor or congestion factor respectively. The time factor and congestion factor are weighted on a scale of 1–10, with higher value indicating that the route takes more time or is more congested. If w indicates the distance between any two nodes $v1$ and $v2$, the adjusted weight w can be given as follows:

$$w' = w * \varphi$$

where φ indicates the congestion factor for the path. Also, the time taken to travel a path may increase or decrease irrespective of the distance. As other factors like some blockage on the road or construction work going on the road may affect the time taken in real life scenarios. Sensors may be used to capture the real-time information of the route before the user can actually decide on which route can be adopted. As per the real-time information received, the congestion and time factor may be adjusted. The revised weight or distance between any two nodes using time factor may be calculated as:

$$w' = w * \delta$$

where δ indicates the time factor with which the weight needs to be adjusted. The revised weight w can now be used for shortest path calculation. The corresponding weight update can be calculated as per Algorithm 1.

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Algorithm 1 Weight Update using MPD

1. If user preference = distance
   w' = w
2. Else if user preference = time then
   w' = w *δ
3. Else if user preference = congestion then
   w' = w *ϕ
4. Return w'

For evaluation of the Multi-parameter Dijkstra's algorithm, real-time information about 500 nodes in Jaipur City was collected. This information included the distance between the nodes, congestion factor and the time taken to travel between any two nodes or cities. This information was collected at different time stamps as in real-time scenarios the values are highly dependent on the time at which they are collected. The Multi-parameter Dijkstra provides higher adaptability and calculates the shortest path as per the preference of the user. For instance, let us consider the graph illustrated in Fig. 1.

As shown in Fig. 1, the original Dijkstra's algorithm gives {1, 2, 5, 6} as the shortest path. In real road networks, other factors such as congestion and the time taken to travel a path may be taken into consideration for better calculation of shortest path. For example, let us consider the congestion factor during real-time analysis is as shown in Table 1.

As shown in Fig. 2, congestion factor is independent of the distance or weight between two nodes. In real-time scenarios the value of congestion factor may vary from one time stamp to another.

The congestion factor may also vary as per the time at which the data is collected. Figure 3 shows the congestion factor for two nodes at different moments of time.

Such information was collected for 500 nodes across Jaipur City. The weight/congestion collected for the sample graph of Fig. 1 is shown in Fig. 4.

Taking the above real-time data into consideration, the shortest path can now be recalculated using Multi-parameter Dijkstra's algorithm. Figure 5 indicates the revised shortest path after taking Congestion into consideration.

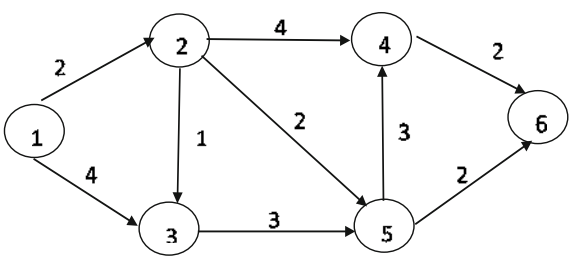

Fig. 1 Shortest path calculation using Dijkstra's algorithm {1, 2, 5, 6}

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Table 1 Revised weight with congestion factor

Source node	Destination node	Weight (w)	Congestion factor (φ)	Revised weight (w')
5	6	2	2	4
1	2	2	3	6
2	3	1	7	7
3	5	3	3	9
2	5	2	8	16
4	6	2	8	16
5	4	3	6	18
2	4	4	5	20
1	3	4	9	36

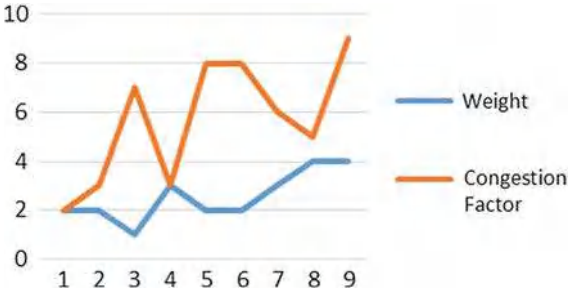

Fig. 2 Weight and congestion factor for different nodes 1–9

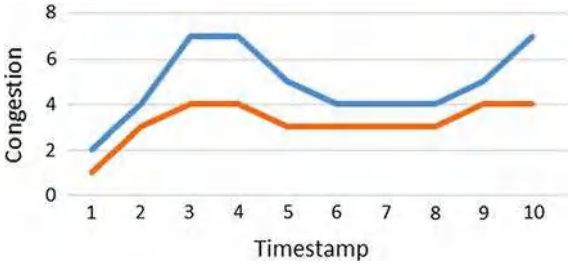

Fig. 3 Congestion factor at different time stamps for n = 2

Similarly it can be shown that time factor is also an important criterion for deciding the shortest route. Thus in real road networks, the shortest path may vary depending on the real-time information about the traffic and road conditions.

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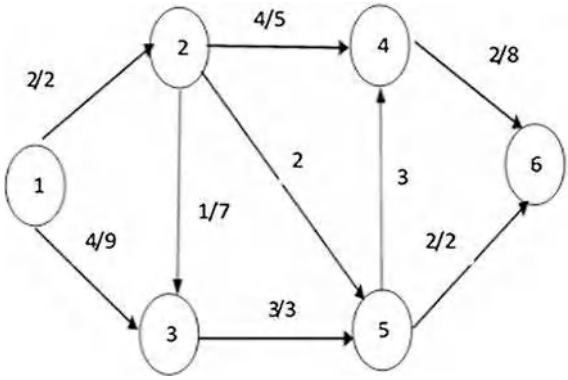

Fig. 4 Weight/congestion for the sample graph

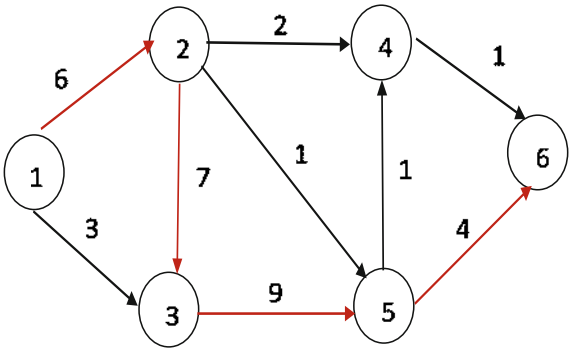

Fig. 5 Shortest path using Multi-parameter Dijkstra with congestion factor $\{1, 2, 3, 5, 6\}$

4 Analysis of Time Complexity

If we consider the time complexity of various approaches, the complexity largely depends on the implementation. Table 2 lists the time complexity of various implementations of Dijkstra's algorithm.

Multi-parameter Dijkstra's algorithm incurs an additional overhead of calculation of the revised weight. Thus the time complexity of the Multi-parameter

Table 2 Time complexity of different algorithms

Algorithm	Time complexity
Dijkstra's algorithm with list	$O(V^2)$
Dijkstra's algorithm with modified binary heap	$O((E + V)\ \log V)$
Dijkstra's algorithm with Fibonacci heap	$O(E + V \log V)$
Johnson-Dijkstra	$O(EV + V^2\ \log V)$
Multi-parameter Dijkstra	$O(E\ \log V) + E$

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Dijkstra's algorithm is $O(E \log V) + E$ where the factor E is added in order to compute the revised weight for all the edges. But in turn a well-updated information about shortest path can be a boon in real road networks. Also it can provide the fastest route between any two set of nodes.

5 Conclusion

Various approaches to shortest path calculation have been discussed in this paper. Multi-parameter Dijkstra's algorithm can be used to incorporate the state-of-the-art information in the real road networks. Factors such as congestion and time taken to reach the destination may affect the shortest path. Though computing the revised weight has an additional overhead but it can contribute towards saving time of travel in real road networks. And thus aide in finding the shortest and fastest route in the real road networks.

Acknowledgments This paper provides Performance Evaluation of our previous work on Multi-parameter Dijsktra's Algorithm published in International Journal of Advances in Engineering Research [1].

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An Outlook in Some Aspects of Hybrid Decision Tree Classification Approach: A Survey

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Abstract Decision tree one of the complex but useful approach for supervised classification is portrayed in this review. Today's research is deemed toward the use of hybridized decision tree for the need of various applications. The recent approaches of decision tree techniques come with hybrid decision tree. This survey, it has been elaborating the various approaches of converting decision tree to hybridized decision tree. For classification of data SVMs and other classifier in decision tree are generally used at the decision node to improve accuracy of decision tree classifier. Then the more penetration is given to some aspects which less likely used by researchers which gives more scope. The ideas of various hybridized approaches of decision tree are given like use of clustering, naïve Bayes, and AVL tree, fuzzy and genetic algorithm.

Keywords Data mining · AVL · Fuzzy clustering · Naïve Bayes · SVM · Cuckoo optimization

1 Introduction

This paper deals with advanced approaches used in decision tree classifier and the approaches on which researchers not focused. This paper summarizes the advancement done and various approaches used in decision tree. Like mining the gold from hefty area of coal, mining useful data from large database is intricate task. The Latest era in data mining is classification. Classification involves predicating

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the approved class of the given sample data. Classification comprises various methods but decision tree classifier is one of the scorching research areas.

When the data grows in size, decision tree is one of the preferred selections of many researchers for classification. Besides complexity of implementation, it is having significant accuracy as compared to other classification methods. It creates supervised model to show the relationship between instances and attributes [1]. It takes polynomial time to create the model. Decision tree is advantageous for various applications like speech recognition, medical research, energy modeling, intrusion detection and many other real time applications. Decision tree approach is hybridized by many researchers for increasing accuracy of classification and reducing training and testing times.

1.1 Decision Tree Construction and Decisive Factors

Decision tree is the visual representation of data which consist of nodes and edges where each node examine attribute, branches represents outcome of test and leaf node represents predicted class. A tree constructs using top-down recursive and divide and conquer approach [1]. Decision tree is generated in two phases

(a) Tree Construction: At start keep all training records at the root node and then partition the records recursively based on the selected attribute.
(b) Tree Pruning: Identify the branches which reflect the noise or outlier and then remove these branches.

Decision tree construction is more emphasized by the strategy used for selecting attributes. Sufficient approaches are provided by researchers to select the attribute which best split the training records. Ben-Bassat [2] categorized these attribute selection measures as use of information theory, distance measure and dependence measure. Some of the measures are enlisted below.

(a) **Measure of Information Theory**

The basic criteria used by Quinlan [3] are information gain and gain ratio for selecting best attribute which increases the accuracy of decision tree learning. Information Gain measure for selecting attribute is used by ID3 decision tree construction algorithm while Gain ratio is used by C4.5 algorithm which are choices of majority researchers. Jun et al. [4] modified entropy by considering the base of the logarithm as the number of successors to the node. This strategy can handle huge amount of data efficiently.

(b) **Measure of Distance**

Gini index is the measure based on distance used by CART (Classification and Regression Tree) for selection of best attribute [5]. It uses separability, deviation and discrimination between classes [6]. Brieman et al. [6] proved that if the dataset

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contains large number of classes then Gini index fails to give performance. Murthy et al. [7] proposed binary criteria towing index which divides multiple classes in two superclasses and chooses splitting criteria based on these two super classes.

Rounds [8] used approach of Kolmogorov–Smirnov distance as an attribute selection measure based on distance whose feature is to produce an optimal classification decision at each node. Utgoff and Clouse [9] used the same measure which modified measure to deal with multiclass attributes and also its contribution is in missing value attributes. Martin [10] has analyzed the difference of splitting criteria like distance, orthogonality, a Beta function and two chi-squared tests.

Chandra et al. [11] presented new splitting measure called as Distinct Class Splitting Measure to produce purer partitions for the dataset with distinct classes.

1.2 Decision Tree Learners

The field of decision tree learning is crafted by researchers from last four decades and done immeasurable improvements in methods of decision tree creation. Some basic algorithms are narrated below.

ID3: ID3 (Iterative Dichotomiser 3) [12] decision tree is a simple decision tree algorithm which is simple and base for all the researchers. ID3 uses information gain for selecting best attribute for partitioning the dataset. Information gain gives poor performance when the feature takes multiple values. No pruning method is used by ID3. It fails to handle numeric attributes, missing and noisy data.

C4.5: The C4.5 algorithm [3] the first choice of researchers is an extension of ID3 algorithm which uses information Gain as splitting criteria. It can handle categorical as well as numerical data. It removes all the drawbacks of ID3 algorithm. Error-based pruning is used by the C4.5. New version of C4.5 is proposed called as the C5.0. The changes in C5.0 encompass new capabilities as well as much-improved efficiency. It is also capable to easily handle missing values.

CART: Classification and regression tree (CART) developed by Breiman et al. [6] creates two ways tree called as binary tree. CART uses Gini index for selecting attribute which divides the data in two child left and right. It can handle missing values and can be applied for any type of data. To reduce size of tree it uses cost-complexity pruning.

With these basic algorithms researchers modified and hybridized these basic techniques to improve performance and accuracy. According to the need of latest era any researchers applied for large datasets with modified approaches. Next section is emphasized on the latest hybridized approaches used in decision tree learning changed according to the application and requirement of area.

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2 Hybridized Approaches of Decision Tree

In the present era, majority researchers are contributing toward the use of hybridized approaches to construct and evaluate decision trees. Because of these methods the performance and accuracy of decision tree is increased. These hybridized methods deals with major areas. Following are some of the methods used by researchers to hybridize the learning of the decision tree.

2.1 Clustering-Based Decision Tree Induction

Clustering is unsupervised learning method which is applied for large data set without class values. To deal with large data set many researchers combined unsupervised learning with the supervised learning.

Jayanta and Krishnapuram [13] proposed interpretable hierarchical clustering method to construct unsupervised decision tree. In this method the leaf node represents the clusters. The rule is constructed from root to leaf. Interpretable hierarchical clustering demonstrates the performance of four attribute selection criteria. This method chooses attribute from unlabeled data in such a way that after performing clustering the in homogeneity get reduced. The results of unsupervised decision trees are outperforming than the supervised decision trees. As the data streams are unbounded data so requires only on scan so Qian and Lin [14] developed efficient approach which produces cluster decision tree. Its main aim to solve the problem of concept drifting produced in data streams. It clusters the data which is not classified by the Very Fast Decision Trees (VFDT). With these new clusters it updates the tree. Due to these strategies the classification accuracy is increased for unlabeled data and works for noisy data.

Esfandiary and Moghadam [15] used *K* means clustering to create decision trees. In this algorithm, data is clustered using *K* means clustering and then sorted data in the cluster. Each cluster creates one layer of decision tree. It uses depth growth constraint to control the size of decision tree. The author argued that this clustering decision tree uses very simple strategy and provides better accuracy, processing time and complexity. Horng et al. [16] used fuzzy strategy to create decision tree. The hierarchical fuzzy clustering decision tree (HFCDT) proposed which is designed for the dataset consisting with large number of classes. It performs better for continuous valued attribute. It uses division degree based hierarchical clustering which successively creates reduced fuzzy rule set. The strategy reduces computational complexity because of reduced size of fuzzy rule set and increases classification rate due to finer fuzz partition. Cheng et al. used the method on real time system that is ion implantation problem where the method performs outstanding.

Recently many researches [17–21] used clustering to construct decision tree for large dataset by considering different parameters of construction and evaluation. These algorithms aimed to create decision tree which is accurate, comprehensible

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and can be applicable for real time data by considering its size and different factors. In today's era many researchers developing hybridized decision tree approaches by combining clustering. From literature it is observed that K means clustering is the choice of many researchers because of its better performance and simplicity to understand.

2.2 Height Balanced Decision Tree Induction

In 80s decade, to reduce size of decision trees height was considered as a major factor. Laber and Nogueira [22] proved that decision tree with minimum height can completely identify the given objects with the given tests.

Gerth et al. [23] had given the solution to the problem of minimum cache. The novel method called dynamic binary tree with small height $\log n + O(1)$. It embeds this tree in the static binary tree which get embedded in an array in cache unaware manner. The new improved height balanced approach is provided [24] which had used AVL trees for classification. This is one of the research areas where researchers are failed to concentrate. Due to the use of AVL trees quality and stability of decision tree is increased without affecting performance and accuracy of the decision trees. Due to successive recursive partitioning the data subset becomes small, so partitioning such data set is not possible. To solve this problem exception threshold is taken after which data subset is not partitioned. It uses merging of nodes if child stores same class as parent. After inserting node in decision tree, height of left and right sub tree is checked. If any imbalance is occurred then the basic rotations are performed to balance tree. This method improves quality of decision tree.

Larsen [25] had given the proof of complexity for the relaxed AVL tree. He suggested whenever use the complex structure, there is a need to know in advance how it is efficient. To find out rebalancing, parallelism and efficiency there is need to give the proof of complexity otherwise it will create inefficient research.

2.3 Decision Tree with Naïve Bayes Classifier

Naive Bayes (NBC) is one of the straightforward techniques used to create classifier models that assign class labels to data instances. These data instances are represented as vectors of feature values in which the class labels are drawn from some finite set. All naive Bayes classifiers presume that value of every feature is different for the given the class variable. For example, to identify fruit as an apple considers values as it should be red and maximum diameter is 10 mm. A naive Bayes classifier thinks each of these features to contribute independently to the probability that this fruit is an apple, regardless of any possible correlations between the color, roundness and diameter features.

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Many researchers [26–33] hybridized decision tree by taking facilities of features of naïve Bayes classifiers. This is one of the aspects of decision tree where the many researchers concentrated. Here we are giving brief literature about it. Ratanamahatana and Gunopulos [26] had given new aspect of decision tree classifier. C4.5 decision tree is used for feature classification and then naive Bayes classifier is applied. According to author the method reduced the size of training and testing data as well as the running time get minimized. The different classifiers with different characteristics given improved performance.

Kohavi [27] proposed the NBTree which hybrid approach combines decision tree with NBC. NBTree constructs using univariate splits at decision nodes and its leaves contains NBC. It will produce accurate hybridized trees which outperforms for many datasets especially for large datasets. Lewis [29] proposed self adaptive NBTree which combines decision tree with NBC. This self adaptive NBTree outperforms for continuous valued attributes. NBC is used for collection of attributes and finds proper ranges. Use of NBC node solves the problem of overgeneralization and overspecialization. So the method avoids negative effect of information loss.

Farid et al. [33] proposed two independent hybrid classifiers that is hybrid DT and hybrid NB classifier. These methods applied for multi-class classification problem. In hybrid DT algorithm, noisy instances are removed using NB classifier and then decision tree is induced. In hybrid NB classifier, decision tree is used to select subset of attributes and then produced naïve assumptions for class conditional independence.

By the literature it is observed that the when decision tree approach for feature selection and NB classifier for classification gives more efficient, accurate classification rate.

2.4 Decision Tree with Support Vector Machine Classifier

Support Vector Machine (SVM) is supervised classifier performs non linear classification using kernel strategy. It uses the hyperplanes to classify the given data. The hyperplane which maximizes the classification is selected. The decision tree with SVM is contributed from last three decades, from which few [34–46] are analyzed in this review.

In [35], decision tree based multiclass support vector machine is proposed. Top node uses hyperplanes to classify the classes. If hypotheses create plural classes then apply hyperplane until single class is obtained. At the top node most separable classes are separated which solves the problem of generalization. It produces highly generalized classifier. Multiclass problem is also tackled in [36–38] which create SVM based decision tree. The method uses modified Self Organizing Map called Kernel SOM. Decisions in binary tree are made by SVM which contribute to solve the problems of multiclass in the database.

Oblique decision trees [41] are the decision trees which performs the multivariate search with the advantage that it performs polygonal partitions of the

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attribute space. Internal nodes uses SVM generated hyperplanes which maximizes the boundary between different classes so no need of pruning which is requirement of any general tree. SVMs achieve best accuracy and capable to operate on mixed data [44]. SVM based hierarchical classifier gives fruitful results. SVM-based decision classifier provides high testing accuracies, low computational and storage cost, interpretable structures used for classification of images [44].

Kumar and Gopal [46] given the approach of hybrid SVM-based decision tree which performs both unit variant and multivariate decisions. Instead of reducing number of support vectors, it aims to reduce number of test data points which requires SVM's decision in classification. Fuzzy SVM-based decision tree [42–44] was interest of last decade.

From the study of literature, we can conclude that SVMs in decision tree are generally used at the decision node to improve accuracy of decision tree classifier.

2.5 Fuzzy and Evolutionary Approach to Decision Tree

In today's hybridized era, decision capabilities of decision tree are increased by countless methods. Fuzzy and evolutionary are the approach is and was the significantly used by the researchers in combination with basic algorithms. Fuzzy decision tree are the decision trees in which the data partition among children is done using fuzzy membership function. Fuzzy decision tree approach is very old. In this review we are going to give some aspects [47–57] of these fuzzy and genetic algorithm in induction of decision trees.

The fuzzy decision tree is similar to the standard decision tree methods characterized by using recursive binary tree. At each node during the construction process of a fuzzy decision tree, the most stable splitting region is selected and the boundary uncertainty is estimated based on an iterative resampling algorithm [48]. The boundary uncertainty estimate is used within the region's fuzzy membership function to direct new samples to each resulting partition with a quantified confidence [48]. The fuzzy membership function recovers those samples that lie within the uncertainty of the splitting regions. One of the best example of combining fuzzy and genetic algorithm based decision tree is proposed in [48, 49]. Fuzzy clustering is carried out using genetic algorithm which creates the nodes of the trees. When tree grows the nodes split into clusters of lower in homogeneity. Effect of these methods highly accurate decision tree gets produced.

Hanmandlu and Gupta [51] applied fuzzy decision tree for dynamic data. It creates fuzzy decision tree in top down manner using new discrimination measure which is used to calculate entropy of fuzzy events. This method best performs time changing data called temporal data. The size of the decision tree is reduced by one of the approach presented in [55] which assigns trapezoidal function of membership to assign fuzzy membership value to the attributes. By fixing the value of attributes the size of fuzzy decision tree is reduced.

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Wang et al. [56] proposed fuzzy rule based decision tree which uses multiple attributes for testing at internal nodes. Due to this strategy the size of the decision tree get reduced. To produce the leaves with most purity, the fuzzy rules are used.

3 Scope of Research

From the literature survey, today's research is more centered to produce hybrid decision trees which combines basic decision tree with multiple approaches like clustering, fuzzy, genetic algorithm and many more methods. But as the sky is limit so to improve the accuracy and performance of decision tree we are suggesting to concentrate on the AVL height balanced decision tree approach where there is more scope to do the improvement. There are new optimizations algorithms like cuckoo optimization algorithm [58, 59] which is not tried in literature for the decision trees. There are many aspects of decision tree where the rays are not reached. Like reducing complexity of decision tree by converting dataset into simplified manner and compressing the data without affecting the accuracy.

4 Conclusion

In this paper we are penetrating some important aspects of decision tree. This literature survey given the basic decision tree aspects along with hybridized decision tree which is today's hot research topic. We have tried to provide some important methods which are used by many researchers to make the hybridized tree. This literature survey will be definitely used for new coming decision trees researchers to combine any soft computing approach to the basic methods. Lastly, we have given the suggestion of new interesting algorithm for optimization which may produce efficient decision tree.

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Content Search Quaternary Look-Up Table Architecture

D.P. Borkute, P.K. Dakhole and Nayan Kumar Nawre

Abstract Scaling of devices due to reduction in technology has reached to a limit. Such nanoscale devices below certain limit are difficult to fabricate for reasons of physical characteristics, dimensions and cost involved in it. Use of multiple value logic (MVL) is solution to this in terms of cost, area. With use of multi-value logic less number of bits is required to store any information as compared to binary number system. In this work look-up table memory structure is chosen to implement. Radix selected for that is 4, called quaternary logic designs. Look-up table begin faster as compared to conventional memory structure which overcome issue of speed which is a limitation of MVL design. Circuit design for quaternary logic is done using available binary circuits using single power supply. In this design instead of Static RAM a Content based search method is used for design which facilitates searching, matching of data and initialize the next stage of circuit if required. Proposed circuit tries reduction of interconnections in binary systems, without power consumption overhead. This works particularly implements Look-up table memories using content-based search.

Keywords Quaternary system · Quaternary SRAM · Content search based memory · Power dissipation

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1 Introduction

Multiple value logic is based on quaternary number system with radix 4. This system can represent data in four different stable and discrete levels. Such designs affect important parameters like power, delay, interconnect and speed [1]. These circuits are designed using single power supply method ensuring logic optimization stated by Multi-Valued Logic [2]. Look-up Tables (LUT) is the kind of memories that uses RAM structures. Look-up tables are structures implement an arbitrary binary logic function. Data to be stored is to converted proper format required for quaternary system. Look-up tables are implemented using CAM-based architecture having facility of storing, searching data and observed how interconnect and power can be saved.

2 Inception of Quaternary Number System in Look-Up Tables

Look-up tables (LUT) are digital blocks which can store data depending on function implemented. The desired result or data are programmed in SRAM and attached to the LUTs. A n-bit look-up table is designed using data selector with select lines as inputs to the LUT [3]. The capacity of an LUT |C| is given by [3, 4].

$$C = n \times b^k \tag{1}$$

n: outputs, k: inputs and b: logic values for a function. The total functions implemented in an LUT with k input are given by [3, 4].

$$F = b^{|C|} \tag{2}$$

Comparing these numbers for binary look-up tables (BLUT) and quaternary look-up tables (QLUT), equivalent logic complexities can be found. These numbers are compared in Table 1.

Table 1 Comparison of logic complexity of BLUT and QLUT

No. of outputs	No. of inputs	Quaternary system radix	Binary system radix	Capacity		Possible functions implemented	
N	K	Base (b)		BLUT	QLUT	BLUT	QLUT
1	2	4	2	2	4	2^4	4^4
	4			16	64	2^{16}	4^{64}
	8			256	65536	2^{256}	4^{65536}

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3 Quaternary Look-Up Table (LUT)

The basic element of look-up table is multiplexer. Number of stages required to implement given functionality define the switching of data. The multiplexers to be used depend upon the number of input processed in LUT and radix of number system. The proposed design quaternary look-up table (QLUT) has 16 inputs and the basic multiplexer used is 4 × 1 MUX. It have 4 quaternary input, a delta literal circuit are connected as select input to multiplexer [3, 4].

3.1 Design of 4 × 1 Data Selector Using Quaternary Transmission Gates

The design of data selector depends upon radix of number system. In quaternary logic design radix is 4 so basic design circuit is 4 × 1 multiplexer as in Fig. 1. To ensure optimum complexity transmission gates are used in design. These circuits use variable threshold voltages transistors and operate with four stable and discreet logic levels, corresponding to ground that is 0 V and power supply of 1/3Vdd, 2/3Vdd and Vdd. The quaternary signal is divided in 3 binary signals by Down Literal Circuits [4–6] for controlling the operation. These control signals given to the pass transistor. It consist of 3 multiplexing stages of transmission gates whose

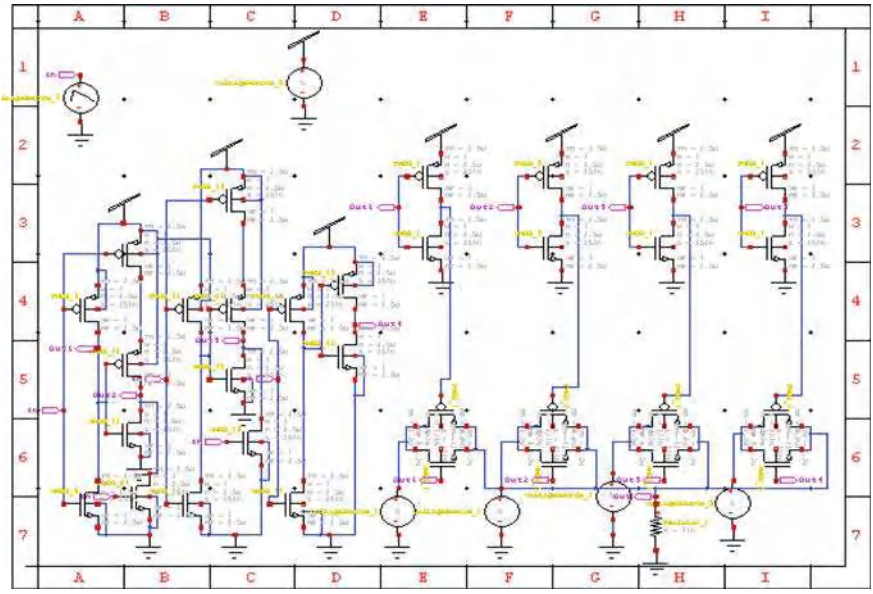

Fig. 1 Design of quaternary transmission gate

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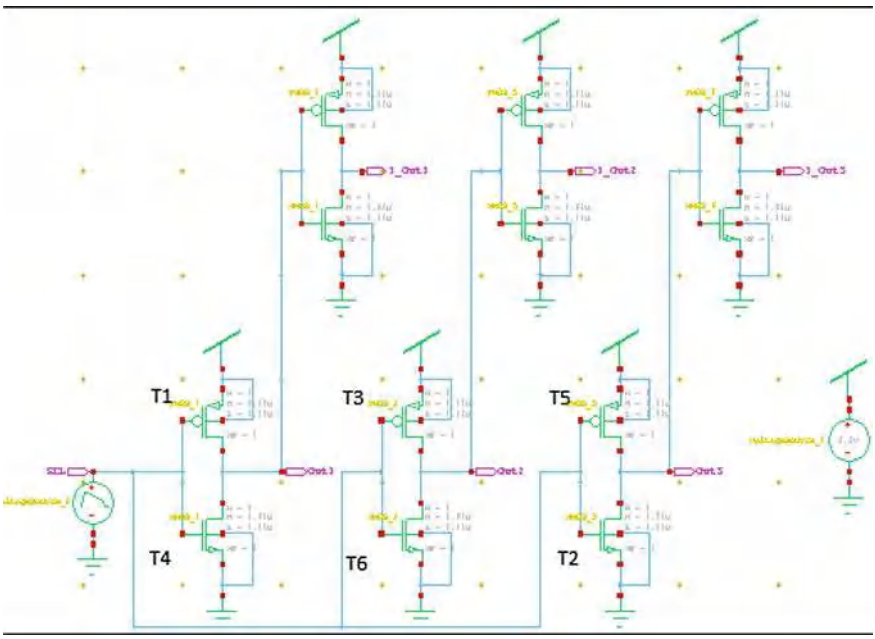

Fig. 2 Down literal circuit

select signal is provided to DLC circuit which triggers the correct transmission gate for appropriate quaternary input to be forwarded to output [4]. Quaternary logic input is applied at each input of multiplexer.

There are 3 types of DLC in quaternary logic as shown in Fig. 2 [3]. The Down Literal Circuits are multi threshold circuits with three variable voltages for PMOS transistors and NMOS transistors [5].

The threshold voltage of DLC circuit transistors is calculated using following equation:

$$\mathrm{Vth}(k) = \left\{ \frac{1-2k-1}{2(n-1)} \right\} \mathrm{Vref}, k = \{1, 2, 3, \ldots, n-1\} \tag{3}$$

First DLC is implemented with PMOS T1, NMOS T2. DLC2 using PMOS T3, NMOS T4 similarly DLC3 implemented with T5 and T6. For each input one transistor works at a time [6, 3, 4]. In DLC1, with logic 0 at input then transistor 1 conducts and transistor 2 is OFF and output is connected to logic 3 means 2.2 V. When logic '1' that is 0.7 V, logic '2' −1.4 V and logic '3' −2.2 V is connected at the input, transistor 1 is not conducting and transistor 2 is conducting and the output connects to ground. Similar operation is carried for other DLC circuits (Tables 2, 3 and 4).

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Table 2 Calculations of capacitance for write operation

Cin		87.29 fF
Cov	(Cov)n = CGD0 × W × 11 = 5.45 fF (Cov)p = CGD0 × W × 9 = 3.29 fF	Avg cov = 4.37 fF
Cjb	(Cjb)n = 0.001078 F, (Cjb)p = 0.001003 fF	Avg Cjb = 0.0010405 F
Cjsw	(Cjsw)n = 2.874 × 10^{-10}, (Cjsw)p = 2.9 × 10^{-10}	Avg Cjsw = 0.000287 fF

CL total = Cin + Cov + Cjb + Cjsw = 91.66 fF, $P_{Dynamic}$ = 131.99 μW

Table 3 Calculations of capacitance for read, search operation, match entries

Cin		87.29 fF
Cov	(Cov)n = CGD0 × W × 11 = 4.905 fF (Cov)p = CGD0 × W × 9 = 3.29 fF	Avg Cov = 4.097 fF
Cjb	(Cjb)n = 0.001078 F, (Cjb)p = 0.001003 fF	Avg Cjb = 0.0010405 F
Cjsw	(Cjsw)n = 2.874 × 10^{-10}, (Cjsw)p = 2.9 × 10^{-10}	Avg Cjsw = 0.000287 fF

CL total = Cin + Cov + Cjb + Cjsw = 89.125 Ff, $P_{Dynamic}$ = 128.34 μW

Table 4 Calculations of capacitance for read operation, search operation, mismatch

Cin		94.192 fF
Cov	(Cov)n = CGD0 × W × 11 = 5.995 fF (Cov)p = CGD0 × W × 9 = 3.29 fF	Avg Cov = 4.645 fF
Cjb	(Cjb)n = 0.001078 F, (Cjb)p = 0.001003 fF	Avg Cjb = 0.0010405 F
Cjsw	(Cjsw)n = 2.874 × 10^{-10}, (Cjsw)p = 2.9 × 10^{-10}	Avg Cjsw = 0.000287 fF

CL total = Cin + Cov + Cjb + Cjsw = 98.837 fF, $P_{Dynamic}$ = 142.326 μW

3.2 Design of Quaternary SRAM

Static RAM is designed to store quaternary data bits. SRAM uses two quaternary inverters connected back to back. The data to be stored in the quaternary SRAM is interpreted as a logic 0, 1, 2, 3. Quaternary SRAM is designed with Quaternary inverters [1, 7]. Figure 3 shows the schematic of the quaternary SRAM with two quaternary inverters and access transistors.

Simulation results of QSRAM cell as shown in Fig. 4. When word line is equals to '1' data is written into the SRAM which is at available bit line through access transistor, and when write line is equals to '0' is available for reading.

3.3 Design of Quaternary LUT

The quaternary multiplexer 16 × 1 is designed using 5 quaternary 4:1 MUX. It contains 6 DLCs, 6 binary inverters and 84 transistors as in Fig. 5. This circuit has 16 inputs decoded as quaternary signals and one output and two control signals that

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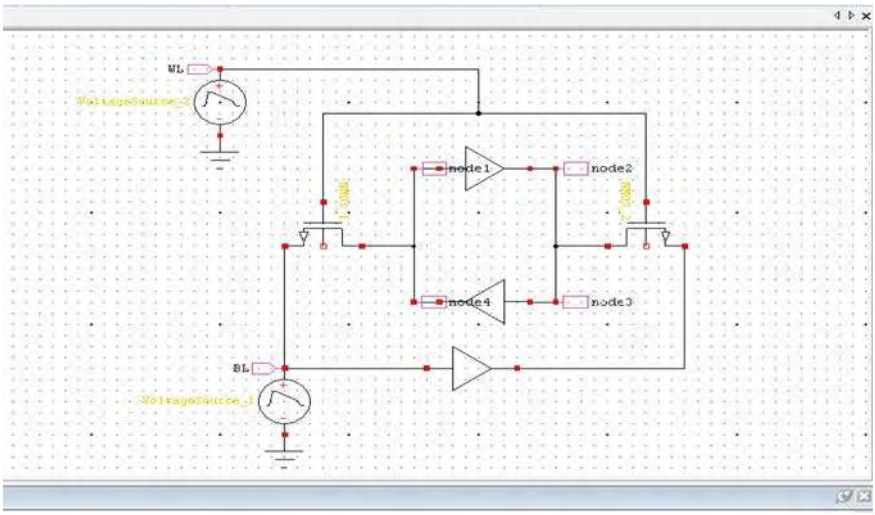

Fig. 3 Quaternary SRAM

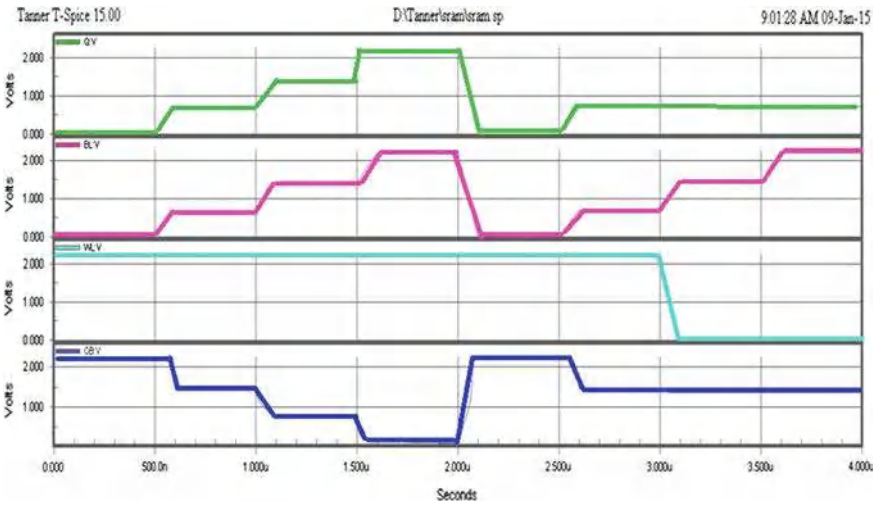

Fig. 4 Simulation results of quaternary SRAM

change the output according to control inputs. To each input quaternary content addressable memory cell is provided to store the data that is to be searched in look-up table.

That Fig. 6 shows For Bit Line (BL0) = 0, Select Line (SL) = 1 and word Line (W)L = 1 it can be seen that Match Line (ML) = 0, i.e. the no match state. For such all possibilities the structure is simulated for correctness.

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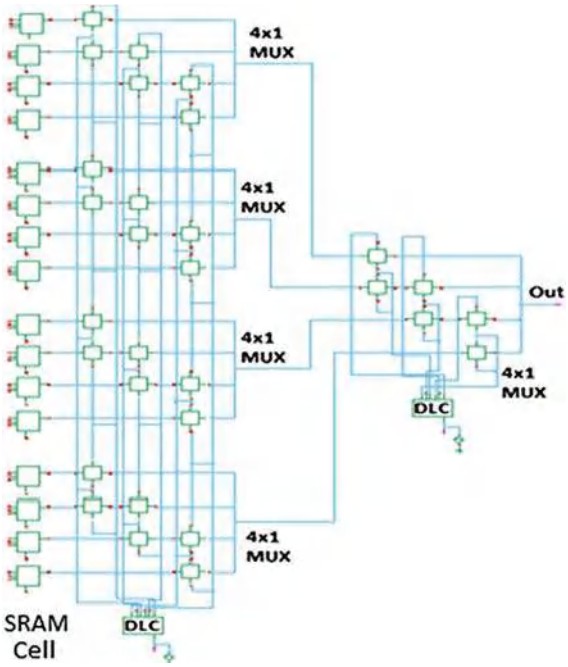

Fig. 5 Quaternary look-up table using SRAM

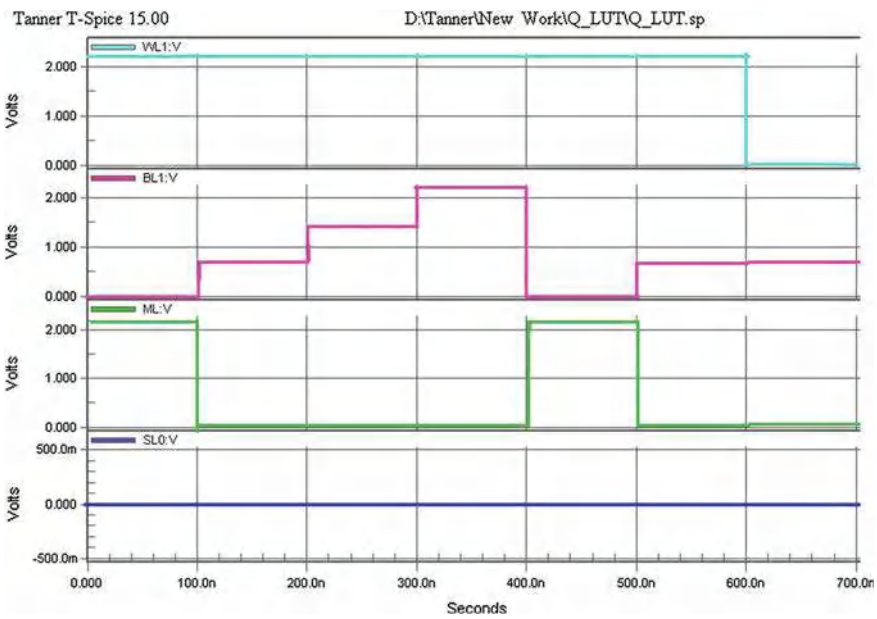

Fig. 6 Simulation result for QLUT

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3.4 Working of Quaternary LUT Using Content Based Searching Method

Figure 7 shows a block diagram of a CAM-based LUT. A search word is given to search lines which are compared with the data in Quaternary CAM Cell having compares circuits. The compare circuit includes two paths between the match line and ground terminal. CAM circuit consisting of a single pull-down transistor coupled to the stored data value in response to a search value. In this design the data is stored in the back-to-back connected inverters that act as storage cell, same as in QSRAM. For the comparison logic, the data stored in QCAM cell, Q (node 1) and its complement, QB (node 2) are compared with the search line data, SL and its complement (SLB). This logic gives successful results for the match and mismatch condition. CAM provide search operation along with read and write operation which reduces the overheads of hardware used for search operation (Fig. 8).

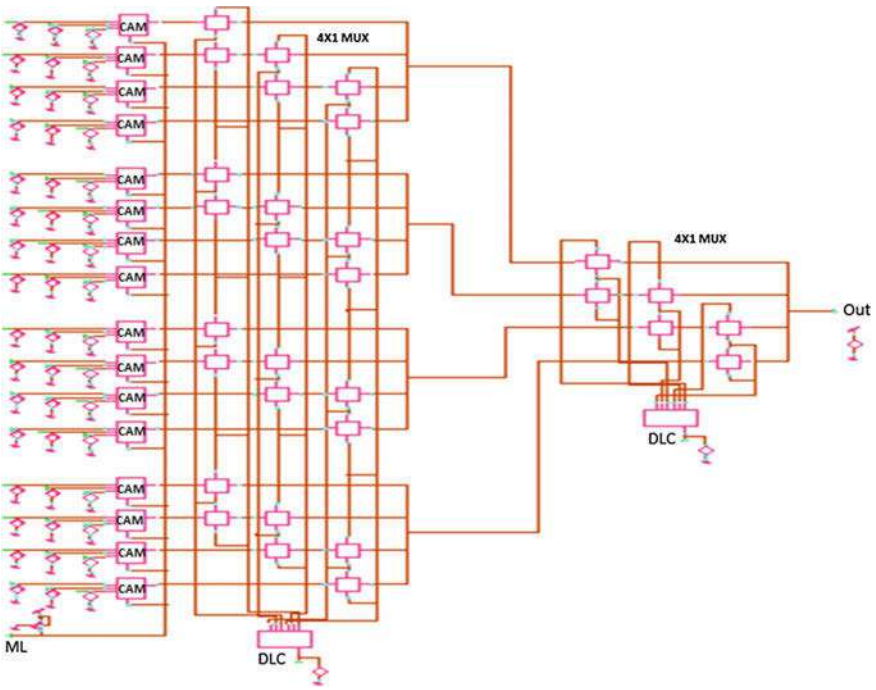

Fig. 7 Content search-based LUT design

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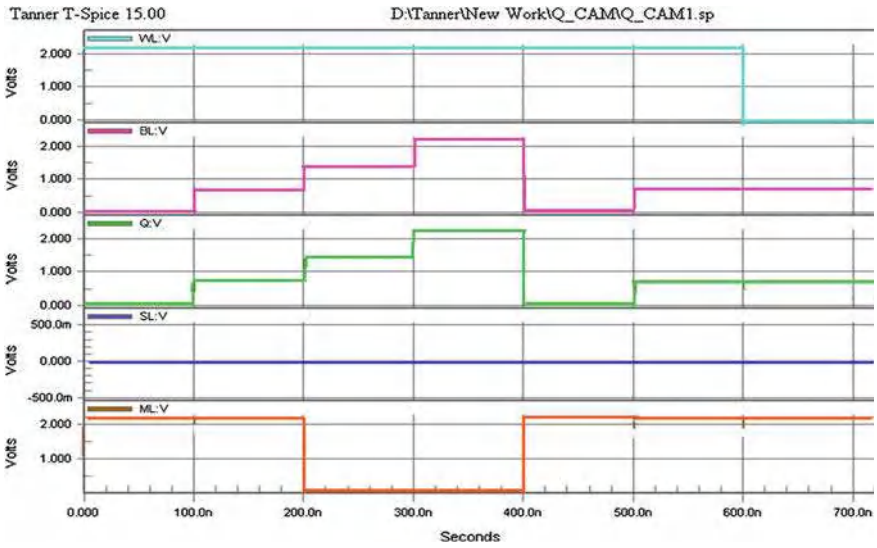

Fig. 8 Simulation result of QLUT using content search method

4 Capacitance and Power Calculations

4.1 Estimation of Input Capacitance

The input capacitance of QLUT is estimated by summing the gate capacitances connected to input under consideration [8],

$$\text{Cin} = \sum_{i=0}^{n} \text{Cgate},\ i \tag{4}$$

The Cgate for a transistors can be calculated as below,

$$\text{Cgate} = \text{Cox} \sum_{i=0}^{n} (\text{WL})i \tag{5}$$

Cox is capacitance per unit of square area (Cox = εox/tox, where tox is the oxide thickness). For cmos process 180 nm technology, tox is around 4.1 nm. Cox = εox/tox = 3.85 * 8.85 × 10^{-12} Fm / 4.1 × 10^{-9} m = 8.31 fF/μm^2 Cgate = 8:31 fF/μm^2 * 12:0672 μm^2 = 10:08 fF.

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4.2 Estimation of Output Capacitance

4.2.1 Cov-Gate to Drain Overlap Capacitance

$$\text{Cov} = \text{Cgdo} * W \tag{6}$$

Cgdo is a SPICE parameter. For an NMOS transistor in cmosp180 nm, Cgd0 = 3.665×10^{-10} and for a PMOS transistor in cmosp18, Cgdo = 3.28×10^{-10}. Thus for a minimum sized device with W = 0.22 μm, Cov = 1.5×10^{-10} fF or Cov = 07 fF, where an average between NMOS and PMOS devices has been used.

4.2.2 Cjb Junction to Body Capacitance

$$Cjb = \left(W \cdot \frac{D}{\text{VDD}}\right) \int 0^{\text{VDD}} \left\{ \frac{CJ0}{\left[1 + \frac{Vj}{Vb}\right]^{mj}} \right\} \text{d}Vj \tag{7}$$

Vj is drain/source to body junction voltage, *Vb* is the built-in voltage of any junction, *mj* is grading coefficient [8, 4, 9]. *D* is given as length of the drain/source contact. Here VDD = 2.2 V and taking an average between PMOS and NMOS devices, the integral evaluates to 5.2×10^{-4} F/m^2 * *W* * *D*. For a minimum sized device of *D* = 0.48 μm and W = 0.22 μm, Cjb = 1.56 fF.

4.2.3 Drain Sidewall Capacitance Cjsw

$$Cjsw = ((W \cdot 2D + W)/\text{VDD}) \int 0^{\text{VDD}} \left\{ \frac{\text{CJsw0}}{\left[1 + \frac{Vj}{Vb}\right]^{\text{mjsw}}} \right\} \text{d}Vj. \tag{8}$$

Cjsw0 = 2.3×10^{-10} F/m^2, VDD = 2.2 V, the integral in Eq. 8 evaluates to Cjsw = 1.2×10^{-10} fF/m^2 (2*D* + *W*). Cjsw = 1. 092 Ff.

Summing all capacitances it comes out to be

Load Capacitance is CL = Cin + Cov + Cjb + Cjsw = 0.7 pF.

Dynamic Power at 1 MHz frequency is Pdyn = CL * Vdd^2 * Freq.

Pdyn = 47 uW.

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4.3 Read/Write Ratio of QCAM Cell

a. For analysis it is found that Power dissipated $_{=}$ 128.34 μW for read operation and match found entries and D_{ynamic} = 131.99 μW for write operation. The ratio for the same is = 0.97.
b. So, read operation for QCAM cell consumes approximately 9 % less power than write when match is found during search operation.
c. For read mismatch the Power dissipated D_{ynamic} = 142.326 μ, Ratio = 1.07.
d. During first mismatch Power dissipated is high by 10.7 % but further search line operations are disabled to power consumption of later stages are saved.

5 Conclusion

CMOS quaternary logic circuits are designed using multi-threshold circuit and quaternary power lines. 16 × 1 QLUT circuit have been simulated using Tanner tool at 0.18 μm technology. QCAM works properly on 4 stable states defined for Quaternary Logic under storing, searching operation. Cross-coupled stages properly defines mismatch and match operations. Propagation delay of QSRAM is lessened by 75 % and static power dissipation is reduced by 40 % and propagation delay of QLUT is reduced up to 29.71 %. On comparing propagation delay of BLUT and QLUT by connecting capacitive load of 100, 400 and 500 fF. It is found that delay of QLUT is reduced by 14.33 %, 22.08 % and 23.53 % respectively. For 1000 fF load capacitance, delay of QLUT is reduced by 29.71 %. Such circuits can be used for modern routers which can store routing tables and need very fast lookups than conventional SRAM based routers.

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Exhaust Gas Emission Analysis of Automotive Vehicles Using FPGA

Ratan R. Tatikonda and Vinayak B. Kulkarni

Abstract This paper presents the exhaust gas emissions analysis of automotive vehicles which is a quick and accurate way to determine the running conditions of an engine. The main aim of the paper is intended to read the data from Sensors such as Oxygen and Carbon monoxide (CO) interfaced to FPGA board to get emissions gas information and to carry out its analysis. The Xilinx ISE timing simulation along with MATLAB waveform results are presented. The final observed concentration for CO gas detection is found to be 287 ppm. The basic principles regarding why and how exhaust analysis carried out is briefly discussed for better understanding along with different methods of gas analysis. This is a very effective reason for designing such a safety system.

Keywords Sensors · Oxygen · Carbon monoxide (CO) · FPGA

1 Introduction

Analysis is one of the important factor in present day life for all aspects whether it be automobiles or any kind of applications, without which the results are not confirmed and as such needed more work and research. The problem of air quality has reaching to an increasing level if taken into account developing country like India. Due to this, proper monitoring and analysis is to be carried out for the excess gas emissions [1]. The main aim of the paper is carry out analysis using FPGA tool and sensors.

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Three main reasons for exhaust gas analysis are: First is to identify mechanical problems and engine performance and second is to test the running efficiency of the engine and the third one is exhaust emissions test for against federal standards and state. Analysis can be done by using external rugged portable analyzer or by using different sensors available in industry for measuring the gas contents in the exhaust pipe. The different methods of measurement required to done for analysis are by Exhaust Gas constituents, Gas Analysis, Conductivity Methods of Analysis and Combustion Methods of Analysis. Exhaust gas is emitted from the exhaust pipe of the vehicle due to the combustion (burning) of fuels such as petrol, natural gas and diesel. FPGA is being used as an intermediate for gas analysis with use of different sensors like Oxygen sensor and Carbon Monoxide (CO) sensor. The use of other previously used portable gas analyzers is not taken into account in this paper because the world is moving to green environment and in future days there will be existing electronic devices for measuring, monitoring and analysing the different application factors [2, 3].

2 Methods of Exhaust Gas Analysis

There are various methods of measurement of exhaust gas analysis of which each is described below.

2.1 Constituents of Exhaust Gas

The exhaust gases composition from the burning of fuels in an internal ignition engine is quite modifiable, which depends to some expanse upon the operation characteristics, but to a greater expanse upon the quantity of air provided per unit of burned fuel. When a large surplus of air is supplied, the fuel hydrocarbons are completely converted to water (H_2O) and carbon dioxide (CO_2), and some oxygen emerge in the analysis. The nitrogen (N_2) present in the air used for burning is passed through the action of combustion which is not changed and so emerges in the final products. When the air to fuel proportion is minimized, the Carbon combustion is incomplete and carbon monoxide (CO) emerges. Similarly, the hydrogen (H) combustion to water is not complete and free hydrogen is present in the products of exhaust. Since, water made gas analyses, the water vapour is generated by the burning of H_2 which is not appeared in the analysis. In general, a full gas analysis will result the constituents such as CH_4, N_2, O_2, CO_2, CO, H_2 [4].

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2.2 Conductivity and Combustion Method of Analysis

The mixture of gaseous analysis by virtue of contrast in the thermal conductivity of the constituents has presented a great attention. Not all gaseous mixtures confer themselves to this type of analysis. Where high thermal conductance gases such as helium or hydrogen are present, however, even in small quantity, there outcomes an appreciable contrast in the conductivity as compared to air or overall thermal conductivity [4].

On the rich side of a theoretically perfect mixture, considerable quantity of combustible gases is present. The quantity of such gases (CO, CH_4, H_2) increases as the mixture becomes richer and this factor has been utilized as a basis for instruments that determine the liberated heat and burn the residual combustible. The combustion is attained by disclosing air along with the exhaust gases and afterwards burning the combustible catalytically upon the surface of a warm platinum wire or a mass catalyst. In either case, the temperature increase gives the quantitative indication [4, 5].

3 Emission Standards

The emission standards are instituted by the Indian Government to control the output of air pollutants from internal combustion engine equipment, including motor vehicles. The exhaust emission limits must be known to keep the vehicle under normal conditions. Below is the table which shows the CO concentration in g/km for 2 and 4 wheeler gasoline vehicles with respect to year's progress (Tables 1 and 2).

In above table Stage BS means Bharat Stage emission standards [6]. As per the results discussed below in next topic it is shown that concentration of CO is measured in ppm (parts per million) and the emission standards are in g/km. Below Eq. (1) is the conversion from ppm to g/km [7].

$$\mathrm{CO(g/km)} = 9.66 \times 10^{-3} \times \mathrm{CO\,(ppm)} \tag{1}$$

The CO concentration for 287 ppm in g/km is 2.77 by calculating using above equation which is excess than the limits mentioned in table above as per the present year to be taken in consideration.

Table 1 Emission standard for 2-wheeler gasoline vehicles (g/km)

Year	Stage	CO
2000	BS I	2.0
2005.04	BS II	1.5
2010.04	BS III	1.0

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Table 2 Emission standard for 4-wheeler gasoline vehicles (g/km)

Year	Stage	CO
2000	BS I	2.72–6.90
2005	BS II	2.2–5.0
2010	BS III	2.3–4.17
2010	BS IV	1.81–2.27

4 Sensors

The different sensors used for exhaust gas emission measurement are Oxygen (O_2) sensor and Carbon monoxide (CO) sensor. The description of these sensors is taken into account below.

Oxygen (O_2) sensor is one of the important sensors in this system which is mounted in the exhaust manifold to check unburned oxygen in the exhaust which tells the system computer if the fuel mixture is burning rich referred as (less oxygen) or burning lean referred a (more oxygen). The O_2 sensor used in vehicles is a voltage generating sensor [8].

CO sensor: When the vehicle with the doors closed is entrapped in a traffic signal or in a traffic jam, the emission of CO from the exhaust of other nearby vehicles will be easily hauled into the vehicle cabin which creates the major tragedy to the persons inside the cabin. The system has a sensor which identifies the presence of CO gas inside the vehicle cabin. A CO sensor is a device that detects the presence of the CO gas in order to stop the poisoning from CO. MQ-7 CO gas sensor is mounted on the vehicle, which will be giving automatic update of the status of the vehicle continuously. So, we can easily detect the excess gas emission status of the vehicle and prevent the engine and canny the user. Sensitive material of MQ-7 gas sensor is tin Dioxide SnO_2, which with lower conductivity in clean air. It make detection by method of cycle high and low temperature, and detect CO when low temperature (heated by 1.5 V). The architecture configuration of sensor and is shown below [9].

Structure and configuration of MQ-7 CO gas sensor is shown in Fig. 1 which is made by micro AL_2O_3 ceramic tube. The necessary work conditions provided by heater for work of sensitive components. The enveloped MQ-7 have 6 pin, 4 are used to take ferry signals, and other 2 are used for generating heating current.

The above Fig. 2 is basic test circuit of the sensor with two voltages, heater voltage (V_H) and test voltage (V_C). V_H is used to supply working temperature to the sensor, while V_C used to perceive voltage (V_{RL}) on load resistance (R_L) which is in series with sensor. The sensor has light polarity, so DC power is needed for V_C. For better performance of the sensor, suitable R_L value is needed. The equations for Power of Sensitivity body (P_S) and Resistance of sensor (R_S) are:

$$P_S = V_C^2 \times R_S / (R_S + R_L)^2 \tag{2}$$

$$R_S = (V_C / V_{RL} - 1) \times R_L \tag{3}$$

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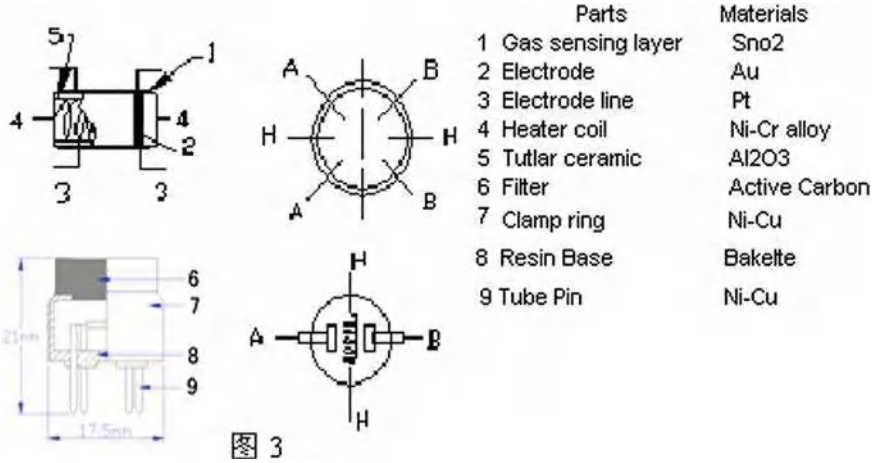

Fig. 1 Architecture of MQ-7 CO gas sensor [11]

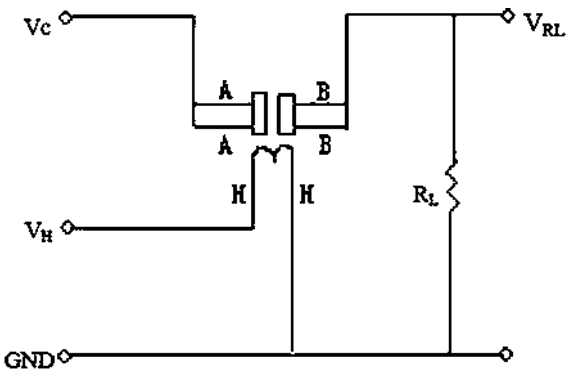

Fig. 2 Basic test loop of MQ-7 CO gas sensor [11]

5 FPGA-Based Exhaust System

The FPGA used for exhaust analysis is device XC3S500E of Spartan 3E family because it meets the high volume and cost sensitive consumer electronic applications. The two reasons for selecting these FPGA is firstly because of its features such as low cost, high performance, embedded processor cores and multi-level memory architecture and secondly because PIC node is a end device and FPGA is Master node to which many end devices can be connected. PIC 16F877A is used as a A-to D converter purpose only because start–stop bit coding in verilog is to be written once for every sensor.

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5.1 System Architecture

The automotive system design is presented below in following figure (Fig. 3).

Two Sensors named Carbon Monoxide (CO) and Oxygen (O_2) sensors are used. The sensors are mounted near by the vehicle exhaust pipe, which sense the emission of gases from exhaust. Sensors are interfaced to PIC microcontroller which is having inbuilt ADC of 10 bit.AC supply of 9 V is applied which rectifies and supplies 5 V to PIC. "Embedded C" code is written with respect to sensors analog voltage. Here only CO sensor consideration is taken into account which gives analog output of 1.5 V to 5 V and CO concentration is represented in 10–10,000 ppm (parts per million). FPGA is interfaced to PIC microcontroller, the processed digital data is then given to FPGA unit. "Verilog" code is written, simulated and dumped in FPGA. LCD displays the concentration of CO gas. MATLAB tool is used to get the analysis of gas which represents in terms of a waveform for different time duration [10]. The simulation results are shown in the next topic.

6 Results

The simulation results for FPGA (Xilinx)-Verilog code timing simulation for UART and MATLAB are shown below (Fig. 4):

The above figure shows the timing simulation for UART reception. The Baud rate set for UART transmission and reception is:

$$\text{Time period} = 1/\text{Baud rate} \tag{4}$$

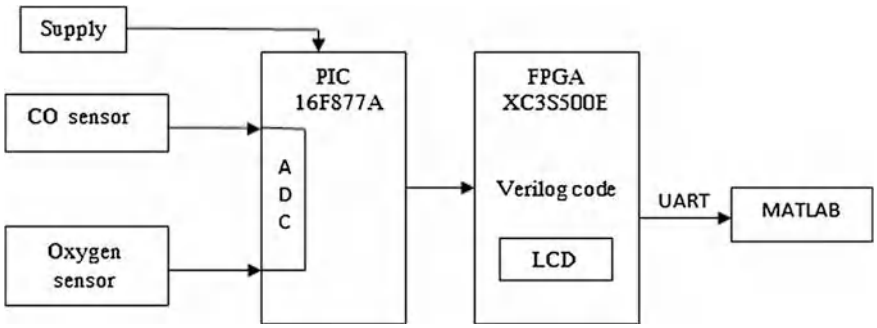

Fig. 3 Block diagram of automotive system using FPGA

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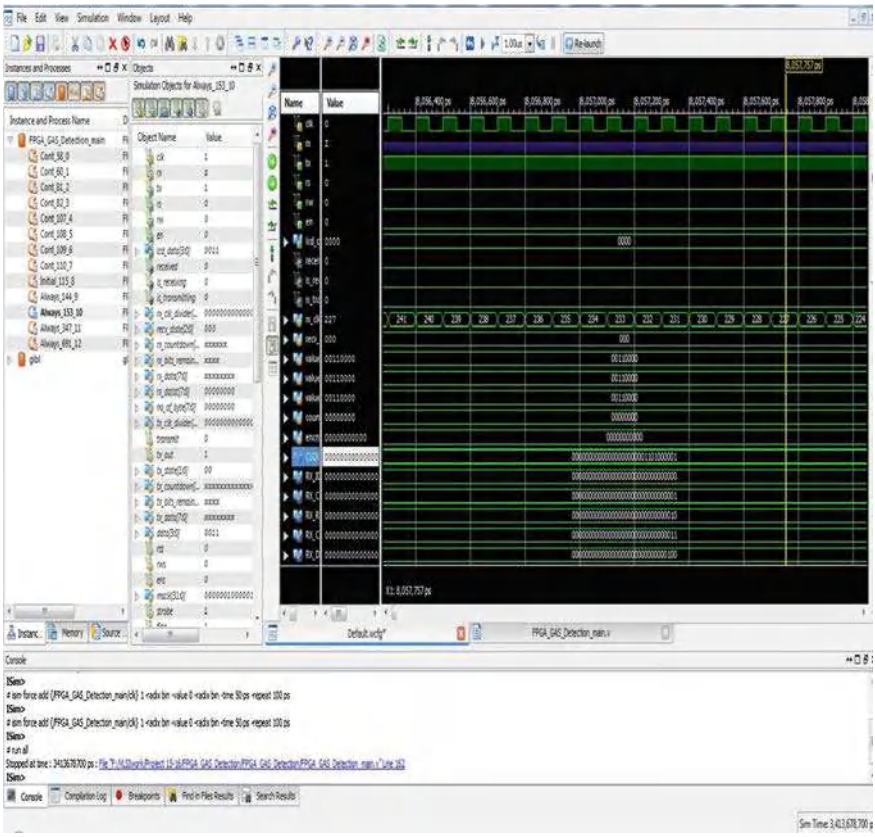

Fig. 4 Xilinx ISE timing simulation for UART reception

Equation 2 shows the time period required according to the baud clock. Hence Time period for 1 bit = 104 µs, since 8 data bit is required for transmission, 1 start bit and 1 stop bit. Therefore total time period for 8 bit to transfer is 104*8 = 832 µs. Input is firstly set to 0 so as to start reception then it is lock till the last bit is received. Sampling time is the important part of UART reception which is set for baud clock and then data is received and is made for better reception to get the required data. The RX buffer helps in reception of data with the help of reception enable signal (Fig. 5).

The MATLAB simulation shows the different levels of CO gas detection with respect to certain time. Y-axis in above figure represents Carbon monoxide in parts per million and X–axis represents the corresponding time duration. 287–CO which displayed in the figure means the last recorded result of CO in parts per million.

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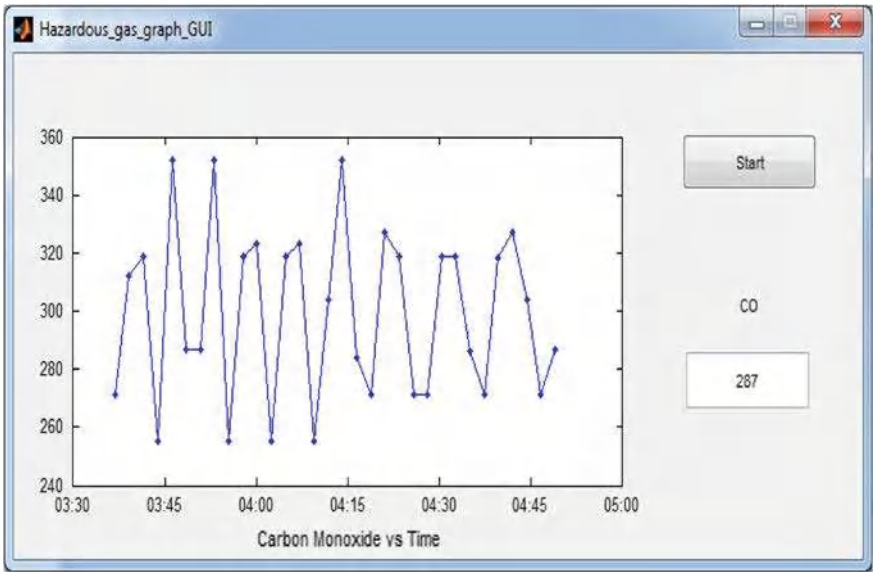

Fig. 5 MATLAB simulation for Carbon monoxide versus Time

7 Conclusion and Future Scope

The exhaust gas analysis methods, automotive system design and results are presented in this paper for efficient and economical checking of levels of exhaust gases from vehicles. Information regarding how exhaust analysis and why it is carried out is also been presented. The system also gives upgraded database for the vehicle that causes excess emission and this database can be used further for applications like vehicle speed control, Vehicle fitness and Pollution control. The emission standards are discussed briefly for excess emission limits. Verilog is used as the design language to achieve the module of UART.

In Future years, the exhaust gas emissions from automated vehicle should be controlled by regular basis checking and by vehicle maintenance analysis to be done per week using the above system design FPGA method and sensors which is to be embedded in a vehicle and from the outcomes the necessary immediate action will be taken.

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A Graph-Based Active Learning Approach Using Forest Classifier for Image Retrieval

Shrikant Dhawale, Bela Joglekar and Parag Kulkarni

Abstract Content-Based Image Retrieval System is comprised of large image collections which find their use in applications such as statistical analysis, medical diagnosis, photograph archiving, crime prevention, face detection, etc. This poses a challenge for pattern recognition techniques used in image retrieval, which require being both efficient and effective. These techniques involve high computational burden in training phase, to separate samples from distinct classes, for active learning. In active learning paradigm, system first returns a small image set. Inference is drawn from this image set based on relevance as per user perception. Hence image retrieval based on context suffers in terms of precision and recall, as retraining and interactive time response is involved. A classifier known as Optimum-Path Forest (OPF) reduces this computational overhead by transforming the problem of classification as a graph obtained from dataset samples in feature space. It involves fast computation of trees built through the forest classifier in a graph resulting from training dataset samples. An optimum path is conquered from least cost approximation of a shortest path through the current prototype sample to the image under consideration.

Keywords Forest classifier · Active learning · Minimum spanning tree · Image retrieval

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1 Introduction

Image Retrieval based on context attempts to retrieve most relevant images in database. Nature of problem is dynamic depending on the relevance inferred. User's perception differs for the similar query image. Such systems usually depend on active learning. In active learning paradigm, system first returns a small set of images and user specifies about the relevance. As large image collections are available for content-based image retrieval system which requires feedback to infer the perception of user, retraining and interactive time response is involved. Existing classifiers such as Support Vector Machine, Artificial Neuronal Network and *k*-Nearest Neighbor take more computation time for big datasets especially in training phase [1]. The problem of computational burden for training is there for above-mentioned classifiers. Although the Support Vector Machine classifier has attained high recognition rate in numerous applications, when training sample set becomes large, its learning becomes improbable due to burden of huge training size over classifier. Other classifiers such as Artificial Neuronal Network, Radial Basis Functions, Self-Organizing Maps and Bayesian classifiers have same problem [2].

A novel approach for pattern classifier based on fast computation of a forest resulting from training samples is addressed in order to overcome such challenges [1, 3]. Optimum-Path Forest can achieve similar effectiveness to above-mentioned machine learning techniques and can be faster in training phase [4]. Content-Based Image Retrieval (CBIR) consists of image database characterized by feature vectors which encodes features of an image such as color, texture, and/or shape. The similarity between images can be a measure of difference between their respective features vectors often called as visual descriptors. For given query image, CBIR System ranks more similar images by comparing their distance from query image. But, a semantic gap exists in retrieved result due to inability of low-level features from an image to meet user's expectations. Existing algorithms fail to precisely relate the high-level concept, or the semantic aspect of image, to lower level content. To minimize the semantic gap, feedback-based learning approach is significant. In typical image retrieval system based on context, user first gives query image and based on similarity measure the small set of images is returned.

The organization of paper is, Sect. 2 provides survey done in similar area, Sect. 3 will give overall idea about the system framework and structural design of project, Sect. 4 presents mathematical modeling, Sect. 5 provides experimental result obtained and Sect. 6 is conclusion.

2 Related Work

The goal of Context-Based Image Retrieval (CBIR) can be divided into two main categories, first one being efficiency and the second one, effectiveness. Efficiency deals with indexing structure involved in CBIR framework where more

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enhancement is possible and there is room for improvement in scalability due to the huge collection of image data set. This can be achieved by techniques such as Principal Component Analysis (PCA) and Clustering and Single Value Decomposition (CSVD) by reducing dimension scale in search space [5]. But to address effectiveness, we need to bridge semantic gap problem. Recently focus is on feedback-based learning, synonymously used for active learning, to figure out composite descriptor which improves ranking of the most relevant images to develop a pattern classifier, responsible for retrieving the most relevant candidates from image database and presenting them to the user [5]. The image retrieval system based on relevance feedback has two approaches, namely, greedy and planned approach [2]. In this paper, greedy and planned image retrieval system based on OPF is discussed. The OPF classification algorithm and two optimization techniques to improve the retrieval process by adding multiple distance spaces called as Multi-Scale Parameter Search (MSPS) and Genetic Programming (GP) algorithms are presented in [5]. Further, many optimizations of OPF have been proposed to speed up classification process [6]. Optimum-Path Forest (OPF) training phase consists of two steps, the first one being Minimum Spanning Tree (MST) generation for detection of prototype nodes, and second is OPF formation. The actual proposed forest classifier optimization method performs both above-mentioned steps simultaneously, that is computation of MST and OPF at the same time, which will further save computational efforts.

3 System Framework

The OPF models the classification problem as a graph obtained from feature space as shown in Fig. 1.

System Architecture, shown in Fig. 2, depicts active learning through Optimum-Path Forest Classifier using feedback technique, which is divided into three modules. In the user interface module, user can give query image for searching as an input. Thereafter, the user will be able to retrieve relevant results and give appropriate feedback. Second module is learning module where feature

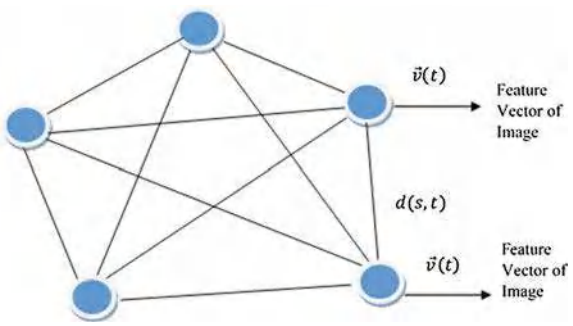

Fig. 1 Image descriptor (v, d)

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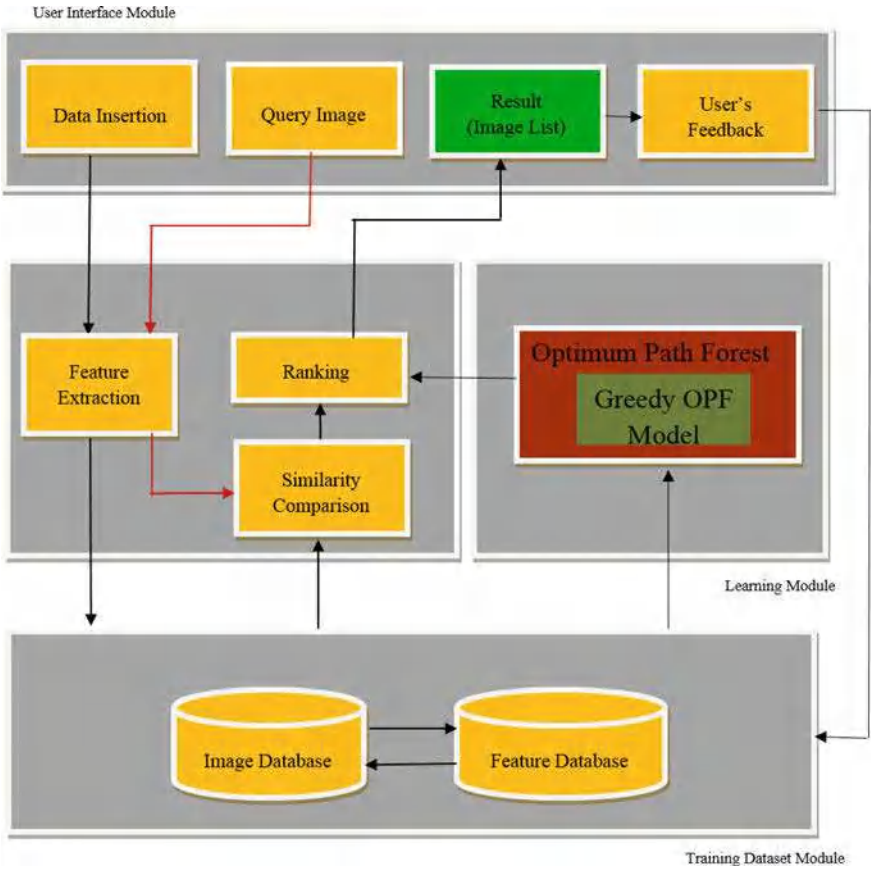

Fig. 2 System architecture

extraction, similarity comparison based on extracted features, image ranking, retraining and learning by OPF classifier takes place. Third module is a database module where all the features extracted from image dataset are saved. The simple descriptor $\mathcal{D} = (\mathfrak{v}, \mathfrak{d})$ shows how nodes are spread in feature space, which is illustrated in Fig. 1. Here $\mathfrak{v}$ is feature extraction function which extracts the features of image and $\mathfrak{d} = (\mathfrak{a}, \mathfrak{b})$ is the distance function between two image representations. In the first iteration, images from database $\mathcal{Z}$ will be returned according to similarity for given query image $\mathfrak{q}$. System simply ranks $\mathcal{N}$ closest image ($\mathcal{Z}$) set from database $\mathcal{Z}(\mathfrak{t} \in \mathcal{Z})$ in the non-decreasing order of $\mathfrak{d} = (\mathfrak{a}, \mathfrak{b})$ with respect to query image $\mathfrak{q}$. Here goal is to return image list $\mathcal{X}$ which has $\mathcal{N}$ most relevant images in $\mathcal{Z}$ with respect to query image $\mathfrak{q}$. Problem is limitation of descriptor $\mathcal{D} = (\mathfrak{v}, \mathfrak{d})$ which fails to represent the users expectation called as semantic gap, such that list $\mathcal{X}$ contains both type of images according to users opinion, i.e. relevant and irrelevant. The Active Learning approach circumvents semantic gap problem. User's feedback

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for the relevancy in returned image set, for a small number of iterations is taken. Here, user marks which images are relevant in $\mathcal{X}$, thereby forming a labeled training dataset $\mathcal{T}$ which increases with new images at each iterations so $\mathcal{T} \leftarrow \mathcal{T} \cup \mathcal{X}$ [5]. We model our OPF classifier on this training set. The process consists of estimating prototypes (adjacent node with different class labels) first and generation of forest as a second step. The training process interprets samples of a training set as a complete graph, which has nodes all from sample image elements of training set $\mathcal{T}$ and arcs between the sample nodes is given by $\mathfrak{d} = (\mathfrak{a}, \mathfrak{b})$. Thereafter, a minimum spanning tree (MST) over underlying graph is formed to obtain prototype nodes [7, 8]. All paths in the graph have a certain cost defined by $f_{\max}$ and minimum cost paths are computed from prototypes to all image nodes of training set $(\mathfrak{t} \in \mathcal{T})$, such that classifier is optimum-path forest rooted in prototype [2].

Thereafter, the classifier is used to evaluate images in the database from prototype to all image nodes $(\mathfrak{t} \in Z/\mathcal{T})$ in incremental manner.

4 Mathematical Modeling

Working of OPF Classifier is transforming the problem of classification in the form of a graph, partitioned in a certain feature space. The nodes of a graph are denoted by feature vector and edges connect all pairs of nodes, thereby forming a fully connected graph. Competition process then partitions the graph, between prototype samples which offer optimum path to left over nodes of the graph [9]. The OPF is a generalization made in Dijkstra's algorithm, to calculate optimum paths from source to remaining nodes [3]. The only difference is that OPF uses a set of source nodes (prototypes) instead of single source node with a more smoothly defined path cost function.

$$\text{Given } Z_1 \cup Z_2;$$

where Z_1 = training set,
Z_2 = test set,
Assume B = Prototype Samples.

An optimum path π with sequence of image samples of terminus $\mathfrak{j}$ can be represented as $\pi_{\mathfrak{j}}$. For each optimum path π, consisting of a sequence of samples, we assign a cost function $f(\pi)$. $f(\pi_{\mathfrak{j}})$ will compute the cost of optimum path for image sequence till terminus $\mathfrak{j}$, such that $f(\pi_{\mathfrak{i}}) \leq f(\pi_{\mathfrak{j}})$ [4, 8, 10]. Smooth path cost function, f_{max}, which is defined as

$$f_{\max}(\langle i \rangle) = \begin{cases} 0 & \text{if } \; i \in B, \\ +\infty & \text{otherwise,} \end{cases} \quad [2, 3, 4, 5]$$

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$$f_{\max}(\prod_i \cdot \langle i,j \rangle) = \max\{f_{\max}\left(\prod_i\right), d(i,j)\}\ [2,3,4,5]$$

The maximum cost of the path will correspond to higher distance value between sample i and j in path, which is a set of adjacent sample of images. OPF consist of two different phases, namely, Training Phase and Classification Phase, further classification consist of fit and predict steps [10], shown in Fig. 3.

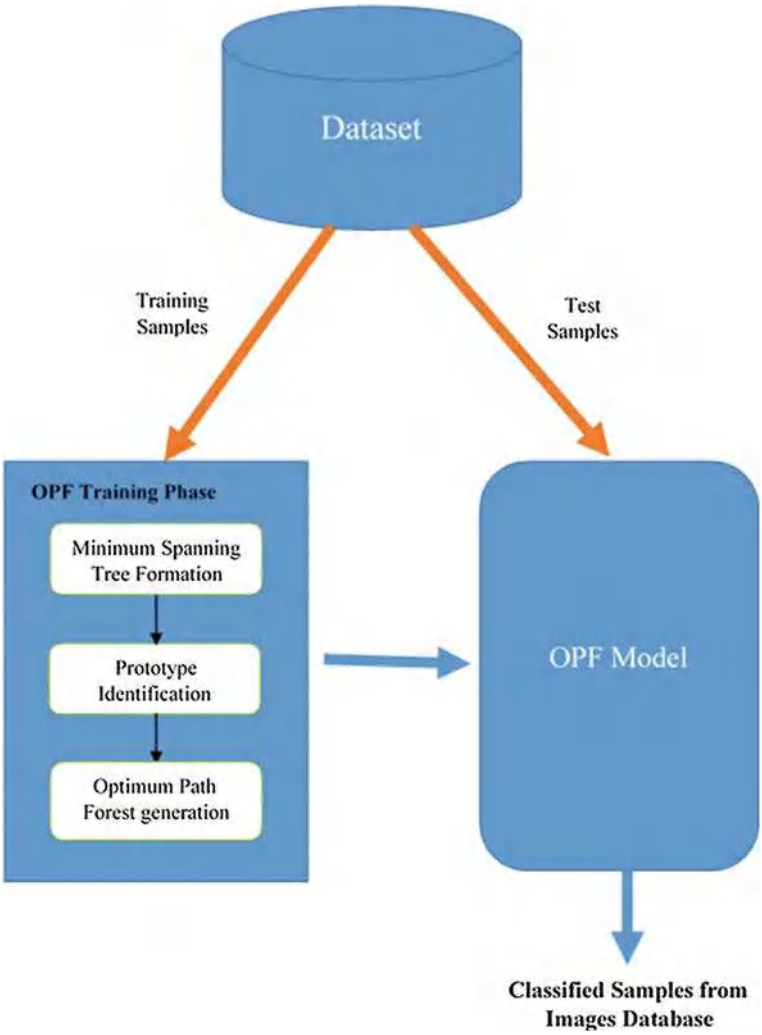

Fig. 3 Optimum-path forest training and classification steps

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4.1 Optimum-Path Forest Algorithm

The input to OPF algorithm is training set T. In our case there are only two classes, $S_R \subset T$ is the set of relevant prototypes which is a subset of training set T and $S_I \subset T$ is the set of irrelevant prototypes and, an image descriptor (v, d).

The outcome of this algorithm is a set $\left(P, C, R, T^{'}\right)$, optimum-path forest ($P$) which is Predecessor Map, Path Cost Map (C), Root Map (R) which will give information about root of image and ordered list of training node (say $T^{'}$).

Priority queue and cost variable (cst), are used as supplementary requisite.

1. *Initialization of image nodes which belongs to training set*
   a. For each image belongs to training set but not prototype ($\mathbf{i} \in T \backslash S_R \cup S_I$)
   b. Set cost of image C($\mathbf{i}$) ← infinity
2. *Initialization of image nodes which belongs to prototype set*
   a. For each image belong to prototype set i.e. $\{\mathbf{i} \in S_R \cup S_I\}$
   b. Set cost of image node $\mathbf{i}$, C($\mathbf{i}$) ← 0
   c. Set predecessor of image node $\mathbf{i}$, P($\mathbf{i}$) ← Nil
   d. Set root of image node $\mathbf{i}$, R($\mathbf{i}$) ← $\mathbf{i}$ (image node itself)
   e. Insert this image node $\mathbf{i}$ into queue Q
3. *Now until queue does not become empty do*
   Remove image node ($\mathbf{i}$) from queue with minimum cost C($\mathbf{i}$) and insert image node ($\mathbf{i}$) in ordered list of training nodes $T^{'}$
   A. For each node which belongs to training node set t ∈ T such that cost of node C($\mathbf{j}$) is greater than cost of node C($\mathbf{i}$) i.e. $\{C(\mathbf{j}) > C(\mathbf{i})\}$, compute cst ← maximum of Cost of image node $\mathbf{i}$, i.e. C($\mathbf{i}$), and distance between node $\mathbf{i}$ and $\mathbf{j}$, i.e. cst ← $\max\{C(\mathbf{i}), d(\mathbf{i}, \mathbf{j})\}$
   B. End
4. End

In classification step, for every image sample that has to be classified from the image dataset but not training set ($\mathbf{j} \in \mathcal{Z}/\mathcal{T}$), the optimum path that has terminus node $\mathbf{j}$ can be obtained by the discovery of which training image node $\mathbf{i}^*$ gives less value in following equation [9],

$$C(\mathbf{j}) = \min_{(\forall \mathbf{i} \in \mathcal{T})} \{\text{Max}\{C(\mathbf{i}), d(\mathbf{i}, \mathbf{j})\}\}$$

Image node $\mathbf{i}^*$ is the predecessor $P(\mathbf{j})$ in the optimum path with terminus image node $\mathbf{j}$, hence image node $\mathbf{j}$ is classified as label of its predecessor node, i.e. label function $\lambda(R(\mathbf{i}^*))$ [1, 4].

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4.2 Complexity Analysis

Consider $Z1$ and $Z2$ as training and test sets respectively having number of samples $|Z1|$ and $|Z2|$ respectively. OPF works in two phases, training and classification. Now consider $|n|$ is the number of sample (considered as vertex) present in the image training set $Z1$ and $|e|$ is the number of edges (arc between vertices given by distance function) in the image training set, represented by graph model of samples [7]. Minimum spanning tree is obtained with the help of Prim's algorithm which requires $O(|e| \log |n|)$ complexity. For finding prototype sets, it requires $O(|n|)$ complexity. OPF runs in $O(|n^2|)$ because of the complete graph obtaining from training samples. Total training phase complexity will be $O(|n| \log |e|) + O(|n|) + O(|n^2|)$, in which $O(|n^2|)$ is dominating factor [7].

The second phase is classification, which evaluates the samples in test set and assigns label to samples. It requires $O(|Z_2| \cdot |n|)$ as $|Z_2|$ is the test set size on which evaluation of OPF will be carried out. An image sample $t \in Z_2$ to which label gets assigned for the classification purpose is connected to all the training image samples (lnl). Therefore, the expected OPF computational complexity is $O(|n^2|) + O|Z_2| \cdot |n|)$.

5 Experiment and Results

Experiment is carried out on Dataset used which is Corel heterogeneous image collection. The average number of marked images per query is N. The experiments were carried out on randomly generated training set $Z1$ and test set $Z2$ for OPF classifier and for different training set sizes. The system is implemented through following screenshots and results obtained are shown below.

As shown in Fig. 4, minimum spanning tree is obtained from underlying graph of training samples through pruning unnecessary nodes so as to reduce the overall complexity involved.

Figure 5, describes the OPF generated through competition process by offering optimum distance. Each prototype conquers the samples most strongly connected to it.

The experiment evaluates the accuracy on dataset. In the experiment, the dataset is divided into two part training set and test set. Figure 6 shows the result obtained by OPF Classifier on increasing number of dataset. The experiments were performed on *Intel® core* I_5 processor with 8 GB RAM. The result proves that OPF is far more accurate in terms of recognition rate and faster in terms of execution time in training phase over huge datasets. The OPF proves to be superior to the sequential random forest in terms of shorter navigation time and reduction in losses. Sequential random forest considers adaptive weight distribution updated in stage-wise growing tree, where the losses are integrated at each level. On the contrary, OPF reduces the navigation time through shortest weighted path. Hence, it

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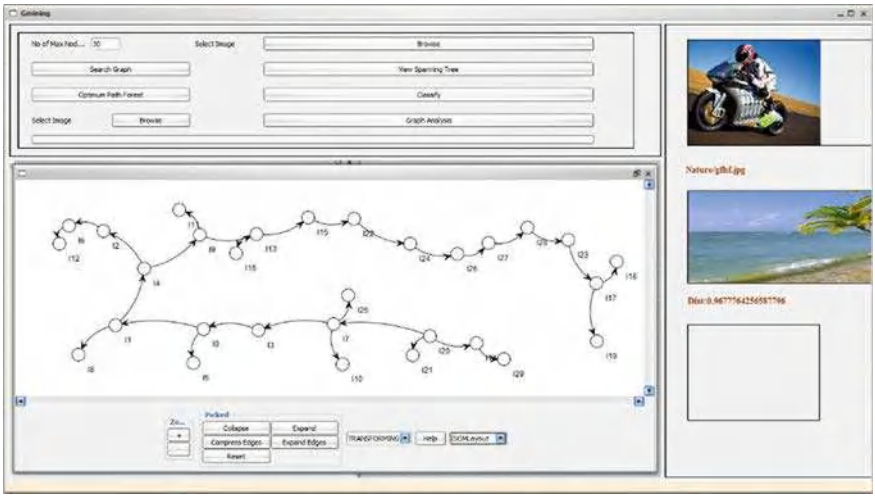

Fig. 4 Minimum spanning tree of graph

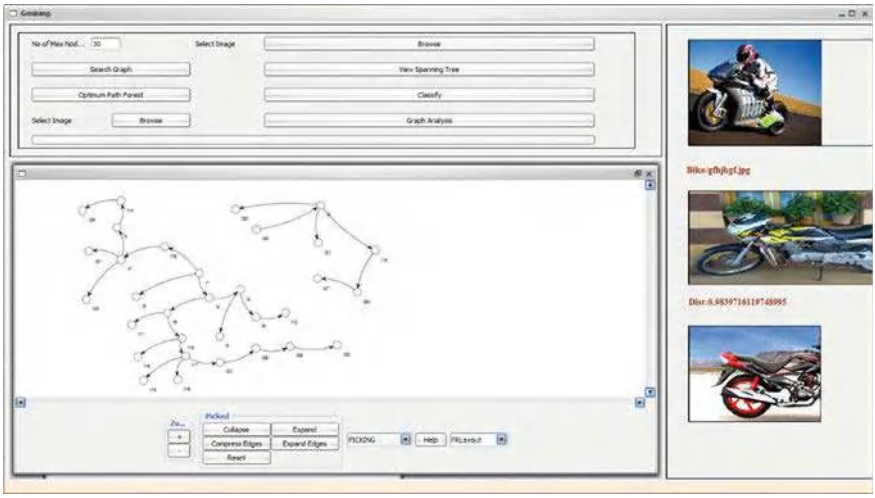

Fig. 5 Optimum-path forest

is clear that OPF can attain greater precision and efficiency for much bigger training set, highly reducing the probability of misclassification. Random Sampling method is not suitable for the said system as it is simple probability sampling technique, used in situation where not much information about the population is available and for a small data size. Here OPF works on huge sample size, hence it is used as classifier for active learning (Table 1).

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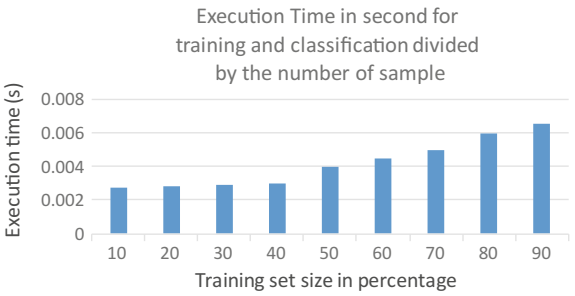

Fig. 6 Efficiency with respect to training set size

Table 1 Optimum-path forest accuracy

No of images in percentage	Percentage accuracy
10	77
20	83
30	85
40	87
50	88
60	90
70	91
80	92
90	94

6 Conclusion

The OPF approach discussed in the paper provides an efficient learning mechanism for large image datasets, for inferring context. The optimum forest emerges from the prototypes resulting out of data samples, which are most relevant to the query. The most important issue of semantic gap in image retrieval domain is reduced through OPF classifier. This is evident from the results obtained for parameters like precision and recall. Also, OPF eliminates probability of misclassification in the training set. The OPF implementation can be extended for larger dataset. Here image database for different datasets is used making total image size of one thousand. Retrieval applications including emotion recognition, face recognition, etc. can be implemented using developed system.

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Comparative Analysis of Android Malware Detection Techniques

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Abstract In recent years, the widespread adoption of smartphones has led to a new age of information exchange. Among smartphones, Android devices have gained huge popularity due to the open architecture of Android and advanced programmable software framework to develop mobile applications. However, the pervasive adoption of Android is coupled with progressively uncontrollable malware threats. This paper gives an insight of existing work in Android malware detection. Additionally, this paper highlights the parametric comparison of existing Android malware detection techniques. Thus, this paper aims to study various Android malware detection techniques and to identify plausible research direction.

Keywords Android · Malware · Signature-based · Machine-learning-based

1 Introduction

Android smartphone operating system has covered 80.7 % of market share worldwide by 2014, retiring its competitor operating systems iOS at 15.4 %, Windows at 2.8 %, BlackBerry at 0.6 % and other OS at 0.5 % [1]. Android adoration has inspired developers to proffer ingenious applications commonly called *apps*. Official Android market Google Play hosts the third-party developer apps for nominal fee [2]. However, enormous acceptance of Android has boosted various Android malwares performing malicious activities [3]. Android malware is a malicious application that transmits sensitive user information to a remote location from the mobile device [4], abuses the telephony service to extract monetary benefits [5] and exploits platform vulnerabilities to gain smartphone control [6].

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Android malware includes SMS Trojans, backdoor, worm, botnet, spyware, aggressive adware and ransomware [7–9].

As malicious activities are committed in the background, user is unaware of these activities [10]. To address this issue, numerous schemes have been proposed by Android security researchers from both academia and industry [11, 12]. Android malware detection techniques can be classified into signature-based detection approach and machine-learning-based detection approach [3]. Signature-based detection approach detects malware by signature matching [13]. Commercial anti-malware solutions use signature-based detection approach for the sake of simplicity and implementation efficiency [14]. Machine-learning-based detection approach trains machine-learning algorithms with the help of noted malware behaviour and identifies unknown and novel malware [13].

This paper aims to make survey of existing Android malware detection techniques. Moreover, we highlight the parametric evaluation of these Android malware detection techniques.

The rest of the paper is structured as follows. Section 2 discusses different Android malware detection techniques. The parametric evaluation of Android malware detection techniques is presented in Sect. 3. Finally, Sect. 4 concludes with a discussion of future research directions in this area.

2 State-of-the-Art

This section gives a detailed description of various Android malware detection techniques based on different approaches. Android malware detection approaches can be classified into signature-based detection approach and machine-learning-based detection approach [3].

2.1 Signature-Based Detection Approach

Signature-based detection approach detects malware by regular expression. Regular expression consists of rules and policies. Various techniques using this approach to detect Android malware are as follows.

2.1.1 Isohara et al.

Isohara et al. [15] implement a system consisting of a log collector in the Linux layer and a log analysis application to effectively detect malicious behaviours of

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unknown applications. Log collector notes system calls from process management activity and file I/O activity. Log analyzer selects process tree of interested application's activity to remove log data of uninterested process. Signature is described by regular expression and 16 patterns of signature are generated for evaluation of threats including information leakage, jailbreak and abuse of root. The discussed prototype system is evaluated on 230 applications in total to effectively detect malicious behaviours of the unknown applications.

2.1.2 DroidAnalytics

Zheng et al. [16] propose DroidAnalytics that automates the process of malware collection, signature generation, information retrieval and malware association. DroidAnalytics implements application crawler to perform regular application downloads. Dynamic payload detector determines malicious trigger code and traces downloaded file behaviour. DroidAnalytics uses *three-level* signature generation scheme and generates signature at method, classes and application level. DroidAnalytics can detect zero-day repackaged malware. Efficacy of DroidAnalytics is demonstrated using 1,50,368 Android applications and successfully determining 2,475 Android malwares from 102 different families.

2.1.3 APK Auditor

In [17], Talha et al. develop a static analysis system APK Auditor that uses permission feature for classification of benign and malicious applications. APK Auditor consists of signature database, Android client and central server. APK Auditor signature database is a relational database that stores the results of analyzed Android applications. APK Auditor client is an application installed on the system that communicates with the central server through web service. APK Auditor central server accesses signature database and manages malware analysis process. To test system performance, 1,853 benign applications and 6,909 malicious applications, 8,762 applications in total, were collected and analyzed.

2.2 Machine-Learning-Based Detection Approach

Machine-learning-based detection approach trains machine-learning algorithms based on noted malware behaviour. This approach detects anomalies, which is

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essential to discover new malware. Various techniques using this approach to detect Android malware are as follows.

2.2.1 DroidMat

Wu et al. [13] present static feature-based mechanism DroidMat for detecting the Android malware. DroidMat extracts information including permission, deployment of components, Intent messages passing and API calls for characterizing the Android applications behaviour. It applies *K*-means algorithm that uses *Singular Value Decomposition* (*SVD*) method on the low rank approximation to decide the number of clusters. Finally, it uses kNN algorithm with $k = 1$ to classify the application as benign or malicious. Total 1,738 applications, comprising of 238 malware applications and 1,500 benign applications, were collected to evaluate the system.

2.2.2 Crowdroid

In [18], Burguera et al. propose Crowdroid for dynamic analysis of application behaviour and detection of Android malware. Crowdroid is a lightweight client that monitors system call and sends it to remote server. Remote server parses the data and creates a system call vector. Finally, *K*-means partitional clustering algorithm is used to cluster dataset with known value of $k = 2$ as input parameter. This system is analyzed using artificial malware created for test purposes and real malware found in the wild.

2.2.3 Yerima et al.

Yerima et al. [19] present an effective Android malware detection approach using Bayesian classification method. Java-based Android package profiling tool is implemented for automatic reverse engineering of the APK files. After reverse engineering an APK, a set of detectors including *API call detectors, Command detectors* and *Permission detectors* are applied to check properties and to map them into feature vectors for the Bayesian classifier. Feature ranking and selection reduces feature while the training function calculates the probability of feature occurrence in malicious and benign applications. The set of 2,000 applications of

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different categories, comprising of 1,000 malware applications and 1,000 benign applications, were made up in order to cover a wide variety of application types.

2.2.4 Samra et al.

In [20], Samra et al. apply *K*-means clustering algorithm for Android malware detection and use machine-learning algorithm for automatic detection of malware applications. Proposed system extracts the permission requested by the application. ARFF file is prepared from extracted features and WEKA (Waikato Environment for Knowledge Analysis) tool is used to train *K*-means clustering algorithm. While training, the clustering algorithm identifies two clusters and assigns an application to a cluster having the minimum distance from the centroid of clusters. To test system performance, 4,612 business applications and 13,535 tools applications, 18,174 Android applications in total, were evaluated.

2.2.5 Android Application Analyzer (AAA)

Almin and Chatterjee [21] propose a system for analyzing and removing harmful applications using clustering and classification algorithms. For classification purpose, the analysis of the applications is done based on permissions requested by the applications. In this system, *K*-means clustering algorithm is used to create malicious clusters based on some known families of malicious applications. Then, Naïve Bayesian classification algorithm is used to classify applications as benign and malicious. The DogWar, ICalender and SuperSolo samples of malicious applications are used for testing.

3 Parametric Evaluation

In case of Android application, features consist of elements such as permission, java code, certification, system call, API call, etc. should be considered for the purpose of application classification. These features can be divided into static, dynamic and hybrid. Based upon the selected features, the technique can be further classified into static analysis technique and dynamic analysis technique. Furthermore, feature selection leads to more accurate results and removes noisy and irrelevant data. Parametric evaluation of the discussed detection techniques is described in Table 1.

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Table 1 Parametric evaluation of android malware detection techniques

Technique	Detection approach	Analysis	Features	Clustering algorithm	Classification algorithm	Type of applications in dataset	Number of applications in dataset
Isohara et al. [15]	Signature-based approach	Dynamic	System calls	–	–	Benign application and malware application	230
DroidAnalytics [16]	Signature-based approach	Static	API calls	–	–	Benign application and malware application	150368
APK auditor [17]	Signature-based approach	Static	Permission	–	–	Benign application and malware application	8762
DroidMat [13]	Machine-learning-based approach	Static	Permission, deployment of component, intent, API calls	*K*-means algorithm, EM algorithm	kNN algorithm, naïve Bayesian algorithm	Benign application and malware application	1738
Crowdroid [18]	Machine-learning-based approach	Dynamic	System calls	*K*-means algorithm	–	Self-written malware and malware application	–
Yerima et al. [19]	Machine-learning-based approach	Static	API calls, command, permission	–	Bayesian algorithm	Benign application and malware application	2000

(continued)

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Table 1 (continued)

Technique	Detection approach	Analysis	Features	Clustering algorithm	Classification algorithm	Type of applications in dataset	Number of applications in dataset
Samra et al. [20]	Machine-learning-based approach	Static	Permission, XML-based features	*K*-means algorithm	–	Business application and tools application	18174
Android application analyzer [21]	Machine-learning-based approach	Static	Permission	*K*-means algorithm	Naïve Bayesian algorithm	Malware application	–

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4 Conclusion and Future Work

As discussed, Android malware detection techniques can be classified into Signature-based detection approach and Machine-learning-based detection approach. Techniques based on Signature-based detection approach require frequent updates to detect new malware. Small modification in a malware generates varying malware that can easily bypass the existing signature database matching process. More time is required by Signature-based detection approach for larger signature database. Finally, it is only capable of detecting malwares which are included in signature database. However, Machine-learning-based detection approach overcomes the limitations of signature-based detection approach by quickly detecting novel or unknown malware from the behaviour of known malwares without frequent updates.

Future work may include devising a more efficient technique based on Machine-learning-based detection approach that considers more features. Moreover, various feature selection methods can be applied to reduce feature set and to consider the most efficient features. Finally, various clustering and classification algorithms can be used to improve the modelling capability.

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Developing Secure Cloud Storage System Using Access Control Models

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Abstract Access control model-based security plays very crucial role in security. Cloud computing is one of the emerging and challenging fields. In the implementation explained in this paper, issues related with cloud security are tried to resolve to some extent using access control model security. Encryption, also being part of access control-based model, also incorporated for better security. Role-Based Access Control (RBAC) model along with AES–RSA encryption algorithm is implemented to achieve efficient security. The main aim of this work is to design a framework which uses the cryptography concepts to store data in cloud storage and allowing access to that data using role perspective with the smallest amount of time and cost for encryption and decryption processes.

Keywords Access control model · RBAC · AES · RSA · Cloud

1 Introduction

Cloud computing is amongst the emerging, required and promising field in the area Information Technology. It provides services to a customer over a network as per their requirements. Third party owns the infrastructure and provides the cloud computing services. It offers the organizations to adopt IT services with minimum cost. Cloud computing has a number of benefits but the most organizations are worried for accepting it due to security issues and challenges that are with cloud. With the third party cloud storage, we may lose control over physical security. In a public cloud, an organization does not have information about where the resources

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are stored, run and who manages them. There are many organizational and distributed aspects that need to be solved at enterprise level. One of the security requirements is to design such models that solve such aspects for the information security at the enterprise level. Such models need to present the security policies intended to protect information against unauthorized access and modification stored in cloud. This work describes a logical approach to modeling the security requirements according to the job functions and work performed in an organization. In this work, we combined two algorithms RSA and AES for securing data, and role-based access control model is used to provide access according to role perspective [1].

The cloud computing provides three main services, Information as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (Saas). It reduces the cost of hardware required to store data that could have been used at user end. Instead of purchasing the infrastructure that is required to store data and run the processes we can lease the assets according to our requirements. The cloud computing provides the number of advantages over the traditional computing and it include: quickness, lower cost, scalability, device independency and location independency. Security in cloud computing is one of the most critical aspects, owing to importance and sensitivity of data on the cloud. But many major issues as data security, user access control, data integrity, trust and performances issues exists for the cloud. In order to solve these problems, many schemes are proposed under different systems and security models [2–6].

Whenever security of cloud computing is concerned, there are various security issues related to the cloud. Some of these security problems and their solutions are described here. Due to sharing, computing resources with another company physical security is lost. User does not have knowledge and control of where the resources run and stored. It can be insured using secure data transfer. Second, maintaining the consistency or integrity of the data. It can be insured by providing secure software interfaces. Third, privacy rights may be violated by cloud service providers and hackers. It can be ensured using cryptographic technique. Forth, when cryptographic technique was used, then who will control the encryption/decryption keys? It can be ensured by giving rights to the users/customers. So implementing security in cloud computing is a must, which will break the difficulty of accepting the cloud by the organizations. There are varieties of security algorithms which can be implemented to the cloud. There are two types of algorithms; symmetric key and asymmetric key. DES, Triple-DES, AES and Blowfish are some symmetric algorithms that can be used to implement cloud security. RSA algorithm is an asymmetric algorithm that can be used to generate encryption and decryption key for symmetric algorithms. In cloud computing, both symmetric-key and asymmetric-key algorithms are used for encryption and decryption. In the presented work, RSA algorithm is used to generate encryption and decryption keys for AES symmetric algorithm.

Another major issue is how to manage user access to cloud storage system. For that, different access control mechanism can be enforced for cloud users. Access Control is nothing but about specifying rights to the users to deal with any of the

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specific system resources or applications or also any system. There are three access control models, such as MAC (Mandatory access control model), DAC (Discretionary access control model) and RBAC Role-based access control models [7]. These access control models specify the set rules or criteria to access the system and its resources. In MAC, the administrator has all the privileges to assign the user's roles according to his wishes. And end users do not have the authority to change the access policies specified by the administrator; therefore it is very restrictive and a less-used access control model. It can be used in a very sensitive environment. For example, military and research centers. In DAC, the end users have authority to change the access policy for its own objects. In RBAC, first different roles or jobs can be specified and then these roles can be assigned to cloud user so these users can get access according to their jobs requirement. It is effectively and mostly used access control model within an organization because access to particular data and resources can be given according to the roles [8, 9]. In the presented work, we used central control of admin to create role and assign user to corresponding roles as in MAC. Each role can access the objects for which they have the access and it cannot be changed by other user, as in DAC. All rules and access are governed and controlled by roles of the system as in RBAC model [10]. Along with basic access control models as MAC, DAC, RBAC, encryption algorithms used as AES and RSA plays crucial role. Why AES and RSA?—is explained below.

2 Methodology

In symmetric-key algorithm, for encrypting and decrypting data, it uses same secret key. In contrast to asymmetric-key cryptography algorithm, symmetric-key cryptography algorithm like AES (Advanced Encryption Standard) is high speed and it requires low RAM requirements, but because of the same secret key used for both encryption and decryption, it faces big problem of key transport from sender side to receiver side. But in asymmetric-key algorithm, it needs two different keys for encryption and decryption, one of which is private key and one of which is public key. The public key can be used to encrypt plaintext; whereas the private key can be used to decrypt cipher text. Compared to symmetric-key algorithm, asymmetric-key algorithm does not have problem while key exchanging and transporting key, but it is mathematically costly [11, 12].

To solve the problem of key transport and get better performance, these two algorithms can be combined together. In this data, receiver generates the key pairs using asymmetric-key algorithm, and distributes the public key to sender. Sender uses one of the symmetric-key algorithms to encrypt data, and then sender uses asymmetric-key algorithm to encrypt the secret key generated by the symmetric-**key algorithms with the help of receiver's public**. Then the receiver uses its private key to decrypt the secret key, and then decrypt data with the secret key. In this paper, asymmetric-key algorithm is used only for encrypting the symmetric key, and it requires negligible computational cost. It similarly works like SSL. For

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encrypting the files or file data, AES (Advanced Encryption Standard) algorithm is used, and RSA (Rivest, Shamir and Adleman) is used to encrypt AES key [11, 12]. These encrypted files can be uploaded according to role perspective. In proposed system, role-based access control is used for authenticating the users to access files uploaded or given rights for the specific roles and to maintain the data privacy and integrity AES and RSA algorithms are used.

General description of AES and RSA algorithms is given below.
AES algorithm starts with an Add round key stage, followed by nine rounds of four stages and a tenth round of three stages. The four stages are Substitute bytes, Shift rows, Mix Columns and Add Round Key. The tenth round does not perform the Mix Columns stage. These stages also apply for decryption. The first nine rounds of the decryption algorithm consist of Inverse Shift rows, Inverse Substitute bytes, Inverse Add Round Key and Inverse Mix Columns. Again, the tenth round does not perform the Inverse Mix Columns stage. [11]. RSA makes use of measured exponential for encoding and decoding symmetric key that is secret key generated by the AES algorithm. Let us consider that S is secret key and C is cipher key, then at encryption $C = S \bmod n$ and at decryption side $S = C \bmod n$. n is very large number which is created during key generation process [11, 12].

In the implemented scheme, the administrator of the system defines different job functionalities required in an organization; then according to the needs of the organization he adds users or employees. After that, owner of the data encrypts the data in such a way that only the users with appropriate roles as specified by a RBAC policy can decrypt and view this data. The role manager assigns roles to users who are appropriate for that role and he can also remove the users from assigned role. The cloud provider (who owns the cloud infrastructure) is not able to see the contents of the data. A role manager is able to assign a role for particular user after the owner has encrypted the data or file for that role. A user assigned to particular role can be revoked at any time in which case, the revoked user will not have access rights to data or file uploaded for this role [13]. Revocation of user from role will not affect other users and roles in the system. This approach achieves an efficient encryption and decryption at the client side.

Our system uses the AES for the function of encrypting and decrypting the data. AES key length used is 128 bits. The main purpose of using this algorithm is for providing more security for data which will be uploaded on the cloud. The system is developed in asp.net. For the public cloud we have taken instance from Microsoft azure and private cloud is created using the Windows Server with i5 processor and 8 GB RAM. The use of latest processor will reduce the response time for uploading and delivering of the data to the owner and user, respectively. The size of the decryption key is another important factor in cloud storage system. The decryption key must be portable as users may use the storage service from different clients [14] (Figs. 1 and 2).

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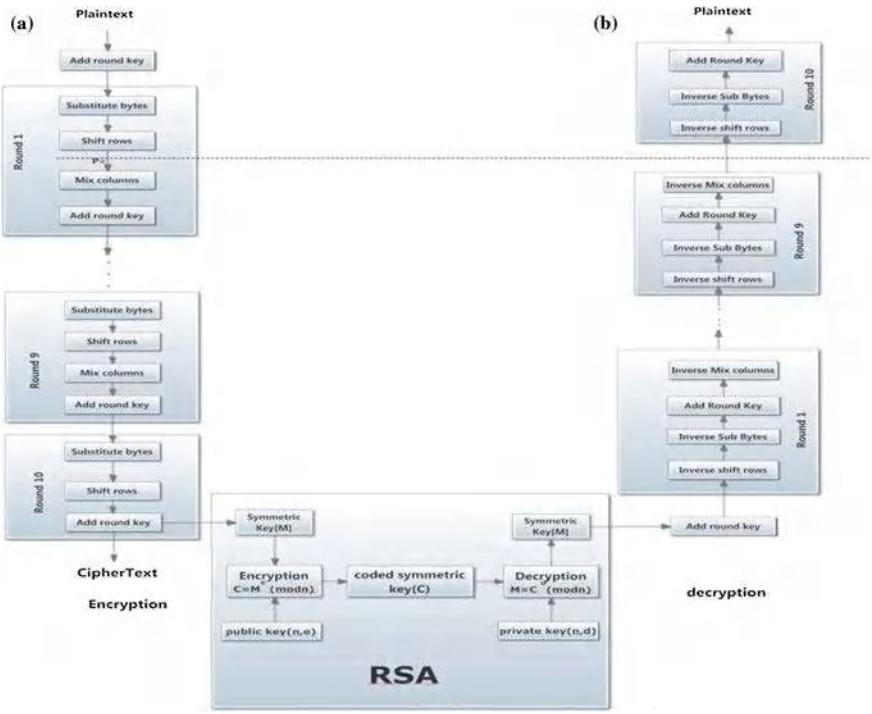

Fig. 1 Flow of encryption algorithm used in implementation

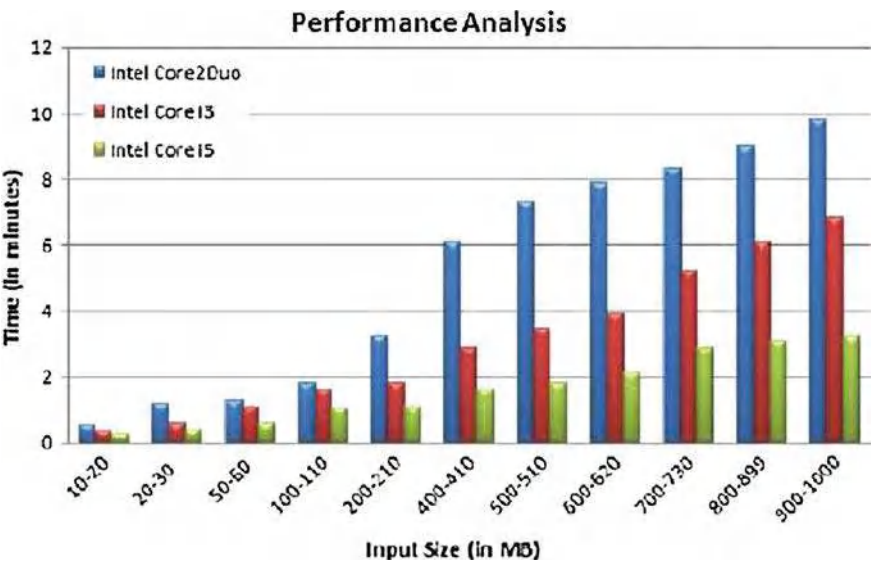

Fig. 2 Performance analysis of AES and RSA on different processor

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3 Performance Analysis of Implemented Scheme

The popular secret key algorithm, AES with RSA was implemented together. Performance of the said algorithm is calculated by applying encryption on different files, which are of different sizes and contents. The algorithm was tested on three different machines (Tables 1 and 2).

3.1 Comparative Analysis of Different Cryptographic Techniques

In the following table, it shows the performance of cryptographic algorithms in terms of encryption time. Here, it compares the time for encryption of DES, AES, AES and RSA algorithm on different packet size on i3 system having 2 GB RAM. AES gives better security but AES uses same key for encryption and decryption. To solve this issue, two cryptographic techniques such as AES and RSA integrated together requires more time than AES but gives higher security. In integrated AES-RSA approach, RSA is used to encrypt key used in AES. This is an additional task introduced in AES. So in integrated AES-RSA approach, it requires more time than AES.

Table 1 Testing result of implemented scheme on different platforms

Input size (MB)	Intel Core2 Duo	Intel Core i3	Intel Core i5
10–20	0.56	0.36	0.26
20–30	1.2	0.58	0.41
50–60	1.3	1.1	0.58
100–110	1.8	1.6	1.05
200–210	3.2	1.8	1.1
400–410	6.1	2.9	1.6
500–510	7.3	3.45	1.8
600–620	7.9	3.9	2.1
700–730	8.3	5.2	2.9
800–899	9	6.1	3.05
900–1000	9.8	6.8	3.2

Table 2 Comparative analysis of different cryptography techniques

Input size (KB)	DES	AES	AES and RSA
200	25.0	14.2	16
557	58.2	38.2	52.38
1024	110.0	72.2	99.0
5120	542.3	1362.2	488.1

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4 Conclusion

The main aim of this work is to design a framework, which uses the cryptography concepts to store and access data in cloud storage and allowing access to that data using role perspective. Security approach used in this work is based purely on access control-based models of security.

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ETLR—Effective DWH Design Paradigm

Sharma Sachin and Kumar Kamal

Abstract Prior to start of any data warehouse project, developers/architects have to finalize architecture to be followed during project life cycle. Two possibilities are (a) Use of commercial ETL tool or (b) the development of in-house ETL program. Both options are having merits and demerits. The scope of this article is to optimize the ETL process with retrieval by making use of technology mix and keep in consideration all the factors which are not been considered by ETL tools.

Keywords ETL · ETLR · DWH · Optimization · Big data

1 Introduction

The tremendous digitization of information in recent past, coupled with the growth of processes and transactions, has resulted in a data flooding. Majority of data of any organization is in unstructured form which needs data cleansing while extraction or transformation. The process of extraction of data from source, cleansing and transformation followed by Loading is ETL (Extraction Transformation and Loading) and is integral part of every Data warehouse. Organizations need to study structured and unstructured data for decision-making and future forecasting. The beauty of ETL in data warehouse is (a) extract data from any source like CSV, mainframe data input, excel data, flat files or any other type of

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data (b) clean and transform the data to the required format and (c) Load data to any database/flat files or any other destination in the required format. The tools responsible for this task are called ETL tools.

Available research has only concentrated on designing and managing ETL workflows. Research approaches have focus on standalone problems and problems related to web data only. When it comes to huge data volumes on daily basis which needs to be loaded after cleansing and transformation, it is always a big challenge. When we refer to "huge data volumes", it signifies data in Terabytes/Petabytes which was not common in recent past. Transformation of every industry in terms of digitization motivates organizations to maintain every aspect of data in data warehouse which eventually leads to emerging field of "Big Data Analytics". Not only ETL is a big challenge, there are many bottleneck in data retrieval from destination data source because there needs meta-data processes and various data mining techniques to fetch relevant information out of data warehouse.

Research area in ETL optimization should also include optimization of operating system parameters, storage hardware and its optimization in terms of storage allocation techniques available and storage configuration, optimization of SQL queries during extraction and transformation, use of parallelism, optimizing DBMS parameters, knowledge of staging data source format for best performance, optimization of ETL tools parameters and their configuration, optimizing memory usage during full load of ETL processes, purging policy optimization, network-level optimization, source data optimization, filter required information at source level and optimization of meta-data information. We should focus on optimizing various area of ETL in which ETL tools are not able to handle and optimize data retrieval techniques.

The scope of this research is to optimize ETL process with retrieval and to tune and optimize every sub-area at micro-level, such that data arriving in huge volumes on daily basis can be extracted, transformed, and loaded in time bound manner without the use of ETL tools. This includes optimization of ETL process in all areas where ETL tools were never been worked upon. The research will result in the complete solution for ETL problem with the retrieval in data warehouse which results in reporting of the intended data from data warehouse in highly efficient way. The beauty of the research includes unique combination of techniques of OS and DBMS utilities.

2 Related Work

A data warehouse is "subject–oriented, integrated, time-varying, non–volatile collection of data in support of the management's decision making process" [10]. We make use of customized ETL process or ETL tools to build a data warehouse. Majority of commercial ETL tools work on application layer and make use of DBMS application programming interface and libraries [20]. Existing tools

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facilitate programmers to interact with various data sources and play graphically with data for analytics [4].

Research has been done in ETL field including (a) ARKTOS II [1], (b) AJAX [17], and Potter's wheel [18]. Research has been carried out in the area of real-time data warehouse for business intelligence [5]. There are challenges in the field of data warehouse as architecture is different for various domains including clinical data [6]. Semi-automated tools have also been proposed for ETL processes [7]. Oracle contributed by providing many features like partitioning, data capture, query rewrite for data warehouse [8], and SQL loader-like utilities [16]; Oracle also contributed by performance tuning guidelines [14] and IBM contributed in many ways including IBM data warehouse manager [11] which aimed at decision-making using data analysis [9]. Research has been carried out for ETL using incremental loading techniques and break point transmission [15].

Research on workflows revolves around three factors: (a) modeling [12], where the authors concentrate on providing a meta-model for workflows; (b) correctness issues [3], where criteria are established to determine whether a workflow is well formed, and (c) workflow transformations [19]. The research was oriented towards fetching huge volumes of data from source and its transformation and pushes more and more data from staging/dimensional area to fact/destination area to form data mart followed by data warehouse [1]. Schafer, Becker, and Jarke have worked on case study of data warehouse of Deutche Bank. The authors describe the management of metadata for huge data warehouse of terabytes in size keeping in view of the business intelligence [2] goals and application-oriented architecture which involves broad spectrum of the business methodologies so as to provide precise reporting in a time-bound manner [13]. The study give emphasis on querying data warehouse as reporting from the data warehouse is the ultimate goal behind establishment of data warehouse.

3 Problem Definition

We can load data in tables much faster without having indexes and other dependencies, as indexes and data loading is inversely proportional to each other. On huge volume databases, it is a more challenging job as if we speed up the data loading speed, we drop indexes and we recreate/rebuild indexes after data loading which again takes a very long time and our motive will not be achieved, as overall time to give usable data set will remain the same without any optimization. The conventional data load speed using different techniques is shown in Fig. 1.

The problem is to extract data from source which may come as ongoing multiple files (which may be thousands per hour) from middleware or any other source system each having fixed size or fixed characters or variable size, read each file content, perform the transformation, perform data cleansing, put it in staging area, and then feed data into production database without compromising retrieval

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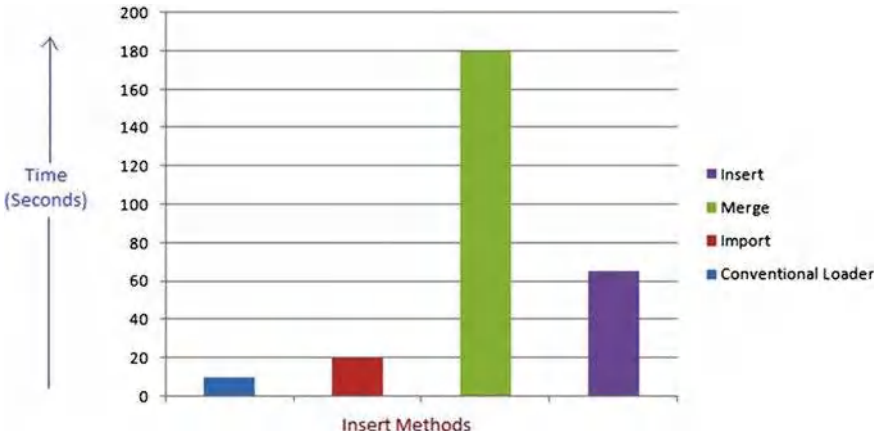

Fig. 1 Conventional data load speed [18]

process. The major problem is to maintain data in production database with all the dependencies and without dropping indexes on huge tables.

4 ETLR—Effective DWH Design Paradigm

Extraction, Transformation, and Load should be further elaborated as Extraction, Transformation, Load, and Retrieval, i.e., **ETLR**. ETLR is the new way of designing data warehouse such that we design and optimize data warehouse by keeping in mind the data retrieval requirements and optimization at various levels as shown in Fig. 2.

For better understanding—we take into consideration an example of an organization which wants to build a data warehouse having very huge data volume on daily basis. Data comes from mediation system in the form of raw files which continues to receive persistently all time.

We propose a different approach to address the issue and build a DWH. Going one step further at source system, tune source system and perform filtration process at source system itself and segregate data at source system. Multiple paths at DWH file server has been identified such that data can be dumped into respective destination paths. Data from source system/mediation is set in such a way that it is being generated in parallel mode in multithreading and parallel data streams are generating which dumps data persistently into DWH server. One file of source system splits into multiple files that contains data of respective filter condition and dumped into predefined destination path at DWH server. By making use of this step, we reduced processing time at DWH server.

After many ETL mechanisms adopted, we propose to make use of external table concept on the raw data files, keeping files in bunch and provide it to external table

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Fig. 2 ETL and retrieval optimization for overall performance

engine. External table engine of the DBMS limits the size of the files to be shown together and show it in the database in tabular form on applying SQL scripting within the database. We are still making use of the OS memory and not DBMS memory to show data in the delimited files. Upon getting data visible in tabular form in the DBMS, view functionality in combination with copy utility of the DBMS can be used to put data from staging area to production area in the required format. This process maintains the integrity of the constraints and indexes while loading with minimum impact on performance. The switching of files happens and parallel execution of different modules incorporated so that desired data loading can be achieved in best minimum time. Error mechanism and its rectification have been incorporated without making use of any ETL tool. Data loading will be done in multiple destination database objects of respective zones and further per zone multiple database objects to take the benefit of modularity among database objects. Retrieval process has been designed in such a way that it calculates the desired statistics before referring to the destination data object and in parallelism mode.

5 Implementation

In DWH server, there are multiple locations where data from mediation system is pushed containing domain-wise data in each location. We will make use of external table concept to load data in which we can access data much before its loading into the database and can perform transform operations without making use of database memory; as it uses the OS memory only. We can change the data in an external

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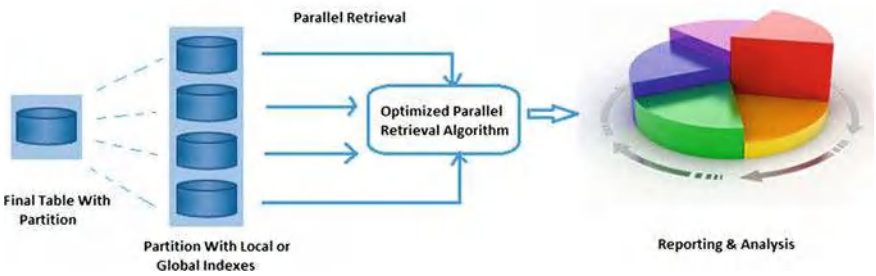

Fig. 3 Optimized retrieval process for reporting and analysis

table by running an OS command. External tables help in efficient loads, by means of applying complex data transformations during the load process includes aggregations, merges, multi-table inserts, etc. There are raw table definitions of individual tables which are similar to the data contained in the raw files. The loading of the data will be done on two criteria (a) Take a bunch of files having predefined number or (b) Bunch of files contains maximum number of records whichever is achieved first.

Further, due to large volume of the data, every database object is range partitioned such that we have multiple database objects each having range partition. Every database objects needs fast retrieval, so we have identified fields on which indexing will be there for fast retrieval. Now we have range portioned database objects with indexes on predefined fields of each table. For transformation operation on raw tables, we make use of predefined views on all raw tables. The raw data will be automatically converted into production format as and when it reflects into the raw objects. To achieve this, we make use of "COPY" functionality of database which takes reference of the data available in raw datasets after processing from different views and then it feeds the data into production database in parallel. The data in production tables can be used for reporting and analysis as shown in Fig. 3.

The data will be loaded into range partitions of the destination objects and then partition swap mechanism has to be used such that the loaded data can be just sandwiched with the table. The partition swap takes only seconds thus ensuring the data availability at the earliest.

6 Result and Discussion

In this paper, we have come up with a different theoretical framework along with its implementation for an effective data warehouse. On combining various tools and techniques and optimization of already available methodologies of ETL, we have a data warehouse of large size with very less maintenance activities associated with it. The techniques like external table, partition swap, and copy command functionality

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of database combined together with the help of operating system programming/ utilities gives us a unique way of ETL process to build a data warehouse which has significantly large volume of data. The main objective of the research work is to maintain effective ETL with retrieval dependencies.

A traditional data warehouse process can only optimize a portion of ETL process, i.e., either ETL tool or in-house ETL program. A bird's eye view is missing in existing ETL process. Not only swift ETL process, but hassle free and quick availability of data is must. The parallelism and layered optimization with partition exchange and scalability is shown in Fig. 4.

To ensure quick ETL process with data availability in time-bound environment, the ETLR architecture with the use of parallel architecture at each layer with optimization gives us the performance we can just imagine of. The scalability is not an issue with ETLR paradigm; just add partitions in tables with optimized hardware and database configuration for storage and scale the data warehouse to the extent you want.

The ETLR objective of the research work has been achieved as constraints and indexes available on the destination data sets are intact during whole process which ensures the data availability all the time. The speed of overall process is at least two times faster when compared with the existing methodologies of ETL process. Now, the further course of action is to write effective extraction programs with knowledge of internal structure of the data warehouse. The reporting of the required data from data warehouse can be done with the hints functionality of the databases and the queries can be optimized on the logic of partitioned tables. For future, we can maintain the same architecture as mentioned above; in building distributed data warehouse and also it is scalable for the cloud networks.

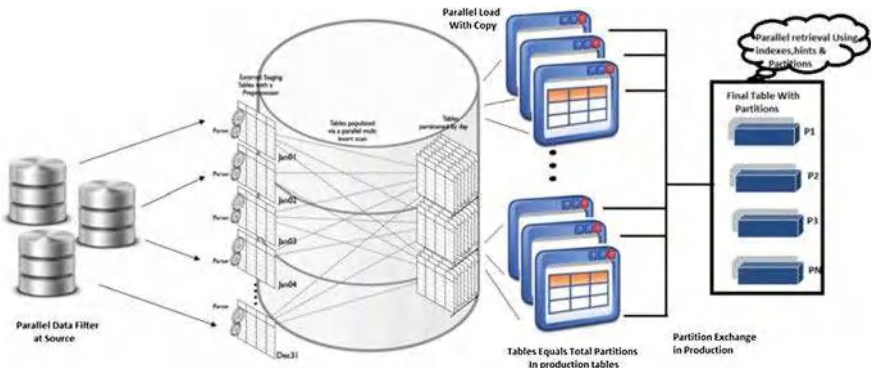

Fig. 4 ETLR—parallelism and layered optimization

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7 Conclusion and Future Work

In this paper, we have presented state-of-the art issues in existing ETL technology. Practically a designer uses commercial ETL tool or develop customized product in-house for establishment of data warehouse. We have concentrated on the fact that ETL cannot be optimized by only making use of ETL tool or optimizing only workflows but it is a many-fold optimization which should be applied at each layer of data warehouse. We have introduced one more layer for optimization along with ETL, i.e., retrieval. Not only a new layer has been introduced, but we have discussed every aspect of individual layer along with optimization techniques used at each level. Additionally, we detailed the major issues and problems during ETL process and we have come up with a new paradigm for developing a data warehouse addressing retrieval part which was totally unexplored.

Finally, we have pointed out that developing a data warehouse system is not only to choose a good ETL tool or write custom code for ETL, but it is about all phases of life cycle of data warehouse considering optimization of every aspect throughout phases which give us not only efficient ETL process, but also ensures quick availability of data. Further, we have indicated list of open research issues: conventional ETL and parallel ETL with retrieval and we have provided several future directions.

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Prediction of Reactor Performance in CATSOL-Based Sulphur Recovery Unit by ANN

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Abstract For the prediction Artificial Neural Network has been used, which is inspired from human biological neural network. Artificial Neural Network tool has very vast application in almost every field. ANN is a very powerful tool in the field of AI and spreading over in every field of Computer Science, IT, Refinery, Medical, etc. We have used MATLAB software for the use of built-in neural network toolbox. MATLAB platform is very user friendly and includes all the important transfer functions, training functions which helps in comparison of results with each other and allow us to predict the best result using ANN. Further, this describes application of ANN in CATSOL process. After complete study about ANN and CATSOL process, our experimental results of using different transfer functions and training functions are shown which results in the overall best network for the CATSOL process.

Keywords Artificial neural network · CATSOL process · Biological neural network

1 Introduction

Fuels are any materials that store potential energy in forms that can be practicably released and used as heat energy [1]. This energy can be used further for the smooth functioning of various machines. One such fuel is natural gas. Natural gas is

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generally regarded as a natural mixture of hydrocarbons found issuing from the ground, or obtained from specially driven wells. Its constituent components can be used as fuels for various purposes [2]. Raw natural gas primarily comes from one of three types of wells, either crude oil well or gas well or condensate well. The major contaminants present in natural gas are: 1. Heavier gaseous hydrocarbons (ethane, propane, butane), 2. Acid gases (carbon dioxide, hydrogen sulphide and mercaptons), 3. Other gases (nitrogen, helium), 4. Water. The raw natural gas needs to be purified before it can be converted to useful proportions [3]. Water vapour from raw natural gas is removed first and sent to amine treating unit for the removal of acid gases. The resultant gas obtained is known as sweetened natural gas [4]. The acid gases obtained after the gas sweetening process cannot be directly released into the atmosphere due to various environmental concerns. Maximum limit of hydrogen sulphide gas released to the atmosphere is 10 ppmv [5]. In refineries, the acid gas generated from amine treating unit contains more than 50 % H_2S [6]. The acid gas is sent to a Sulphur Recovery Unit (SRU) based on CLAUS process [7]. One-third of H_2S is burnt into SO_2 and forms sulphur by reaction with SO_2 and remaining in a combustion chamber. In case of Gas Processing Complex, the acid gas generated from gas sweetening unit contains less than 5 % H_2S [8]. This type of acid gas cannot be handled in CLAUS type SRU due to unstable flame inside the burner of combustion chamber. SRU based on Liquid Redox Process is used for efficient removal of H_2S from such type of acid gas [9–11]. EIL [11] and GNFC [12] developed an indigenous Liquid Redox Process called CATSOL Process for the conversion of H_2S into elemental sulphur in the presence of metal-based catalyst. Catalyst is regenerated by air. Both the absorption and regeneration is taking place inside a single reactor called as auto circulation reactor [13, 14]. Elemental sulphur is recovered from the acid gas settles down and is removed regularly as part of slurry. Sulphur is separated from slurry using a filter system and sent to sulphur yard for storage [15]. Various chemicals used in the process for maintaining the pH, settling of sulphur particles, avoiding foaming inside reactor, avoiding biological growth inside reactor, etc. The chemicals required during the operation of the SRU are: Catalyst, Chelate, KOH solution, Surfactant, Defoamer and Biocide [16–21]. This process is working based on a number of parameters like pressure of the feed acid gas, temperature of the feed acid gas, concentration of H_2S in feed acid gas, pressure of regeneration air, temperature of regeneration air, pH of the solution, concentration of catalyst and chelate dosing of other chemicals, etc. [22–25]. A mathematical model is required for predicting the performance of the reactor according to all the above-mentioned parameters. Artificial Neural network (ANN) [26] is used for modelling complex relationships between inputs and outputs or to find patterns in data by connectionist approach. ANN is a very good tool for predicting the performance of the reactor which depends on the number of process parameters mentioned above [27–29]. CATSOL Process is a complex process in which a number of process parameters are interlinked non-linearly. ANN is a good tool for finding out the connections within all process parameters.

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2 Process Description

The CATSOL process uses iron chelate solution as catalytic reagent for conversion of H_2S in acid gas to elementary sulphur in a reactor [30, 31]. During conversion of H_2S, the iron catalyst is reduced from ferric ion to ferrous ion. Subsequently, ferrous ion is oxidized by air in the same reactor. The whole process is shown in Fig. 1. The prominent features of this technology are

1. Overall reaction is carried out at low temperature. 45–50 °C.
2. Technology treats acid gas with very low H_2S concentration and can also handle acid gases with variation in H_2S concentration.
3. Technology shows high H_2S removal efficiency and ensures H_2S less than 10 ppmv in the gas discharge to the atmosphere.
4. Use of filter minimizes the catalyst loss and less maintenance in the plant. The reactor of SRU consists of two main sections—Absorption Section (draft tube) and Regenerator Section (annular). In the absorption section, H_2S is absorbed in

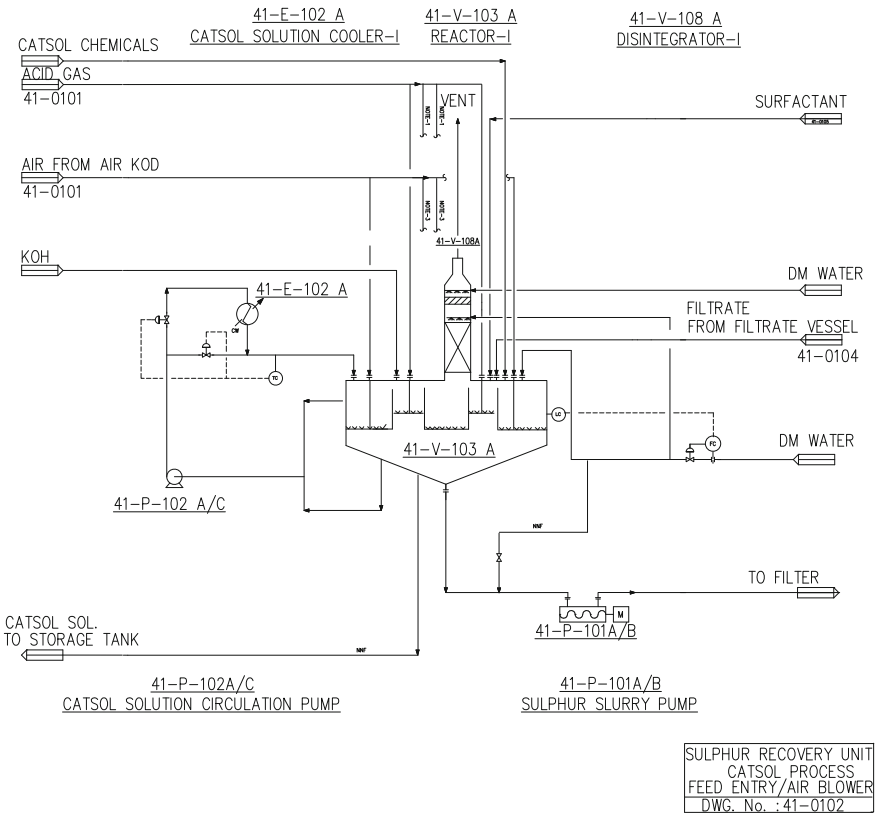

Fig. 1 SRU for CATSOL process

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the alkaline catalyst solution as S_2 ions. Subsequently, sulphide ion is converted to sulphur in the presence of ferric ion and ferric ion is reduced to ferrous ion [32–35]. The reaction in absorption section is given below.

2.1 Absorption Section

$$\mathbf{H_2S(g) + H_2O \rightleftarrows H_2S\,(aq) + H_2O} \tag{1}$$

First ionization:

$$\mathbf{H_2S(aq) \rightarrow H^+ + HS^-} \tag{2}$$

Second ionization:

$$\mathbf{HS^- \rightarrow H^+ + S^-} \tag{3}$$

Oxidation by metal ions (Fe^{+++})

$$\mathbf{S^- + 2\,Fe^{+++} \rightarrow S(Solid) + 2Fe^{++}} \tag{4}$$

2.2 Regeneration Section

The reduced ferrous metal ion is oxidized to ferric by plant air. After regeneration of catalyst, the ferric ion is reused in the absorption section. Two moles of metal ions and half mole of oxygen are required to produce one mole of sulphur.

$$\mathbf{O_2(g) + H_2O \rightleftarrows O_2(aq) + H_2O} \tag{5}$$

$$\mathbf{1/2\,O2(aq) + H_2O + 2Fe^{++} \rightarrow 2OH^- + 2Fe^{+++}} \tag{6}$$

Or Overall

$$\mathbf{1/2\,O_2(g) + H_2O + 2Fe^{++} \rightarrow 2OH^- + 2Fe^{++}} \tag{7}$$

Overall Reaction is

$$\mathbf{H_2S(g) + 1/2\,O_2(g) \rightarrow S(Solid) + H_2O\,(Liq)} \tag{8}$$

Besides the main redox reaction, the process undergoes various side reactions at different extents. The side reactions are given below

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(a) **Reaction** 1

$$\mathbf{2HS + 2O_2(g) \rightarrow S_2O_3^{--} + H_2O} \tag{9}$$

Combining reaction (2) and (9)

$$\mathbf{2H_2S + 2O_2(g) \rightarrow 2H^+ + S_2O_3^{--} + H_2O} \tag{10}$$

(b) **Reaction** 2

$$\mathbf{H_2O + CO_2(g) \rightarrow H_2CO_3} \tag{11}$$

Although overall reaction (Reaction 8) shows no H^+ ion formation, H^+ ions generated in the solution due to side reaction leads to unfavourable situation. To prevent the lowering of pH of the solution, KOH solution is added either intermittently or continuously and pH of the solution is maintained good enough to get high degree of H_2S absorption in the absorption section [36]. Operation at high pH causes formation of thiosulfate. As concentration of thiosulfate increases in the solution, density of the solution increases and it results in more purging of the solution. Generally, pH range of 7.8 and 8.1 is favoured for better performance [37].

Slurry filter is used for separating sulphur from the catalyst solution. After separation, the filtrate is returned to the reactor. Filter system ensures minimum loss of catalyst and chemicals with solid sulphur cake.

It is required to analyse the catalyst solution intermittently for checking of the metal and chelate contents in the solution [38, 39]. The catalyst and chelate solutions are added to the reactor to maintain the right concentration and addition is done based on the analysis results [40].

2.3 Parameter Selection

There are variable process parameters which affect the CATSOL process and can be elemental in the amount of sulphur recovered and concentration of H_2S released into the atmosphere. Lists of these parameters are: Air Flow Rate, Concentration of H_2S in the acid gas, Acid gas flow rate, pH, ORP, Temperature, Pressure of Air, KOH solution added, Concentration of the chelate added, Catalyst, Vent release and Absorber level.

The first 10 parameters listed above are input parameters and the last two are output parameters. From the set of input parameters, only the first five are most important ones. The other input parameters are not of that much importance as the

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rest are maintained at almost a constant level due to which there is no non-linear change in their presence to make them useful while modelling the process. For modelling of the CATSOL process the parameters selected are given below.

Input Parameters:

1. **Air flow rate**: Air is used for the regeneration of the chelate and also helps in the circulation of the aqueous solution.
2. **Concentration of H_2S in the acid gas**: Concentration of H_2S in acid gas is in the range of 0–5 %v. The acidic gas is sent to the SRU to reduce the amount of H_2S gas released into the atmosphere.
3. **Acid gas flow rate**: Input parameter that takes into account the flow of the acid gas from gas sweetening unit into the CATSOL Unit.
4. **pH**: The pH of the solution needs to be constant within the range of 7–8.3. Due to unwanted reactions that take place, there is a change in pH, KOH is added continuously or intermittently to maintain it
5. **ORP**: The oxidation reduction potential of the solution gives information whether catalyst is regenerated properly or not.

Output Parameters:

1. **Vent release**: The amount of H_2S released into the atmosphere
2. **Absorber level**: The level of catalyst solution in the reactor

3 Artificial Neural Network

Now, based on the selected set of parameters the data with respect to them need to be collected from various sources or recorded from various measurements of the CATSOL process. The data that is collected should contain values for both input and output parameters. This set of data would be used for training, validation and testing of the network. Multilayer networks can be trained to generalize well within the range of inputs for which they have been trained. However, they do not have the ability to accurately extrapolate beyond this range, so it is important that the training data span the full range of the input space.

The data collected from the CATSOL process has been divided into three subsets viz. Training data, Validation data and testing data. Each of these three different sets would be used for training the network, validating the network and testing the trained network.

The training of the network with a set of sample data, the number of neurons in hidden layer was varied and the results were recorded. The following result is shown in the Fig. 2. It can be inferred easily from the graph that a hidden layer containing 11 neurons gives us best result. The graph clearly depicts that till 11

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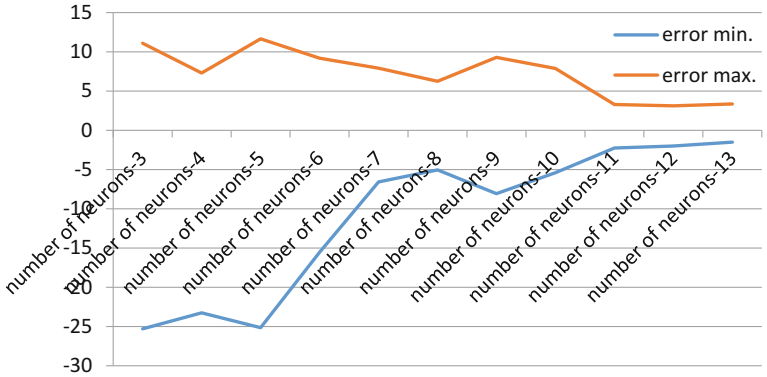

Fig. 2 Hidden layer

neurons there is a lot of change in the performance of the trained network. From 11 neurons onwards it is clearly visible that the graph smoothens up and there is not much change leading to the belief that 11 neurons in the hidden layer would provide the best trained network.

The various network training function were used and the best of them all was chosen. From the Fig. 3 it can be inferred that trainbr and trainlm give the best result with regards to training the network. But even though trainlm has a higher

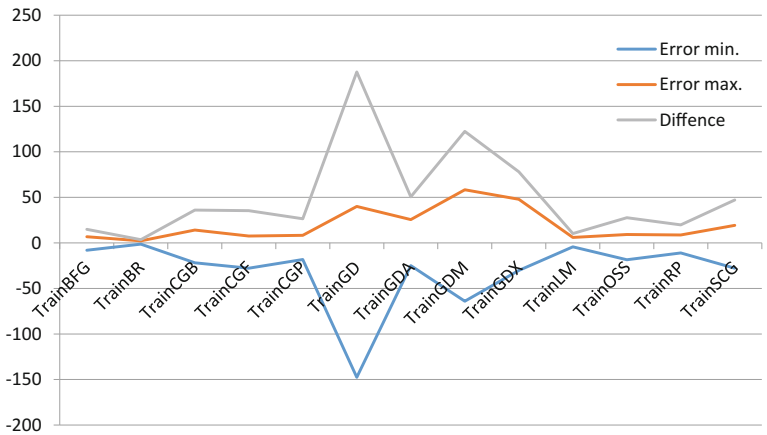

Fig. 3 Training function

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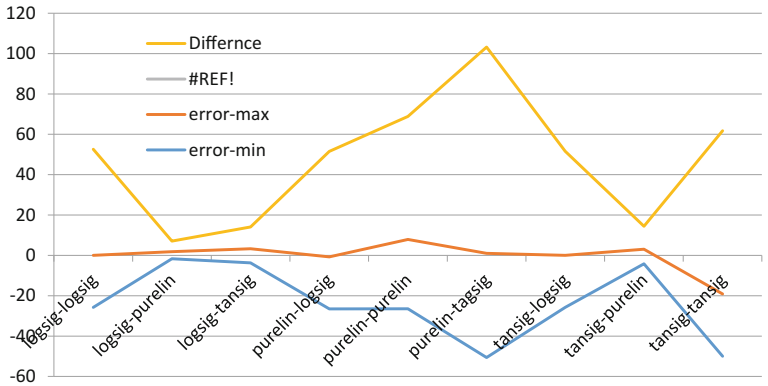

Fig. 4 Transfer function

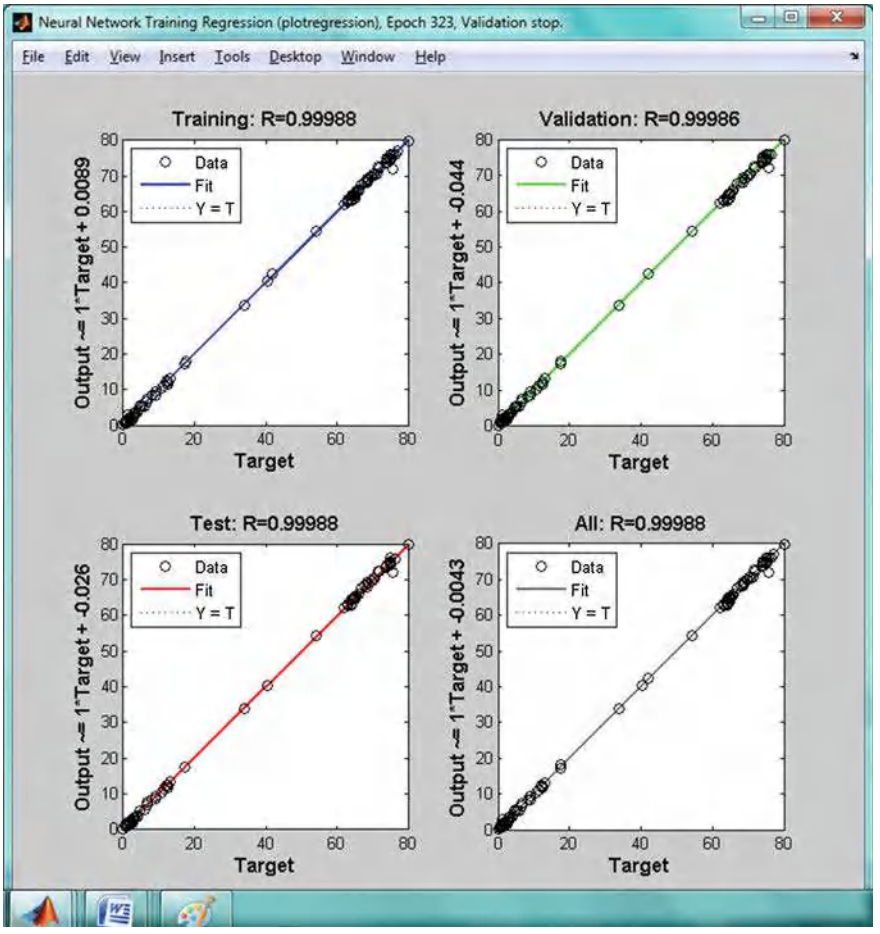

Fig. 5 Regression plot of the neural network

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error range than trainbr, it validates the network which the latter neglects to do. This results in the belief that the training function trainlm produced the best result.

For the training of the network, there is a need to specify the transfer functions with respect to each non-input layer which is what makes artificial neural network non-linear in nature. There are various transfer functions which can be used. There are two main types of transfer function viz. Linear and non-linear. The linear transfer functions are used in the final layer of multilayer networks as function approximates. The non-linear transfer functions can be used in the hidden layers of the network as they are differentiable in nature. A graph depicting the result of the use of various transfer functions is given in Fig. 4. From this it can be inferred that purelin transfer function for the output layer and logsig function for the hidden layer provides the best result (Fig. 5).

4 Strength of Proposed Technique

In the industry it is not an easy process to take corrective action only after the entire reaction process is complete as it may lead to adverse situations. The proposed system would help in predicting the reactor's performance on varying the inputs and observing what it results in without actually having to let the reaction take it course. This would also help in producing the desirable outcome when the reaction reaches it completion along with reducing the wastage and any kind of contamination of pollution. And with 97 % accuracy we can say that the amount of gas release into the atmosphere would be within the permissible limits. The presence of equipment in the reactor for measurement of the inputs and outputs of the reactor adversely affects the reaction that takes place within the reactor. The use of the proposed system would reduce this risk also (Table 1).

Table 1 Results of the neural network

Sr no.	Acid gas flow rate (knm^3/h)	H_2S conc. in acid gas (ppmv)	Air flow rate (knm^3/h)	pH	ORP (mV)	Absorber level (%)	Vent (ppmv)
1	5.82	4679	9.15	7.66	−22	68.3201	2.3645
2	5.8	4702	9.48	7.62	−22	73.3791	2.0173
3	5.97	4722	9.41	7.6	−25	69.7314	2.8937

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5 Conclusion

The Neural Network which has been trained, validated and tested against data collected from the CATSOL process. It is now ready to be used for prediction of the output parameter values given the input parameters. This model would be very helpful in gas processing units as it is not an easy task to repeatedly test the various output parameters and take action accordingly. The modelled network can instead be used to predict the values that the output parameters would give and use it as a basis to perform further actions as required in the reactor with regards to the CATSOL process.

The Network currently simulated is only with regards to the data obtained from the CATSOL process. But the same can be extended for various other processes which are a part of the gas processing/refining process. This would make it a lot easier to predict what kind of result could be obtained for a particular set of inputs.

The neural network is 97 % accurate in providing results.

6 Future Scope

In this scope, the study was based on only the five most important factors that affect the reaction. But further studies can be conducted to find effect of the other factors on the reaction. Also the CATSOL process is just a small part of the refinery unit and the input to it is controlled by another process. A study on the purification of natural gas and its relation to the CATSOL process needs to be determined.

As both are two separate process and output of one forms the input to the other an uncertainty may arise, which can be reduced by the use of Fuzzy Logic.

The same predictive analysis can be performed with other techniques and can be compared with the results obtained from the use of ANN for better results. And in case a single technique is not sufficient for this then hybrid AI techniques can be utilized for better results.

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A Multilevel Clustering Using Multi-hop and Multihead in VANET

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Abstract Clustering is the process of grouping similar objects, to provide secure and stable communication in wireless network. Clustering plays a vital role in wireless networks, as it assists on some important concepts such as reusing of resources and increasing system capacity. In current research scenario, among different types of clustering, multilevel clustering is considered to the hot research topic as it is not exploited to its full potential. Multilevel clustering is the process of partitioning the nodes within the cluster in hierarchy manner. This multilevel method results in very fast clustering. Among the multilevel clustering techniques mentioned in the literature, only few of them forms the cluster with equal size. The major problem in the multilevel clustering techniques is the farthest nodes from head are not able to be communicated within the short span of time. To overcome the above-mentioned problems, this paper proposes an algorithm which satisfies the multilevel approach by combine the multi-hop and multihead concept. The proposed method of cluster is justified and implemented by using OMNET++ simulator.

Keywords Multilevel clustering · VANET clustering · Location · Distance · Cluster stability · Life time · OMNET++

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1 Introduction

Vehicular Ad hoc Networks (VANET) are a type of network which is emerging in peak among various wireless networks. VANET [1] is a form of Mobile Ad hoc Network (MANET) which is basically a vehicle to vehicle and vehicle to roadside communication. Now it has recently drawn significant research attention since it provides the infrastructure that enhances driver's safety, less accidents, and avoid congestion. It also helps drivers to acquire real-time information about road conditions in prior so that they react properly on time. This prior information about road conditions and traffic helps the driver to take new routes by avoiding the vehicles to enter crash dangerous zone with the help of Vehicle to Vehicle (V2V) communication. VANET is characterized by high vehicle mobility and thus the changes in topology occur. Many control mechanisms and topology management has been proposed [1]. Clustering permits the formation of dynamic virtual backbone and it is a great challenge of clustering in highly dynamic environments. Most of the clustering algorithms for VANET are drawn from MANET clustering concepts. These algorithms lack to capture the mobility characteristics and other important drawback is formation of cluster that is based only on the position and direction of vehicles in geographic locations regardless of relative speed. And thus clustering is concentrated more than another. To enhance the stability, the clustering models are redefined based on the elements such as location, speed difference, and direction.

As discussed by Yvonne et al. [2], clustering techniques can be classified into many types. One such clustering technique is multilevel clustering which uses hierarchical structure for clustering. Multilevel clustering is gaining its importance over other clustering technique as it is faster than other clustering techniques when cluster formed are equal in size.

The proposed algorithm involves four main steps in formation of clusters, they are initiating clustering process, head selection, slave selection, and merging the clusters. There are several advantages in the proposed method as multihead approach is used, these merits are validated in simulation environment. The rest of the paper is structured as: Sect. 2 contains existing works in clustering techniques. Section 3 explains the proposed approach and algorithm for multilevel clustering with multihead and multi-hop concepts. Section 4 deals with simulation of the proposed algorithm and its details. And finally Sect. 5 concludes the paper.

2 Existing Work

Literature survey has been made on both clustering and multilevel clustering algorithms in which the multilevel clustering has to be subjugated more. Various algorithms have been implemented for multilevel clustering by considering network parameters. The existing algorithms are surveyed and those are summarized below.

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In [3], cluster-based location routing (CBLR) was proposed, in which the nodes uses HELLO messages to share out their state. When a new node enters the system, it stays in the undecided state and announces itself as the cluster head to all other nearby nodes by receiving the HELLO message. If it does not receive the HELLO message for a period of time from other nodes then it register it as the cluster member. For the infrastructure changes, nodes maintain the table which contains the list of neighboring nodes to exchange the messages. The main objective of the protocol is to improve the routing effectiveness in VANET. The nodes are assigned to know their position and the position of their destination and therefore, the packets are directly forwarded toward the destination. But the straight forwarding of the packets to the destination is completely dependent on the table. If any problem in updating the table occurs then the complete method is not achieved which is the drawback of this technique.

In [4], authors proposed a heuristic clustering approach that is equivalent to the computation of minimum dominating sets (MDS) used in graph theory for cluster head elections. This technique is called position-based prioritized clustering (PPC). To build the cluster structure priorities associated with the vehicles traffic information and geographic position of nodes are used. To attain clustering, each node must transmit small amount of message to itself and also to its neighbors. The message contains five tuples (cluster head ID, node location, node priority, node ID, and ID of the next node). A node which has highest priority becomes a cluster head. Based on the node ID, eligibility function and current time the priority of the node is calculated.

Hung hai Bui et al. [5] proposed another algorithm for multilevel clustering "Bayesian non parametric multilevel clustering with group—level contexts" they presents Bayesian nonparametric framework for multilevel clustering which utilizes group level context information to discover the low dimensional structure of the group contents and partitions the groups into clusters. They use Dirichlet process as the building block; Dirichlet process is a set of probability distributions which use Bayesian inference to describe the knowledge about the distribution of random variables. The Dirichlet process is specified by a concentration parameter (base distribution H and positive real number α). This work concentrates on multilevel clustering problem in multilevel analysis, the theme is to join two clusters based upon the content data and group level context information.

Meirav galum et al. [6], introduced a scheme for clustering formation in which various aspects such as cluster noise, dimensionality, and size are considered. A large variety of clustering algorithm has been proposed but they focus on the spherical shape, average linkage, and spectral methods. To conquer this problem they introduced fast multilevel clustering for different shape of cluster. In this scheme they apply recursive coarsening process, resulting in a pyramid of graphs. The pyramid provides a hierarchical decomposition of the data into clusters in all resolutions. This algorithm is easily adaptable to handle different types of data sets and different clustering shapes.

Yan Jine et al. [7], proposed an energy efficient multilevel clustering protocol for heterogeneous environment. This algorithm is proposed for minimum energy

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consumption in heterogeneous wireless sensor network. There are three common type of resources heterogeneity: computation, energy, and link. Among above three, the most important heterogeneity is energy because computational and link depends on energy resources. In energy heterogeneity the nodes is line powered and its battery is replaceable. If some heterogeneity nodes are placed in the sensor network, then the average energy consumption will be lower in forwarding packet from nodes to the sink. Thus the network lifetime will increase.

The existing clustering algorithms suffer from unequal sized clusters [8, 9]. All the existing algorithms reported in the literature does not consider about the important parameters such as location, relative speed and distance while forming clusters. To overcome the above-mentioned problems, this paper proposes an algorithm which uses both the multihead and multi-hop concept. With the help of cluster head the members of the clusters can be communicated in short span of time. It also paves way for formation of equal-sized clusters. The proposed algorithm also generates an alert message that can be easily passed to others clusters without any congestion.

3 Proposed Work

In existing multilevel clustering the coarsening of the process are carried out in which the proposed system overcomes many presented drawback. In planned system according to Dedicated Short Range Communication (DSRC) terms, data link layer provide transmission range of up to 1,000 m for a channel. By using control channel, the cluster head can be able to communicate with neighboring cluster heads and vehicles can gather information about neighboring vehicles. In the proposed work, there are four processes to form effective clusters, they are:

1. Initiating clustering process
2. HEAD selection
3. Slave selection
4. Merging the clusters.

3.1 Initiating Clustering Process

In the algorithm first process is to initialize the cluster. When the node enters into the Road Side Unit (RSU) range the node sends the initialize message to the RSU. After the initialize the message the new node sends the beacon message to all the neighbor nodes to form a node list. The beacon message contains the information about the node ID and this message share to all the nodes within the particular range. The pseudocode for initiating clustering process is given below in Fig. 1.

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Fig. 1 Pseudocode for initiating clustering process

```
If node enters the range of RSU
{
    Send message ("initialize")
} // End if
```

3.2 Head Selection

In the second step, once the node list is maintained with the help of that head selection will be done. The nodes which have the maximum list will be elected as Head (i.e., master). In the cluster formation Head plays the major role because with the help of the Head all the information (road condition, traffic and accidents) from the RSU is passed to all the neighbor nodes within the transmission range. The pseudocode for head selection process is given below in Fig. 2.

3.3 Slave Selection

In the third step, slave selection will be done. To reduce the cluster overhead we introduce the slave method. The Head act as master and the other nodes act as slave.

After the Head selection, the head check the distance of all the nodes by sending the beacon message. The nodes which are approximately at 200 distance is elected as slave because each node (car) will have the transmission range of 200 m, whereas remaining nodes beyond the 200 m distances will act as slave members. The pseudocode for slave selection process is given below in Fig. 3.

Fig. 2 Pseudocode for head selection process

```
On receiving ("initialize") message
For 1... Size (nodelist)
{
    Check suitability ()
    If suitability == true then
    {
        Send message ("head") to the node
    } // End if
} // End for
```

Fig. 3 Pseudocode for slave selection process

```
For 1... Size (nodelist)
{
    getposition()
    if (Check distance ~ 200)
    {
        Send message ("slave")
    } // End if
} // End for
```

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```
For j=i... Size (head list)
{
   For j=i+1... Size (head list)
   {
      getposition( i )
      getposition( j )
      if Check distance (i, j) ~ 200
      {
          Send message (i, "head")
         Send message (j, "slave")
      } // End if
   } // End for j   } // End for i
```

Fig. 4 Pseudocode for merging of clusters

3.4 Merging of Clusters

In the fourth step, merging of the clusters will be done to reduce the cluster congestion. When two neighboring clusters merge within its transmission range, the role of Cluster Head (CH) will be loosed by the head which has less number of members then it joins other cluster and become a cluster member. Here cluster restructuring will be take places, if the losing node has cluster members, then it became member of new cluster. While restructuring the cluster two processes take place either the members join any nearby clusters or form a new cluster if they could not find a cluster to join. The pseudocode for merging of clusters is given below in Fig. 4.

4 Simulation and Performance Evaluation

To evaluate the performances of our proposed work, OMNET++ simulation tool is used by considering different road traffics and different network parameters such as transmission speed of the message, congestion, and cluster overhead [10]. In OMNET++ existing sample GOOGLE EARTH demo is used to simulate a wireless vehicular ad hoc network. The simulation contain cars as mobile nodes that move randomly over a 2 km-by-2 km area in which nodes have identical radios, with transmission range of 500 m. When nodes (cars) come within same transmission range then they communicate with each other by ad hoc formation to share the information like accidents, road condition, and traffic. Once the nodes are assigned start the simulation in fast or express mode. Then we are in the platform where the browser supports. We can run this simulation in Internet with help of Google earth plugin. For the simulation purpose, we have different network parameters. The data rate is set in Mbps and the periodic messages are sent, the size of the message contains the mobility information in the form of bytes. The data rate is supported by the dedicated short range communication (DSRC) standard.

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The parameters which we consider majorly in our proposed system and algorithm are position, direction of vehicle (car), speed and velocity of the vehicle, cluster overhead, and cluster maintenance.

4.1 Cluster Overhead

To reduce the cluster overhead we should form a stable cluster by considering the number of nodes in each cluster. The first process is to form a cluster in equal size in which one cluster acts as head and others as slave. So to form a stable cluster we consider certain limit for numbers of nodes. When the nodes reach the limit cluster formation take places with the help of that we can reduce the cluster overhead.

4.2 Cluster Maintenance

For the topology change there are three types of events in VANET which can be defined as follows: a mobile node joins the network, a node leaves the cluster formation, and two cluster heads come into direct transmission range. When the new node joins the network and has non-clustered members, then these nodes will form a new cluster according to the rules used by each clustering method. And if it has the cluster head as a neighbor then it tries to join by sending the message to CH. And finally, this cluster joining overhead is same for both weight-based (WB) and position-based (PB) methods. When two neighboring clusters merge within its transmission range, the role of CH will be loosed by the head which has less number of members then it joins other cluster and become a cluster member. If the losing node has cluster members, then the members are processed for cluster restructuring. The members either join any nearby clusters or form a new cluster if they could not find a cluster to join.

4.3 Cluster Stability

To increase cluster stability direction of the vehicles play a major role. Transmission speed, reclustering, communicating with RSU (to share the information about traffic and road condition) will be difficult when vehicles moves in different directions. Therefore, in multilevel clustering unidirectional vehicles must be considered for effective cluster formation. The number of cluster changes is dependent on following conditions, they are (i) A node leaves its cluster and forms a new one (ii) A node leaves its cluster and joins a nearby cluster (iii) A CH merges with a nearby cluster.

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5 Conclusion

Clustering methods should be designed to adapt to the VANET atmosphere. These methods should take into account all vehicle dynamics. In this paper, we proposed a novel VANET multilevel cluster formation algorithm that tends to group vehicles showing similar mobility pattern in one cluster. This algorithm explains the speed difference among vehicles as well as the position and the direction during the cluster formation process. After the simulation experiment, it is observed that our technique increases the cluster lifetime and reduces the transmission time of messages between the nodes. And the cluster head to head communication is made possible and the proposed algorithm significantly increases the stability of the clusters.

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Patient-Specific Cardiac Computational Modeling Based on Left Ventricle Segmentation from Magnetic Resonance Images

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Abstract This paper presents three-dimensional computational modeling of the heart's left ventricle extracted and segmented from cardiac MRI. This work basically deals with the fusion of segmented left ventricle, which is segmented using region growing method, with the generic deformable template. The multi-frame cardiac MRI image data of heart patients is taken into account. The region-based segmentation is performed in ITK-SNAP. The left ventricle is segmented in all slices in multi-frame MRI data of the whole cardiac cycle for each patient. Various parameters like myocardial muscle thickness can be calculated, which are useful for assessing cardiac function and health of a patient's heart by medical practitioners. With the left ventricle cavity and myocardium segmented, measurement of the average distance from the endocardium to the epicardium can be used to measure myocardial muscle thickness.

Keywords Patient-specific · Cardiac model · Computational modeling · Left ventricle · Segmentation · Magnetic resonance images

1 Introduction

Cardiac disease is the number one leading cause of deaths worldwide. Hence, cardiological research is underway to build patient-specific computational models of patient cardiac anatomy in order to aid the cardiologist's diagnosis and evaluation of cardiac function of a patient's heart. In cardiac modeling, the left ventricle is of particular significance. The heart consists of four chambers, namely the left ventricle, right ventricle, left atrium, and right atrium. A ventricle is one of two large chambers that gathers and ejects blood received from an atrium towards the peripheral beds within the body and lungs. The anatomy of the heart indicating the left ventricle is shown in Fig. 1. The pumping in the heart is primed by the atrium (an adjacent/upper

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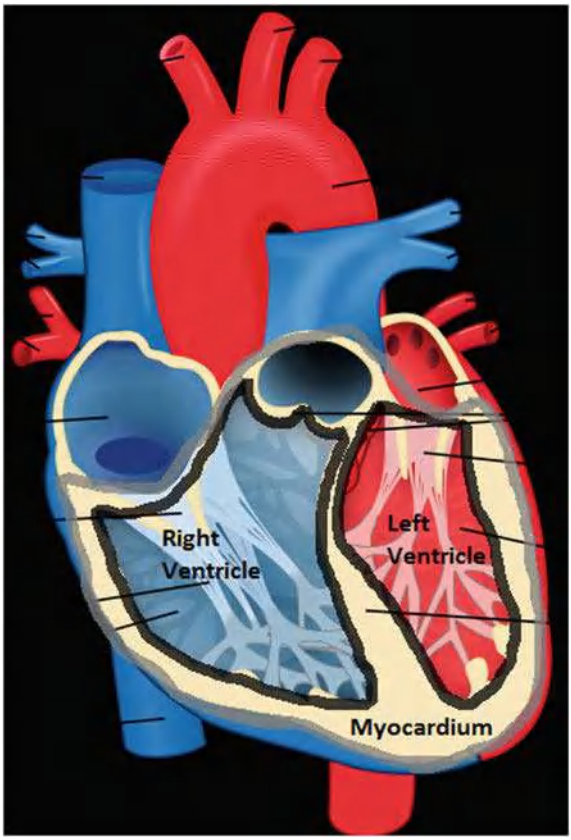

Fig. 1 Anatomy of the heart

heart chamber that is smaller than a ventricle). Extracting and reconstructing the left ventricle from cardiac MRI images is an important aspect of creating a computational model of a patient's heart.

Segmentation of the left ventricle function is essential for diagnosing and planning therapy for the cardiac diseases. For this purpose, there are various cardiac imaging modalities such as echocardiography, X-ray angiography, multispice spiral computed tomography (CT), and magnetic resonance imaging (MRI). Out of all these, MRI is most commonly used to image and quantify the function of the left ventricle due to its advantages of being noninvasive, radiation-free, and high quality resolution. The most important advantages of MRI are that it is nonintrusive and radiation-free. Second, it has high quality resolution as compared to other methods. Third, soft tissue can be easily distinguished in MRI images. A cardiac MRI image labeled with the left ventricle (LV), right ventricle (RV), and myocardial muscle (MYOCARDIUM) is shown in Fig. 2.

A number of methods are commonly used for LV segmentation in MRI images [1–4] of the heart such as edge detection, region-based segmentation, and pixel

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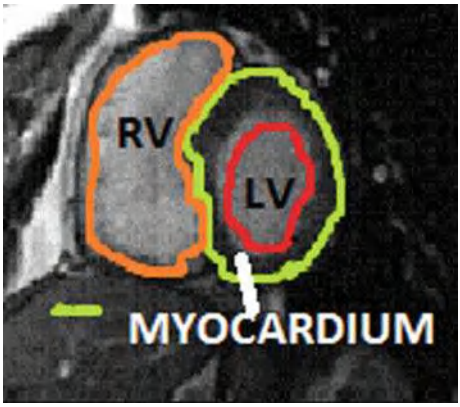

Fig. 2 Labeled MRI image showing LV, RV, and myocardium

classification. The method based on tracing edges is edge based detection [1]. The region-based method is based on pixel similarity of image regions [2]. There are various pixel-based classification methods like k-means, fuzzy c-means clustering, and graph cuts methods. These methods divide the pixels into groups based on pixel similarity measures such as intensity, texture, color or gray level [5–7]. In this research, the segmentation is done with the region-based method in the ITK-SNAP tool. The segmented binary image can then be used for deforming a generic template of the cardiac anatomy for generating a patient-specific computational model.

In our body, the four-chambered muscular organ is called the human heart. The human heart is situated behind the breastbone in the chest usually at par with the level of thoracic vertebrae. The pericardial sac is a double membrane that encloses the heart wall. Three layers of tissue comprise the heart wall. The outer one is designated as the epicardium, the one in the middle is known as the myocardium, and one inside is referred to as endocardium. The heart is divided into four chambers where we have upper two atria and lower two ventricles. The atria can be termed as receiving cavities whereas ventricles are described as discharging cavities. The function of two atria is to receive blood flowing through the veins. The function of two ventricles is to pump blood to the rest of the body. The differences in wall thickness of cardiac chambers are because of the variation in myocardium. Two kinds of blood flows in the body one is deoxygenated and other is termed as oxygenated. The deoxygenated blood is received by the right atria and oxygenated blood is received by left atria. The oxygenated blood goes to pulmonary veins as a medium for flowing.

In any pump we need valves so that fluid flows in unidirection. Similarly our heart has two types of valves, known as cuspid valves and semilunar valves. The valves which lie between the atria and ventricles are called cuspid or atrioventricular valves. The function of the cuspid walls is not to allow blood flowing back into the atrium. The other set is semilunar valves which are located at the lower edges of the large vessels quitting the ventricles and have a function of blocking blood flowing back into ventricles when ventricles tighten. The atrioventricular valve on the right is known as the tricuspid valve. The atrioventricular valve at the left is known as

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metrial valve. Between the pulmonary trunk and right ventricle lies the pulmonary semilunar valve. Between the aorta and the left ventricle lies the aortic semilunar valve.

The blood flow is conveniently described at right side then at the left side. Other thing which is to be noted is that both atria and ventricles have identical timing of contraction and expansion. To understand the function of heart we assume it as two pumps, with both the pumps operating in opposite directions but working simultaneously. First, we understand the function of first pump which functions to pump the blood streamed from the right atrium into the right ventricle, to the lungs to be oxygenated. The second pump is used for systemic circulation of the blood which streams to the left atrium from the lungs and then to the left ventricle.

The heart has a complex structure and in order to study its anatomy various image processing techniques are applied. Various stages of imaging system such as segmentation, filtering, restoration etc. are applied on anatomical structures mostly heart and brain. Apart from this various mathematical transforms are also used.

To comprehend the motion of the left ventricle and to model and conceptualize the elaborate three-dimensional motion and shape of the LV, segmentation of patient cardiac MRI is necessary [8–11]. The methodology section describes the approach used in this work.

2 Methodology

2.1 Image Segmentation Algorithm

Region-growing is a simple image segmentation method. It comes under pixel-based image segmentation method and this method requires initialization that is a pre seed point. Basic approach consists of starting with the seed point and the regions are grown by applying to neighbouring pixels having same properties such as specific ranges of gray levels. These properties may be defined under predefined criteria. When the predefined criteria is not given the procedure is to compute at every pixel same set of properties that will be used to assign pixels to regions during growing process. However if we use description alone it leads to misleading criteria such as connectivity and adjacency. The method actually constitutes two parts first determining the seed point and second determine criteria for growing the region. The basic formulation is:

1. $\cup_{i=1}^{n} R_i = R$
2. R_i is a connected region for all i=1,2,…,n
3. $R_i \cap R_j$ = NULL for all i=1,2,…,n
4. $P(R_i)$ = TRUE for all i=1,2,…,n
5. $P(R_i \cup R_j)$ = FALSE for any adjacent region R_i and R_j

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Step 1 means that each and every pixel should be taken into account while doing segmentation. Step 2 means that the connectivity in the pixels should be there else it will lead to misleading results. Step 3 indicates that regions which are taken into account should not overlap. Step 4 indicates the properties which are predefined for the pixels. For example, $P(R_i)$ = True if all pixels in R_i have similar intensity values. Step 5 indicates that P, the regions R_i and R_j are non identical.

2.2 Model Reconstruction Procedure

The entire MRI image dataset was written into VTK format acceptable to the ITK-Snap tool which allows segmentation. ITK-SNAP is a user friendly software platform. The three-dimensional medical images can be visualized using this software. We can perform the delineation to obtain the object outline, and segment images automatically. The software also uses snakes for delineating anatomical structures in an image. A snake is also referred to as an energy minimizing deformable spline. ITK-SNAP is a user friendly software and is mostly used with magnetic resonance imaging (MRI) and computed tomography (CT) data sets. The software is an interactive software used on various platforms.

2.3 Image Navigation

Using the image navigation component,the orthogonal planes can be visualized in 3-D plane. The cut planes are linked by common cursor, such that moving the cursor in one plane updates other plane too. The cut planes are observed by dragging a mouse. Another high point of this software is an option of linked cursor which works over several windows sessions, making it possible to direct various artifacts.

2.4 Manual Segmentation

ITK-SNAP allows for segmentation of physical objects in images. Under manual segmentation we study the anatomy of the heart wall and manually delineate the object of interest. We can segregate the region using various tools.

2.5 Automatic Segmentation

Using the level set method ITK-SNAP provides automatic functionality segmentation. The level set functions make use of numerical methods to be applied on the surfaces. Even the deformed surfaces can be taken into account using this method.

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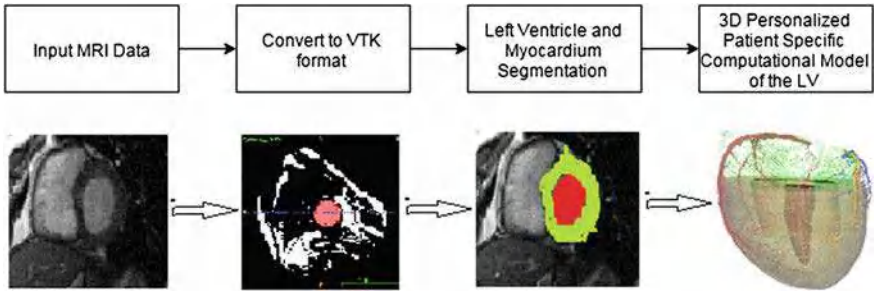

Fig. 3 Left ventricle and myocardium extraction, segmentation, and reconstruction flowchart diagram

ITK-SNAP is software which is written in C++. It can be downloaded free of cost at various platforms. It is provided with documentation and support and is user friendly. ITK-SNAP can work with many medical image formats, including DICOM, NIfTI, VTK, etc. It is a great help for researchers in field of medical imaging. The MRI images for patients are loaded in ITK-SNAP after first writing them in the VTK format in MATLAB. The images are then segmented and boundary is traced once they are read into ITK-SNAP in the VTK format. The flowchart of the work carried out is shown in Fig. 3.

2.6 Computational Model Generation

To accurately display clinical cardiac ventricular information, 3-D models can be used. The technique for creating a personalized patient-specific computational cardiac model is fusing a generic template mesh to the binary segmentation of the left ventricle. The least square circular fitting technique is used to deform the generic template of the left ventricle to the binary segmentation of the left ventricle. The flowchart of the work is shown in Fig. 4.

3 Results

Figure 5 shows that the left ventricle cavity has been segmented and myocardial muscle has been extracted. This procedure is rapid because it does not require any iterations which require more processing time and initialization from user intervention. Hence, the method presented in this paper can be performed on several MRI image frames for fast fully multi-frame segmentation.

The segmentation of the left ventricle is next saved as a binary 3-D image. This creates the patient's binary segmentation 3-D image of the left ventricle. The generic

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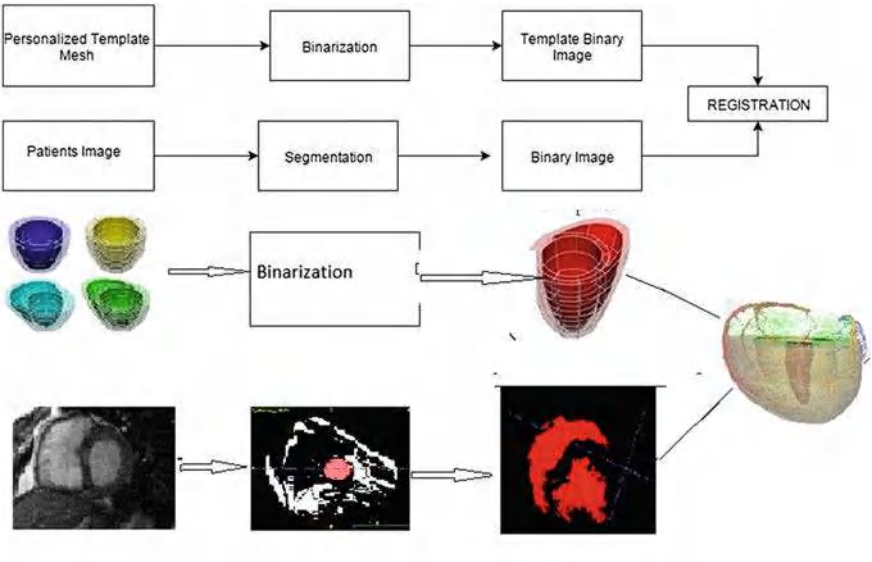

Fig. 4 Computational cardiac ventricular model reconstruction flowchart diagram

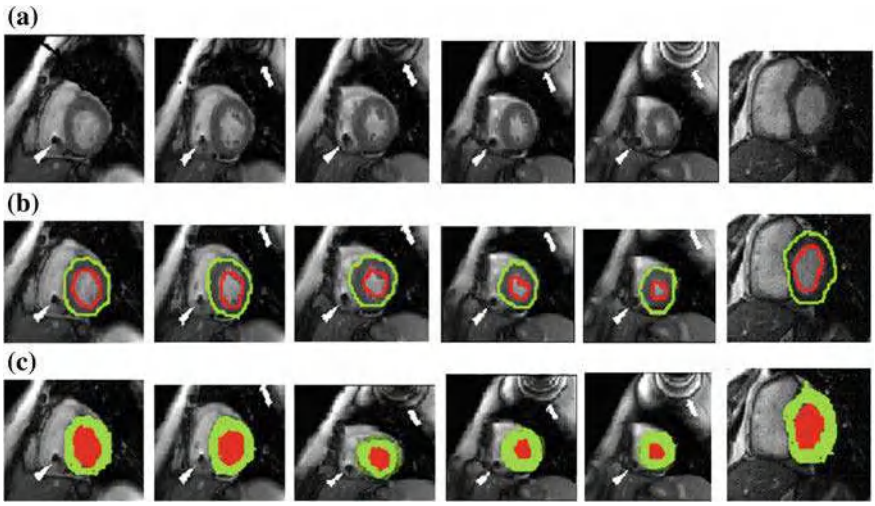

Fig. 5 Left ventricle and myocardium extraction: **a** *first row* shows the original MRI Images, **b** *second row* shows the endo-cardial and epi-cardial boundaries of the left ventricle, and **c** *third row* shows the colored segmented left ventricle and myocardium regions

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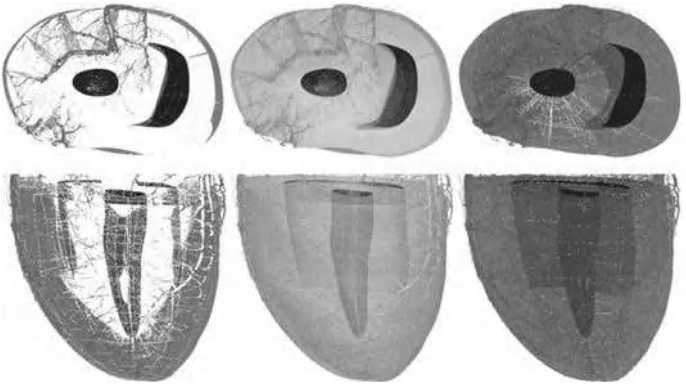

Fig. 6 Three-dimensional computational model generation of the left ventricular cardiac anatomy, personalized and patient-specific to the left ventricle segmentation from patient cardiac MRI image dataset

template of the cardiac ventricular anatomy is deformed to match the patient's binary segmentation 3-D image of the left ventricle. The results of the personalized patient-specific computational model of the cardiac anatomy are shown in Fig. 6 below.

4 Discussion

The research in this paper presents patient-specific personalized computational model generation of the cardiac anatomy obtained of the left ventricle segmented from cardiac MRI images of the patient. The medical motivation for this work includes personalized visualization of the heart muscle of a patient and calculation of the myocardium muscle thickness for clinical evaluation of the patient cardiac function. This parameter is very important for medical practitioners for assessing cardiac function. Additional future work may include computational modeling of the many structural and functional characteristics of the myocardial muscle.

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A Cryptographic Key Generation on a 2D Graphics Using RGB Pixel Shuffling and Transposition

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Abstract Now a day with incredible change in social media network like mobile communication and computer, all type of a data, such as audio, video, images are used for the communication. Privacy for that data is an important issue. Cryptography is one of the techniques used for stopping unauthorized access and increasing integrity of that data. In research area encryption and decryption scheme is used based on image pixel shuffling and transposition. For security purpose, we can use cipher algorithm for generating key using RGB values of the pixel instead of using only pixel values. For that purpose in our proposed system we are using *m*n* size image on which different operations can be performed. Our proposed system is more secure as compare to existing system.

Keywords Cryptography · Encryption · Decryption · Cipher text · Pixel · 2D graphics image · Integrity · Key network

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1 Introduction

We cannot think about the world without communication. Nowadays hiding of data from unauthorized person is an important task. There are many online services present in which communication takes place through social media network. In that case there is high probability of hacking [1]. Integrity of a data is not maintained well.

Different techniques are used to maintain a security in all social networks communication. The techniques such as cryptography and stenography. Cryptography is the best technique to increase the security between communications. It is applied on a different type of data such as text, image, video, etc. In cryptography two different processes are there, first is encryption in which specific key is used to encrypt the data. It is a process of converting plain text into cipher text and second is decryption in which cipher text is converting into plain text. Two things are important for performing encryption and decryption, first is algorithm and second is key. Plain text is combined with the algorithm to form a key. This generated key is then used for the encryption process. This cipher text is applied to the algorithm for generating the plain text. Symmetric and asymmetric are the two approaches of encryption. In symmetric same cryptographic key is used for encryption and decryption but in decryption different key's are used for processing. In this approach keys are identical or combination of different keys.

Image is made up of different color pixels. Every pixel having different colors at a single point, so pixel is a single color dot. Digital approximation can be resulted from that color dot using this values reconstruction of that image take place. Digital image having two types first is color image made up of color pixels. Color pixel holds primary colors such as red, blue and green. This values proportion used for creating secondary colors. If each primary contain the 256 levels then four byte memory required for each. Bi-level image having single bit to represent each pixel. It's having only two states with color black and white [2].

In this paper we focused on key part. In image-based cryptographic technique, cipher algorithm of $m*n$ size image used for fetching RGB pixel values. Encryption and decryption of an $m*n$ size image is based on the RGB pixel values. Property of 2D graphics image is only viewing and listing image dimensions is sometimes impossible for generating the image.

Rest of the paper is organized as, Sect. 2 is related to related work. Sect. 3 gives information related to proposed system, Sect. 4 represent the advantages, Sect. 5 proposes experimental work with some mathematical part. Section 6 provides the overall summary of our paper with conclusion of the paper.

2 Related Work

Xiukun Li, Xianggian Wu*, Ning Qi, Kuanguan Wang has proposed a Novel Cryptographic algorithm containing Iris features nothing but the iris textural features. Its algorithm having Add/minus operational and read—Solomon error

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Table 1 Analysis of existing system

Year of publication	Paper title	Drawback	Solution
2012	A novel cryptographic key generation method using image features	Create a novel algorithm for secure communication with image features	Image features and properties are used to key generation
2012	Cryptographic algorithm based on matrix and a shared secrete key	Image key generation using pixel	using pixel values key generation Techniques take place
2014	Color image encryption decryption using pixel shuffling with Henon chaotic system.	Generate a key for 2d graphic image	Scrambling the position of a pixel depend on 2D Henon chaotic system
2014	A new color-oriented cryptographic algorithm based on unicode and RGB color model	Encryption of a data using unicode data	Unicode uses RGB values for key generation

correcting. He defines the Region of Interest which used to differentiate different images [3]. Using another technique for a novel cryptographic some extension is given by a shujiangXu.yinglong Wang, Yucui Geo and Cong Wang. He uses a nonlinear chaotic map and means of XOR operations to encrypt a novel image. In which two rounds are proposed for encryptions [4] (Table 1).

Krishan, G.S, and Loganathan proposed a new scheme based on a visual cryptography in which binary images is used as the key input. The secret communicated images than decomposed into three monochromatic images based on YCbCr color space and this monochromatic images converted into binary images were encrypted using key called share—1 [5]. This technique is extended by christy and seenivasgam. He uses Back Propagation Network (BPN) to produce the two shares. Using this technique images has been produced having same features like original [6].

B. santhi, K.S. Ravichandran, A.P. Arun and L. Chakkarapani explains using images Features. Its uses Gray Level co-occurrence matrix of an image to extract the properties of an image [7]. Kester, QA proposed a cryptographic algorithm, which is based on a matrix and shared secrete key. He extends his research and use RGB Pixel to encrypt and decrypt the images [8].

RuisongYe and Wei Zhou proposed a chaos-based scheme for image encryption. In which chaotic orbits is constructed by using a 3d skew tent map with three control parameters. This generation is used to scramble the pixel positions. This approach having same good qualities such as sensitivity to initial control parameters pseudorandomness [9]. Extension to this approach for increasing the security purpose, AsiaMahdi Naseralzubaidi propose a encryption technique using pixel shuffling with Henon chaotic. He divides scrambled image into 64 blocks rotate each one in clockwise direction with go angle. For making distortion, two

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dimension Arnold Cat Mapping is applied and original position of pixel is reordered back to its original position [10].

AmneshGoel and Nidhi proposed a contrastive method. This method uses RGB values of pixels for rearranging the pixel within image than encryption take place [11].

Panchami V, Varghese Paul, Amithab Wahi proposed a techniques in which massage encoded using Unicode and encrypted using the RGB color. Hexadecimal values present for cipher color its distributes into two equal parts and 1st parts act as a message and 2nd is a key.

3 Proposed System

In previous existing system key generation is take place using the pixel values of the 2D graphics image. In which proposed algorithm used for extracting the pixel values as well as creating the key from pixel [1]. For increasing the security of image during the communication and transmission we propose new techniques. In last module we use RSA algorithm for encryption and same key is used for decryption process of 2D graphics image [2].

In this paper user having freedom to generate any type of pattern signature, etc. having fixed size of design pattern. Any image is made up of using different colors pixels. Each pixel having three components ass RGB. This RGB values first of all extracted and after shuffling we get cipher image. It is done only by using a RGB values.

In this method, we not use the bit values of pixel as well as pixel expansion at the end of the encryption and decryption process. Pixel having numeric values which interchanged or the RGB values displaced from their original position to create a cipher text. When we add all values in between image no change take place in original size and shape in image. All the features of an image remain unchanged during the process of encryption and decryption [2].

3.1 Architecture of Proposed System

Above Fig. 1 describes the architecture of encryption and decryption. We provides user interface for designing the pattern. According to cipher algorithm we fetch the all RGB values and manipulation take place using reshuffling, transposition techniques for generating key. Image decomposed into three components which act upon the cipher algorithm. That components form the all features and characteristics of original image. Within image boundaries all the RGB values are shuffled and interchanged, created array is different for all components.

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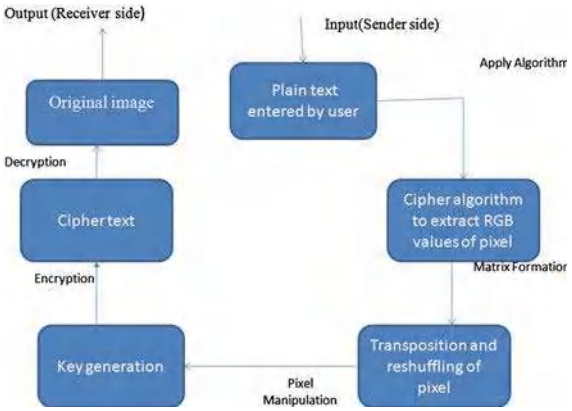

Fig. 1 Block diagram of proposed system

3.2 Flow of Proposed System

Figure 2 describes the flow of encryption and decryption process. In which first of all we accept the image, fetch all the RGB components using cipher algorithm and convert plain text into cipher text. We use RSA algorithm for the encryption process. In which key is combined with cipher text for performing encryption process.

Decryption process take place by importing all data and using reveres process of encryption. This process is done for generating original image with its shape and size. We can extract all pixel values only when image is given as an input. We can apply cipher algorithm having following steps.

1. Start
2. Import data and form image by interpreting each element.
3. Extract all r, g, b component from image.
4. Reshape all r, g, b component into one-dimensional array for each.
5. Let, $t = [y; 1; p]$ which is a column matrix.
6. Transpose 't'.
7. Reshape 't' into one dimensional array.
8. Let, n = Total number of array.
9. Let, r = (1st part of n): (1/3rd part of n) as one-dimensional array.
10. Let, b = (1/3rd part of n): (2/3rd part of n) as one-dimensional array.
11. Let, g = (2/3rd part of n): (nth) as one-dimensional array.
12. Transform it is with its original dimensions.
13. Finally all data will convert into an image.

For decrypt the image from cipher text to plain text inverse of algorithm is used.

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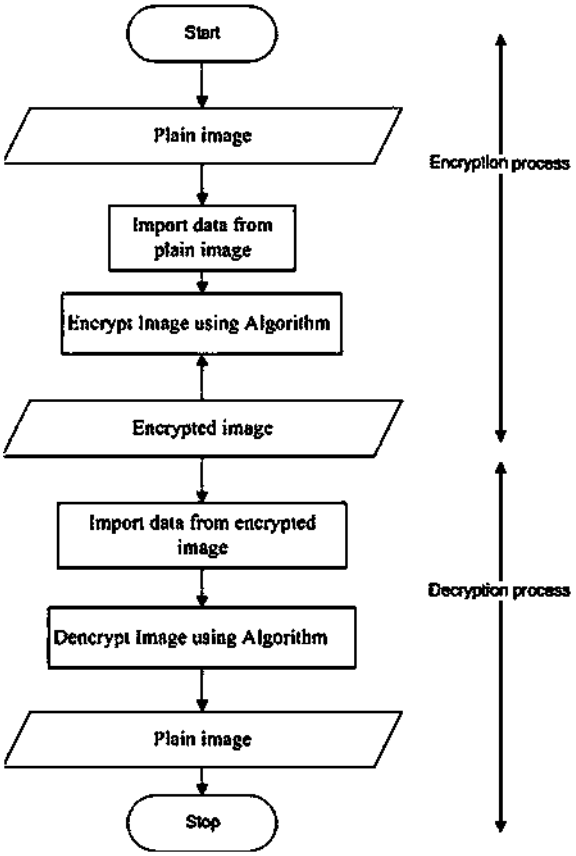

Fig. 2 The flow chart diagram for the encryption and decryption process

4 Advantages

In terms of security analysis transposition and reshuffling of the RGB values of 2D graphics is really effective. Security of image against all the attacks is increased due to extra swapping of component. Using RGB values we extract all the exact features of the image and it is quite easy to generate exact shape and size of the original image.

5 Future Scope

In existing system security is less as compared to our proposed system because we are using RGB pixel values as an input from the given image but existing system uses only pixel values of the given image. Similarly, our proposed system gives accurate and same image on receiver's side as that of a sender's side but in existing system there may be few modifications on receiver's side (Table 2)

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Table 2 Comparative analysis/study of proposed system with existing system

	Input	Security	Image features
Existing system	Pixel values	Less	On receivers side there may be some changes in image after sending
Proposed system	RGB values	More	On receivers side there will not be any changes in image after sending

6 Conclusion

In this paper, we have proposed cryptographic key generation on a 2D graphics using RGB pixel shuffling and transposition. For our proposed system we use any size of image as an input. Small change in image creates a number of keys. In proposed system at each stage cipher algorithm generates different keys using the RGB pixel values on which different operations are performed. Existing system uses pixel values only but our proposed system extracts RGB pixel values of given image. This will be helpful for increasing security of given 2D graphics image. In future, we can combines different RGB values of pixel with each other and generate a new pattern for key generation management.

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Methods for Individual and Group Decision Making Using Interval-Valued Fuzzy Preference Relations

B.K. Tripathy, Viraj Sahai and Neha Kaushik

Abstract Although a lot of research has been done in studying and exploiting, both, interval valued fuzzy sets and intuitionistic fuzzy sets, we still believe a lot more focus is still required on interval-valued fuzzy preference relations (IVFPR). In this paper, our focus shall be IVFPRs as we put forward two algorithms, based on the additive and multiplicative consistencies, to select the best alternative from a certain set of alternatives. Fuzzy preference relations have few advantages in preciseness and consistency as they give the freedom, to the experts, to evaluate the alternatives relatively. Further, we also extend our algorithms to group decision making and demonstrate their efficacy through numerical illustrations.

Keywords Interval-valued fuzzy preference relations · Group decision making · Individual decision making · Additive consistency · Multiplicative consistency

1 Introduction

Decision making is a process that we go through every day. No matter how different each decision-making scenario seems, there will always be a set of alternatives to choose from. A decision maker's ultimate realization of goal occurs with a successful choice of the best alternative. However, this is not as easy in reality. When Zadeh and Klaua first introduced their concept of fuzzy sets [1] in 1965, it was lacking in certain aspects- as the inability to express uncertainty of a decision maker's decision about an alternative. Zadeh's fuzzy sets used one fundamental

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value, μ, as the membership function and 1 − μ was defined as the nonmembership function. As observed, there was no function to consider decision maker's abstinence in the process. In 1975, Zadeh extended his work to define interval valued fuzzy sets [2]. These sets defined the membership functions of fuzzy sets as a range of values having range of values with r^- and r^+ as the lower and upper range. They took into consideration the hesitancy factor for decision makers by using ranges to define the extent of certainty. Later in 1986, Atanassov proposed the concept of intuitionistic fuzzy sets [3] that also took into consideration the concept of hesitancy. However, these sets can still be imprecise as they ask the decision makers to rate alternatives in a more absolute sense. This can be overcome by utilizing fuzzy preference relations, intuitionistic, or interval. Here, we shall be focusing on IVFPRs and shall propose algorithms for decision making.

Section 2 establishes the basic definitions for building the concerned models. In Sects. 3 and 4, we propose the decision-making models for additive and multiplicative consistent IVFPR, respectively. Section 5 extends the concept to group decision-making problems. Section 6 will demonstrate the methods using a numerical. Section 7 marks the conclusion of the paper.

2 Preliminaries

Interval value fuzzy sets are defined as [2]:

$$A = \{(x_i),\ r^-(x_i),\ r^+(x_i) | x_i \in X\} \tag{1}$$

where

$$\begin{aligned} &r^-: X \to [0,\ 1], \\ &r^+: X \to [0,\ 1], \\ &r^- \le r^+ \end{aligned}$$

Definition 2.1 [2]: An IVFPR, R on X is defined as a matrix $R = (r_{ij})_{n \times n}$ $X \times X$ where $r_{ij} = [r_{ij}^-,\ r_{ij}^+]$ for all $i,\ j = 1,\ 2,\ 3,\ldots,\ n$. Here, r_{ij} represents the interval-valued preference degree of x_i over x_j, such that:

$$\begin{aligned} &{r_{ij}}^+ \ge {r_{ij}}^- \ge 0, \\ &{r_{ij}}^- + {r_{ij}}^+ = {r_{ij}}^+ + {r_{ij}}^- = 1, \\ &{r_{ij}}^- = {r_{ij}}^+ = 0.5 \\ &\text{for all } i,\ j = 1,\ 2,\ 3,\ \ldots,\ n. \end{aligned} \tag{2}$$

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Definition 2.2 [1]: A fuzzy interval preference relation $R = (r_{ij})_{n\times n}$ where $r_{ij} = [r_{ij}^{-}, r_{ij}^{+}]$ is additive consistent if a normalized priority vector exists, $w = [w_1, w_2, w_3, \ldots, w_n]$ so that,

$$\begin{aligned} &r_{ij}{}^{-} \le 0.5\left(w_i - w_j + 1\right) \le r_{ij}{}^{+}, \text{ for all } i = 1, 2, 3, \ldots, n-1; j = i+1, \ldots, n, \\ &w_i \ge 0,\ i = 1, 2, 3, \ldots, n \\ &\textstyle\sum_{i=1}^{n} w_i = 1 \end{aligned} \tag{3}$$

Definition 2.3 [1]: A fuzzy interval preference relation $R = (r_{ij})_{n\times n}$ is multiplicative consistent if a normalized priority vector exists, $w = [w_1, w_2, w_3, \ldots, w_n]$ so that,

$$\begin{aligned} &r_{ij}{}^{-} \le \frac{w_{\mathrm{i}}}{w_{\mathrm{i}} + w_{\mathrm{j}}} r_{ij}{}^{+}, \text{for all } i = 1, 2, 3, \ldots, n-1; j = i+1, \ldots, n, \\ &w_i \ge 0,\ i = 1, 2, 3, \ldots, n \\ &\textstyle\sum_{i=1}^{n} w_i = 1 \end{aligned} \tag{4}$$

3 Priority Vector from Additive Consistent IVFPR

Let there be an interval-valued fuzzy preference relation $R = (r_{ij})_{n\times n}$ where $r_{ij} = [r_{ij}^{-}, r_{ij}^{+}]$. If additive consistency holds for $R = (r_{ij})_{n\times n}$ there will be some priority vector $w = [w_1, w_2, w_3, \ldots, w_n]^T$ that satisfy Eq. (3). However, this might not always be the case as the opinions of decision makers might be fairly subjective [1]. Thus, as suggested by Xu [4] we relax the Eq. (3) by introducing two non-negative real deviation variables d_{ij}^{-} and d_{ij}^{+}:

$$\begin{aligned} &r_{ij}{}^{-} - d_{ij}{}^{-} \le 0.5\left(w_i - w_{\mathrm{j}} + 1\right) r_{ij}{}^{+} + d_{ij}{}^{+}, \text{ for all } i = 1, 2, 3, \ldots, n-1; j = i+1, \ldots, n, \\ &w_i \ge 0,\ i = 1, 2, 3, \ldots, n \\ &\textstyle\sum_{i=1}^{n} w_i = 1 \end{aligned} \tag{5}$$

The smaller the values d_{ij}^{-} and d_{ij}^{+} the closer the interval-valued fuzzy preference R gets closer to becoming additive consistent.

Basing on his initial efforts of Xu [5] for intuitionistic FPR we establish a model for IVFPRs as:

$$\delta = \mathrm{Min} \textstyle\sum_{i=1}^{n-1} \sum_{\mathrm{j}=i+1}^{n} \left(d_{ij}{}^{-} + d_{ij}{}^{+}\right)$$

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such that,

$$\begin{aligned}
&0.5\left(w_i - w_j + 1\right) + {d_{ij}}^{-} \geq {r_{ij}}^{-} \\
&0.5\left(w_i - w_j + 1\right) - {d_{ij}}^{+} \leq {r_{ij}}^{+} \\
&w_i \geq 0, = 1, 2, 3 \ldots, n \\
&\textstyle\sum_{i=1}^{n} w_i = 1 \\
&{d_{ij}}^{-}, {d_{ij}}^{+} \geq 0 \\
&\text{for all } i = 1, 2, 3, \ldots, n-1; j = i+1, \ldots, \qquad (\text{MOD} - 1)
\end{aligned}$$

For arriving at the optimal deviation values, d_{ij}^{-} and d_{ij}^{+}, we need to solve model (MOD-1). If $\delta = 0$ then $d_{ij}^{-} = d_{ij}^{+} = 0$, for all $i = 1, 2, 3, \ldots, n-1; j = i+1, \ldots, n$ and R is an additive consistent interval-valued fuzzy preference relation. If not, then we need to improve its consistency by using the nonzero deviation values:

$$\begin{aligned}
\dot{R} &= \left(\dot{r}_{ij}\right), \\
\dot{r}_{ij} &= \left({\dot{r}_{ij}}^{-}, {\dot{r}_{ij}}^{+}\right), \\
{\dot{r}_{ij}}^{-} &= {\dot{r}_{ij}}^{-} - {d_{ij}}^{-}, \\
{\dot{r}_{ij}}^{+} &= {\dot{r}_{ij}}^{+} + {d_{ij}}^{+} \qquad (6)
\end{aligned}$$

Considering the above improved preference relation, we use the following optimization models to calculate the priority vector:

$${w_i}^{-} = \min w_i$$

such that,

$$\begin{aligned}
&0.5\left(w_i - w_j + 1\right) \geq {\dot{r}_{ij}}^{-} \\
&0.5\left(w_i - w_j + 1\right) \leq {\dot{r}_{ij}}^{+} \\
&w_i \geq 0, \; i = 1, 2, 3, \ldots, n \\
&\textstyle\sum_{i=1}^{n} w_i = 1 \\
&\text{for all } i = 1, 2, 3, \ldots, n-1; j = i+1, \ldots, n \qquad (\text{MOD} - 2)
\end{aligned}$$

$${w_i}^{+} = \max w_i$$

such that,

$$\begin{aligned}
&0.5\left(w_i - w_j + 1\right) \geq {\dot{r}_{ij}}^{-} \\
&0.5\left(w_i - w_j + 1\right) \leq {\dot{r}_{ij}}^{+} \\
&w_i \geq 0, \; i = 1, 2, 3, \ldots, n \\
&\textstyle\sum_{i=1}^{n} w_i = 1 \\
&\text{for all } i = 1, 2, 3, \ldots, n-1; j = i+1, \ldots, n \qquad (\text{MOD} - 3)
\end{aligned}$$

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Solving the above two models, namely (MOD-2) and (MOD-3), we can calculate the priority vector intervals $[w_i^-, w_i^+]$. If both happen to be equal, one unique weight vector can be calculated and defined as $w = [w_1, w_2, w_3, \ldots, w_n]^T$.

4 Priority Vector from Multiplicative Consistent IVFPR

Similarly, using already established equations and relaxing the definition for multiplicative consistency we get the following as before:

$$\begin{aligned} & r_{ij}{}^- - d_{ij}{}^- \le \frac{w_i}{w_i + w_j} \le r_{ij}{}^+ + d_{ij}{}^+, \text{ for all } i = 1, 2, 3, \ldots, n-1; j = \mathrm{i}+1, \ldots, n, \\ & w_i \ge 0, i = 1, 2, 3, \ldots, n \\ & \textstyle\sum_{i=1}^{n} w_i = 1 \end{aligned} \tag{7}$$

$$\delta^* = \text{Min} \textstyle\sum_{i=1}^{n-1} \sum_{j=i+1}^{n} \left(d_{ij}{}^- + d_{ij}{}^+\right)$$

such that,

$$\begin{aligned} & \frac{w_i}{w_i + w_j} + d_{ij}{}^- \ge r_{ij}{}^- \\ & \frac{w_i}{w_i + w_j} - d_{ij}{}^+ \le r_{ij}{}^+ \\ & w_i \ge 0,\ i = 1, 2, 3, \ldots, n \\ & \textstyle\sum_{i=1}^{n} w_i = 1 \\ & d_{ij}{}^-,\ d_{ij}{}^+ \ge 0 \\ & \text{for all } i = 1, 2, 3, \ldots, n-1; j = 1 + 1, \ldots, n \end{aligned} \tag{MOD - 4}$$

$$\begin{aligned} \dot{R} &= \left(\dot{r}_{ij}\right), \\ \dot{r}_{ij} &= \left(\dot{r}_{ij}{}^-, \dot{r}_{ij}{}^+\right), \\ \dot{r}_{ij}{}^- &= r_{ij}{}^- - d_{ij}{}^-, \\ \dot{r}_{ij}{}^+ &= r_{ij}{}^+ + d_{ij}{}^+ \end{aligned} \tag{8}$$

$$w_i{}^- = \min w_i$$

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such that,

$$\begin{aligned}
&\frac{w_i}{w_i + w_j} \geq \dot{r}_{ij}{}^{-} \\
&\frac{w_i}{w_i + w_j} \leq \dot{r}_{ij}{}^{+} \\
&w_i \geq 0,\ i = 1,\ 2,\ 3,\ \ldots,\ n \\
&\textstyle\sum_{i=1}^{n} w_i = 1 \\
&\text{for all } i = 1,\ 2,\ 3,\ \ldots, n-1;\ j = i+1,\ \ldots,\ n
\end{aligned} \qquad (\text{MOD} - 5)$$

$$w_i{}^{+} = \max w_i$$

such that,

$$\begin{aligned}
&\frac{w_i}{w_i + w_j} \geq \dot{r}_{ij}{}^{-} \\
&\frac{w_i}{w_i + w_j} \leq \dot{r}_{ij}{}^{+} \\
&w_i \geq 0,\ i = 1,\ 2,\ 3,\ \ldots,\ n \\
&\textstyle\sum_{i=1}^{n} w_i = 1 \\
&\text{for all } i = 1,\ 2,\ 3,\ \ldots, n-1;\ j = i+1,\ \ldots,\ n
\end{aligned} \qquad (\text{MOD} - 6)$$

5 Extension to Group Decision Making

If we have the individual IVFPRs for, say, m experts and if we know the weight vector for these experts as $\lambda_k = [\lambda_1, \lambda_2, \lambda_3, \ldots, \lambda_m]^T$ we can easily extend the models by aggregating the IVFPRs as:

$$\begin{aligned}
\bar{r}_{ij}{}^{-} &= \textstyle\sum_{k=1}^{m} \lambda_k \left(r_{ij}{}^{-}\right)^{(k)} \\
\bar{r}_{ij}{}^{+} &= \textstyle\sum_{k=1}^{m} \lambda_k \left(r_{ij}{}^{+}\right)^{(k)} \\
\bar{r}_{ij} &= \left[\bar{r}_{ij}{}^{-}, \bar{r}_{ij}{}^{+}\right] \\
\bar{R} &= \left(\bar{r}_{ij}\right) n \times n
\end{aligned} \qquad (9)$$

Using the above obtained equations, the set of preference relations of all the experts can be aggregated into one interval-valued fuzzy preference matrix. Now all the three models (MOD-1), (MOD-2), and (MOD-3) can be applied, to get:

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$$\delta = \text{Min} \sum_{i=1}^{n-1} \sum_{j=i+1}^{n} \left({d_{ij}}^{-} + {d_{ij}}^{+} \right)$$

such that,

$$\begin{aligned}
&0.5\left(w_i - w_j + 1\right) + {d_{ij}}^{-} \geq {\bar{r}_{ij}}^{-} \\
&0.5\left(w_i - w_j + 1\right) - {d_{ij}}^{+} \leq {\bar{r}_{ij}}^{+} \\
&w_i \geq 0,\ i = 1,\ 2,\ 3,\ \ldots,\ n \\
&\sum_{i=1}^{n} w_i = 1 \\
&{d_{ij}}^{-},\ {d_{ij}}^{+} \geq 0 \\
&\text{for all } i = 1,\ 2,\ 3,\ \ldots,\ n-1;\ j = i+1,\ \ldots,\ n
\end{aligned} \qquad (\text{MOD} - 7)$$

For determining the optimal deviation values for d_{ij}^{-} and d_{ij}^{+}, we need to solve model (MOD-7). If $\delta = 0$ then $d_{ij}^{-} = d_{ij}^{+} = 0$ and $\bar{R}$ is an additive consistent interval-valued fuzzy preference relation. If not, then we need to improve its consistency as before:

$$\begin{aligned}
\dot{R} &= \left(\dot{r}_{ij}\right), \\
\dot{r}_{ij} &= \left({\dot{r}_{ij}}^{-},\ {\dot{r}_{ij}}^{+}\right), \\
{\dot{r}_{ij}}^{-} &= {\bar{r}_{ij}}^{-} - {d_{ij}}^{-}, \\
{\dot{r}_{ij}}^{+} &= {\bar{r}_{ij}}^{+} + {d_{ij}}^{+}
\end{aligned} \qquad (10)$$

Use the following optimization models to calculate the priority vector:

$${\bar{w}_i}^{-} = \min w_i$$

such that,

$$\begin{aligned}
&0.5\left(w_i - w_j + 1\right) \geq {\dot{r}_{ij}}^{-} \\
&0.5\left(w_i - w_j + 1\right) \leq {\dot{r}_{ij}}^{+} \\
&w_i \geq 0,\ i = 1,\ 2,\ 3,\ \ldots,\ n \\
&\sum_{i=1}^{n} w_i = 1 \\
&\text{for all } i = 1,\ 2,\ 3,\ \ldots,\ n-1;\ j = i+1,\ \ldots,\ n
\end{aligned} \qquad (\text{MOD} - 8)$$

$${\bar{w}_i}^{+} = \max w_i$$

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such that,

$$
\begin{aligned}
&0.5\left(w_i - w_j + 1\right) \le \dot{r}_{ij}{}^{-} \\
&0.5\left(w_i - w_j + 1\right) \le \dot{r}_{ij}{}^{+} \\
&w_i \ge 0,\ i = 1,\ 2,\ 3,\ \ldots,\ n \\
&\textstyle\sum_{i=1}^{n} w_i = 1 \\
&\text{for all } i = 1,\ 2,\ 3,\ \ldots,\ n-1;\ j = i+1,\ \ldots,\ n
\end{aligned}
\qquad (\text{MOD} - 9)
$$

The solution from (MOD-8) and (MOD-9) determines the priority weight vector as $\bar{w} = [\bar{w}_1, \bar{w}_2, \bar{w}_3, \ldots, \bar{w}_n]^T$ for the alternatives.

Similarly for multiplicative consistent IVFPR, following the same approach, we get:

$$
\begin{aligned}
&\frac{w_i}{w_i + w_j} + d_{ij}{}^{-} \ge \bar{r}_{ij}{}^{-} \\
&\frac{w_i}{w_i + w_j} - d_{ij}{}^{+} \le \bar{r}_{ij}{}^{+} \\
&w_i \ge 0,\ i = 1,\ 2,\ 3,\ \ldots,\ n \\
&\textstyle\sum_{i=1}^{n} w_i = 1 \\
&d_{ij}{}^{-}, d_{ij}{}^{+} \ge 0 \\
&\text{for all } i = 1,\ 2,\ 3,\ \ldots, n-1;\ j = i+1,\ \ldots,\ n
\end{aligned}
\qquad (11)
$$

$$
\delta = \text{Min} \textstyle\sum_{i=1}^{n-1} \sum_{j=i+1}^{n} \left(d_{ij}{}^{-} + d_{ij}{}^{+}\right)
$$

such that,

$$
\begin{aligned}
&\frac{w_i}{w_i + w_j} + d_{ij}{}^{-} \ge \bar{r}_{ij}{}^{-} \\
&\frac{w_i}{w_i + w_j} - d_{ij}{}^{+} \le \bar{r}_{ij}{}^{+} \\
&w_i \ge 0,\ i = 1,\ 2,\ 3,\ \ldots,\ n \\
&\textstyle\sum_{i=1}^{n} w_i = 1 \\
&d_{ij}^{-}, d_{ij}^{+} \ge 0 \\
&\text{for all } i = 1,\ 2,\ 3,\ \ldots, n-1; j = i+1,\ \ldots,\ n
\end{aligned}
\qquad (\text{MOD} - 10)
$$

$$
\begin{aligned}
\dot{R} &= \left(\dot{r}_{ij}\right), \\
\dot{r}_{ij} &= \left(\dot{r}_{ij}{}^{-}, \dot{r}_{ij}{}^{+}\right), \\
\dot{r}_{ij}{}^{-} &= \dot{r}_{ij}{}^{-} - d_{ij}{}^{-}, \\
\dot{r}_{ij}{}^{+} &= \dot{r}_{ij}{}^{+} + d_{ij}{}^{+}
\end{aligned}
\qquad (12)
$$

$$
\bar{w}_i{}^{-} = \min w_i
$$

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such that,

$$\begin{aligned}
&\frac{w_i}{w_i + w_j} \geq \dot{r}_{ij}^{\,-} \\
&\frac{w_i}{w_i + w_j} \leq \dot{r}_{ij}^{\,+} \\
&w_i \geq 0,\ i = 1,\ 2,\ 3,\ \ldots,\ n \\
&\textstyle\sum_{i=1}^{n} w_i = 1 \\
&\text{for all } i = 1,\ 2,\ 3,\ \ldots, n-1;\ j = i+1,\ \ldots,\ n
\end{aligned} \qquad (\text{MOD} - 11)$$

$$\bar{w}_i^{\,+} = \max w_i$$

such that,

$$\begin{aligned}
&\frac{w_i}{w_i + w_j} \geq \dot{r}_{ij}^{\,-} \\
&\frac{w_i}{w_i + w_j} \leq \dot{r}_{ij}^{\,+} \\
&w_i \geq 0,\ i = 1,\ 2,\ 3,\ \ldots,\ n \\
&\textstyle\sum_{i=1}^{n} w_i = 1 \\
&\text{for all } i = 1,\ 2,\ 3,\ \ldots, n-1;\ j = i+1,\ \ldots,\ n
\end{aligned} \qquad (\text{MOD} - 12)$$

The solution from (MOD-11) and (MOD-12) determines the priority weight vector as $\bar{w} = [\bar{w}_1, \bar{w}_2, \bar{w}_3, \ldots, \bar{w}_n]^T$ for the alternatives.

6 Numerical Illustration

Let us take one example for an IVFPR and try to solve it using the proposed models (MOD-1)-(MOD-3).

Example There is a multiple criteria decision-making problem having five criteria of measure namely x_i ($i = 1, 2, 3, 4, 5$). The IVFPR matrix is as follows:

$$R = \left(r_{ij}\right)_{n\times n} = \begin{bmatrix}
[0.5, 0.5] & [0.6, 0.7] & [0.3, 0.7] & [0.7, 0.8] & [0.4, 0.5] \\
[0.35, 0.4] & [0.5, 0.5] & [0.5, 0.7] & [0.6, 0.9] & [0.3, 0.4] \\
[0.2, 0.5] & [0.3, 0.5] & [0.5, 0.5] & [0.6, 0.8] & [0.4, 0.5] \\
[0.2, 0.3] & [0.1, 0.4] & [0.2, 0.4] & [0.5, 0.5] & [0.35, 0.4] \\
[0.5, 0.65] & [0.6, 0.7] & [0.5, 0.6] & [0.6, 0.7] & [0.5, 0.5]
\end{bmatrix}$$

After solving the above with (MOD-1), we get, $\delta = 0.075$. Since δ is not equal to 0, the interval valued fuzzy preference relation is additive inconsistent and the optimum deviation values are as follows:

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$$d_{14}{}^{-} = 0.025,\ d_{24}{}^{-} = 0.025,\ d_{34}{}^{-} = 0.025$$

Apply (MOD-2) and (MOD-3) and get the following:

$$w_1{}^{-} = w_1{}^{+} = 0.30,\ w_2{}^{-} = w_2{}^{+} = 0.25,\ w_3{}^{-} = w_3{}^{+} = 0.20,$$
$$w_4{}^{-} = w_4{}^{+} = 0.25,\ w_5{}^{-} = w_5{}^{+} = 0$$

Therefore, we have found a unique priority vector $w = [[0.30, 0.30], [0.25, 0.25], [0.20, 0.20], [0.25, 0.25], [0, 0]]^T$. Arranging these priorities in decreasing order we get the rank of the alternative as $x_1 \succ x_2 \sim x_4 \succ x_3 \succ x_5$.

7 Conclusion

There is still scope for developing algorithms using transitivity property of IVFPRs. Also, the algorithm can be improved for missing information case. As from our end, we have tried to propose a linear model, as well as, a nonlinear model for decision making IVFPRs and extended it to encompass group decision making. These may be used for individual and group decision making with a wide area of application in the supply chain management, risk assessment and prioritizing, natural disaster prediction system or personnel evaluation system.

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A New Approach to Determine Tie-Line Frequency Bias (B) in Interconnected Power System with Integral Control AGC Scheme

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Abstract This work is of investigative type to suggest a new approach for determining appropriate value of tie-line frequency bias '*B*' for an interconnected power system. The present discussion is not for challenging the conventional trends of selecting values of '*B*', however, simulations of single and two area power systems with integral control AGC scheme have been carried out using Matlab and Simulink. Exhaustive investigation has been carried out so as to correlate the parameter '*B*' with governor regulation '*R*,' power system constant '*Kp*' and integral controller gain '*K*.' These investigations are limited to (i) making certain remarks on *B* and *R*, (ii) determining relation between *B* and *Kp* under wide range of operating conditions of power system and (iii) suggesting a possible way in which the AGC scheme can be made to determine appropriate value of '*B*' on its own in real time as per prevailing load situations so as to give satisfactory overall performance.

Keywords Automatic generation control (AGC) · Area frequency response characteristic (AFRC) · Interconnected power systems · Tie-line frequency bias parameter

AFRC	Area Frequency Response Characteristic
AGC	Automatic Generation Control
GRC	Generation Rate Constraint
Δf_1	Deviation in frequency of area 1
Δf_2	Deviation in frequency of area 2
P_D	Prevailing load on power system
P_r	Rated capacity of power system
ΔP_{D1}	Load perturbation of area 1
ΔP_{D2}	Load perturbation of area 2
ΔP_{tie}	Perturbation in tie-line power

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1 Introduction

In AGC studies of interconnected (multi-area) power system, the question of selecting most appropriate value of tie-line frequency bias parameter 'B' is very important and the same has been much hotly and controversially discussed in all the past years [1, 2]. From most of the literature related to AGC of interconnected power system, it is evident that the value of 'B' is conventionally taken equal to the area frequency response characteristic 'β' for certain reasons [1–9].

i.e.,

$$B = \beta = \frac{1}{Kp} + \frac{1}{R}$$

Where 'Kp' is the power system constant and 'R' is the governor regulation (droop). Further, in majority of the related literature and published papers, the analysis of interconnected system is done with the help of models which almost always assume $Kp = 120$ and $Tp = 20$ [8–14].

By definition, $Kp = \frac{1}{D}$, where, $D = \frac{\partial P_D}{\partial f}$. '$D$' is the rate of change of existing (prevailing) load with change in prevailing value of frequency. For example, if at a certain instant the prevailing load on a power system is 50 % of its rated capacity (i.e., when $P_D = 0.5P_r$) with a normal frequency of 60 Hz, then any addition or removal of load on the system (ΔP_D) at this instant will cause $D = \frac{0.5}{60} = 0.008333$ pu MW/Hz and value of Kp at this instant will be $K_P = \frac{1}{D} = 120$ Hz/pu MW. Also, by definition, the power system time constant is given by; $Tp = \frac{2H}{fD}$, where H = inertia constant, which is usually taken as 5 s [5, 7]. For the present case, $Tp = 20$ s. Thus, it is evident that, the values $Kp = 120$ and $Tp = 20$ correspond to a specific condition, i.e., when the power system is operating at 50 % of its rated capacity.

However, in practice, the load perturbation can occur at any random operating condition of power system. Hence, the values of Kp and Tp solely depend on amount of prevailing load and frequency at the time of perturbation. Thus, if the prevailing load is assumed to be at any value in the range of Pr to 0.1 Pr, the

Table 1 Some values of Kp and Tp in entire operating range

Prevailing load on power system (MW)	Kp (Hz/pu MW)	Tp (second)
1.0 Pr	60	10
0.9 Pr	66.6666	11.1111
0.8 Pr	75	12.5
0.7 Pr	85.7143	14.2857
0.6 Pr	100	16.6666
0.5 Pr	120	20
0.4 Pr	150	25
0.3 Pr	200	33.3333
0.2 Pr	300	50
0.1 Pr	600	100

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corresponding values of *Kp* will be in the range of 60–600 Hz/pu MW and corresponding values of *Tp* will be in the range of 10–100 s. as given in "Table 1."

It is therefore necessary to consider appropriate values of *Kp* and *Tp* while studying the behavior of interconnected power system under AGC scheme. In present discussion, the term 'satisfactory overall performance' is limited only to initial overshoot in dynamic responses of Δf_1 and Δf_2, final steady-state values of Δf_1 and Δf_2 and final steady-state value of tie-line power ΔP_{tie}. The exhaustive simulations were carried out using Matlab and Simulink.

2 Procedure

As a first step, a single area power system using non-reheat turbine along with integral control AGC scheme was simulated. The simulation model is shown in "Fig. 1" [5, 7].

The Regulation '*R*' was adjusted to 4 % pu, i.e., 2.4 Hz/pu MW. The load perturbation 'ΔP_D' was assumed to be 1 % of Pr, i.e., 0.01 pu. Various prevailing load conditions were assumed as shown in "Table 1." By setting values of *Kp* and *Tp*, every time the integral controller gain '*K*' was adjusted to critical level i.e., to a value such that the dynamic response of Δf just avoided positive overshoot. These values of *K* were recorded and averaged to get a single value of *K*. In this case, i.e., for 4 % regulation, the average value of *K* was found to be 0.2025.

After determining value of *K* as above, an interconnected system comprising of two identical areas was simulated. The simulation model is shown in "Fig. 2."

The integral controller gains for both areas, i.e., K_1 and K_2 were set to 0.2025. The regulations for both areas, i.e., R_1 and R_2 were kept at same value, i.e., 2.4 Hz/pu MW. The load perturbations for two areas were assumed as $\Delta P_{D1} = 0.01$ pu and $\Delta P_{D2} = 0$.

For different operating states as shown in "Table 1," the values of *Kp* (ranging from 60 to 600) and corresponding *Tp* (ranging from 10 to 100) were set and every time the value of tie-line frequency bias parameter '*B*' was so adjusted that final

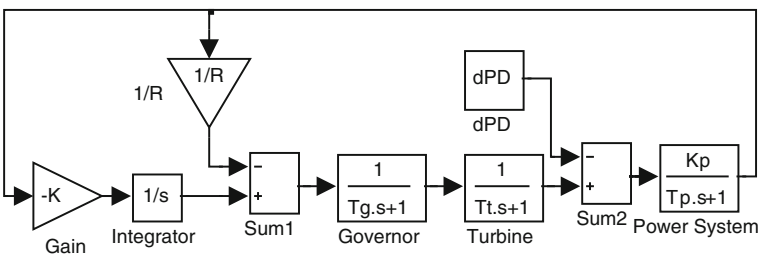

Fig. 1 Single area power system simulated in Matlab and Simulink

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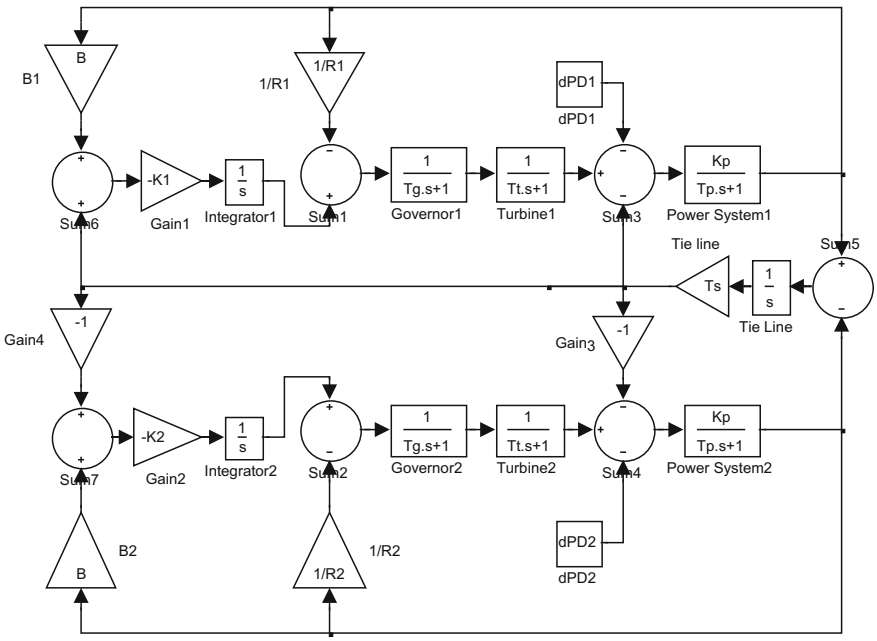

Fig. 2 Two area power system simulated in Matlab and Simulink

Table 2 Values obtained for '*B*' for various values of *Kp* and *Tp* for $R = 2.4$ Hz/pu MW

Kp	B	Δf_1 (p.u.)	Δf_2 (p.u.)	ΔP_{tie} (p.u.)
60	0.424477	-1.18×10^{-9}	−0.002831	−0.001211
66.6666	0.423530	-2.64×10^{-9}	−0.002831	−0.001209
75	0.422585	-5.20×10^{-9}	−0.002832	−0.001208
85.7143	0.421643	-4.31×10^{-9}	−0.002832	−0.001206
100	0.420704	-9.15×10^{-10}	−0.002833	−0.001204
120	0.419767	-2.17×10^{-9}	−0.002833	−0.001202
150	0.418833	-3.31×10^{-9}	−0.002833	−0.001200
200	0.417903	-1.16×10^{-9}	−0.002833	−0.001198
300	0.416976	-6.09×10^{-9}	−0.002833	−0.001196
600	0.416052	-4.70×10^{-9}	−0.002833	−0.001194

steady-state value of Δf_1 became nearly zero *before going positive*. These values of *B* were recorded in "Table 2".

2.1 B-Kp Curve

The values of *B* when plotted against the respective values of *Kp*, gave a smooth hyperbolic curve as shown in "Fig. 3"

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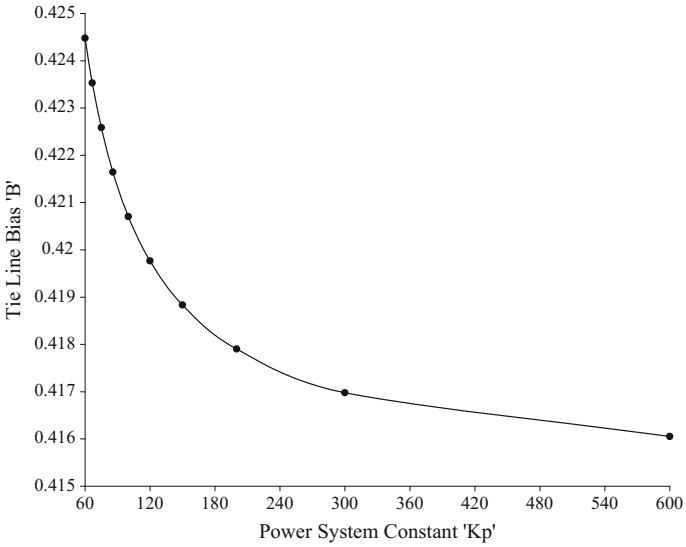

Fig. 3 Variation of tie-line frequency bias '*B*' with power system constant '*Kp*' at governor regulation value of 2.4 Hz/pu MW and controller gain of 0.2025

2.2 B-Kp Curve for Various Other Values of Regulation

The entire procedure as mentioned above was repeated for regulation of 3 % p.u. and 5 % p.u., i.e., 1.8 Hz/pu MW and 3 Hz/pu MW, respectively. The average integral controller gains were calculated as, 0.2383 and 0.1685, respectively. In both cases, the variation of *B* with *Kp* was again observed to be smooth hyperbolic curves. These curves are shown in "Figs. 4 and 5," respectively. "Figure 6" shows the curves for all the three cases on a common scale.

2.3 Equations for 'B'

Using curve fitting techniques, the equations for hyperbolic functions were determined for the above three cases. The hyperbolic function was assumed to be of a form $B = \frac{C_1}{Kp} + C_2$, where C_1 and C_2 are constants. The equations obtained for the three cases as above are shown in "Table 3." It should be noted that, the values of C_1 and C_2 are calculated approximately, however, they can be calculated more accurately using appropriate mathematical techniques.

The two area model was then investigated with conventional values of *B* (i.e. with $B = \beta$) and comparison was made between the performances obtained in two cases.

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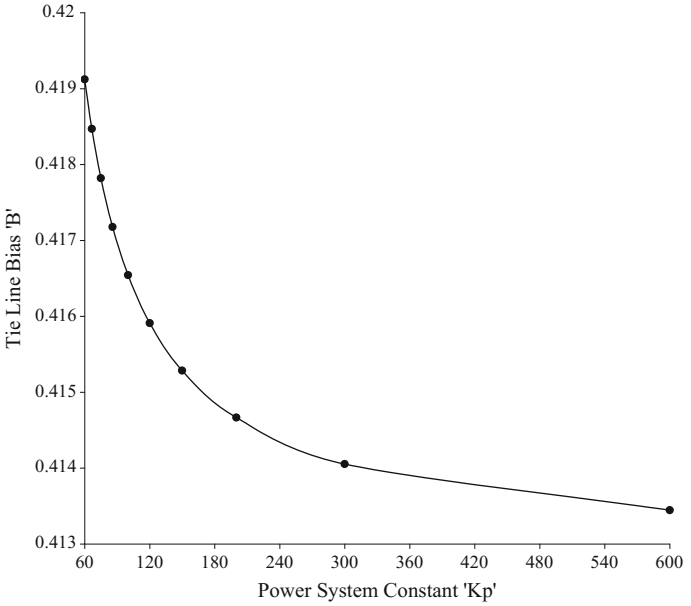

Fig. 4 Variation of tie-line frequency bias '*B*' with power system constant '*Kp*' at a governor regulation value of 1.8 Hz/pu MW and controller gain of 0.2383

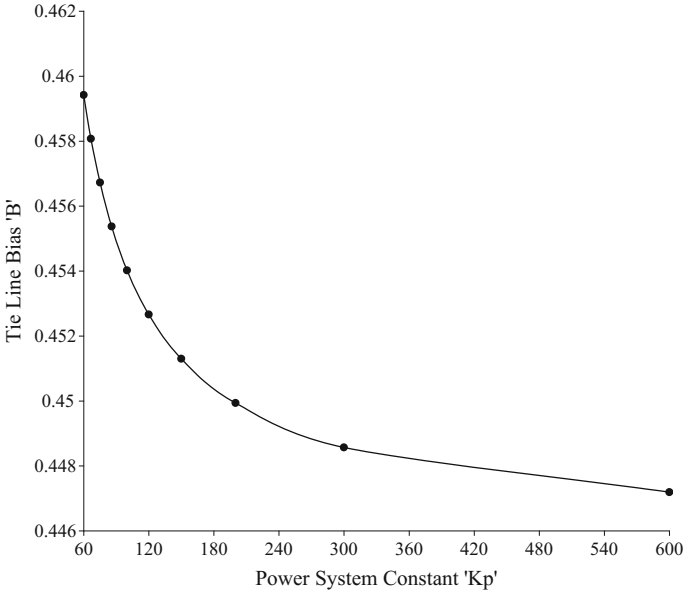

Fig. 5 Variation of tie-line frequency bias '*B*' with power system constant '*Kp*' at a governor regulation value of 3.0 Hz/pu MW and controller gain of 0.1685

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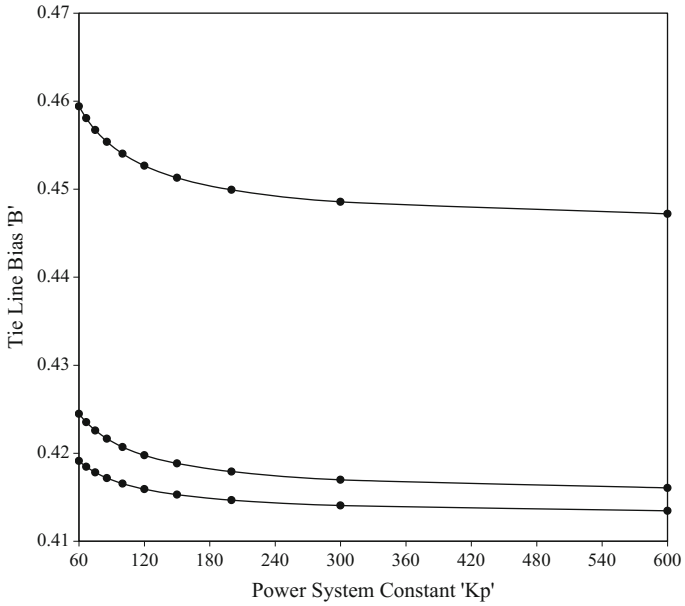

Fig. 6 Variation of '*B*' with '*Kp*' for $R = 1.8$, 2.4, and 3.0 on common scale. The lower curve corresponds to $R = 1.8$, middle to $R = 2.4$ and the upper corresponds to $R = 3.0$ Hz/pu MW

Table 3 Equations for '*B*' at various values of regulation

Regulation	Equation for B
3 % p.u. (1.8 Hz/pu MW)	$B = \frac{0.37853}{Kp} + 0.41281$
4 % p.u. (2.4 Hz/pu MW)	$B = \frac{0.56166}{Kp} + 0.41511$
5 % p.u. (3.0 Hz/pu MW)	$B = \frac{0.81513}{Kp} + 0.44583$

The values of *B* determined with this method and the conventional values of B are tabulated in "Table 4".

3 Observations and Concluding Remarks

(1) With conventional value of *B* (i.e., when $B = \beta$), every time when ΔP_{D1} was changed, the integral controller gain was required to be changed for getting comparable results for Δf_1, Δf_2, and ΔP_{tie}, which could be difficult to achieve in practical systems, whereas, with the values of *B* as determined in present method, the integral controller gain, once set to a value as calculated before,

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Table 4 Observed and conventional values of *B*

Kp	'*B*' with present method $B = \frac{C_1}{Kp} + C_2$			'*B*' with conventional method $B = \beta = \frac{1}{Kp} + \frac{1}{R}$		
	R = 3 %	R = 4 %	R = 5 %	R = 3 %	R = 4 %	R = 5 %
60	0.419123	0.424477	0.459420	0.572222	0.433333	0.350000
66.6666	0.418469	0.423530	0.458074	0.570555	0.431666	0.348334
75	0.417821	0.422585	0.456725	0.568888	0.430000	0.346666
85.7143	0.417178	0.421643	0.455374	0.567222	0.428333	0.344999
100	0.416542	0.420704	0.454020	0.565555	0.426666	0.343333
120	0.415911	0.419767	0.452662	0.563888	0.425000	0.341666
150	0.415286	0.418833	0.451301	0.562222	0.423333	0.340000
200	0.414666	0.417903	0.449937	0.560555	0.421666	0.338333
300	0.414053	0.416976	0.448567	0.558888	0.420000	0.336666
600	0.413445	0.416052	0.447193	0.557222	0.418333	0.334999

was not required to be changed even for the entire range of load perturbation right from $\Delta P_{D1} = 1$ to 100 % and for the entire range of prevailing load on power system.

(2) Since C_1 and C_2 are constants, once they are determined for a particular value of regulation, the corresponding equation for *B* becomes standardized for that value of regulation, as shown in "Table 3."

(3) With this method, if the power system is enabled to sense the prevailing load in real time so as to determine the current value of *Kp* at the time of load perturbation, the value of *B* can be determined and adjusted accordingly almost instantaneously.

(4) The methodology adopted here to determine equation for *B* would be equally applicable for any other model, including nonlinearities and for load disturbances in both areas.

(5) The main benefit of present method of determining the value of *B* is that, the four parameters namely *B*, *Kp*, *R*, and *K* are correlated with each other in such a way that, the value of integral controller gain '*K*,' once set for a particular value of regulation, need not be changed for entire range of operating conditions and for any amount of load perturbation [15, 16].

Parameters values assumed:

Tg Governor time constant = 0.08 s
Tt Turbine time constant = 0.4 s
Ts Tie-line synchronizing coefficient = 0.0707
H Inertia constant = 5 s
f Normal operating frequency = 60 Hz

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Significance of Frequency Band Selection of MFCC for Text-Independent Speaker Identification

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Abstract This paper presents significance of Mel-frequency Cepstral Coefficients (MFCC) Frequency band selection for text-independent speaker identification. Recent studies have been focused on speaker specific information that may extends beyond telephonic passband. The selection of the frequency band is an important factor to effectively capture the speaker specific information present in the speech signal for speaker recognition. This paper focuses on development of a speaker identification system based on MFCC features which are modeled using vector quantization. Here, the frequency band is varied up to 7.75 kHz. Speaker identification experiments evaluated on TIMIT database consisting of 630 speaker shows that the average recognition rate achieved is 97.37 % in frequency band 0–4.85 kHz for 20 MFCC filters.

Keywords Speaker recognition · Feature extraction · Mel scale · Vector quantization

1 Introduction

Speaker recognition is nothing but to recognize the person from known set of voices. Speaker recognition is classified into speaker identification and speaker verification. Speaker identification is nothing but to identify a person from the known set of voices. It is a task of identifying who is talking from known set of voice samples. While, speaker verification is to verify claimed identity of a speaker,

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i.e., Yes or No decision. Speaker identification is further classified into text-dependent identification and text-independent identification. Text-dependent speaker identification requires same utterance in training and testing phase. Whereas, in text-independent speaker identification training and testing utterances are different. Speaker identification system consists of two distinct phases, a training phase and testing phase. In training phase, the features computed from voice of speaker are modeled and stored in the database. In testing phase, the features extracted from utterance of unknown speaker are compared with the speaker models stored in database to identify the unknown person.

Feature extraction step in speaker identification transforms the raw speech signal into a set of feature vectors. The raw speech signal is represented in compact, less redundant feature vectors [1]. Features emphasizing on speaker specific properties are used to train speaker model. As feature extraction is the first step in speaker identification, the quality of the speaker modeling and classification depends on it [2].

In the computation of MFCCs, the spectrum is estimated from windowed speech frames. The spectrum is then multiplied by triangular Mel filter bank to perform auditory spectra analysis. Next step is the logarithm of windowed signal followed by discrete cosine transform. An important step in the computation of MFCC is the Mel filter bank [1, 3]. The MFCC technique computes speech parameters based on how human hears and perceives sound [2]. However, MFCC does not consider the contribution of piriform fossa, which results in high frequency components [4].

The auditory filter created by the cochlea inside human ear has frequency bandwidth termed as critical band. The existence of auditory filter is experimented by Harvey Fletcher [5]. The auditory filters are responsible for frequency selectivity inside the cochlea which helps the listener for discrimination between different sounds. These critical band filters are designed using frequency scales, i.e., the Mel scale and the Bark scale [5]. The MFCCs are widely used in speaker recognition system [2, 6–8]. In previous work, many researchers have demonstrated the dominant performance of MFCCs and contributed to enhance the robustness of MFCC features as well as speaker recognition system. Such efforts are [2, 7–15]. The importance of speaker specific information present in the wideband speech in demonstrated in [16].

This paper presents the importance of frequency band selection. The speaker specific information extends beyond telephonic pass band [16]. The performance of MFCC scheme in different frequency bands is demonstrated in this paper. The organization of this paper is as follows. Section 2 discusses frequency warping scale Mel scale and MFCC computation process. Experimental set-up is discussed in the Sect. 3. Section 4 discusses the results followed by conclusion in Sect. 5.

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2 Mel Scale and MFCC

Nerves in human ear perception system responds differently to various frequencies in a listened sound. For example, sound of 1 kHz triggers nerves while sound of other frequencies will keep quite. This scale is roughly nonlinear in nature. It is like a band-pass filter that looks like triangular in shape. This was observed for how human ear perceives Melody sound. Mel scale is based on pitch perception [5]. Mel scale uses triangular-shaped filters and is roughly linear below 1 kHz and logarithmically nonlinear above 1 kHz. The relationship between Mel scale frequencies and linear frequencies is given as per the following equation,

$$F_{mel} = 2595^{*} \log_{10}\left(1 + \frac{F_{Linear}}{700}\right) \quad (1)$$

Figure 1 shows Mel scale filter bank. MFCC procedure starts with pre-emphasis which boosts the higher frequencies. The high-pass filter given by transfer function, $H(z) = 1 - az^{-1}$ where, $0.9 \leq a \leq 1$ is generally used for pre-emphasis. The pre-emphasized signal is divided into frames of duration 10–30 ms with 25–50 % overlap to avoid loss of information. Over this short duration, speech signal is assumed to remain stationary. Then, each frame is multiplied with Hamming window in order to smooth the speech signal. After windowing step, fast Fourier transform is used to estimate the frequency content present in speech signal. Next, the windowed spectrum is integrated with Mel filter bank which is based on Mel scale as given in Eq. (1). The vocal tract response is separated from excitation signal using logarithm of windowed spectrum integrated with Mel filter bank followed by discrete cosine transform.

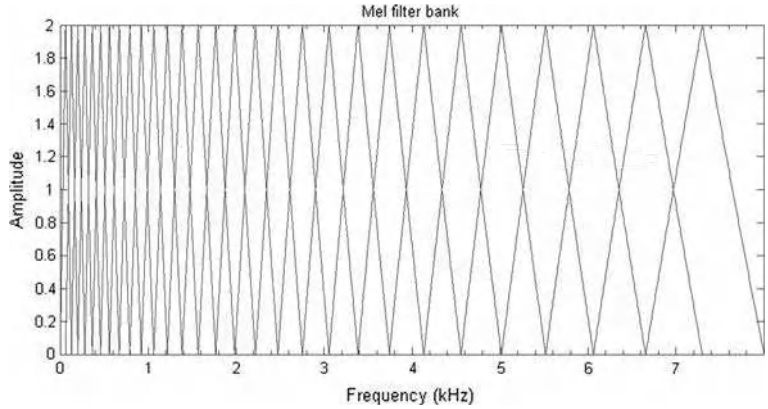

Fig. 1 Mel filter bank

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3 Experimental Set-up

In this paper, the performance of Mel-frequency cepstral coefficients frequency band selection for text-independent speaker identification system is evaluated on TIMIT [17] database. TIMIT database consists of a total number of recordings of 630 speakers among which 438 are male speakers and 192 are female speakers. There are ten different sentences of each speaker of sampling frequency 16 kHz which makes a total of 6300 sentences recorded from 8 dialect region of the United States. For training of speaker model, eight sentences, five SX and three SI (approximately 24 s) were used. For testing purpose, two remaining SA sentences (sentences of 3 s each) were used. All the experiments have been performed using HP Pavilion g6 laptop with CPU speed of 2.50 GHz, 4 GB RAM, and MATLAB 8.1 signal processing tool.

The speech signal has been pre-emphasized with the first-order high pass filter given by equation $H(z) = 1–0.95z^{-1}$. The signal is divided into 256 samples per frame with 50 % overlap followed by the Hamming window. The spectrum of the windowed signal is calculated by fast Fourier transform (FFT). The spectrum is multiplied by Mel-filter bank followed by logarithm and discrete cosine transform (DCT) to obtain MFCCs. Speaker model is generated for each speaker from the MFCCs using vector quantization (LBG algorithm). This speaker model is stored in the database. In testing phase, MFCC features of an unknown speaker are extracted. Next, Euclidean distance between MFCC features and speaker model stored in the database is calculated. The speaker is recognized on the basis of minimum Euclidean distance computed between MFCC features in testing phase and speaker model stored in database. The experiments are carried out for different number of MFCC filters, i.e., 20 and 29 in the frequency band 0–4 kHz. Next, frequency is varied up to 7.75 kHz with 20 MFCC filters. The number of MFCC filters is varied as 13, 20, and 29 in the significant frequency band to observe the average recognition rate. In each experiment, first 12 cepstral coefficients excluding the 0th coefficient are selected and the number of clusters of vector quantization is 32.

4 Results and Discussion

Frequency band 0–4 kHz is analyzed for MFCC filters equal to 20 and 29. This frequency band is analyzed in two separate intervals. First, frequency band 0–2 kHz is analyzed and then frequency band 0–4 kHz is analyzed. The recognition rate in percentage is calculated by,

$$\text{Recognition Rate} = \frac{\text{Number of correct matches}}{\text{Total number of test speaker}} \times 100\%$$

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Table 1 Recognition rate for frequency range 0–4 kHz

Sr. no.	Frequency band (kHz)	Sampling frequency (kHz)	No. of filters	Average recognition rate
1	0–2	0–4	20	81.18
2	0–2	0–4	29	83.41
3	0–4	0–8	20	95.95
4	0–4	0–8	29	95.80

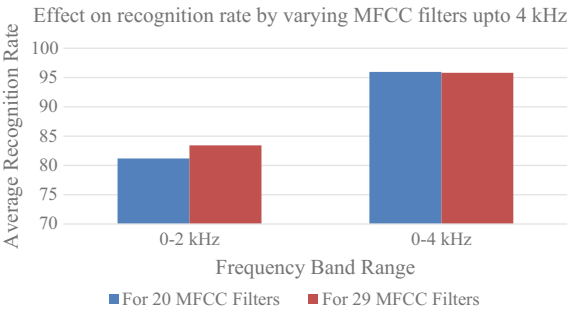

Fig. 2 Effect on recognition rate by varying MFCC filters up to 8 kHz

The following Table 1 and Fig. 2 shows the average recognition rate observed in these bands.

It is observed that the frequency band 0–4 kHz has provided a good resolution as compared to frequency band 0–2 kHz. This is because average recognition rate of 95.95 % is observed for 20 MFCC filters in frequency band 0–4 kHz. This indicates that speaker specific information is present up to 4 kHz. Also, varying the number of filters in these bands has less effect on recognition rate as compared to variation in frequency band. In addition to number of filters, it is also important to select a frequency band which is having good resolution for speaker identification.

In next subsequent experiments 20 MFCC filters are chosen and frequency band is varied up to 7.75 kHz. Table 2 and Fig. 3 shows the effect on recognition rate by varying frequency band.

Table 2 Effect on average recognition rate by varying frequency band up to 7.75 kHz for 20 MFCC filters

Sr. no.	No. of filters	Frequency band (kHz)	Sampling frequency (kHz)	Average recognition rate
1	20	0–4	0–8	95.95
2	20	0–4.75	0–9.5	96.66
3	20	0–4.85	0–9.7	97.37
4	20	0–4.9	0–9.8	96.90
5	20	0–4.95	0–9.9	96.58
6	20	0–5	0–10	96.66
7	20	0–6	0–12	81.58
8	20	0–7.75	0–15.5	61.83

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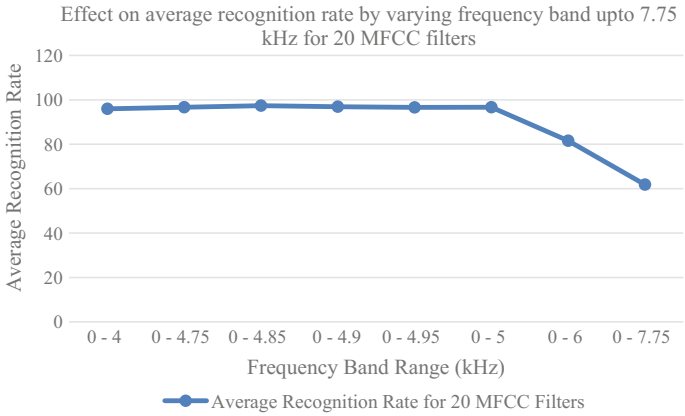

Fig. 3 Effect on average recognition rate by varying frequency band for 20 MFCC filters

Table 3 Effect of varying MFCC filters in frequency band 0–4.85 kHz

Sr. no.	No. of MFCC filters	Frequency band (kHz)	Sampling frequency (kHz)	Average recognition rate
1	13	0–4.85	0–9.7	95.32
2	20	0–4.85	0–9.7	97.37
3	29	0–4.85	0–9.7	97.30

From Table 2, it is observed that frequency band 0–4.85 kHz is the significant frequency band. This is because the maximum average recognition rate achieved is 97.37 % in this frequency band for 20 MFCC filters. Thereafter, average recognition rate is decreasing as shown in Table 2. It is observed that speaker specific information extends beyond 4 kHz, and therefore, it is important to select frequency band. Next, in the significant frequency band, i.e., 0–4.85 kHz, MFCC filters are varied and effect on average recognition rate is observed. Following table shows the effect of varying MFCC filters in frequency band 0–4.85 kHz.

From Table 3 and Fig. 4, it is observed that there is no much more improvement in average recognition rate by varying number of filters in the significant frequency band.

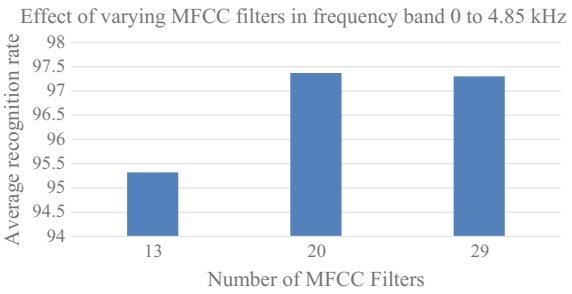

Fig. 4 Effect of varying MFCC filters in frequency band 0–4.85 kHz

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5 Conclusion

In this paper, the significance of selection of Mel-frequency Cepstral Coefficients (MFCC) frequency band for speaker identification is proposed. First, frequency band 0–2 kHz is selected and MFCC filters are varied in this frequency band. Next, frequency band is varied 0–4 kHz and MFCC filters are varied in this band. It is found that speaker specific information is present in the frequency band 0–4 kHz is much more as compared to 0–2 kHz. Further, frequency band is varied up to 7.75 kHz. It is observed that the average recognition rate achieved is 97.37 % in the frequency band 0–4.85 kHz for 20 MFCC filters. This indicates that speaker specific information is present up to 4.85 kHz. Thereafter, recognition rate is decreasing. In the significant frequency band 0–4.85 kHz, MFCC filters are varied as 13, 20, and 29 and it is observed that there is no much more improvement in the average recognition rate.

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Ensuring Performance of Graphics Processing Units: A Programmer's Perspective

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Abstract This paper mainly focuses on the usage of automation system for ensuring the performance of graphics driver created at Intel Corporation. This automation tool takes into account a client-server structural planning which can be utilized by the developers or the validation engineers so as to guarantee whether the graphics drivers are programmed and modified accurately or not. The tool additionally actualizes some of the Driver Private APIs (it allows any application to talk directly with the driver) which will guarantee the properties of the features which are not bolstered by the Operating System (OS).

Keywords Graphics Processing Unit (GPU) · Operating System (OS) · Windows Display Driver Model (WDDM) · Driver Private APIs

1 Introduction

The integrated graphics component, specifically called the Graphics Processing Unit (GPU) resides on the same chip die as the Central Processing Unit (CPU), and communicates with the CPU via on-chip bus, with internal memory and with output device(s). As Intel GPUs have evolved, it occupies a significant percentage of space on the chip, and provides high performance and low-power graphics processing by eliminating the need to purchase a separate video card. A driver enables OS and

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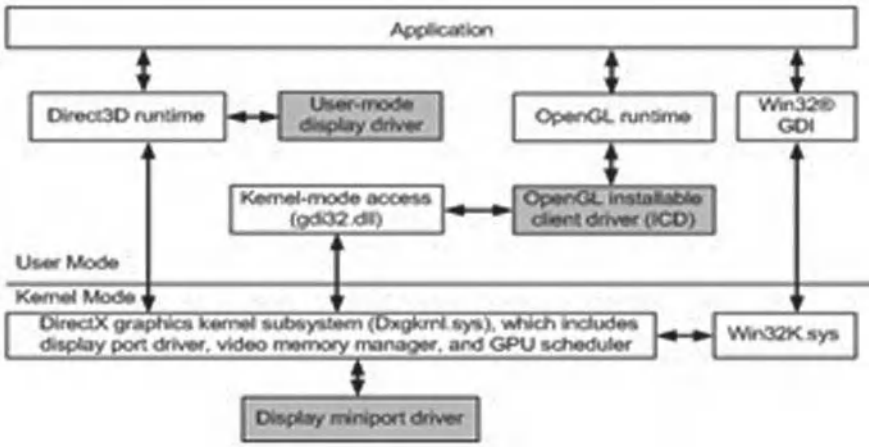

Fig. 1 Architecture required to support WDDM

other computer programs to access hardware functions without the knowledge of the hardware being used.

The display drivers at Intel Corporation are written according to the Windows Display Driver Model (WDDM) [1] as shown in Fig. 1. The display driver model architecture for WDDM, available starting with Windows Vista, is composed of user-mode and kernel-mode parts. WDDM drivers contribute towards greater operating system (OS) stability and security because of small code execution in kernel-mode where it can access system address space and possibly cause crashes. At whatever point an engineer implements any new feature/fixes any bug for the GPU device driver and/or device drivers expected to be redesigned much of the time keeping in mind the end goal to allow better use of the GPU, one needs to verify that the GPU is working and customized effectively for the particular device driver including different display's setup having distinctive variations of the displays.

This tool explores the development of an automation system for totally ensuring the performance of the device drivers for the cutting edge GPUs. This tool ensures that GPU is customized and works accurately for the particular device driver by setting distinctive display setups and features including different variations of the displays. The hardware may bolster different properties of the features which may not be supported by the Operating System. Keeping in mind the end goal to guarantee those properties this tool will implement several new Driver Private APIs that will let the developer guarantee those properties by bypassing the operating system. Each graphics driver created at Intel Corporation is initially validated by the developers themselves and afterward validated by the validation team before releasing, yet the graphics driver created may have some bugs. Since there is a two-level approval mechanism for every display driver or driver redesign, developers/validation engineers dependably attempt to catch as many bugs as possible in the drivers before releasing them to the customers, yet at the same time the bugs may be there due to

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missing some corner case validation or a percentage of the bugs may be sporadic bugs which happens at unpredictable interim or just with a very unusual kind of scenario which may have been missed by the developers or the validation engineers.

Automation [2] system helps in expanding the effectiveness, adequacy and scope of validation of the item before it is released to the customers. The principle point of interest of test automation is to keep away from the human-inclined bugs while executing the tests. For each release of the graphics driver it must be validated on all supported operating systems, platforms and with all supported display configurations. Physically testing these systems is costly and tedious. Utilizing an automation tool, these validation techniques can be rehashed various times, with no extra cost and they are much speedier than the validation done by the developers and/or validation engineers. Automation system can decrease the time to run monotonous approval strategies from days to hours.

2 Motivation

The performance of a GPU device driver is a measure that how effectively the GPU is functioning and modified. Ensuring the performance of the device driver for a GPUs is an extremely complex assignment since as it includes manual choice of distinctive displays setups including display variations like DP (Display Port), EDP (Embedded Display Port), HDMI (High Definition Multimedia Interface), VGA (Video Graphics Array), and diverse display related features like, modeset, scaling, deep color, display switching, wide gamut, Gamma, and many others. These determinations frame a situation and for better performance check display driver ought to be confirmed over all such possible situations. This is driving and prompting development of automation system where these situations can be produced in type of experiments and GPU can be checked over all these experiments.

The test improvement is a real exertion and regardless of the fact that an expansive arrangement of tests is composed, a developer or validation engineer cannot humanly expect every single possible thing that can happen and create tests appropriately. A validation group comprises of number of specialists, every in charge of an outline unit. A validation engineer will outline a unit base on his instinct, suspicions and his comprehension of how the modules to which his module will convey, carries on. There are risks that a validation engineer comprehension of outside environment is inadequate and thus risks of bugs. Here again, the validation engineer cannot in any way, shape or form foresee all the issues that can come up. So it is an extremely monotonous and the shots of accurately confirming the quality are likewise exceptionally thin.

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3 Literature Survey

Few benchmark tools like HP Quick Test Professional (QTP) and IBM Rational Functional Tester (RFT) have been clarified in a nutshell.

3.1 HP QuickTest Professional [3]:

HP QuickTest Professional gives practical and relapse test automation for programming applications and situations. Some piece of the HP Quality Center tool suite, HP QuickTest Professional can be utilized for big business quality confirmation. HP QuickTest Professional backings essential word and scripting interfaces and features a graphical client interface. It utilizes Visual Basic Scripting Edition (VB Script) scripting dialect to indicate a test method, and to control the articles and the application under approval. It can be utilized for taking following operations:

- Verification: Checkpoints confirm that throughout approval system, the genuine application conduct/state is steady with the normal application conduct/state.
- Exception Handling: HP QuickTest Professional oversees special case taking care of utilizing recuperation situations; the objective is to keep running approval system if a startling disappointment happens
- Data driven acceptance: HP QuickTest Professional backings information driven approval. For instance, information can be yield to an information table for reuse somewhere else.

3.2 IBM Rational Functional Tester [4]:

IBM Rational Functional Tester is programming test computerization device utilized by quality affirmation groups to perform robotized relapse acceptance. Execution designers make scripts by utilizing a test recorder which catches a client's activities against their application under approval. The recording component makes an approval script from the activities. The approval script is delivered as either a Java or Visual Basic. net application is spoken to as a progression of screenshots that frame a visual storyboard. Execution specialist can alter the script utilizing standard charges and sentence structure of these dialects or by acting against the screen shots in the storyboard. Acceptance scripts can then be executed by Rational Functional Tester to accept application usefulness. To utilize the IBM Rational Functional Tester execution specialist ought to have learning of Java or Visual Basic.net application.

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3.3 Test Automation for Web Applications:

Numerous, maybe most, programming applications today are composed as online applications to be keep running in an Internet browser. The viability of testing these applications fluctuates generally among organizations and associations. Selenium [5] is a set of different software tools each with a different approach to supporting test automation specially for the web applications. The entire suite of tools results in a rich set of testing functions specifically geared to the needs of testing web applications of all types.

The study [6] has been done on what are all the different features which must be tried keeping in mind the end goal to ensure the performance of the Graphics Driver created at Intel Corporation. It incorporates distinguishing different display design and display variations which are conceivable with every era of Intel Graphics Processing Chipset.

4 Challenges and Need

Key components needed for a Test Automation [7] to be effective include Committed Management, Budgeted Cost, Process, Dedicated Resources, and Realistic Expectation. Test computerization system advancement is a multi-stage process. Every stage includes various difficulties to be tended to that are defined beneath

1 Clear Vision: Clear vision of what needs to be attained out of this mechanization must be characterized and reported. To figure the reasonable vision, the accompanying needs to be recognized (refer Fig. 2):

   a Testing Model—To be adjusted (Enterprise, Product, Project)
   b Types of testing under the extension in light of the testing model
   c Prioritizing the mechanization action taking into account application/ module (for instance: Conducting practical testing and afterward execution testing)
   d Identify the zones that need to be mechanized (for instance: Registration, Order preparing)
   e Challenging acceptances that need to be considered (for instance: Communicating from windows to Linux machine and executing the tests)
   f Critical and required functionalities

2 Tool Identification And Recommendation: Tool recognizable proof methodology is a critical one, as it includes discriminating components to be considered. The various components are:

   a Creating a standard tool assessment agenda which needs to be made by considering sorts of testing, groups included, authorizing expense of the

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Fig. 2 Testing automation feasibility

instrument, upkeep cost, preparing and backing, device's extensibility, instrument's execution & dependability and so forth.

b Testing necessities which may incorporate sorts of testing, for example, Functional, Performance, and Web Service and so forth.

c The need of various instruments to perform distinctive sorts of testing on the item/venture.

3 Framework Design: System configuration includes distinguishing prerequisites from different ranges. At an abnormal state, this incorporates (not restricted to):

a Identification of important utility/parts identified with application functionalities.

b Types of information store to be conveyed for information stream.

c Communication between the utilities/segments (for instance: information registration parts imparting to the lumberjack).

d Communication between the frameworks and utility/segment advancement identified with the same.

e Tool developing abilities—Developing utilities/segments for the approvals not bolstered by the distinguished test mechanization tool, if any.

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5 The Tool

The thought is to give a bound together standard stage to accept the nature of Intel Graphics Driver by the architects on any obliged stage, i.e., distinctive graphics cards and diverse display devices. The tool depends on the current display configuration and the register qualities being sent to the display port. The inward graphics pipeline stages are disregarded. This is in light of the way that when the same image is shown at the same display configuration, the register values for the yield port will likewise be the same. In order to guarantee the features which are upheld by the hardware, however, not by the working OS, new Driver Private API (Driver Private APIs is the particular case that let any application to talk with the driver) will be executed to sidestep the operating system and makes fake calls which should be finished by the operating system.

5.1 Implementation:

This tool gives a client-server model [8] where the developers/validation engineer can calendar tests remotely from their PCs and get the report of tests conveyed once the test is over. Hence, the user no longer has to worry about setting up the system to run the test and whatever other needed (abstraction of tests from user). The general approach followed for the design of tool is shown in Fig. 3.

It will be implemented in three parallel tracks:

Fig. 3 Design methodology

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1. Track 1: Implementation of Client Server Architecture [9] so as to dispatch the test remotely from any area and implementing web services in place guarantee the CRC (Cyclic Redundancy Check) with the end goal of accepting the yield of the test for different graphics related features including different displays variations (HDMI, DP, EDP, and VGA) and diverse era of processors too.
2. Track 2: Implementation of mechanizing different graphics related features, catching CRC with the end goal of approving the further tests.
3. Track 3: Integration of new Driver Private APIs which are to be utilized to bypass the OS. Whatever should be finished by the OS, these driver APIs will do those fake capacity calls and afterward we can guarantee the nature of those features which are not upheld by OS.

The specimen command line which is to be utilized to ensure Mode set feature on the Tri Extended display design: TestSuite.exe EDP 1 DP 1 HDMI 1 FEATURE MODESET TESTLEVEL 1 DISPCONFIG TE

The tool will supports three distinctive level of test execution regarding the multifaceted nature of the test:

1. Test level 1 (Basic): Used to guarantee the predefined feature with fundamental test situations like for ModeSet with just two resolutions
2. Test level 2 (Intermediate): Used to guarantee the predefined feature with some more unpredictable test situations like for ModeSet with some more distinctive resolutions
3. Test level 3 (Extensive): Used to guarantee the predefined feature with all the conceivable different features which may be influenced by any progressions to the predetermined feature.

Contingent on the necessity of the engineers, they can utilize the test as need be.

5.2 Components of the Tool:

The tool consists of several components which provide related set of services are (shown in Fig. 4):

1. Control Panel: Control board is utilized to choose the different parameters for the test like Display Configuration, feature to be tried, show variations, test level and discretionary CRC related parameters (Fig. 5).
2. CRC Manager: CRC Manager is in charge of giving the CRC related administrations like capturing CRC in the CRC database and afterward later utilizing the same CRC for the confirmation reason.
3. Grid Controller/Node Controller Services: This is utilized to give the correspondence between the Server which dispatches the test and in charge of the CRC stuff and the test hubs which are only the genuine equipment.

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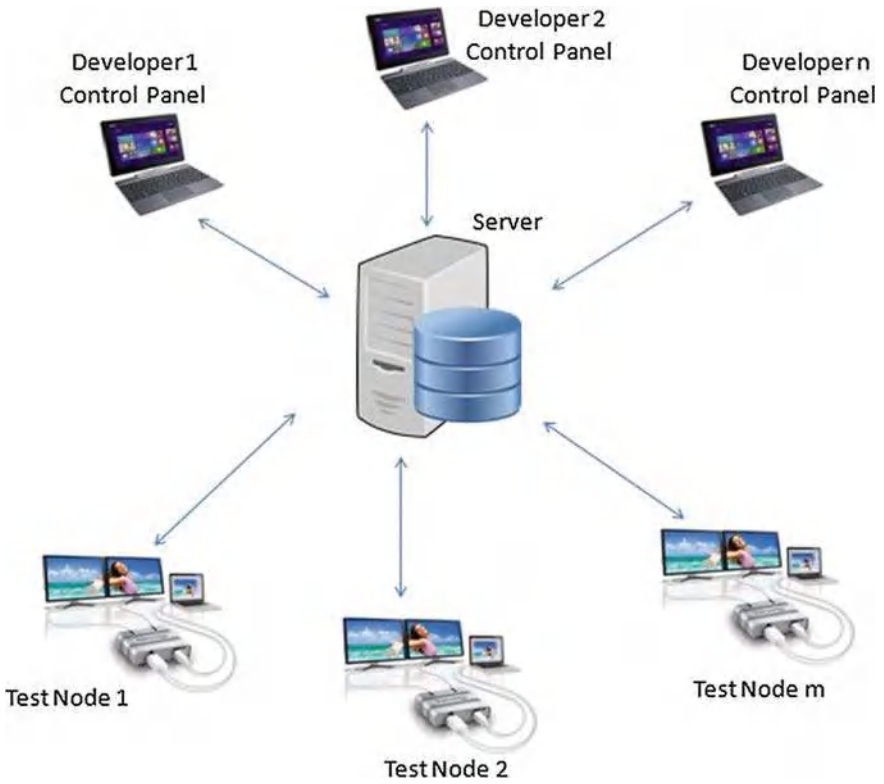

Fig. 4 Tool architecture

4. Test Nodes: The real equipment machine where one of the test is launched and executed.
5. Log Manager: Responsible for creating a wide range of logs and including doing the register dump moreover.
6. Interface Manager: gives the from now on correspondence between the equipment, illustrations CUI and the test.
7. Test Suite: Collection of every last one of tests for the distinctive feature and for each of the three unique levels.
8. Feature Suite: Consists of the computerization of every last one of design related feature which can be tried.

6 Results

This task brought about a computerization tool which is three times quicker than different devices and lessened the work power and the time needed to approve the display driver created at Intel Corporation. This tool helps in expanding the accuracy

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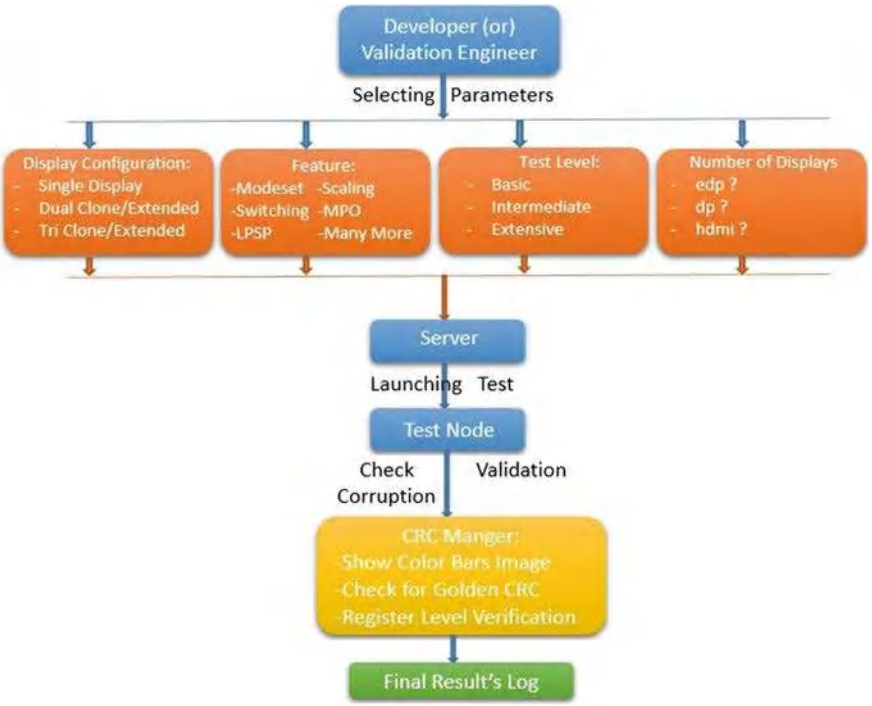

Fig. 5 Steps to be followed to run a Test

of the graphics driver and in the meantime spares the time required for ensuring the performance of the graphics driver. Presently, with the assistance of this tool the developer/validation engineer require not to invested their important energy for performing Unit Level Testing, it will be taken into consideration by the tool and in the instance of failure the developer/validation engineer will be getting the detailed logs which can be utilized to examine the failure that happens.

7 Conclusion

Considering the end goal to automate [10], a great deal of time ought to be spent in examination about the styles and methods of automation and discover a building design that fits nature. In Testing GPUs the client needs to set up distinctive setups to run every test which is a pointless overhead. Besides this is additionally brings about underutilization of assets as the setup needed for one test may be obliged to run some other test for testing an alternate GPU.

This automation system takes out the need of equipment setup for every individual necessity, as test hubs will be pre-configured. Any client can plan tests on these

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hubs without having to stress over where these tests will run physically. Regardless of the fact that no hubs are accessible right now to launch the test, the test will get queued. The server will run the test once a free hub with coordinating equipment setup is accessible. This system expands asset usage likewise as the same test hubs can be utilized by any number of clients so taking out the need of an alternate setup for every group. Likewise, the tests can be requested specifically from the developers/validation engineer's PCs through the Control Panel which speaks with the server remotely, hence extraordinarily expanding the accommodation of the client.

This undertaking introduces a savvy method for automation of approval procedures for the graphics driver developed by Intel Corporation. This tool has a superior execution, when contrasted with alternate devices accessible in the business sector, regarding the speed of execution and the circle space utilized. It is easy to use and simple to learn. It automates the procedure of acceptance effectively with little assistance from the developer and the individual who automates the application needs to take after basic Test Descriptive Language linguistic structure while composing the approval explanations.

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Analytical Study of Miniaturization of Microstrip Antenna for Bluetooth/WiMax

Pranjali Jumle and Prasanna Zade

Abstract In this paper, we propose a different size reduction approach of MSA for Bluetooth, WiMAX applications. Prime emphasize of this work is to study the reactance of MSA, i.e., effect of inductive and capacitive reactance and it is validated by Smith chart. A novel technique of insertion of two parallel plates in the middle of patch and in close vicinity to the feed position to achieve the inductive effect for different applications is presented with 82 % size reduction. By single shorting plate along the edge of MSA and near to the feed position separately 2.4 and 3.5 GHz band with 75, 110 MHz BW and 3.4, 3.8 dBi gain, respectively, and 73 % size reduction is obtained. Capacitive effect by varying and selecting optimum feed position without any complexity for dual band WiMAX and WLAN 115, 150 MHz BW with gain 3.8, 4.3 dBi reported and 36 % of size reduction is reported.

Keywords Miniaturized patch antenna · Single/two parallel shorting plate · Smith chart · Capacitive and inductive reactance

1 Introduction

Compact designing of microstrip patch antennas has received much interest due to the increasing demand of small antennas for private communications systems such as portable and handheld wireless devices.

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Microstrip antennas having the advantages of low profile, light weight, low fabrication cost, and compatibility with MMIC [1, 2], are half-wavelength structures which are bulky in personal wireless devices. Many techniques have been adopted to reduce the size of the patch antennas, such as employing high dielectric substrate [3, 4], introducing fractal geometries [5], introducing shorting post [3, 6], loading chip-resistor and chip-capacitor [7, 8], loading of complementary split-ring resonator [9], loading reactive components [10], lengthening electrical path of the current by meandering [3, 11], introducing slots and slits into the patch [12–14], loading suspended plate [15], also many papers have quoted the metamaterial structures to reduce the size of patch antennas [16].

Also, loading distributed reactive components yield in miniaturization. In [17], paper presents two by two multiple-input multiple-output patch antenna systems with complementary split-ring resonator loading on its ground plane for antenna miniaturization. In [18], a loaded shorting elements is introduced which are parasitic to the driven patch, but are shorted to the ground plane which results in size reduction as well as a good radiation pattern. In [19], a via-patch is introduced under the radiating element to create a capacitive coupling effect and lowering the resonating frequency results in reduction of antenna size by almost 50 %. Also, a slight change in the height and location of via can regulate the resonant frequency of the antenna and is also presented. In [20], a method for size reduction of patch antennas is presented by introducing an irregular ground structure to provide capacitive and inductive loading to the patch.

In this paper, a size reduction of microstrip patch antenna and study of impedance characteristics from smith chart are presented. Paper is organized into three parts; first the effect of feed position and shorting plate is studied by varying distance between their locations and shifting of resonant frequency is studied with Smith chart. By means we study and explain the effect of dominant inductive reactance. Second, a very simple approach to obtain dual band characteristics with simply optimizing feed position and study of capacitive reactance with the help of Smith chart is validated. Finally, a novel concept of insertion of two parallel plates in the middle of patch and in the vicinity of feed position is presented, size reduction of 82 % is reported.

2 Design

To design a MSA, we use FR4 Substrate with dielectric constant 4.4 and loss tangent 0.0019 is used throughout this study. Simulation and design are performed in IE3D software.

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2.1 Case I: Study of Inductive Effect by Adding Shorting Plate

As shown in Fig. 1a, the RMSA, rectangular microstrip patch antenna is analyzed at the operating frequency of 3.5 GHz (see Fig. 3a). Feed point located along length, the fundamental resonating mode obtained is TM_{10} can be calculated from Eq. (1).

$$f_o = \frac{c}{2\sqrt{\varepsilon_r}}\sqrt{\left[\left(\frac{m}{L}\right)^2 + \left(\frac{n}{W}\right)^2\right]} \tag{1}$$

It is important to note that a 3.5 GHz is showing slightly capacitive in the Smith chart shown in Fig. 2a. Figure 1b shows the RMSA with shorting plate along edge (see Fig. 1c), which introduces the inductive effect, i.e., 2.4 GHz is obtained from 3.5 GHz by adding single shorting plate (see Fig. 3b).

3.5 GHz is modified to reduce antenna physical size by adding single plate in the vicinity of feeding probe. It shows better impedance matching if the distance between plate and feed is about 1.45 mm. If distance between plate and feed is reduced to less than 1.45 mm, i.e., if feed point is close to plate, then frequency shifts to higher side.

Smith chart in Fig. 2b indicates that by adding plate along the edge, 3.5 GHz of basic patch shift to inductive region, i.e., by adding shorting plate, inductive effect

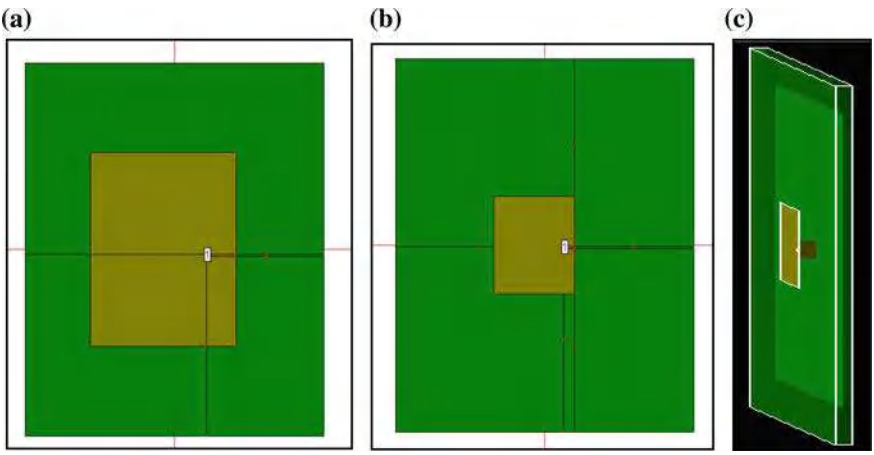

Fig. 1 RMSA in IE3D, Zeland Software, **a** without shorted-plate, **b** with shorted-plate, **c** 3D View of part **b**

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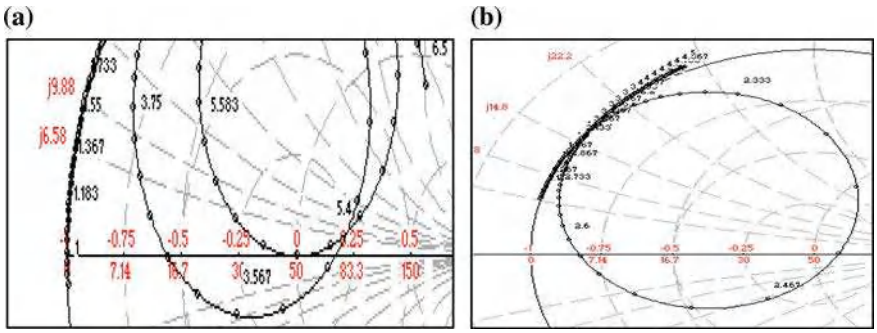

Fig. 2 Smith chart of RMSA, **a** without shorted-plate, **b** with shorted-plate

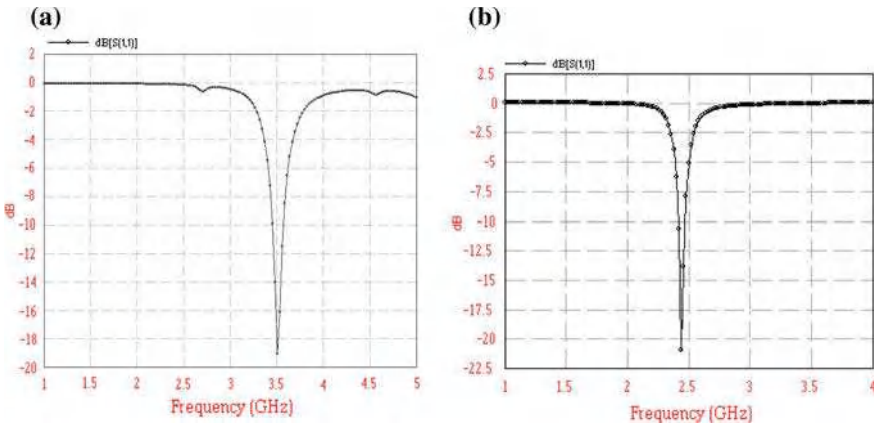

Fig. 3 Return loss of RMSA, **a** without shorted-plate, **b** with shorted-plate

Table 1 Comparison between RMSA dimension parameters without and with shorting plate

	Length (mm)	Width (mm)	Area (sq. mm)	% of size reduction
RMSA	19.97	26.08	509.6	72.91 %
RMSA with shorting plate	10.55	13.1	138.02	

is leading in overall reactance. Thus, by addition of shorting plate, the physical size of antenna becomes $L * W = 10.55 * 13.1 =$ Area $= 138.02$ sq.mm.

Percentage size reduction $= \frac{509.6 - 138.02}{509.6} * 100 = 72.91\%$ as compared to original patch (see Table 1).

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2.2 Case II: Study of Capacitive Effect by Changing the Feed Position for Dual Band

Changing the original feed location from 4.28 to 4.60, i.e., (0.32 mm) from TM_{10} mode, next higher order mode can be excited. By optimizing feed point and width we get 5.5 GHz. Smith chart in Fig. 4b shows shifting of 3.5 GHz to capacitive half portion as compared to basic 3.5 GHz (see smith chart in Fig. 4a), where 3.5 GHz is along resistive line.

In this case, there is no electrical as well as physical size reduction but we make the dual band antenna (see Fig. 5) by only well optimizing feed point location.

$$\text{Size reduction in frequency} = \frac{5.5 - 3.5}{5.5} * 100 = 36.36\,\%$$

2.3 Case III: Study of Inductive Effect by Adding Shorting Parallel Strips

Figure 6a shows the layout of RMSA having calculated parameters are $L = 12.16$ mm, $W = 16.6$ mm in IE3D, Zeland Software operated at 5.5 GHz. Smith chart in Fig. 6b shows 5.5 GHz location less capacitive.

Adding shorting parallel strips in the vicinity of feed point, a lower order resonating mode for the antenna having same parameter for 5.5 GHz can be achieved. The same structure is now resonating at 2.4 GHz by observing Smith chart in

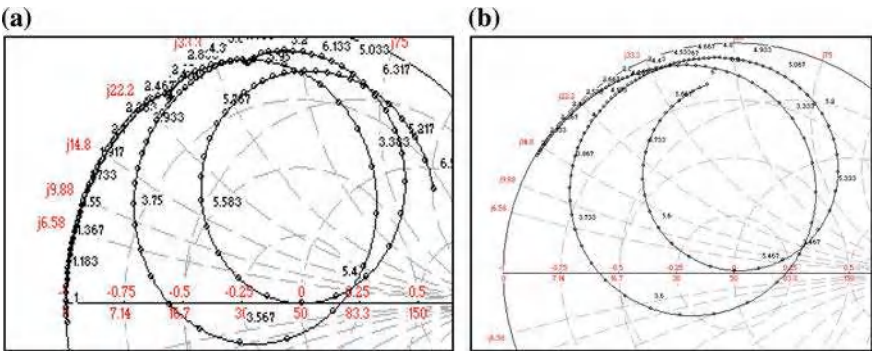

Fig. 4 Smith chart of RMSA, **a** 3.5 GHz along resistive line, **b** 3.5 GHz toward capacitive region

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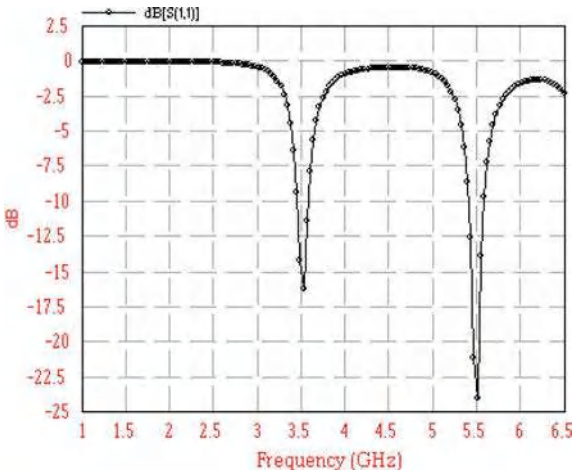

Fig. 5 Return loss of RMSA incorporating 5.5 GHz along with 3.5 GHz, i.e., higher order mode excited

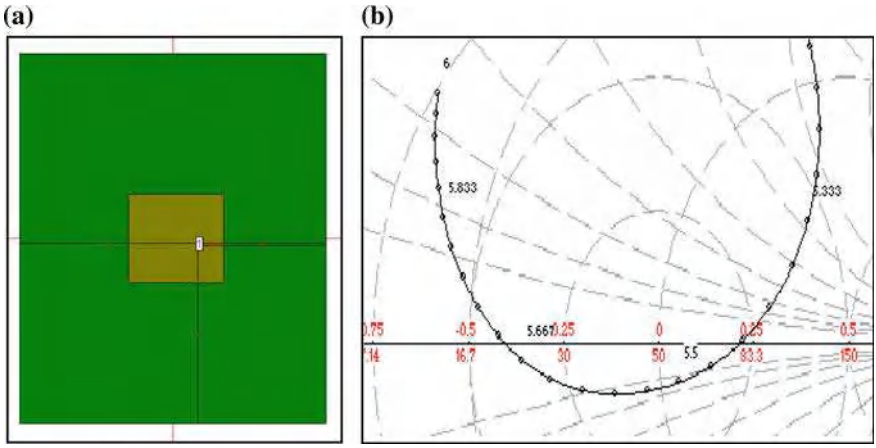

Fig. 6 **a** RMSA in IE3D, Zeland Software operated at 5.5 GHz, **b** its Smith chart

Fig. 7b carefully and if we compare smith chart of Fig. 6b and that of Fig. 7b, it is clearly shown that in smith chart of Fig. 6b for 5.5 sq. patch impedance the location is near to resistive line with less capacitive effect, i.e., overall reactance is capacitive but after addition of two parallel plate in the vicinity of feed point, the lower order mode is excited. It is clearly evident from Smith chart in Fig. 7b where it is shown the shift of 5.5 GHz location to more upper part of inductive region.

Physical size reduction (see Table 2) $= \frac{1119.9 - 206.3}{1119.9} * 100 = 81.60\,\%$

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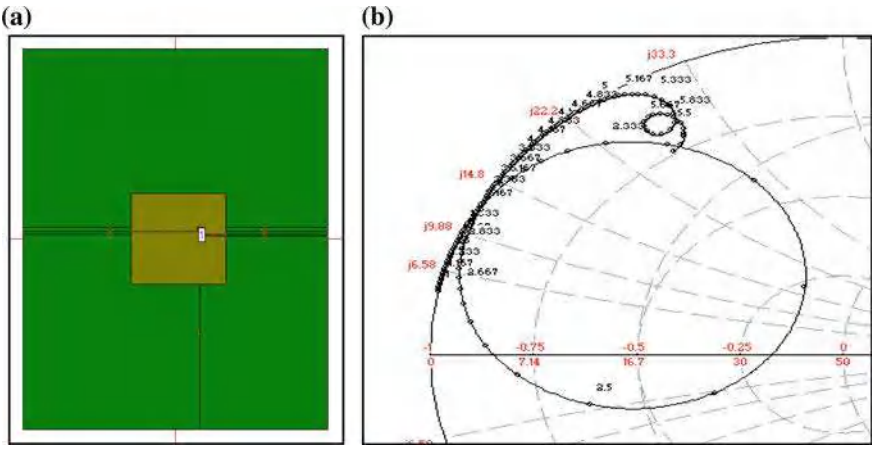

Fig. 7 **a** RMSA in IE3D, Zeland Software operated at both 2.4 and 5.5 GHz, **b** its Smith chart

Table 2 Comparison between 5.5 and 2.4 GHz dimensional parameters

Resonating frequency	W (mm)	εreff	Leff (mm)	2ΔL (mm)	L (mm)	Area (mm^2)
5.5 GHz	16.59	3.85	13.89	1.45	12.44	206.3
2.4 GHz	38.04	4.08	30.92	1.48	29.44	1119.9

3 Conclusion

In this paper, a microstrip antenna is presented which is compacted by 82 % after loaded with two parallel shorted plates. By studying the above cases, it is concluded that loading the inductance in overall reactance causes shifting of resonance frequency toward lower end while loading the capacitance in overall reactance causes excitation of higher order modes. The experimentation is carried out for Bluetooth/WiMax applications (Table 3).

Table 3 Study of gain and BW for Bluetooth/WiMax/WLAN

	Bluetooth	WiMax	WLAN
Frequency	2.4 GHz	3.5 MHz	5.5 GHz
Gain (dBi)	3.4	3.8	4.3
Bandwidth (MHz)	70	115	150

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Novel All-Optical Encoding and Decoding Scheme for Code Preservation

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Abstract This paper presents an all-optical code preserving encoder and decoder. The proposed encoder and decoder serve to preserve the code in between the communication channel for enhanced security of binary data. It is designed using the XGM effect in SOAs. The communication includes encoder and decoder simulations and results are evaluated in terms of logic received and Extinction ratio of systems. The encoder and decoder are verified to preserve the code appropriately.

Keywords All-optical · Encoder · Decoder · XGM · SOA

1 Introduction

The interminable need for superior processing speed for high bandwidth and information processing application is placing stern pressure on researchers to design techniques that can remarkably promise massively parallel data processing. More and more novel techniques and methods are being explored with increase in bit rates, number of optical channels. Study in the arena of new modulation formats is in a great pace for past few years. Alteration from simple line coding to DPSK-modulated system is gaining speed as it has made possible the upliftment of operational bit rate from 10 to 40 Gbps [1]. DPSK justifies interest in using it by

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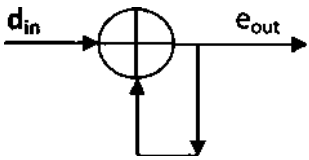

Fig. 1 Encoder schematic

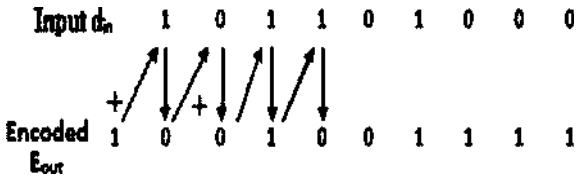

Fig. 2 Encoding operation illustration

presenting forbearance to nonlinear impairments occurring in optical communication links [2]. In this communication, we present an all-optical code preserving encoder and decoder using cross phase modulation in semiconductor optical amplifiers. The simulation shows encoding, phase reversal, and decoding process.

Digital bit streams passing by numerous communication circuits and channels are unintentionally but usually inverted [2]. This is known as phase ambiguity. Thus comes the use of differential encoder to shield against the possibility. Differential encoding is one of the uncomplicated forms of encoding done on a baseband sequence prior to external modulation to safe guard it from the above discussed possibility.

Let us consider $\mathbf{d_{in}}$ is the input data sequence and $\mathbf{e_{out}}$ be the output of differential encoder. Encoding is based on modulo 2 adder operation as shown in Fig. 1. For illustration, we take a data sequence $\mathbf{d_{in}} = 101101000$. A reference bit (0 or 1) is taken. The incoming data stream is added to this reference bit and thus generates the second bit of differentially encoded sequence [3]. This bit is then added to next incoming bit to prolong the process as shown in Fig. 2. The approach to this encoding circuit replication in all-optical domain is made by utilizing Cross Gain Modulation Properties of SOA [4].

2 System Description and Operation

The setup used for encoding comprises of two SOAs exploiting the effect of XGM as shown in Fig. 3. Both the SOAs share a common pump laser source at 1540 nm and 0.25 mw input power. The SOA in upper arm along with pump power is fed with input data sequence at 1550 nm and 0.316 mw. The lower arm SOA is fed with pump laser and output of encoder after filtration from a 20 GHz 1540 nm Gaussian optical filter. For this purpose an initializer is used in simulation. XGM effect is exploited in SOA. The exact course occurring in SOA, the mathematical equations under consideration are taken from [5] and [6]. Assuming that temporal

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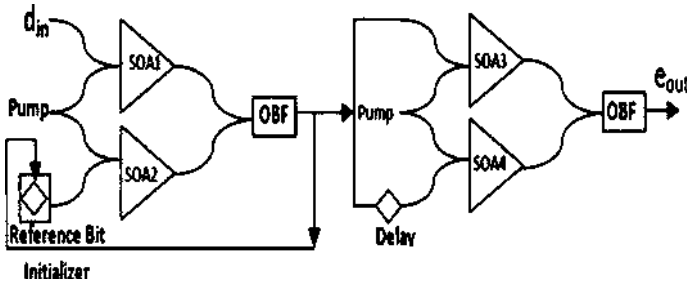

Fig. 3 Schematic diagram of simulation setup

width of input pump and probe pulses in same and pulses are overlapping perfectly, the powers are set as above mentioned values.

When two co-polarized pulses from pump and probe propagate into SOA and interference between them occurs the pump pulse at w_1 center frequency and probe at $w_{0,}$ provokes a bit of carrier density pulsation at detuning frequency of $\Omega = w_1 - w_0$.

This leads to creation of a pulse at frequency $w_2 = w_0 - \Omega = 2\ w_0 - w_1$. The newly generated pulse is a negated copy of probe pulse and can be taken out from all signals using an optical filter timed at optimum frequency [5].

Here, $A_j\ (z, t), j = 0, 1, 2$ corresponds to slowly changing pump envelopes probe and negated pulses respectively. Taking into account following equation:

$$A_0(L,t) = A_0(0,t)e^{(1/2)(1-i\alpha)h} \tag{1}$$

where $A_0\ (0, t)$ describes amplitude of input pump pulse at initial end of SOA and $A_0\ (L, t)$ is amplitude of input pump pulsed at length L of SOA at time t [6].

$$\begin{aligned} A_1(L,t) = A_1(0,t)e^{1/2[(1-i\alpha)h - \eta 10|Ao(0,t)|^2\left(e^h-1\right)]} \\ \times\ \cosh\left[\left(\frac{1}{2}\right)\sqrt{\eta 02\tilde{\eta}01}|Ao(0,t)|^2\left(e^h-1\right)\right] \end{aligned} \tag{2}$$

and

$$\begin{aligned} A_2(L,t) = \frac{-\hat{A}'1(L,t)Ao(L,t)}{\hat{A}o(L,t)}\sqrt{\eta 01/\tilde{\eta}02} \\ \times \sinh\left[\left(\frac{1}{2}\right)\sqrt{\eta 01\tilde{\eta}02}|\,A0(0,t)|^2\,e^{-h}\left(e^h-1\right)\right] \end{aligned} \tag{3}$$

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The amplification function h is defined by the following equation:

$$h = \int_0^L \frac{g(z,t)}{1 + \in Po(z,t)} dz \tag{4}$$

The output of SOA to a great extent also depends upon coupling of pump and probe pulses. The behavior of coupling can be understood by coupling coefficient *nij* [7].

$$\eta 01 = \eta 01^{\mathrm{CD}} + \eta 01^{\mathrm{CH}} + \eta 01^{\mathrm{SHB}} \tag{5}$$

where
CD is carrier depletion,
CH is carrier heating, and
SBH is spectral hole-burning
and

$$\eta_{01}^{\mathrm{CD}} = \frac{\in_{\mathrm{CD}}(1 - i\alpha)}{(1 + i\Omega\tau_{\mathrm{s}})(1 + i\Omega\tau_1)} \tag{6}$$

$$\eta_{01}^{\mathrm{CH}} = \frac{\in_{\tau}(1 - i\alpha_T)}{(1 + i\Omega\tau_h)(1 + i\Omega\tau_1)} \tag{7}$$

$$\eta_{01}^{\mathrm{SHB}} = \frac{\in_{\mathrm{SHB}}(1 - i\alpha_{\mathrm{SHB}})}{(1 + i\Omega\tau_1)} \tag{8}$$

Where ϵ_{CD} is the coefficient allied to carrier depletion, ϵ_{T} and ϵSHB are non-linear gain compression factors satisfying the following equation:

$$\in = \in_{T+} \in_{\mathrm{SHB}} \tag{9}$$

Also α_T and α_{SHB} are line width enhancement factors related to carrier heating and spectral hole-burning [7].

The signal thus received from filter is encoded sequence. For decoding the bit sequence to original, the above process is reversed. The incoming sequence and one bit delayed version of it are added together to recreate the original sequence as (Fig. 4):

For this purpose same architecture as encoder is used. Now, as the problem definition, the polarity reversal may occur in between the communication circuitry [8]. For replicating this reversal into simulation, we use an all-optical NOT gate. This gate is also a SOA-based architecture and reverses the whole sequence and makes it as demonstrated in Fig. 5.

So, in either case the decoding circuit is capable to get the original bit sequence.

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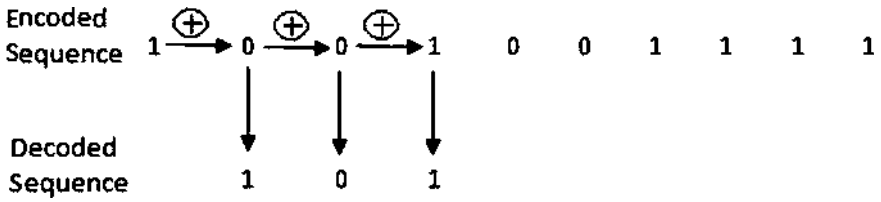

Fig. 4 Decoding operation illustration

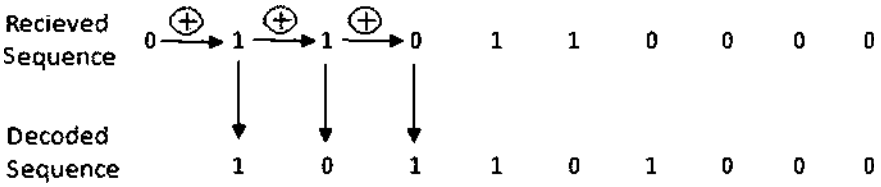

Fig. 5 Decoding operation of polarity reversed sequence

3 Results and Discussion

The simulation is performed at 10 Gbps operational speed. The complete sequence input, encoding, reversal, and decoded pulses in time domain are shown in figure. The input sequence 101101000 is fed to encoder and after the effect of XGM the output of encoder comes out as 100100111 (Figs. 6 and 7).

In case of polarity reversal the sequence becomes 011011000. This case is simulated by an all-optical NOT gate using SOA (Fig. 8).

Even after the reversal of pulse the concluding output comes to be 101101000, i.e., same as the original sequence. The system extinction ratio is found to be 11.02 dB (Fig. 9).

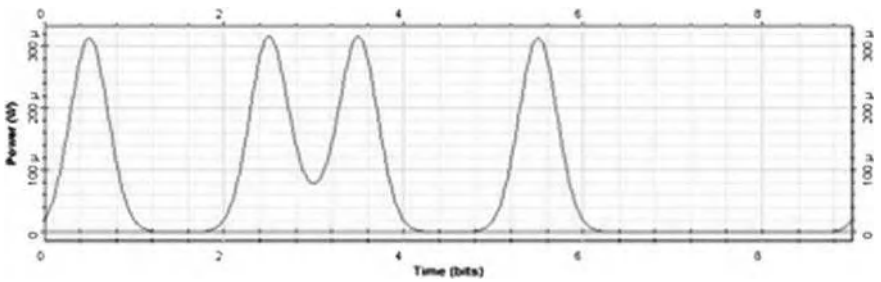

Fig. 6 Input sequence

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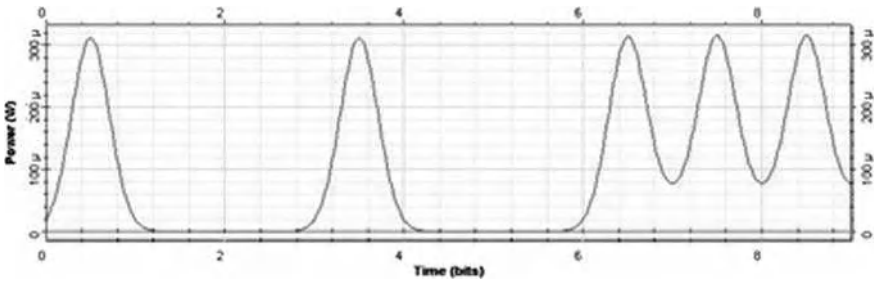

Fig. 7 Encoded sequence

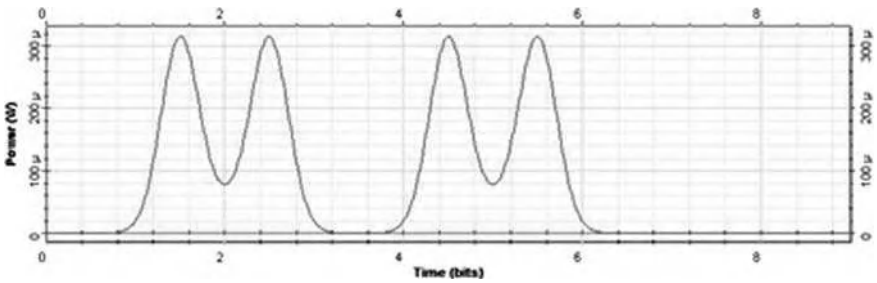

Fig. 8 Sequence after polarity reversal

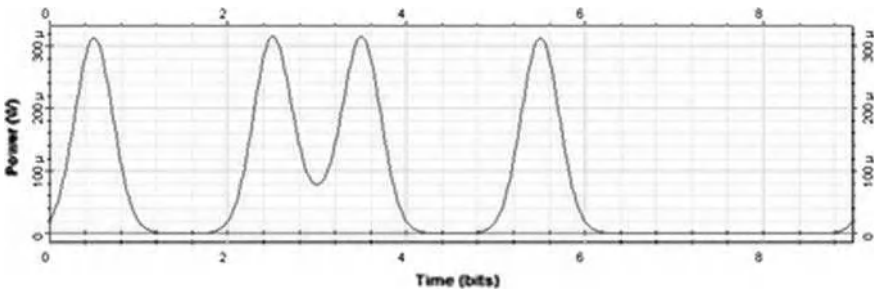

Fig. 9 Decoded sequence

4 Conclusion

The system description was described, architecture was designed, and simulations were processed. The findings prove that the proposed encoder and decoder are observed and as well found valid for all input sequences. The results obtained from simulation match with their logical counterparts. The system extinction ratio is found to be satisfactory. The model is made to operate at 10 Gbps. More

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operational speed can be achieved with a trade off with extinction ratio. The proposed setup can be used for duobinary encoding in advanced modulation formats and generation of DPSK, DEBPSK-modulated signals.

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XPM-Based Bandwidth Efficient WDM-to-OTDM Conversion Using HNLF

Abhishek Sharma and Sushil Kakkar

Abstract With the growing requirement for advanced speeds and better capacity brought about by speedy data expansion on the Internet, Optical time division multiplexing attracted much attention for its high-speed operations and ability to overcome the electronic bottleneck problems. In this article, 4×10 Gb/s WDM/OTDM conversion using supercontinuum (SC) generation at 100 GHz is proposed for 12, 24, and 36 km using SPWRM (Symmetrical pulse width reduction module). HNLF-based multiplexing eliminate the requirement of extra pump sources and provide cost-effective solution. FWM (four wave mixing) demultiplexing using SOA (semiconductor optical amplifiers) is achieved for all the 4 channels with acceptable limits of BER = 10^{-9} at 24 km.

Keywords Pulse width reduction · Four wave mixing · Supercontinuum · Semiconductor optical amplifier · Wavelength division multiplexing

1 Introduction

Wavelength division multiplexing (WDM) and optical time division multiplexing are the promising technologies characterized by capacity of high transmission in optical communication systems possess their own benefits [1]. In current scenario, it is quite obvious to expand the reach of optical systems and to enhance all-optical processing in order to overcome bottleneck problems, which replace conventional E/O conversion with electronic switches in high-speed OTDM networks. WDM–to-OTDM systems to provide all-optical conversion, such solution becomes a significant move for providing system operations at photonic gateways [2]. Basics of WDM/OTDM system is to aggregate or transmultiplex lower data

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rate tributaries operated at dissimilar frequencies for the realization of high-speed core networks [3]. Till now, lot of work has been reported for WDM/OTDM conversion using different nonlinear mediums such as electro-absorption modulator (EAM), semiconductor optical amplifiers(SOA), and MZI-SOA [4]. However, the limitation of modulators and amplifiers is the restricted frequency response. Highly nonlinear fibers provide efficient solution and attracted much attention for realization of optical signal processing. Another approach for OTDM/WDM conversion using four wave mixing and XPM (cross phase modulation) [5]. However, additional pump sources are required to realize conversion based on Raman compression [6], nonlinear optical loop mirror (NOLM). Supercontinuum generation using HNLF has been reported experimentally for 4 × 10 Gb/s WDM/OTDM conversion at 200 GHz spacing [7]. Advantage of using SC generation is a cost-effective solution to eliminate the requirement of extra pump sources.

In this article, we investigated a simulation setup of WDM/OTDM conversion using SC generation at 100 GHz channel spacing for long distance transmission employing symmetrical pulse reduction technique. Conversion of 4 × 10 Gb/s WDM to 40 Gb/s OTDM has been realized at less channel spacing with time interleaving provided by delay blocks and isolation of different wavelengths achieved with 4 × 4 array waveguide grating in demultiplexed mode. FWM demultiplexing is used for reception of each channel incorporating semiconductor optical amplifier (SOA). Therefore, a bandwidth efficient all-optical WDM/OTDM system with the cost-effective solution measuring BER $<10^{-9}$ for 24 km has been proposed.

2 Functioning Theory

M wavelengths $\lambda 1$, $\lambda 2$ …λ_M are generated using MZM (Mach–Zehnder modulator) and followed by EAM (electro-absorption modulator) for generating RZ line coding converted with a drive from sine generator synchronized to NRZ in order to realize ultra short pulse. Transmitted data from M channels with D rate is calculated using $B = M \times D$ for total data rate. AWG is operated in demultiplexing mode for routing of each wavelength to different output port followed by time delay module. Each channel delayed by t for time interleaving and fed to HNLF for SPM (Self phase modulation). SPM is calculated as [8]

$$\Delta\omega = \frac{w}{c} n2z \frac{Ic}{\tau} \tag{1}$$

SPM cause spectrum broadening in HNLF and overlapped spectrum achieved with common wavelength is referred as λc. Optical filter is used to select the λc from the broader and overlapped spectrum. Symmetrical pulse reduction technique is used with $L/2$ km length of SMF before and after DCF of length L Km in order to mitigate the effects of pulse broadening.

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3 Supercontinuum Generation

Highly nonlinear fibers (HNLF) are used to generate phase shift and spectrum broadening referred as supercontinuum generation due to lower effective area (A_{eff}) [8]. SC generation is very popular and attracted much attention because of its application in WDM systems. At higher launched powers, response of HNLF becomes prominent and introduce frequency shift to larger extent. Major advantage of using HNLF as a channel for SC generation is that its nonlinear response is ultra fast and eliminates the requirement of additional pumps to introduce spectral broadening.

4 Simulation Setup

Figure 1a. Represents the Transmitter setup for 40 Gb/s WDM/OTDM system at 100 GHz channel spacing employing symmetrical pulse width reduction technique. A continuous wave laser array is used to transmit four optical reference signals starting from 1557.35 to 1559.79 nm with 0.8 nm channel spacing followed by a Mach–Zehnder modulator driven by NRZ line coder from PRBS of order 2^7–1 biased at 10 Gb/s. EAM converts NRZ to RZ for generating a ultra short pulse which synchronized with 10 GHz sine pulse generator. 4 × 4 AWG is used in demux mode for routing of different wavelengths to different output ports. Each separated wavelength temporarily interleaved or shifted by 0, 0.025, 0.05, 0.075 ns and amplified by EDFA then fed to HNLF for SC generation as shown in Fig. 1b. Specification of HNLF are given in Table 1. Overlapped spectrum wavelength λc at 1558.88 nm is filtered out using optical Bessel filter of bandwidth 0.3 nm. Power booster EDFA with 10 dB gain incorporated after optical filter and converted signal transmitted over symmetrical pulse width reduction module consisting of single-mode fiber (SMF), EDFA and DCF. Specification of PWR module is given in Table 2. Figure 1c shows the demultiplexing of each channel at receiver part using SOA of 0.3 confinement factor. BER visualize evaluates the system performance in terms of eye opening, power penalty, eye closer penalty, and OSNR.

5 Results and Discussion

Figure 1a represents the four different wavelengths each biased with 10 Gb/s data signal after MZM. Signal broadening spectrum of all the four channels after SC generation due to SPM shown in Fig. 1b. Overlapped spectra achieved after HNLF and λc is filtered out using optical Bessel filter as 40 Gb/s OTDM signal represented in Fig. 2c.

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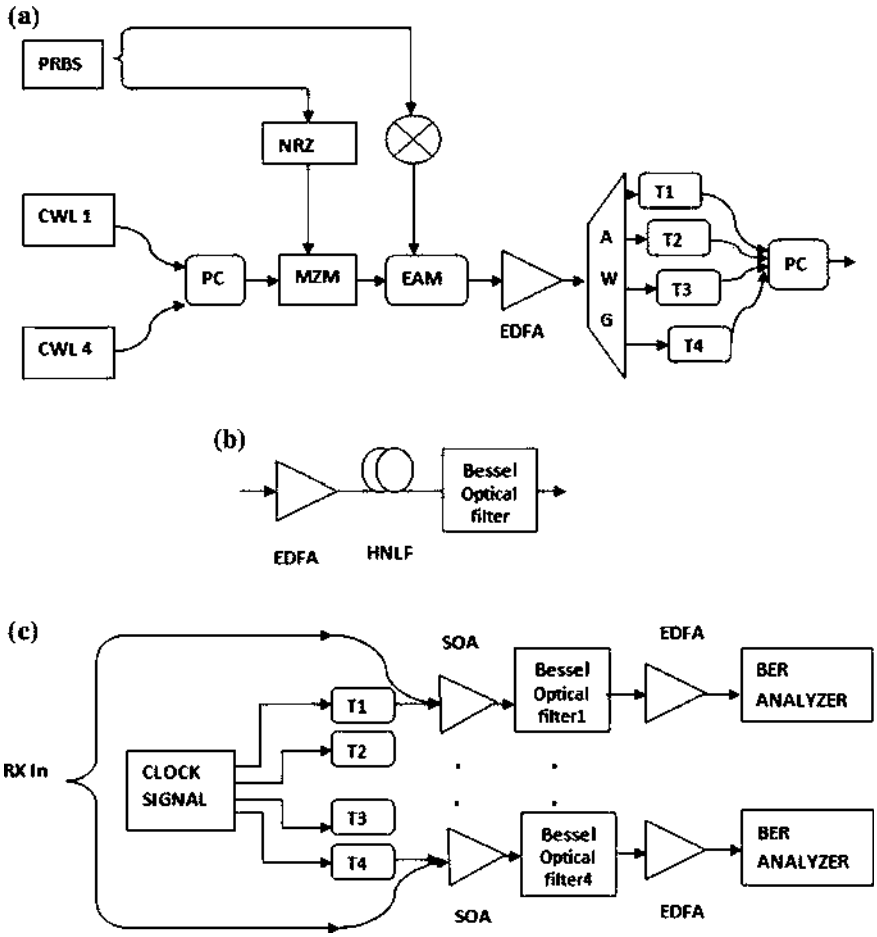

Fig. 1 **a** Transmitter setup for 40 Gb/s WDM/OTDM system at 100 GHz. **b** Super continuum Generation. **c** FWM based demultiplexing using SOA

Table 1 Specification of HNLF

Quantity	Values
HNLF length	2 km
Second-order dispersion	−2.2 ps/nm/Km
Third-order dispersion	0.032 ps/nm^2/Km
A_{eff}	11 um^2
Attenuation	0.55 dB/Km

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Table 2 SPWR module specifications

Parameters	Values
SMF	10 km/each loop
DCF	2 km/each loop
Attenuation $_{SMF}$	0.2 dB/Km
Attenuation $_{DCF}$	0.5 dB/Km
Aeff $_{SMF}$	72 um^2
Aeff $_{DCF}$	22 um^2
Dispersion $_{SMF}$	17 ps/nm/Km
Dispersion $_{DCF}$	−85 ps/nm/Km

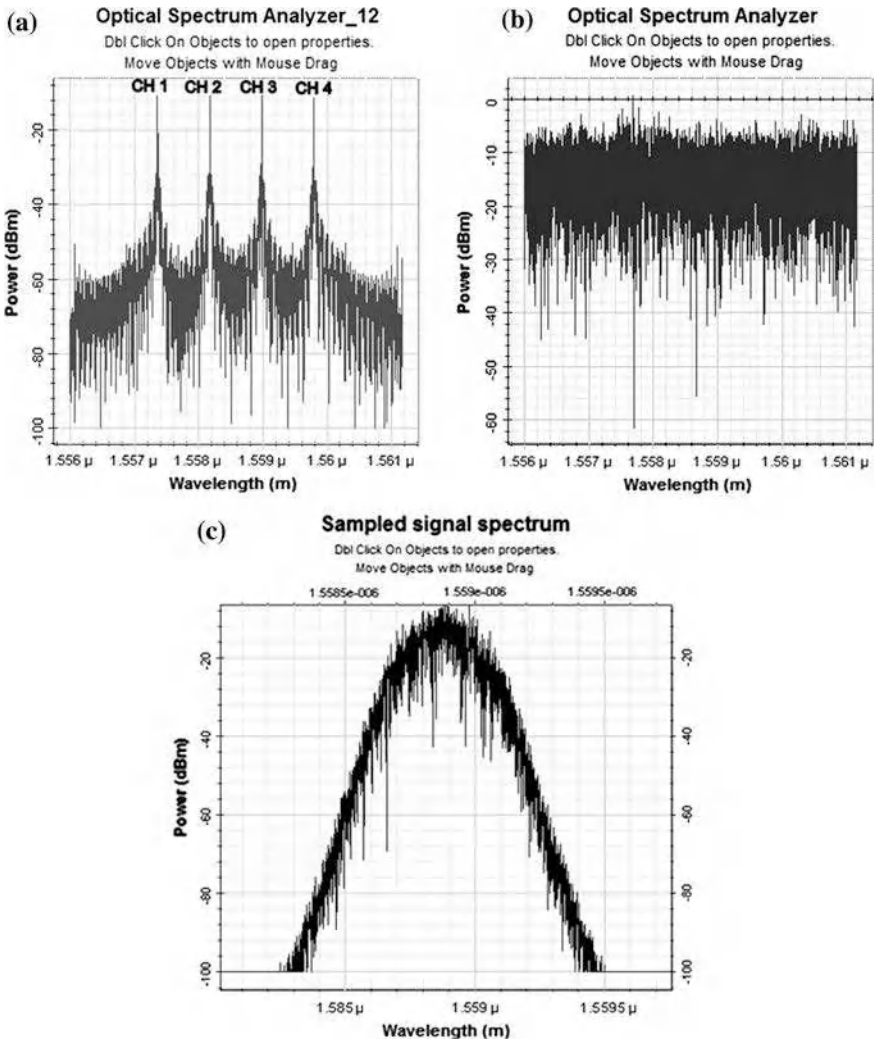

Fig. 2 Optical power spectrum of **a** 4 × 10 Gb/s WDM channels. **b** After SC generation. **c** Filtered λc

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OTDM signal transmitted over optical fiber transmission module consisting of SMF of 10 km and DCF of 2 km followed by EDFA with 5 dB gain after each SMF and DCF in order to compensate attenuation effects. Symmetrical pulse width reduction arrangements are used and system performance is investigated for 12, 24, and 36 km. Figure 3 shows the graphical representation of all demultiplexed channels at different distance in terms of Q-factor. Also BER performance of all the channels with respect to received power has been evaluated as shown in Fig. 4. System works successfully for 12 km of link distance with BER value 10^{-11} and maximum achievable distance evaluated at BER 10^{-9} for 24 km. Power penalty is observed more at channel 4 as compared to other demultiplexed channels.

In this work, we investigated WDM–to-OTDM conversion at 100 GHz channel spacing and converted OTDM signal successfully transmitted over 24 km using SPWRM. More system capacity may be achieved using more application specific highly nonlinear fiber in the system as HNLF face challenges to work on higher bit rates due to high nonlinear coefficient.

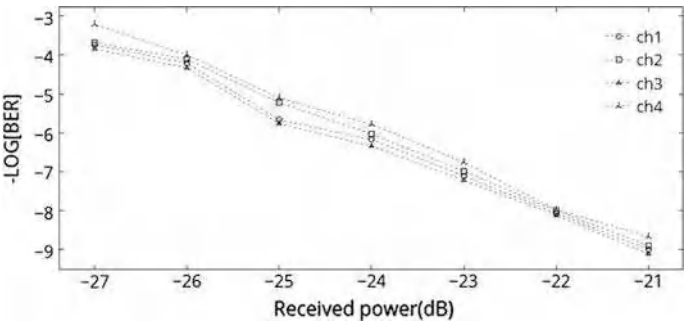

Fig. 3 BER measurements for demultiplexed channels

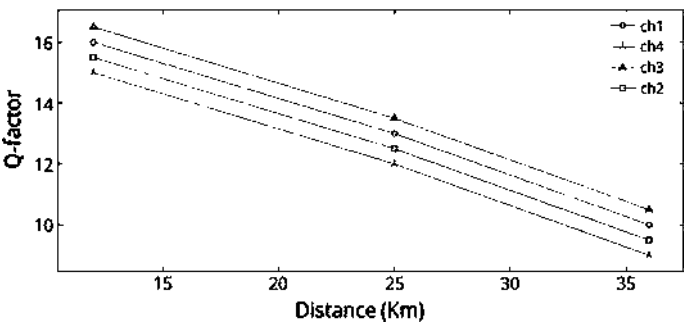

Fig. 4 Evaluation of demultiplexed channels at varying distance

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6 Conclusion

All optical 4 × 10 Gb/s WDM-to-OTDM conversion at 100 GHz has been successfully investigated in this work using super continuum generation based on SC multiplexing by incorporating HNLF. Further 40 Gb/s OTDM signal transmitted over 24 km link of fiber using SPWRM with acceptable BER of 10^{-9}. Demultiplexing of four different channels realized with semiconductor optical amplifiers (SOAs) using four wave mixing (FWM). Advantage of using SC generation in the system is, elimination of additional pumps required for the WDM-to-OTDM conversion.

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Analysis of a Sporting Event on a Social Network: True Popularity & Popularity Bond

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Abstract Events in a social network and their popularity are described by the quantitative participation of its users. A special occasion in an event is an activity that may hamper or strengthen its popularity or popularity of its entities. Such a study helps the researchers to analyze the trends to know how they change with time during an occasion. Till now popularity is computed by considering the number of tweets. To the best of our knowledge, no study has been done on computing the number of tweets considering the population. Here in this paper, we coin the following terms (a) true popularity, which is the number of tweets normalized with the population. Through this we compare intra-group popularity of entities, and (b) popularity bond, so as to study concentration of tweets for pairs of entities. Through this we compare the inter-group popularity of entities. Experiments are carried out on the content posted by users on Twitter during the Cricket World Cup 2015. Experimental study indicates the effectiveness of the coined terms in providing better insights.

Keywords Data analysis · Data mining · Social network · Sports · Event · Popularity

1 Introduction

The social networking services facilitate to connect people who wish to share interests and activities across political, economic, and geographic borders. It leads to a massive growth in terms of research on the enormous data so generated and its impact. Such social networks provide people a platform to create, evaluate, express,

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and convey information, preferences, and opinion. As described in [1], Twitter, a social network service, is considered to be superior over its other competitors because of its massive following, large use of hashtags, and real-time connection through conversations that are 140 characters long. Hence it attracts mass attention of millions of its users.

An event in real world is a planned activity that happens or takes place. In a social network, a trending event is a real-world occurrence associated with a time period, a time order sequence of documents about the occurrence and published during the time period having mass following. The users express their opinions on the event as a whole or one of its entities. A special occasion in an event is an activity that hampers or strengthens the popularity of an event or its entity on a social network. The studies that have been done so far have focused only on the number of tweets for popularity. Here we feel that if we incorporate the population of the country to which an entity belongs along with the number of tweets for estimating its popularity, we are likely to see a different picture altogether. Further, the relationship between the different pairs of entities of an event on the basis of popularity is likely to give informative insights. We try to explain these concepts through the following example.

Consider an international sporting event of game X that is taking place from January 1 to January 31. The teams are divided into two groups—Group Alpha and Group Beta. For initial stages, the teams only play against the teams in their groups. In this example, we shall consider three teams that are a part of this event. One of them is team Challengers. This team belongs to a country Qwerty and is in group Alpha. Second team we shall consider is team Hitters. This team belongs to a country Trew and is also in group Alpha. Third team under consideration is team Attackers. This team belongs to a country Uiop and is a part of group Beta.

Most of the international sporting events are a great source of remuneration for their organizers. Also such events turn out to be very beneficial for the advertisers who are able to promote their product amongst the mass. However, the organizers are not firm about how to arrange the teams in the groups so that there can be matches which can lead to massive earnings. Similarly an advertising company is always in a dilemma of choosing the right matches so that they can obtain maximum promotion of their product.

In this example, we discuss how the popularity of event and its entities is of importance for the organizers of the event and the advertisers. Consider a company Z interested in advertising in this sporting event but it has limited number of funds. So it is on a lookout for the matches that will be high on the viewership for its advertising.

The tweets obtained can be broadly broken down under three categories. There can be General tweets with content about the event. There can be tweets talking about a particular team like the performance of team Attackers. There can also be tweets concerning a particular pair of teams like a match between team Challengers and team Hitters.

Consider team Challengers. On the day of their match, there will be a large number of tweets for them as compared to their rest days. Suppose there is a huge craze for the sport X in Qwerty, there will be large number of tweets coming with geolocation as Qwerty. This is the best indication for the company Z to invest in the

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advertisements on the matches related to Challengers in Qwerty. If Qwerty has a large population, they also stand a big chance of being the most popular team in the sporting event. Similar trends will exist for the other teams.

Now considering the team Hitters. They belong to the same group as that of Challengers. The intra-group analysis can be made on the popularity in terms of number of tweets about the teams amongst their group. This popularity can be further analyzed after normalizing it with the population of the countries these teams belong to. We propose to define this through a term "true popularity" subsequently in this paper.

Now let us take into account the third team under consideration that is team Attackers. Suppose Qwerty and Uiop are arch rivals. The match between Challengers and Attackers will be highly anticipated and there will be a large inflow of tweets concerning this match. Hence this is used for studying inter-group relations among the teams in different groups. We propose to define this through a term "popularity bond" subsequently in this paper. The company Z must eye this match for their advertisement.

For the organizers it is very important to tactfully arrange the teams to get maximum viewership, both on and off the stands. Number of viewers for terminal matches is always greater than the initial ones. They have to make sure that they get large viewership for these matches too. As Challengers and Attackers are a part of different groups, there will be no match between them at initial stages. Hence the total number of Challengers versus Attackers matches in the World Cup will be very few. As the popularity of the few matches held between these teams at later stages in the event is high, this is a clear indicator for organizers to keep these teams in the same group for the next edition of this sporting event. This will lead to more viewership for the intra-group initial stage, more number of advertisers for these matches and hence leading to more monetary profit.

We have now coined two new terms related to popularity through the above example. Before we define these terms, it is important to have a look at the existing research on popularity trends in social networks which we describe in the subsequent subsection.

1.1 Related Work

There are many event based studies on which researchers have worked. Becker [1] has given definitions of an event and a trending event for different mediums. The study of trending events during peak activity periods has been studied by Kairam et al. [2]. Persistence and decay of trending events on Twitter has been studied by Asur et al. [3]. Becker et al. [4] and Kim et al. [5] have explored approaches for identifying real-world event related Twitter posts and studied the diffusion patterns of such events.

Content on the web like news articles, blog posts, and posts in social networks about such events has a temporal activity and popularity. Arora et el. [6] have studied

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this temporal activity for a inter-state sporting event Indian Premier League 2013 on social network. They have also determined that geo-tagged data showed major activity from metropolitan suburbs. Clusters in tweets for the same event held in 2011 have been identified by Kewalramani [7] on the basis of the teams that were a part of a particular league. Mazumdar et al. [8] have introduced the notion of Time-aware News Concept Graph to depict the temporal dynamics for news articles. Credibility of content on Twitter for crisis situations has been studied by Gupta and kumaraguru [9].

Temporal popularity on online platforms mentioned earlier has a different meaning for different people. Sun and Ng [10] have proposed the comment arrival model to measure popularity. They have considered four parameters, viz, total number of comments, average comment frequency, peak comment frequency, and highest rising rates of comments.

1.2 Limitations and Motivation

First there has been research on basic popularity trends [6] for a national level cricketing event but no research on a common method for international events. Second clustering of tweets [7] has been identified but the relationship among different clusters or amongst the same cluster has not been observed. Third temporal popularity of entities has been calculated through different techniques in [10] but the significance of population has not been taken into account. These limitations motivate us to overcome them in our study. Further the study by Mazumdar et al. [8] is a motivation to analyze the time-aware trends of popularity of the entities. Research by Asur et al. [3] also motivates us to study the growth and decay of the event under consideration.

2 Notations and Definitions

Some of the essential notations that are further used in the definitions below are formally introduced.

An event is denoted by E. An occasion in an event is denoted by O. There are n entities taking part in an event denoted by set $\rho = \{e_1, e_2, e_3, ..., e_n\}$. G_1 is a set of entities in group-1 and G_2 is a set of entities in group-2, such that $G_1 \cup G_2 = \rho$. We shall now consider the sets of tweets. D denotes the complete set of tweets. g represents a set of general tweets, t a set of team specific tweets and p a set of pair specific tweets such that $g \cup t \cup p = T$.

We first formally define the constituents of our dataset in terms of a Document Stream.

Definition 1 (*Document Stream* [1]) A document stream is a time-ordered sequence of documents; each document represents a set of features, or terms. In this paper, a

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document is a tweet whereas the document stream is the set of tweets D. There exists a specific time period for which the document stream is large quantitatively.

Definition 2 (*Trending Time Period* [1]) A trending time period for a feature over a document stream is a time period where the document frequency of the feature in the document stream is substantially higher than expected. In our example, the trending time period for the international sporting event is the complete month of January. When we consider a document stream over such a time period for an event, it gives rise to what is known as a trending event.

Definition 3 (*Trending Event* [1]) A trending event is a real-world occurrence with (1) an associated time period T, (2) a stream of documents D about the occurrence and published during time T, and (3) one or more features that describe the occurrence and for which T is a trending time period over document stream D. For a trending event, the popularity of the entities is of great concern. In our example, the international sporting event is a trending event and the popularity of its entities like the Team Challengers is of interest for the advertisers. However, just the tweet count for the determination of popularity may lead to wrong analysis. For this purpose, we take into account the population of the countries to which these teams belong and define True Popularity.

Definition 4 (*True Popularity (TP)*) The true popularity of an entity e_i in a trending event E is the number of occurrence of e_i in t normalized by its population, that is n_{e_i}/X is the true popularity of e_i where n_{e_i} is the number of occurrences of e_i in g and X is the population of the country to which e_i belongs.

Definition 5 (*Popularity Bond*) A popularity bond between e_i and e_j is the quantitative measure of the occurrences of (e_i, e_j) in p. The strength of a popularity bond is the relative measure of the popularity bonds among different entities $\in \rho$. There may exist a strong or a weak popularity bond depending on whether the occurrences of the pair is high or low respectively. For inter-group popularity bonds, we shall consider the occurrences $\forall(e_i, e_j) \in G_1 \times G_2$ in p. In our example, team Challengers and team Attackers are from two different groups and thus have an inter-group bond. Their bond is of strong strength due to rivalry between the countries to which these two teams belong. For intra-group popularity bonds, we shall consider the occurrences $\forall(e_i, e_j) \in G_k \times G_k$ in p where $i \neq j$. Team Challengers and team Hitters share an intra-group popularity bond.

3 Dataset

3.1 Data Extraction

The tweets for the Cricket World Cup 2015 have been collected using Twitter REST API. Further we made use of reverse geocoding APIs for studying the geolocation of the users.

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Event Extraction The posts made by users of a social network on the network is a large dataset. Such a big dataset is filtered according to the keywords or hashtags particular to a sporting event. We obtained official hashtag used for World Cup tweets that is #CWC15. We then used this hashtag for querying the Twitter API for fetching these tweets. The results returned by the API is a collection of JSON objects containing the tweet content, user information and the geolocation of the user, if mentioned. There exists a limit of 180 queries per 15 min window in Twitter API. Hence we used multiple instances of our crawler to pipeline the requests and obtain efficiency in terms of quantity of tweets per hour.

Parsing of Geolocation provided by Twitter API The Twitter API provides the longitude and latitude coordinates of the current location of a user, if he has allowed Twitter to post with information about his location. We converted these coordinates returned by the Twitter API to convert it into the country code to which it belongs. For this conversion we made use of reverse geocoding APIs provided by Bing, Google and Data Science Toolkit.

Entity Extraction We developed an entity classifier which filtered out the tweets depending upon the team (s) it is referring to. For this we built regular expressions to tackle the possible combinations for a team name. All the combinations are checked as separate words, usernames (@[expression]) and hashtags (#[expression]). All the tweets are checked for all the teams to obtain the type of tweets and the teams involved in each of them.

3.2 Data Description

The cricket world cup was held from February 14, 2015 till March 29, 2015. However, the data has been collected from February 9 till April 3 to analyse the pre and post match tweets as well. Our data set consists of 3,162,124 (∼3 million) tweets collected through Twitter API. Out of the total number of tweets in the data set, 1,334,964 (∼42 %) of the tweets are geo-tagged.

The tweets obtained can be broadly divided into three categories—General, Team Specific, and Match Specific as mentioned in Table 1. This shows us the interests of the tweeters related to the World Cup, whether it is general or attachment with a particular team or concerning matches. On analyzing the tweets it is found that 51.1 % of the total tweets (∼1.6 million) are talking about a particular match. The team specific tweets are the least, indicating more interest in matches rather than a team.

Table 1 Category of tweets

General world cup tweets	51.1 %
Team specific tweets	32.5 %
Match specific tweets	16.4 %

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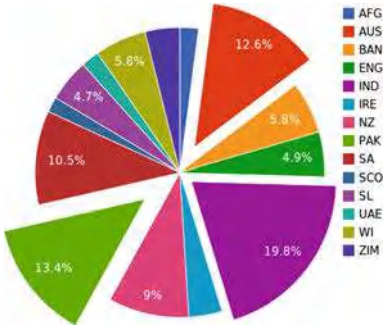

Fig. 1 Popularity of teams

There were 14 teams that took part in the event. They are India, Australia, New Zealand, Ireland, Kenya, Sri Lanka, Bangladesh, South Africa, Zimbabwe, England, UAE, Pakistan, Scotland, Afghanistan. Figure 1 gives the domination of a team in the World Cup in terms of the percentage of the number of tweets. The three offset tweets in the plot indicate the top three popular teams. India is the most popular team in the cricket World Cup 2015 having 19.8 % tweets trending about them followed by Pakistan with 13.4 % and Australia with 12.6 %.

4 Experiments and Discussion

4.1 Intra-Pool Analysis

In order to determine the popularity of a team we use Tree Maps. A tree map is used to depict hierarchical data as a set of nested rectangles of varying sizes. Here we use it to measure the true popularity of a team. The most accurate calculation of popularity is made in terms of the number of tweets viz-a-viz the population size. Figure 2 represents Tree Maps for teams in the two pools. The size of the rectangle is relative to the popularity of the team in the world cup while the color is relative to the population of the country to which the team belongs.

From Fig. 2a and Table 2, it can be observed that the number of tweets obtained for Australia is greater that New Zealand in Pool A but the true popularity shows an opposite trend. Bangladesh has the third highest number of tweets but lies at the last spot in terms of the true popularity. In Fig. 2b and Table 3 it can be seen that Ireland having a small number of tweets is the most popular in terms of true popularity while India having the largest number of tweets is at the least position in Pool B. It can be inferred that cricket world cup is of major interest in Ireland with mass attraction.

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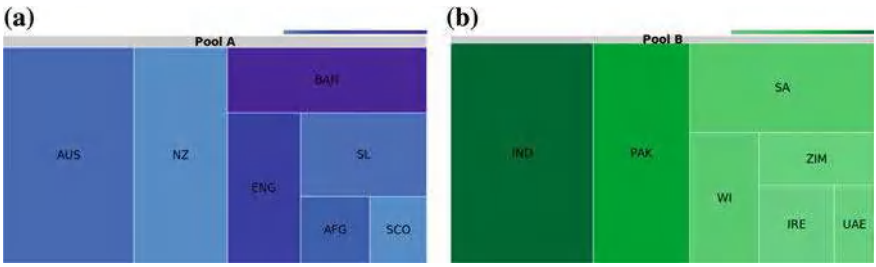

Fig. 2 Popularity of teams in pool with population of associated country. **a** Pool A. **b** Pool B

Table 2 Calculation of true popularity for pool A (population in millions)

Team	Tweets:Population	TP
NZ	351837:5	70367
AUS	493991:23	21477.87
SCO	67117:5	13423.4
SL	185435:20	9271.75
ENG	193013:53	3641.75
AFG	80939:30	2697.97
BAN	228070:156	1461.99

Table 3 Calculation of true popularity for pool B (population in millions)

Team	Tweets:Population	TP
IRE	145762:5	29152
ZIM	151657:14	10832.64
UAE	79801:9	8866.78
SA	409112:53	7719.09
WI	225109:39	5772.03
PAK	525278:182	2886.14
IND	776248:1252	620

4.2 Inter-Pool Analysis

For the purpose of analysis the inter-pool trends, we have used a Sankey diagram. Sankey diagrams are primarily used to show the flow of energy or matter through a system. These have been also used by Ogawa et al. [11] in similar studies to depict dynamic interaction between entities. In the Sankey diagram in Fig. 3, the nodes are the teams and the weightage of the links determines the strength of relationship among the teams of the two different pools. It can be observed that Afghanistan, England and Scotland from Pool A and UAE, Ireland and Zimbabwe from Pool B

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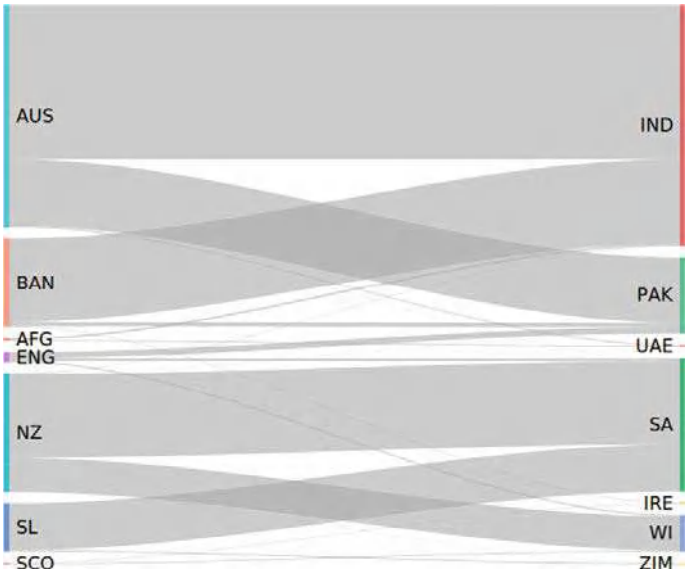

Fig. 3 Relationship between teams from pool A and pool B

are the least popular in terms of inter-pool relationship. They share a weak popularity bond.

On further analysis it is observed that the team pair of Australia and India is the most talked about on Twitter. Hence these two teams share the strongest popularity bond among the other inter-pool pairs. This pair is followed by Bangladesh and India, New Zealand and South Africa, Australia and Pakistan in order of decreasing bond strength.

4.3 Team-Oriented Analysis

We have till now discussed about the teams as a group in their respective pools. Now we will study the behavior of popularity pattern in terms of team-specific analysis. We first depict the time-aware popularity trends of the three most popular teams of the cricket world cup 2015—India, Pakistan, and Australia (Fig. 4).

Figure 5 represents time-aware popularity line charts which show the day-wise popularity trend of the top three trending teams in terms of the percentage of total tweets obtained for the team. We analyze some idiosyncratic peaks in the charts. There is a massive peak of over 50 % popularity of India on March 26, 2015. The day is the semi-final match between India and Australia. There is one major peak of over 45 % popularity of Pakistan. The day is the quarter-final match between Australia and Pakistan. The special interest can be related to the fact that if Pakistan would have

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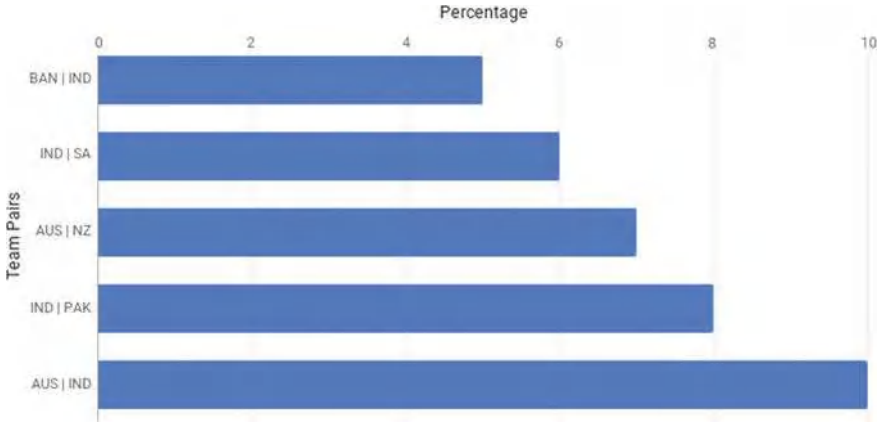

Fig. 4 Most popular and trending team pairs with percentage by tweets

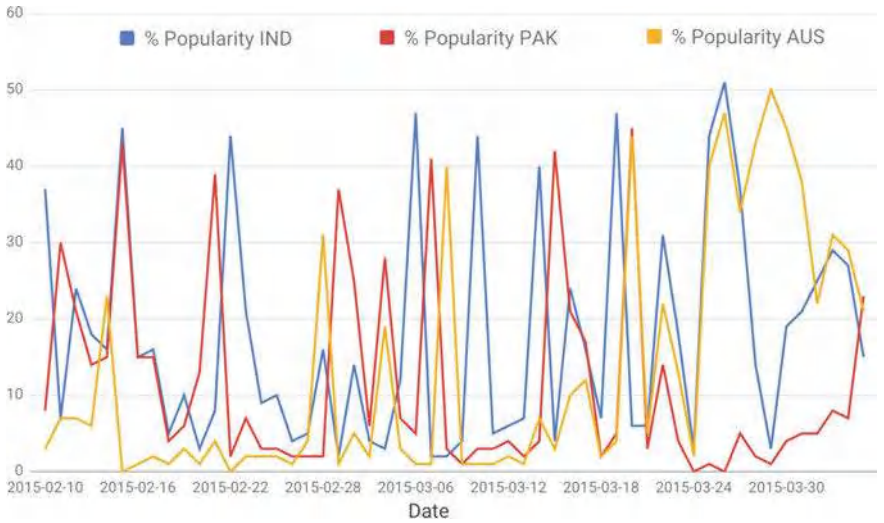

Fig. 5 Time-aware popularity of top 3 most popular teams

won the match, the next match would have been against its arch rival India. Next we observe an exception in the usual popularity trend of Australia for obtaining about 50 % of the total tweets on March 29, 2015. The day is the final match of the world cup. The final win by Australia further justifies the special popularity it has earned that day.

Next we will talk about the popularity of team pairs among the complete cross product of the entities. Figure 4 represents a Bar Chart to show the popularity of team pairs throughout the World Cup on the basis of the percentage tweets domination. The chart represents the top five trending pairs. It can be observed that Australia

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and India are the most popular and trending pair in this World Cup with 10 % of the tweets. It is followed by the arch rivals, India and Pakistan having a domination by 8 % and Australia and New Zealand having a domination by 7 %.

4.4 Geo-Analysis

We analyze the geo-tagged tweets obtained in our data set to better understand the geographic distribution of World Cup activity on social media. About 42.1 % of the total tweets obtained are geo-tagged as mentioned in Sect. 3.

Table 4 represents the domination by the number of tweets obtained from the country geographically associated with each team. It can be seen that India accounted for more than a quarter of the total geotagged tweets. However significant interest is also seen from Australia, New Zealand, South Africa, and Pakistan.

Figure 6 represents a geo chart which shows the popularity of the World Cup by tweets all over the world. It can be observed that World cup is the most trending event in India followed by Pakistan, USA, and Indonesia. Significant interest can also be observed from UAE, South Africa, Australia, and New Zealand. Brazil, South America and major part of Europe show negligible interest in the World Cup.

Table 4 Team-wise statistics of geo-tagged dataset (top 5)

Team	Geo-Tagged tweets	Percentage
India	363,036	27.19
Australia	27,974	2.09
New Zealand	40,319	3.02
South Africa	32,200	2.41
Pakistan	117,186	8.77

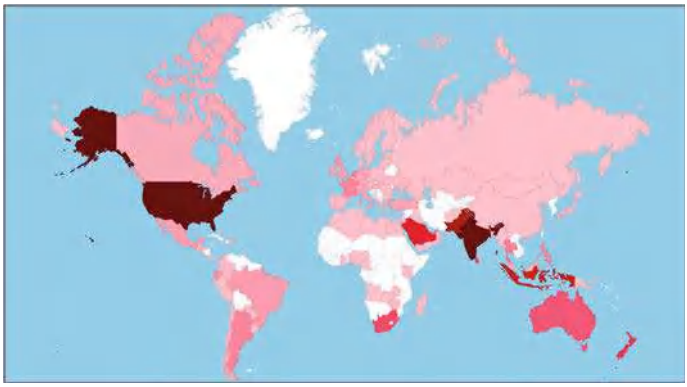

Fig. 6 Stream of world cup tweets from different parts of the world

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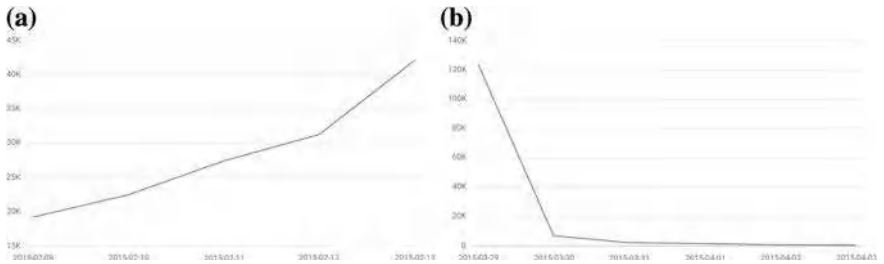

Fig. 7 Popularity trend of world cup. **a** Growth in popularity before start. **b** Decay in popularity after end

4.5 Growth and Decay of Popularity

Cricket World Cup is a scheduled event about which the people already knew. Such events become popular gradually and the popularity of the event finally attains maximum popularity closer to the event date. In Fig. 7a, the number of tweets related to world cup rise from 20 thousand to about 45 thousand, 3–4 days before the world cup which is a gradual growth.

The impact of an event can be judged by observing its decay. Short lived events have a steep decay whereas events with a longer presence on social networks have a gradual fall [11]. In Fig. 7b, the number decreases from about 120 thousand to a few hundred after the world cup. It shows how rapidly popularity for the cricket world cup diminishes after its end.

5 Conclusion and Future Work

Geographical, social and temporal characteristics of the popularity trend of Cricket World Cup 2015 have been described in this paper along with its potential use for organizers and advertisers. The true popularity of entities and popularity bond strength of pairs of entities are derived. The obtained time-aware popularity trends correlate to the impact of special occasions. In our future work, we aim to work to on the tweets which are not textual. We also aim at developing a predictive system through analysis of pre-match, during match, and post-match analysis by studying tweets obtained for these short intervals of time.

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Performance Analysis of LPC and MFCC Features in Voice Conversion Using Artificial Neural Networks

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Abstract Voice Conversion is a technique in which source speakers voice is morphed to a target speakers voice by learning source–target relationship from a number of utterances from source and the target. There are many applications which may benefit from this sort of technology for example dubbing movies, TV-shows, TTS systems and so on. In this paper, analysis on the performance of ANN-based Voice Conversion system is done using linear predictive coding (LPC) and mel-frequency cepstral coefficients (MFCCs). Experimental results show that Voice Conversion system based on LPC features is better than the ones based on MFCC features.

Keywords Voice conversion · Morphing · Mel-frequency cepstral coefficients · Linear predictive coding and neural networks

1 Introduction

Speech signal is a convolution of excitation source signal from vocal cords and transfer function of vocal tract. Excitation features contain information about the pitch while transfer function has information about voice quality. Frequency domain transformation of speech signal is used to separate these functions. Cepstral knowledge thus obtained can then be used to find mel-frequency cepstral coefficients (MFCCs) of the speech signal which are helpful characterise to every individual. Formants are

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the spectral peaks in the sound spectrum where high energy is concentrated. These formants are unique for every phoneme. Feature extraction using linear predictive coding (LPC) mechanism uses this information, where speech signal is analysed after removing the effect of these formants, intensity and frequency of the remaining buzz is analysed this information together with the formants and residue can be used to construct the speech back. LPC and MFCCs are widely used features for auditory modelling. LPC predicts the future values based on the previous samples whereas MFCC considers the nature of the speech while it extracts the features.

Voice Conversion is a technique to modify source speakers speech utterance to sound as if it is spoken by a target speaker. There are two important things to be considered in developing an efficient voice morphing system: One is optimal selection of features and then a model to evaluate a transform function from source speech signal to that of target signal.

Several approaches have been followed in the development of a voice conversion system. A framework for voice conversion using pitch-shifting algorithm by time-stretching with P-SOLA and re-sampling is proposed in [1]. The authors had done testing the performance of the proposed algorithm on a set of Arabic vowels spoken by male and females. A complete voice morphing system and the enhancements needed for dealing with the various artifacts, including a novel method for synthesising natural phase dispersion is described in [2]. Morphing of certain Telugu-Hindi voiced speech and vowels and the conversion between male, female and child speech is tested in [3]. A neural network-based voice conversion system is proposed in [4] where system is trained using MFCC features from the source and target voices. The authors have compared the performance of GMM and ANN. The experiments show that the performance of ANN system is better than GMM. They also address the issue of dependency of voice conversion techniques on parallel data between the source and the target speakers. In this paper, we compare the performance of LPCs and MFCCs features using ANN voice conversion system.

The paper is organised as follows. Section 2 overviews the motivation of work. In Sect. 3 dataset information is discussed. Section 4 describes the experiment simulation. Section 6 describes the result analysis followed by Sect. 7 concludes the work.

2 Motivation

Voice conversion or voice morphing has extensive applications in industrial and commercial sector. For example, it is used in security-related applications to hide the identity of the user. Vocal pathology, voice restoration, games are few other systems where voice conversion is extensively used. One very important step to be considered while building this system is selection of features. There has been a lot of work in building voice conversion system each of them have their own set of features to train the system. In this paper, we considered to evaluate the performance of two such systems considering linear predictive coding (LPC) and mel-frequency cepstral coefficients (MFCCs) as features and artificial neural network (ANN) to train

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the system. We have analysed performance of this system for four different scenarios considering voice conversion from male to female, female to male, male to male and female to female. Under each of these scenarios, we have analysed the performance of ANN-based conversion system. ANN in this system acts as transform function to convert the voice from source to that of target.

3 Corpus

The bench mark dataset of CMU Arctic database is used for experimentation. The data set is recorded in English language with USA male and female speakers. Six parallel utterances are spoken by them at sampling frequency of 16000 Hz. The silence portion of the speech samples are removed automatically using silence removal algorithm and used them to convert into target speakers' voice.

4 Feature Extraction Process

As described in the previous sections, our paper concentrates on the performance analysis of two important features of speech signal LPC and MFCCs. In this section, we briefly explain these features.

4.1 Linear Predictive Codig (LPC)

LPC methods are the most commonly used in speech coding, speech recognition, speech synthesis, speaker recognition, speaker verification and for speech storage. They are used to represent spectral envelop of a speech in a compressed form using linear predictive model. Basic steps in LPC calculation:

- *Preempahsis:* The speech signal $s(n)$ which is digitised, is sent through a low order digital system, to spectrally flatten the signal this makes it less susceptible to finite precision effects later in the signal processing.
- *Segmentation:* Find $s(n)$ and $R(0)$ through segmentation which will be required to find further $R(i)$ using autocorrelation mechanisms.
- Apply Levinson–Durbins Algorithm to find α coefficients which converts each frame of $p + 1$ autocorrelations into LPC parameter.
- Transmit the output of previous step to a decoder [5].

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4.2 Mel-Frequency Cepstral Coefficients (MFCCs)

MFCC features are coefficients that put together make up Mel-frequency Cepstrum. These coefficients represent short-term power spectrum of a sound, based on a linear cosine transform of a log power spectrum on a nonlinear mel scale of frequency. Steps in MFCC calculation are given below:

- Take Fourier transform (FFT) of speech signal.
- Using triangular overlapping windows like hamming window map the powers of spectrum obtained in the previous step onto the mel scale.
- At each of the mel frequencies take logs of the power. Then take the discrete cosine transform on the list of mel log powers.
- The amplitudes of the resulting spectrum are MFCCs.

LPCs or MFCCs thus obtained from the above processes are fed to ANN. In next section, we analyse performance of these features in our voice recognition system.

5 Experiment Simulation

A set of 13 MFCC features were obtained from each frame of size 25 ms with an overlap of 10 ms which is used as an input to ANN for mapping source to target features. Experiments are conducted for four different cases, male to female, female to male, male to male and female to female. Performance of system under each of these cases was analysed.

With varying number of layers in ANN, it is observed that four-layered model with two hidden layers consisting of 50 neurons [13N 50N 50N 13N] performed better than a three-layered or five-layered architecture and hence all our simulations are based on a four layered ANN model. In order to train our system, we have used speech samples consisting of around 20 words and analysed performance under all the above mentioned cases.

6 Result Analysis

In this section, we explain our results and conclusions drawn about the performance of MFCC and LPC features for voice conversion system using ANN training model. The system was trained using voice samples from CMU_ARTIC Database which consists of around 1000 parallel utterances of same sentences from four speakers which include two male and two female speakers. LPC coefficients as feature set for training Voice Conversion system is observed to outperform the system compared when compared with MFCC as training set. The error histogram plots further explain the conclusions drawn from the experiments are shown in Fig. 1.

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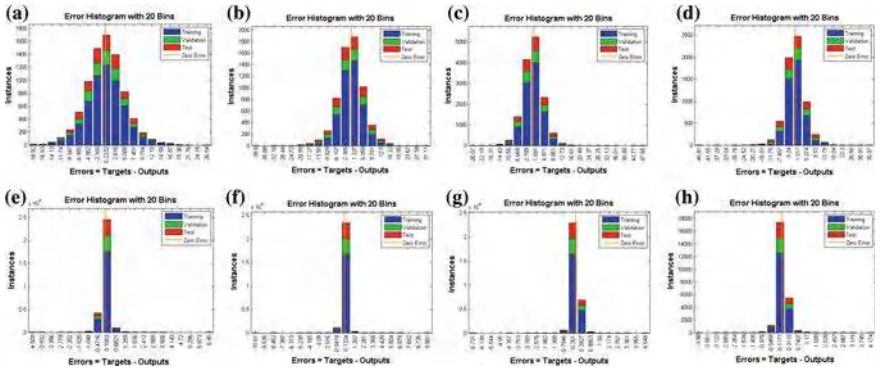

Fig. 1 Error histograms of different combinations of gendres for MFCCs and LPCs. **a** M-F conversion using MFCCs. **b** F-M conversion using MFCCs. **c** M-M conversion using MFCCs. **d** F-F conversion using MFCCs. **e** M-F conversion using LPCs. **f** F-M conversion using LPCs. **g** M-M conversion using LPCs. **h** F-F conversion using LPCs

From the plots, it is seen that the voice conversion system using LPC coefficients as feature vectors have less error compared with that of MFCCs. This could be because LPC coefficients use linear prediction mechanisms to predict expected co-efficients, whereas MFCC uses mapping of features as a mechanism and hence LPC can predict and learn better using ANN compared to that of MFCC.

Figure 1b and f explains the behaviour for voice conversion from Female to Male even in this case it is observed that LPC outperforms MFCC further the output error in the case of MFCC was observed to be more than the previous case.

The behaviour of Voice Conversion system from Male to Male is plotted in Fig. 1c and g. As before LPC coefficients feature vectors were found to be better than MFCC. One important observation made is that the error in this case was observed to be quite higher than the previous cases because here the voice conversion is between Male to Male where the difference between features is less and hence difficult to map the feature vectors and train the system.

Figure 1d and h describes the observations made for Female to Female voice conversion system. As clear from the results LPC features are better to be used as feature vectors when compared to that of MFCC and even in this case the error rate was observed to be more than first two cases as the difference between features are less compared to the first two cases (Male to Female and Female to Male).

7 Conclusion and Future Work

In this paper, we have analysed the performance of MFCC and LPC feature vectors to train Voice Conversion System and in most of the cases it is found that the system using LPC features performed better than those using MFCC further the error rate

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was more for voice conversion between Male to Male and Female to Female voice conversion cases. In our future work, we look forward for building a complete voice conversion system that can dynamically adopt for any voice given that the system is trained for that voice at-least for two minutes.

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Person Detection and Tracking Using Sparse Matrix Measurement for Visual Surveillance

Moiz Hussain and Govind Kharat

Abstract Research in the domain of human processor interaction is associated to target segmentation and tracking. The significant analysis in this sector is encouraged as of a view that the multiple field of applications, consisting of observation, computer–human interaction, will benefit from a vigorous and efficient result. In this paper, we propose a framework for the object tracking using sparse matrix and AdaBoost classifier. The technique includes three steps: at the first stage, we use extracted image features. Later, frame features are represented as a sparse matrix. At the final stage, AdaBoost classifier is used to classify correctly the sparse matrix values based on which the tracking task is performed. Experimental results presented in the paper shows that the framework gives improved performance in comparison with other techniques of object tracking.

Keywords Adaboost classifier · Video surveillance · Sparse matrix

1 Introduction

A basic problem for most of the involuntary visual surveillance framework is to identify objects of concern in a known visual scene. A regularly used method for segmentation and detection of moving targets is background differencing [1–5]. Although, the great amount of research is done in the area of the surveillance system, yet it is a tough job to design efficient and robust models for object segmentation and tracking owing to issues such as shape variation, complete and mutual occlusion, lighting change, and motion blur. Today's tracking models frequently update the framework with patches from observations in current frames.

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Still, many issues are remaining to be addressed; in spite of a great deal of success has been achieved in the image processing applications.

First, most tracking models frequently come across the change in pixel problems [6, 7]. Second, as all these frameworks are data dependent, at the beginning there is a not sufficient amount of information to learn the model. The system performance can be degraded by the fact of over learning; misclassified samples are added to the model. A classic surveillance application includes 3 blocks [8–11]: "Motion" detection, "Object" tracking and "Behaviour" analysis. The job of most of the surveillance system applications is to identify, track and categorize the targets.

The available modules of video surveillance for object segmentation and tracking can be categorized into three key classes: silhouette-based frameworks [12, 13], region-based frameworks [14–16] and attribute point-based frameworks [17–19]. Moreover, the popular automatic surveillance system uses affine flow/optical flow technique for object segmentation and tracking. This is based on the theory that flow [20–22] cannot be estimated regionally, since simply one sovereign dimension is available from the frame string at a point, while the optical flow rate has 2 elements a second restraint is crucial. Intelligent programmed tracking frameworks must be capable to predict the alteration generated by an approaching new object, whereas nonstationary background regions, such as smoke, curtains waving in the air or drizzle must be predicted as a part of the background image. Optical flow; calculates a separate approximation of motion at every pixel; this generally engages decreasing the brightness between successive pixels added over the frame. It is considered that these changes are due to motion variation and because of other consequence, for example, illumination variation. The elucidation can change in an inside and an exterior frame sequence [23, 24]. The elucidation in room sequence can alter as the luminosity changes least 60 times per second by reason of within room illumination [25]. Therefore, elucidation has an effect on the camera captured frame [26, 27]. The elucidation in an open-air also changes due to varieties of causes [28], for instance, the day radiance change, and these changes are enormously sudden in comparison to the interior sequence.

The framework described in this paper is a key to the difficulty of successfully tracking the moving individuals with the easy model and low cost of computation. One of the major merits of the model, compared to the former techniques is that it decreases the incorrect classification, as feature matrix is generated using representation of sparse and the pixels are precisely categorized using AdaBoost network.

The structure of the proposed framework is illustrated in Fig. 1. The Figure shows various levels involved in the model. At first, we extract the frames from video, after that, 'multiscale' frame attributes are estimated using matrix (sparse). Extracted frame characteristic vectors are then given as an input to AdaBoost network for the tracking job. The rest of this paper is structured as follows: Sect. 2 describes literature review. Section 3 represents the system framework. Section 4 presents the database selection for testing work. In Sect. 5 experimental results are shown and finally, Sect. 6 concludes the paper.

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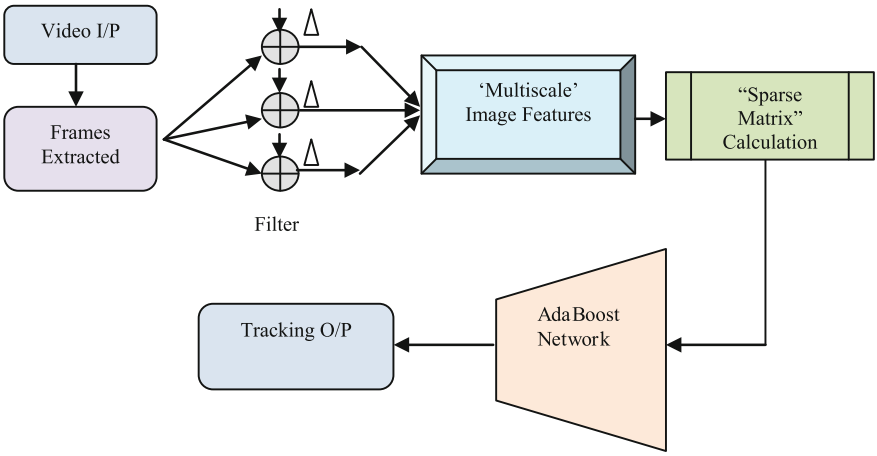

Fig. 1 Tracking system model stages

2 Related Work

Enormous quantity of research is done in the field of surveillance for human/object motion segmentation and tracking. In our [29] latest work, we have presented a threshold initialization model to the segment target from an image frame based on the hypothesis that the mobile targets are visually removed with no partly covered regions. Avidan [30] uses SVM neural n/w classifier and persist it inside the optical flow structure for tracking of an object. An irregularity ratio of interested target and surrounding classes to fix on discriminative features for object tracking is used by Collins et al. [31].

Ravi et al. [32] and Bao and Intille [33], have presented systems to guess actions like standing, walking, sit-ups, running and others using characteristics from accelerometer information and a multiple number of training techniques. On the contrary, they have not applied this information for an interior location. Since this technique focuses on intra image illumination discrepancies and spatial compared to sequential, inter image elucidation changes, it is a divergent collection of illumination compensation. In a study by Cwojek et al. [34], described a technique for some human action recognition in the workplace location with direct tracking. In this model, image and sound attributes are employed to use a multilevel Hidden Markov Model (HMM) technique. A procedure developed to describe a moving individual in indoor surroundings was developed by Pfinder [35]. It detects and tracks solo non-overlapped human/objects in composite scenes. Cai [36] developed a mixture model of 3 parameters with an EM method to model appearance variations during tracking. The technique graph cut, was also designed for motion tracking by estimating a lighting invariant flow field Musa et al. [37]. Ross et al. [38], proposed a technique that shows sturdiness to large variations in pose, size and elucidation using PCA. The Babenko [39], presented algorithm for online

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multiple instances learning that effectively tracks a moving object in real time, where the object is occluded by others and illumination conditions changes drastically.

The modern improvement of sparse depiction [40] has gained substantial importance in tracking [41, 42], because of its sturdiness to image noise and occlusion. Since these methods uses simply generative depiction of targets and do not consider the surrounding scene into account, they are far less successful for tracking in untidy surroundings. Durucan and Ebrahimi [43], the techniques that are employed in action identification were categorized into local and global representation. We realized target segmentation and tracking framework that not only supports complete assessment of sparse technique but also handle the difficulty of elucidation variations and vibrant surroundings.

3 Methodology

Relatively effortless, yet a competent and effectual tracking model based on attributes extracted [44] from frame space with data basis is presented. The proposed algorithm utilizes a non-adaptive arbitrary projection which protects the formation of the image quality space of an object. A sparse matrix is developed to capably take out the characteristics for the appearance model. Pattern images are compacted of the target and the surroundings due to the similar sparse matrix. The tracking job is devised as a binary categorization via an AdaBoost network with an update in the condensed area. A broad to narrow search strategy is implemented to further decrease the estimation difficulty in the recognition procedure.

The presented tracking framework runs at real-time speed and performs positively against the other methods on different challenging video clips in terms of exact tracking and sturdiness.

3.1 Image Representation

At first, from video sequence all the image frames are grabbed. The 'multiscale' image depiction is developed by convolving the input frame with a Gaussian filter of dissimilar spatial variances. For every input frames its 'multiscale' depiction is developed by convolving the image with a bank of filters at 'multiscale' values $\{I_{1,1} \ldots I_{w,h}\}$ denoted by

$$I_{w,h}(x,y) = \frac{1}{wh} \times \begin{cases} 1, & 1 \le x \le w, 1 \le y \le h \\ 0, & \text{Otherwise} \end{cases}$$

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Here, w is width and h is the height of a rectangle filter. Every filtered image is then symbolized as a vector in column R^{wh} and combine these vectors as an extremely large-dimensional image attribute vector $v = (v_1, \ldots v_n)^T \in R^n$ where $n = (wh)^2$. The value n is normally of the order $10E^6$–$10E^{10}$.

3.2 Integral Image

Rectangle image attributes can be estimated exceptionally quickly by means of a centre illustration for the frame which is known as the integral image. The image position x, y has the summation of the pixels over and to the left of x, y inclusive:

$$jj(x, y) = \sum_{x' \le x, y' \le y} j(x', y')$$

$jj(x, y)$ is an integral image and $j(x, y)$ is the unique image. With subsequent pair equations:

$$c(x, y) = c(x, y-1) + i(x, y)$$
$$jj(x, y) = jj(x-1, y) + c(x, y)$$

where $c(x, y)$ is a collective row sum, $c(x, -1) = zero$, and $jj(x-1, y) = zero$ integral frame can be estimated in 1 pass over the unique image.

3.3 Image Features

To reduce the inter class variations of the pixel and to increase the outer class variability in comparison to the raw data, the features are used as a substitute of pixel value [45, 46]. This technique makes the classification process easier. Features normally encode information concerning to the area, which is complex to be trained from the finite and raw set of data input. General and an especially big bank of simple Haar features in combination with attribute collection, consequently can improve the capability of the learning model. The feature evaluation pace is also an essential characteristic as approximately every object segmentation and tracking frameworks slide a specific size pane at each scales above the input frame.

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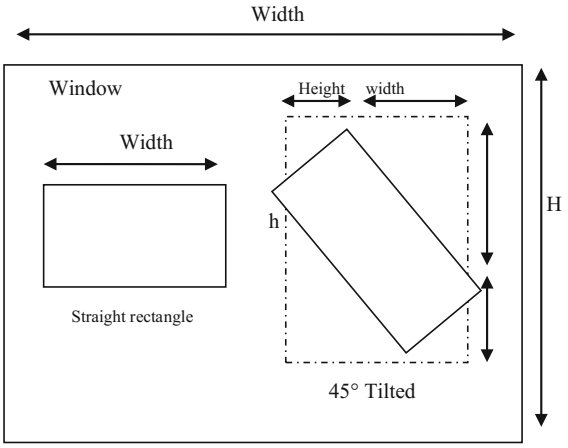

Fig. 2 45° titled and the straight rectangle

The proposed attribute selection method is encouraged with the comprehensive set of Haar-like characteristics initiated through Lienhart and Maydt in [47]. Let us presume the essential component for checking for the occurrence of a target is a window of *Width* × *Height* pixels. Furthermore, presume that we have an extremely quick means of calculating the summation of pixels of any vertical and 45° tilted rectangle within the window. A rectangle is described by a region with $reg = (x, y, w, h, \beta)$ through $zero \le x, x + w \le W, \quad zero \le y, y + h \le H, x, y \ge zero, \ w, h \ge zero, \ \beta \in \{\text{zero}°, 45°\}$ and its pixel summation is indicated by $RSum(reg)$. Two cases of such rectangles are shown in Fig. 2. The presented attribute set is subsequently the collection of every probable attributes of the form

$$fe_1 = \sum_{i \in I = \{1, \ldots N\}} w_i \cdot RSum(reg_i)$$

where network weights $w_i \in R$, the rectangles reg_i and N are randomly selected.

3.4 Fast Feature Calculation

Every single feature for the object detection can be calculated extremely fast and in steady time for every dimension using two supplementary images. For vertical "rectangles" the supplementary image is an Area of Summed Table, i.e. $AT = (x, y)$. $AT(x, y)$ this is described as addition of pixels of the vertical rectangle starting with the apex left corner at (0, 0) to base right corner (x, y).

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$$AT(x, y) = \sum_{x' \le x, y' \le y} I(x', y')$$

3.5 Classifier Design

Let us consider that all requisites in v are alone dispersed an formulate them with an AdaBoost training model [48]. Known training set and attribute set of frames, any quantity of system training ways might be used to train a categorization function. In this framework, a modification of AdaBoost network is utilized equally to choose a selected set of attributes and to learn the classifier. In its unique form, the AdaBoost training technique is applied to enhance the categorization result of a simple (occasionally called weak) training algorithm. AdaBoost learning model provides the number of formal guarantees.

For every attribute, the weak learner chooses the most favourable threshold classification constraint, due to which the least numbers of samples are wrong classified. AdaBoost classifier $Bj(x)$ thus includes a feature fj, a polarity pj and a threshold θj representing the direction of the dissimilarity sign:

$$Bj(x) = \begin{cases} \text{One} & pjfj(x) < pj\theta j \\ \text{Zero} & \text{else} \end{cases}$$

In terms of calculation, AdaBoost network is possibly faster than the most other training mechanism. Unfortunately, the simple method to enhance the tracking result, adding attributes to the network, directly enlarges the calculation period.

4 Database Collections

In our study we used two datasets. First "Weizmann" dataset which is accessible for research purpose publically and second is "self" developed dataset. This dataset includes 86 video sequences consisting of four and five classes of human actions that includes Jumping, Running, Walking, Side walking, Handwaving and Jogging in that order executed by 19 different subjects in two dissimilar environmental conditions e1 and e2. e1: Indoor Environment e2: Outdoor Environment (Playground + elucidation variations) (Figs. 3 and 4).

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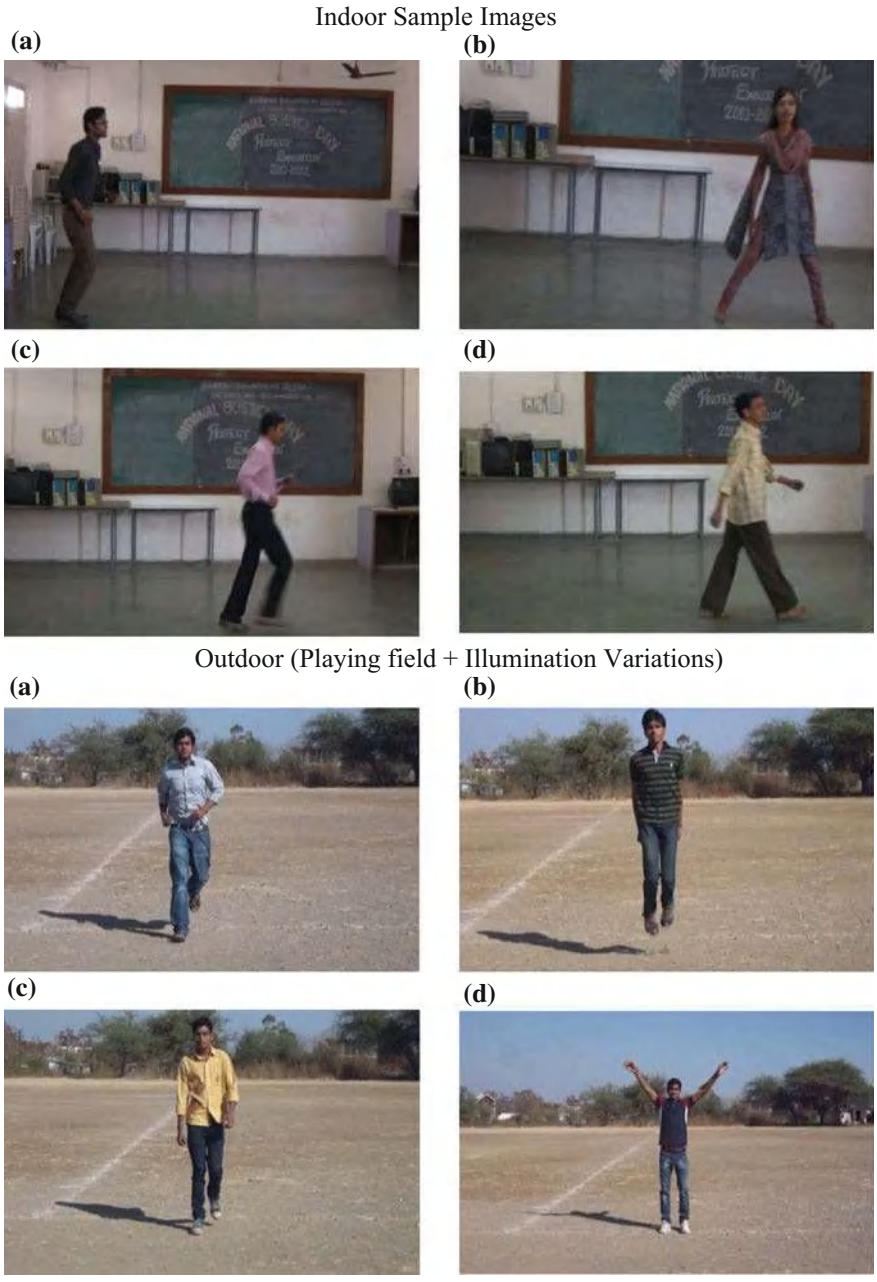

Fig. 3 "Self" dataset images. Indoor sample images: **a** Jumping. **b** Sidewalk. **c** Running. **d** Walking. Outdoor (playing field + illumination variations): **a** Jogging. **b** Jumping. **c** Walking. **d** Handwaving

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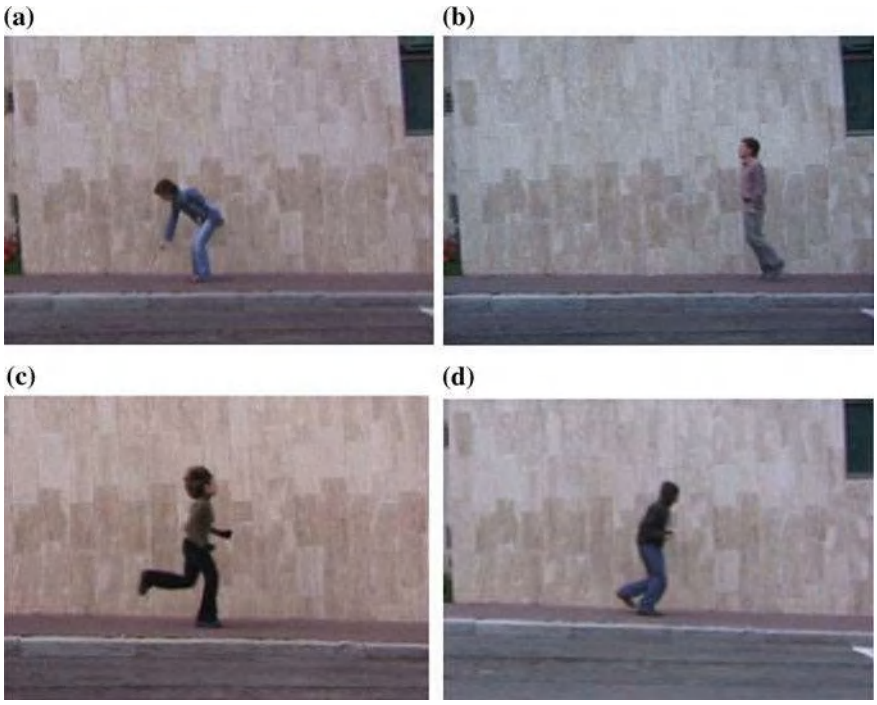

Fig. 4 "Weizmann" dataset images. **a** Bending. **b** Jumping. **c** Running. **d** Skipping

5 Experimental Result

The presented algorithm for the video surveillance system using motion analysis is evaluated with the general motion technique for the state of tracking accuracy and computational time. The settings for experimentation work are briefed in Table 1.

The sparse technique uses raw an attribute collection of an object. To increase the absolute detection of the moving target AdaBoost network is trained with extracted 'multiscale' attributes and the nonstationary target is precisely segmented and tracked. The technique gives the best tracking output as depicted in Fig. 5 as compared to the other motion segmentation method in terms of preciseness.

Table 1 Experimental conditions

Sequence	1280 × 720 pixels, 24 bit colour, 30 fps
CPU	Corei3, 2.13 GHz
RAM	4 GB
OS	Windows 7.0
MATLAB	Version 7.10.0.499 (R2010a)

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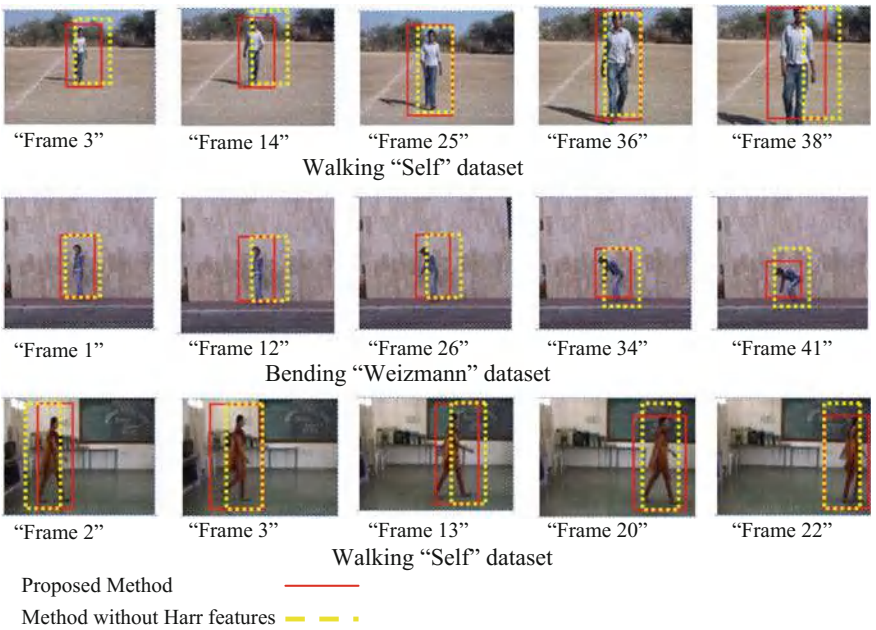

Fig. 5 Experimental results

Fig. 6 Error of the tracking window for different frames

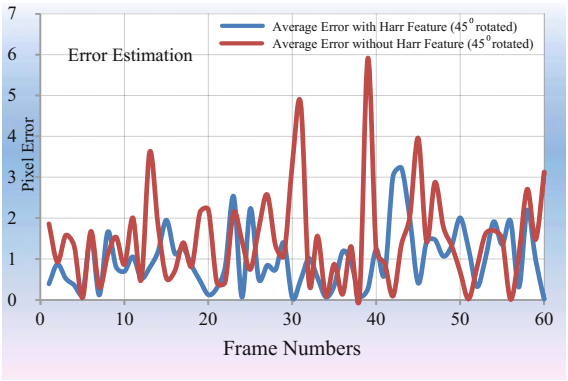

Figure 6 shows the error between the actual target and the tracking window position in terms of pixel value distance for a different number of frames. The highest error is restricted in 3 pixels for the classifier considering the 45° rotated Harr features and is nearly six pixels (Double Error) for the classifier without 45° rotated Harr features, which shows that the proposed algorithm provides a reliable prediction performance.

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6 Conclusion

In this paper, the authors have presented a vigorous and proficient 'multiscale' sparse matrix attributes based on a object tracking model that uses the consistent sparse nature of image particle representation using a dictionary of object and background templates. The authors have modeled the visual surveillance tracking system as a classification problem that is regularized with the AdaBoost classifier at the stage of elements, and described a competent solution. The authors have systematically analyzed the result of the tracking framework against a challenging method on different demanding video datasets. Quantitative and qualitative experimental results show that the described detection and tracking algorithms outperform other methods, especially in the occurrence of pose variations and illumination changes.

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Improvisation in Frequent Pattern Mining Technique

Sagar Gajera and Manmay Badheka

Abstract At present, so many techniques are available which can be applicable to wide range of datasets. They provide an effective way to mine frequent pattern from the datasets. Most of them use different kind s of data structures for the processing which provide variations in requirement of time and space. Generally, traditional techniques are restricted to the narrow area or provide effective results only in the specific environment. So, it requires continuous optimization and updation. Dynamic data structure and mapping shows more effectiveness compared to the traditional techniques in terms of time and space requirement for processing.

Keywords Association rule mining · Frequent pattern mining · Frequent itemset · A priori algorithm

1 Introduction

Data Mining is a process of deriving knowledge from a database or data warehouse. It is also known as Data Dredging [1].

The main task of the data mining activity is to mine precious nuggets of knowledge from a data set and converts it into a transparent structure which can be used for additional analysis.

Apart from the analysis step, it contains various tasks like data preprocessing, decision-making, pattern recognition, consideration of complexity, pictorial representation, updating knowledge, schema generation, and online analytical processing. Frequent pattern mining is a technique of finding hidden pattern from a data which occurs frequently [1]. It is emerged as an interesting area of research in recent years. It is presented in the form of Association Rule ($R \Rightarrow S$) [1].

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It is also known as Association Rule Mining. This technique is useful in many sectors such as banking, bioinformatics, telecommunication, financial corporation, etc. Basic approach is to find an association and correlation among the data in a database but it should be interesting. The interesting measures are shown below [1].

$$\text{Support}\,(R \Rightarrow S) = P\,(R\ U\ S) \tag{1}$$

$$\text{Confidence}\,(R \Rightarrow S) = P\,(R|S) \tag{2}$$

Items which have values of interesting measures above the predetermined threshold are said to be the frequent item set.

Dynamic programming is one of the techniques to design an efficient algorithm [2]. This technique is used for those problems where optimization of task is needed. This technique stores the previous solutions [3]. So, whenever it reappears, it can be directly accessed from those pre-calculated values without creating more overhead. It has the important feature named memorization [3]. The word memorization comes from memo means recording of solutions, which relates to storage of the solutions of sub problems.

The structure of paper is as follows. Section 2 represents existing work and theories. Section 3 presents designed technique. Section 4 gives a complete analysis proposed algorithm. Section 5 concludes a paper.

2 Related Work

The various algorithms for frequent pattern mining are described below.

2.1 Association Rule Mining

Suppose that Q = {q1, q2, …, q*m*} is the set of data items, while P = {p1, p2, …, p*n*} is the collection which has the relevant data, T is the subset of Q. The association rule is the implication in the form of R ⇒ S, where R, S ⊂ I and R ∩ S = ϕ [1]. Association rules are judged by using interesting measures. The purpose of the association rule mining is to discover correlation among itemsets which is used for decision-making [4].

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2.2 A Priori Algorithm

The A priori algorithm is a basic algorithm for frequent pattern mining and association rule generation. It usually works with transactional datasets which contains transaction id and set of items called itemset.

A priori is using level-wise searching procedure for exploration of association rules. There are mainly two steps for generating frequent itemsets in this algorithm [1, 5].

- Join Step: The candidate itemset C_k is acquired by combining previous frequent itemset L_{k-1} with itself.
- Prune Step: Look the dataset to acquire the occurrence count of each candidate itemset in C_k.

This procedure is recursively done until no more frequent itemsets can be produced from that dataset [6]. It has one important property called anti-monotonicity [1]. This property states that the subset of any frequent itemsets is also a frequent itemsets. At each step, the possible itemsets are getting multiplied. This makes more use of memory and time [6].

2.3 A Priori Algorithm with Dynamic Programming

This is a variation of A priori algorithm which stores the support count for every itemset using dynamic programming approach. It overcomes the main disadvantage of A priori algorithm, i.e., A priori needs a new pass for each itemsets generation.

It uses the special data structure named count table which is used to store the occurrences of the itemsets [5]. Using count table, only one dataset scan is needed to discover 1-itemsets and 2-itemsets. In this algorithm, only one scan is performed on dataset. During scan, one by one transaction is scanned and processed in terms of deriving combinations of 1-itemsets and 2-itemsets. All the entries of count table which relates to these combinations are incremented by one.

2.4 Pattern Indexing

Pattern Indexing algorithm works in two steps. In the first step, unique pattern indexing takes place. Initially, the pattern will be encoded to a numerical value. This numerical value is unique and stored in a HashMap [7]. While encoding, the pattern is searched into HashMap. If it is not present then new entry is made. Next, the pattern is replaced by its index [7]. In second step, unique pattern is searched and counted by searching and counting its unique index into the input data. This pattern indexing makes task easier of searching any pattern.

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2.5 AIS Algorithm

AIS is the oldest algorithm for frequent pattern mining. It generates and counts candidate itemsets at run time [8]. It makes multiple passes of database for generation of candidate itemsets. It uses frontier set which undergoes extension during the scan. In each pass, the supports of certain itemsets are counted which is known as candidate itemsets and also determine whether the itemsets is to be added for the further pass. When this frontier set becomes null, the algorithm ends up with the final result [8].

2.6 Direct Hashing and Pruning

Direct Hashing and Pruning algorithm uses new data structure called Hash Bucket for generation of candidate itemsets [8]. In the first step, it generates hash table for 2-itemsets from 1-itemsets. In the second step, set of candidate itemsets is hashed into hash entry which is frequent. In third step, the pruning procedure is carried out.

2.7 Partition Algorithm

Partition algorithm is the variation of A priori Algorithm. It generally overcomes the problems of multiple passes which exists in A priori and Direct Hashing & Pruning. It consists of two passes on the dataset. It logically partitions database into n partitions and scans the whole database only two times [8]. In the first pass, it scans the entire database as a group of partitions and searching is made for any pattern. It gives the local frequent patterns for a specific part of database. In the second pass, it finally derives the globally frequent pattern which occurs frequently in the database.

2.8 Quantitative Association Rule Generation for Weather Forecast

This is a specific constructed algorithm for the analysis of local weather. It works mainly in three steps and uses real-time weather database [4]. In first step, Database Transformation is performed as a change of each attributes according to local situations. In second step, Quantitative Association Rules are generated. In third step, Dynamic Interdimension Rules are generated from which weather is forecasted.

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3 Improved Technique

Using Dynamic data structure and Mapping technique, the performance is improved for generation of candidate itemsets. As it uses Dynamic data structure, the approach stores the occurrence counts for the itemsets. Here, the data structure used is dynamic so it uses the least memory space. It only stores occurrence counts, not its corresponding itemsets. Using Mapping equations, it converts item numbers of itemsets to the unique index in the data structure. Thus, it is efficient and reduces the overhead of storing the itemsets with their occurrence counts. Here, the improved technique is explained for maximum 4-itemset generation. This technique can be extended up to *k*-itemset by extending mapping technique on the data structure.

Input

Transactional Dataset D with No. of Transactions T and No. of Items N.
Minimum Support and Minimum Confidence.

Output

Association Rules generated from Frequent 2, 3 and 4-itemsets.

Procedure

```
For each transaction, item list X holds the items in the transactions.
for items in X
        make possible combination of length 1, 2, 3 and 4.
        for each combination of items
                find unique index n in data structure using Mapping
                increment value at index n by 1
        end for
end for
```

Special Results

1-itemset: a = 0, b = 0 and c = d
2-itemset: a = 0, b = 0 and c & d are distinct (c < d)
3-itemset: a & b are distinct (a < b) and c = d
4-itemset: a, b, c and d are distinct such that a < b < c < d

Mapping

From Special Results, a, b, c and d are initialized such that a < b < c ≤d. (Exception: a = b when a = 0 and b = 0)

$t = \frac{(x-b)(x-b+1)}{2}$ where, x is total number of items.

$m = \frac{(d-b-1)(d-b)}{2} + 1$ where, m points first element for block d.

$n = m + (c - b) - 1$ where, n is index of stored support.

m and n ≤t

For example, Table 1 shows transactional dataset with items I = {I1, I2, I3, I4} and five transactions. Using the Procedure and Mapping equations, the data structure will be created as Fig. 1a. For itemset (*a*, *b*, *c*, *d*), the data structure is

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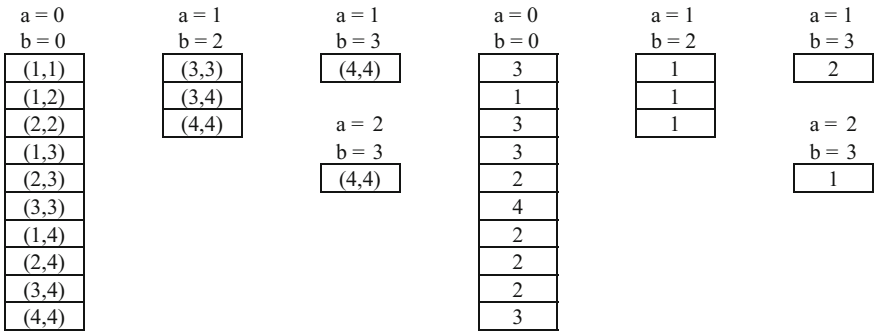

Fig. 1 Dynamic data structure (**a**, **b**) with values (**c**, **d**) and values of example

identified with values of a and b while index of occurrence count is determined by values c and d.

For Table 1, the values of occurrence counts in the data structure can be shown as Fig. 1b. Here, the occurrence count of any itemset means support count.

Example If the occurrence count of itemset (I1, I2, I4) is to be stored or retrieved from the data structure, the unique index of that itemset is to be calculated.

From Special Results, $a = 1$, $b = 2$, $c = 4$ and $d = 4$.
Next, x = total number of items = 4.
$t = \frac{(4-2)(4-2+1)}{2} = 3$. So, data structure with $a = 1$ and $b = 2$ contain three values.

$$m = \frac{(4-2-1)(4-2)}{2} + 1 = 2.$$

$n = 2 + (4 - 2) - 1 = 3$. Where, $m = 2 \leq 3 = t$ and $n = 3 \leq 3 = t$.

Thus, the itemset (I1, I2, I4) has 3rd index in the data structure $a = 1$ & $b = 2$. Here, value at above index is 1. So, the occurrence count or support count of itemset is 1.

Table 1 Transactional dataset

TID	Itemset
T1	I1, I3
T2	I2, I4
T3	I1, I2, I3, I4
T4	I2, I3
T5	I1, I3, I4

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4 Experiments and Results

To exhibit the effectiveness of the research work, we performed several experiments on a Supermarket and Synthetic dataset. Supermarket dataset contains 4627 transactions, 213 items. Synthetic dataset is generated using the random function which provides uniform distribution over the given ranges. A system with core i3 processor and 4 GB RAM is used for performing experiment and analyzing results.

Experiment 1: (Measures of Quality)
This experiment compares the total number of combinations with the actually generated total number of combinations. Figure 2 concludes both the combinations and compares their values on the base of the total items. From the figure, it is clear that the total combinations are increased as the total numbers of items are increased.

As shown in figure, this method makes the less number of combinations than the total number of combinations which can be generated from the items. Thus, this approach stores less number of combinations and utilizes the space.

Experiment 2: (Measures of Performance)
This experiment shows the effect on the execution time by varying the size of the data (number of records) and the total number of items.

Figure 3 shows the effect when the numbers of records are increased. From figure, the execution time varies linearly with increasing the number of records. Here, the total numbers of records varies from 1000 to 5000.

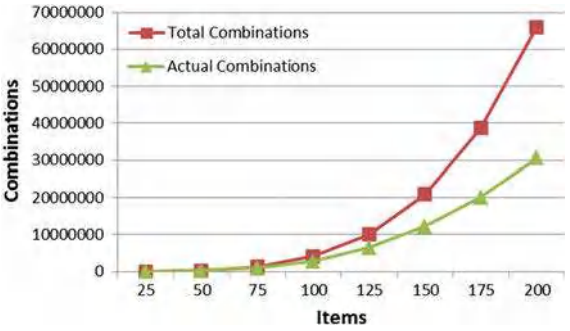

Fig. 2 Comparison of total combinations and actual combinations

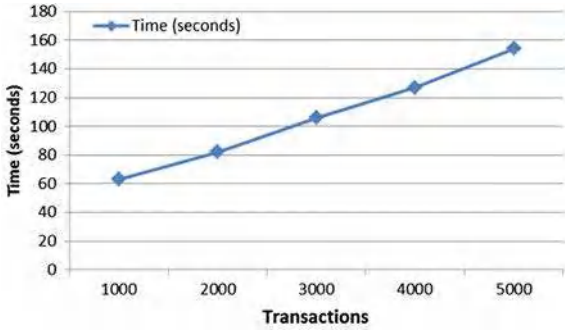

Fig. 3 Execution time by varying number of records

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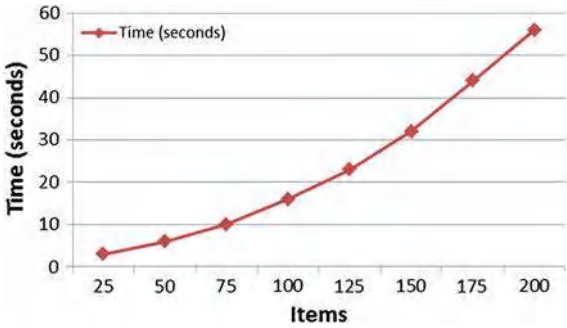

Fig. 4 Execution time by varying number of items

Figure 4 shows the effect on the execution time when the total numbers of items are increased. From figure, the execution time varies linearly with the number of items. Here, the total numbers of items varies from 25 to 200.

5 Conclusion

From the generated results, it is concluded that this method removes some limitations of other techniques of frequent pattern mining. It uses only one dataset scan which is the minimum limit. So, it consumes less time for *k*-itemsets generation. It also stores the support counts of itemsets in a data structure efficiently which utilizes memory space. Also, this is helpful to decide the strength of association rule without extra effort.

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Design and Simulation of Hybrid SETMOS Operator Using Multiple Value Logic at 120 nm Technology

Raut Vaishali and P.K. Dakhole

Abstract Motivation behind this paper is to bring new method for multi-feature compact designs with low power requirement which is beyond the capacity of binary logic as well as use of only CMOS technology. Simplicity, compactness, and low power requirement can be achieved by hybridization of single electron transistor and CMOS with quaternary logic. The proposed implementation overcomes several limitations found in the previous quaternary implementation such as MIN, MAX, XOR gate and Full Adder which is simulated in 120 nm technology requires less number of transistors as well as with very low power dissipation.

Keywords Single electron transistor · CMOS · Quaternary · Multivalue

1 Introduction

An important aspect of multi-valued logic systems is of choosing the radix value and the choice of radix is available in actual or conceptual domains. Actual and conceptual domains may be different. The choice mainly depends on the ease of manipulations of variables in conceptual domain and manipulations of voltage, current, charge, etc., in the actual circuits. In this thesis, logic levels are represented as voltage levels and are 0, 1, 2, and 3. The number of bits required for binary representation of an n-digit base-r value is $n[\log_2 r]$. When the radix is not a power

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of 2, more number of bits are required than minimum and this leads to an inefficient representation. Hence, when $r = 2^k$ exact k bits are required. Among the radix values that are powers of 2, the system based on 4 shows considerable promise. The values 8 and 16 are potentially useful. Quaternary logic is quite feasible since the implementations can be designed using available circuitry, and no additional special components are required. Hence, quaternary radix is selected to realize the logic circuits [1–4].

2 Single Electron Transistor

The SET is a four-terminal device. It has a source and drain along with two separate gates. One gate resembles the functionality similar to CMOS transistor gate and second gate is specifically used as back gate for controlling purpose. A single electron transistor consists of a small conducting island coupled with source and drain, leads by tunnel junctions, and capacitively coupled to one or more gates [5]. Tunnel junction is a combination of capacitor and resistor. Figure 1 shows symbol of single electron transistor and PMOS. Single electron transistor which is shown in Fig. 1 consists of two tunnel junction formed by R1C1 and R2C2 whose values are given in Table 1. For hybrid design SET [6] and BSIM4.1.0 PMOS model used.

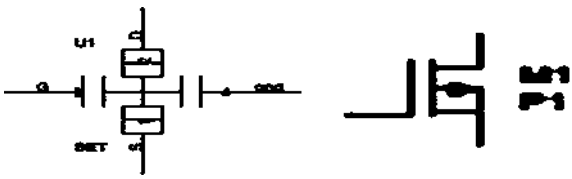

Fig. 1 Symbol of single electron transistor and PMOS

Table 1 Description of single electron transistor and P MOSFET

SET	PMOS [BSIM 4.1.0]
SET C1 = 1E-18 C2 = 1E-18 R1 = R2 = 1E5 Cg1 = 1E-18 Cg2 = 0	**PMOS** Vth = −0.42 V W/L = 600 nm/120 nm

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3 Quaternary Single Electron Transistor Logical and Arithmetic Operators

An assortment of logical and arithmetic operators is requisite for countless applications in the processing units. These various operators are available in binary logic in which interconnection increases as the number of components increases. Hence use of binary logic for complex circuits is not worthwhile. Similarly, CMOS-based circuits consume more power which is also not suitable in today's world of low power VLSI. In this section, single electron transistor technology and hybrid CMOS with SET in quaternary logic-based MIN, MAX, XOR gates are designed and simulated which can be used as logical operators for future applications.

3.1 Quaternary SETMOS MAX Gate

The MAX gate is designed by using only two N-type single electron transistors and one P-type MOSFET. The power dissipation of MAX gate is almost zero. As compared with various previous quaternary MAX gate the implemented quaternary MAX gate is much more efficient as well as optimized (Fig. 2 and Table 2).

$$\mathrm{MAX}(\mathrm{A},\ \mathrm{B}) = \begin{matrix} \mathrm{A} + \mathrm{B} & \mathrm{A\ when\ A} > \mathrm{B} \\ & \mathrm{B\ when\ B} > \mathrm{A} \end{matrix}$$

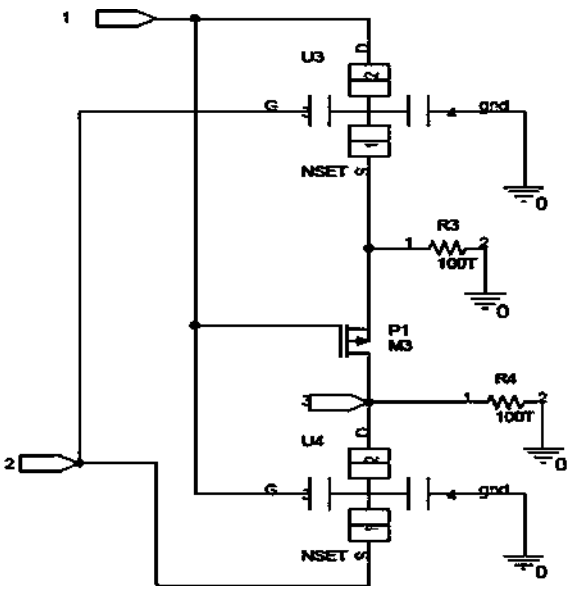

Fig. 2 SETMOS quaternary MAX gate

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Table 2 Truth table of quaternary SETMOS MAX gate

A	0	1	2	3
B				
0	0	1	2	3
1	1	1	2	3
2	2	2	2	3
3	3	3	3	3

3.2 Quaternary SETMOS MIN Gate

The MIN gate is designed by using only two N-type single electron transistors and one P-type MOSFET. The power dissipation of MIN gate is almost zero. As compared with various previous quaternary MIN gate the implemented quaternary MIN gate is much more efficient as well as optimized (Fig. 3 and Table 3).

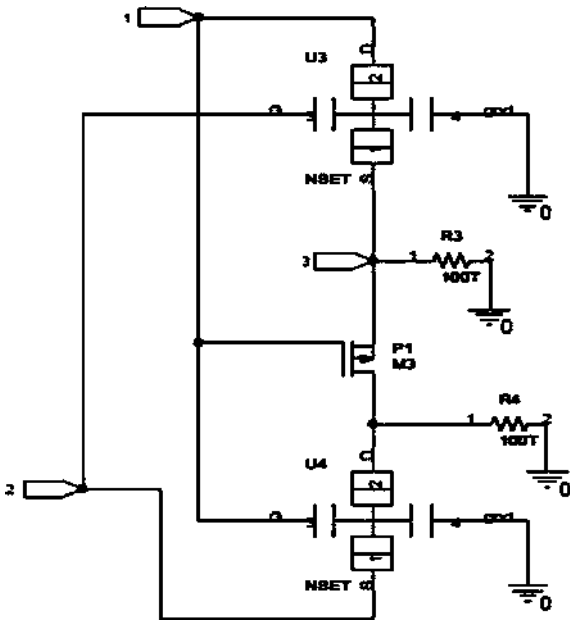

Fig. 3 SETMOS Quaternary MIN gate

Table 3 Truth table of quaternary SETMOS MIN gate

A	0	1	2	3
B				
0	0	0	0	0
1	0	1	1	1
2	0	1	2	3
3	0	1	2	3

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$$\text{MIN}(A, B) = A \cdot B \quad \begin{matrix} A \text{ when } A < B \\ B \text{ when } B < A \end{matrix}$$

3.3 Quaternary SETMOS XOR Gate

A new Quaternary SETMOS XOR gate is designed which is shown in Fig. 4 (Table 4). For the design of Quaternary SETMOS XOR gate one MAX, two MIN, one NAND and one AND gate are used. Comparative analysis of Quaternary SETMOS XOR with different XOR gate such as binary three types of XOR gate which is designed with only using single electron transistor and XOR gate which is designed with combination of single electron transistor and MOSFET [7] in terms of power dissipation is given in Table 5.

The graphical representation of power dissipation of XOR gate is shown in Fig. 5 which shows that power dissipation of Quaternary SETMOS XOR gate is less.

3.4 Quaternary SETMOS FULL ADDER

For the design of Full adder various operators are used such as Level 3, Level 0, TSUM, TDIFF [8, 9]. The operators which are introduced in [8, 9] are designed with combination of depletion and enhancement type of MOSFETs as well as with some change of W/L ratios. While in the proposed design of full adder all the four operators along with MIN and MAX gates are used but in that use of N-type single electron and P-type MOSFETs are used. Due to which there is no need of using

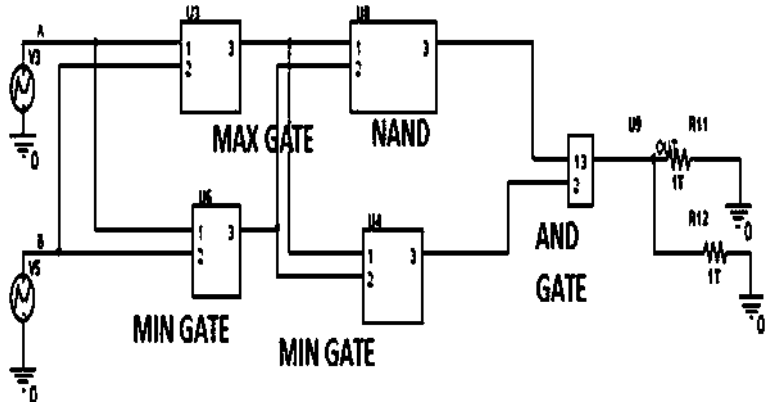

Fig. 4 SETMOS quaternary XOR gate

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Table 4 Truth table of quaternary SETMOS XOR gate

A	0	1	2	3
B				
0	0	1	2	3
1	1	0	3	2
2	2	2	0	1
3	3	3	1	0

Table 5 Comparison of power dissipation Of XOR gate with quaternary SETMOS XOR

Sr. no.	Gate type	Power dissipation (μW)
1	Single electron transistor xor (set-xor)	4.2
2	Hybrid single electron transistor-MOSFET xor (SETMOS xor-type i)	10.87
3	Hybrid single electron transistor-MOSFET xor (SETMOS xor-type ii)	6.49
4	Hybrid single electron transistor-MOSFET xor (SETMOS xor-type iii)	5.87
5	Quaternary hybrid single electron transistor-MOSFET xor (quaternary SETMOS xor)	0.2

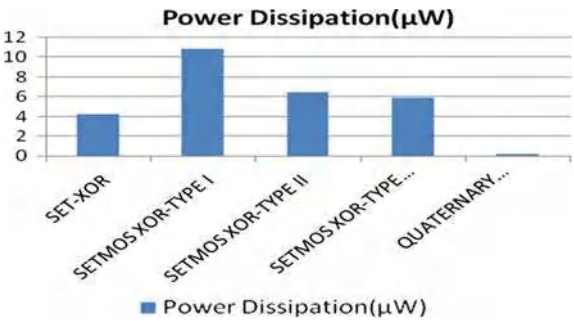

Fig. 5 Comparison of various XOR gate with SETMOS quaternary XOR gate

particularly depletion and Enhancement type of MOSFETs as single electron transistor is multithreshold device as well work on principle of transferring one electron at a time for conduction of current hence consumes less power as compare with the operation of MOSFET in which conduction of current takes place when number of electrons are transferred from source to drain side.

Figure 6 shows the circuit diagram SETMOS Quaternary Level 3 Operator and its input output waveform. In this two inputs X, b and one output vout is shown in Fig. 6. The principle of operation is very simple if X is less than or equal to b then OUT = 3 and if X is greater than b then OUT = *b*. Figure 7 shows SETMOS Quaternary Level 0 operator.

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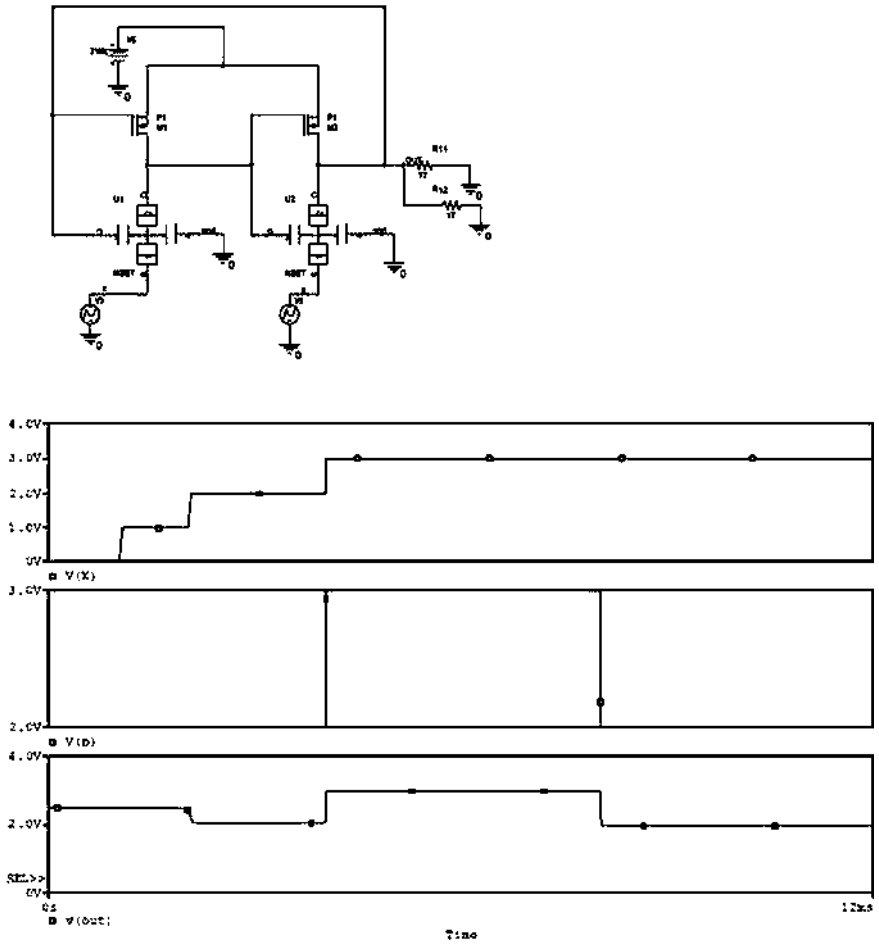

Fig. 6 SETMOS quaternary Level 3 operator and input and output waveform of SETMOS quaternary Level 3 operator

In that when $x = b = 0$ allowing the level of 0v to appear at output. Figures 8 and 9 shows the TSUM operator circuit diagram and input/output waveform. In this, at the output level of input voltage is incremented by one which is shown in Fig. 9. Similarly, Fig. 10 shows TDIFF operator in which input will be decremented by one at output. Table 6 shows the comparison between implemented operator and proposed operator in terms of TOX values and worst case delays. With the use of all operators including MIN and MAX initially a half adder is created. By using this half adder a full adder is designed and whose symbol is shown in Fig. 11.

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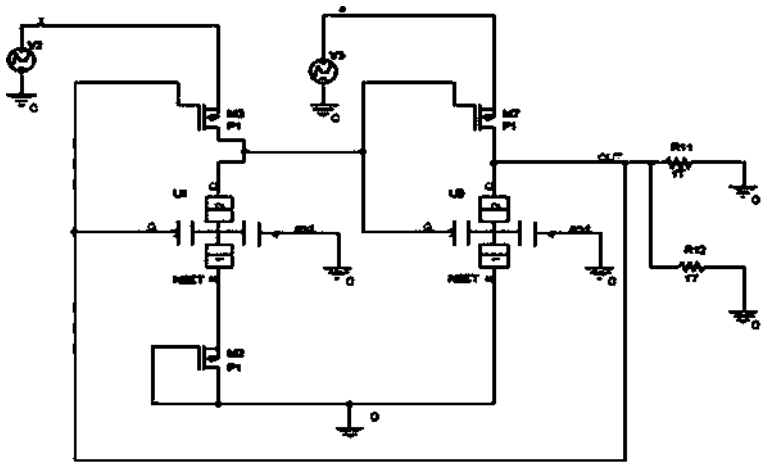

Fig. 7 SETMOS quaternary Level 0 operator

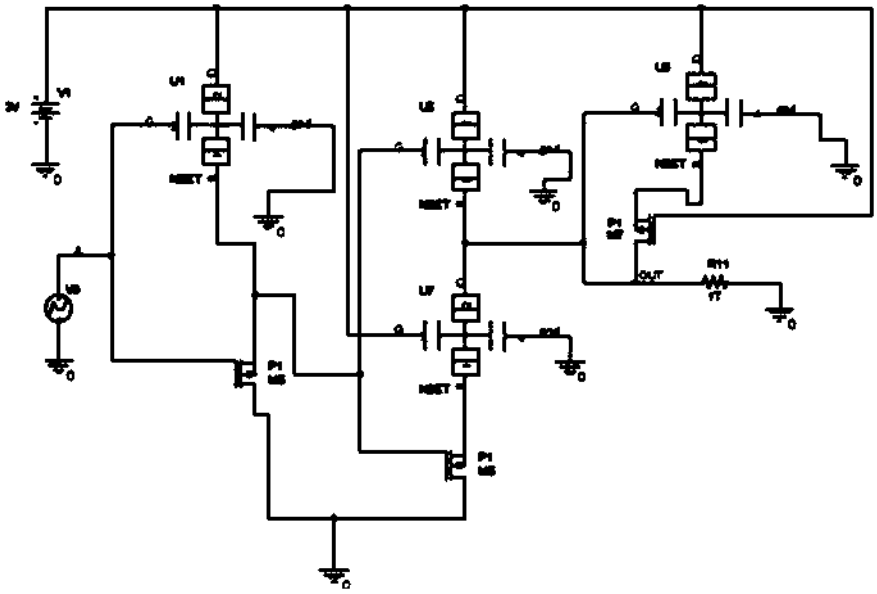

Fig. 8 SETMOS quaternary TSUM operator

Figure 12 and Table 7 shows the comparative analysis full adder in terms of power dissipation. For comparison full adder designed using single electron transistor and combination of single electron transistor with MOSFETs are used in that three types of hybrid full adder are designed with different method.

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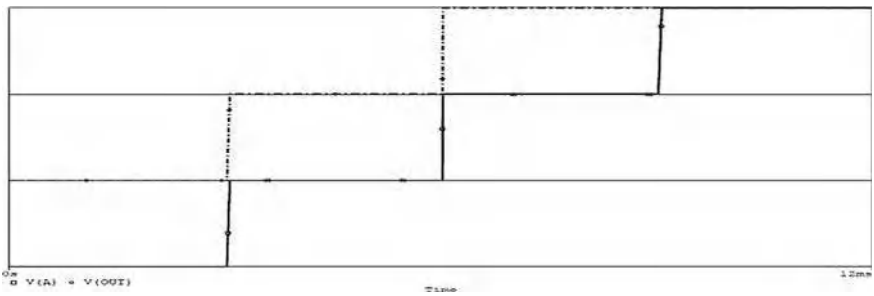

Fig. 9 Input and output waveform of SETMOS quaternary TSUM operator

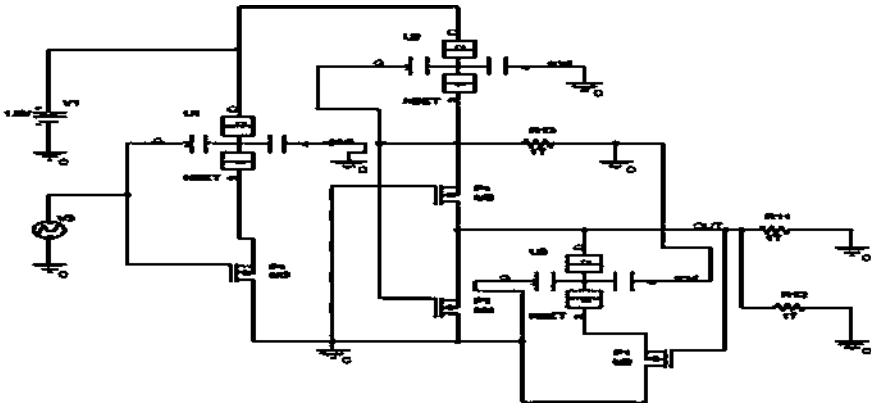

Fig. 10 SETMOS quaternary TDIFF operator

Table 6 Comparisons between Implemented operator and proposed operators

Implemented operator	Operation's worst delay (ns)						
	TOX (Å)	MAX	MIN	TSUM	TDIFF	Level 3	Level 0
Watanabe et al. [8]	400	<1	<1	~300	~300	~400	~400
Thoidis et al. [9]	250	<1	<1	6	9	22	17
Proposed	100	<1	<1	6	10	14	12

Fig. 11 SETMOS quaternary full adder symbol

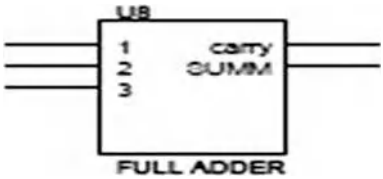

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Fig. 12 Comparison of power dissipation of full adder with SETMOS quaternary full adder

Table 7 Comparison of power dissipation of full adder with quaternary SETMOS full adder

Sr. no.	Full adder	Power dissipation (μW)
1	Single electron transistor full adder (set-full adder)	1. 624
2	Hybrid single electron transistor-MOSFET full adder (SETMOS full adder-type-i)	2.58
3	Hybrid single electron transistor-MOSFET full adder (SETMOS full adder-type-ii)	2.57
4	Hybrid single electron transistor-MOSFET full adder (SETMOS full adder-type-iii)	5.96
5	Quaternary hybrid single electron transistor-MOSFET full adder (quaternary SETMOS Full adder)	12.92

3.5 Quaternary Hybrid SETMOS Operator

Figure 13 shows the block diagram of Hybrid SETMOS quaternary operator. In that selection of operator is implemented with quaternary 4:1 multiplexer. When select line is equal to zero then MAX operation will be executed. When select line is equal to one then MIN operation will be executed. When select line is equal to two then XOR operation will be executed and when select line is equal to three then Full adder operation will be executed. Table 8 provides the description of hybrid quaternary SETMOS operator whereas Table 9 provides comparative information of power dissipation values of hybrid quaternary SETMOS and hybrid binary SETMOS operator [7, 10]. Table 10 provides the comparison of power dissipation of arithmetic logic operator. As for hybridization, single electron transistor and MOSFET are used due to which low power and high speed is achieved as well as interconnects gets reduced with the help of quaternary logic, like for binary 4:1 multiplexer two select lines are required whereas in case of quaternary 4:1 multiplexer only one select line is used which reduces the various interconnections as compared with binary logic (Fig. 14).

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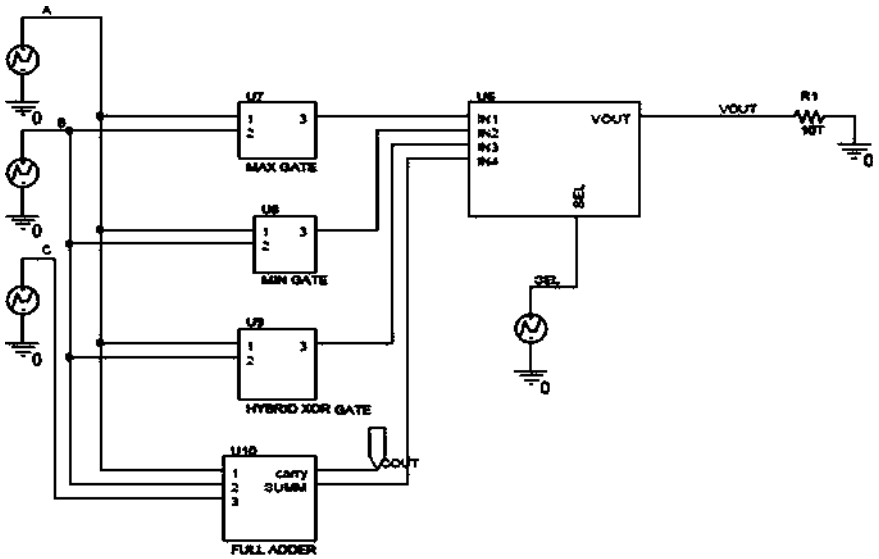


Fig. 13 SETMOS quaternary arithmetic logic operator

Table 8 Description of proposed SETMOS arithmetic logic unit

Sr. no.	Circuit description	Proposed SETMOS quaternary operator
1	Simulator	PSPICE
2	Voltage for logic '0'	0 V
3	Voltage for logic '1'	1 V
4	Voltage for logic '2'	2 V
5	Voltage for logic '3'	3 V

Table 9 Summary of quaternary SETMOS gate and full adder

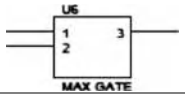
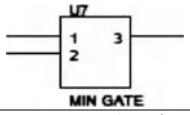
Function	Hybrid quaternary (power dissipation) (μW)	SET-CMOS binary (power dissipation) (μW)	Symbolic representation
MAX gate	0	5.9	
MIN gate	0	5.9	

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Table 9 (continued)

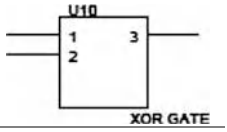
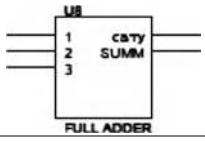
Function	Hybrid quaternary (power dissipation) (μW)	SET-CMOS binary (power dissipation) (μW)	Symbolic representation
XOR gate	0.214	10.87	
Full Adder	12.92	15.35	

Table 10 Comparison of power dissipation of arithmetic logic operator

Sr. no	Type	Power dissipation (μW)
1	Single electron transistor ALU (set-arithmetic logic unit)	60.30
2	Hybrid single electron transistor-MOSFET ALU (SETMOS arithmetic logic unit)	70.30
3	Quaternary hybrid single electron transistor-MOSFET ALU (quaternary SETMOS-arithmetic logic unit)	59.40

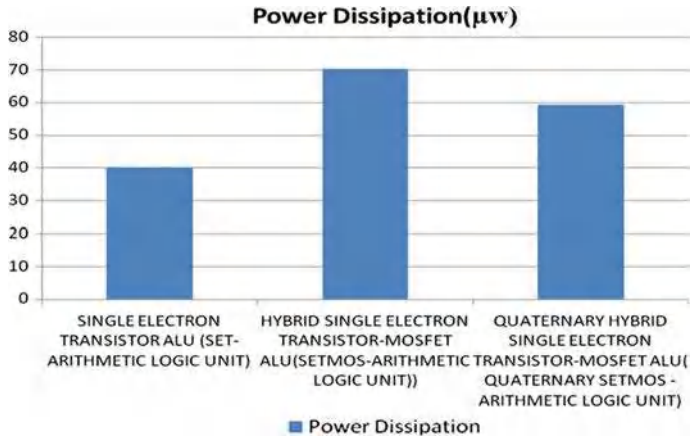


Fig. 14 SETMOS quaternary arithmetic logic operator

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4 Conclusion

Hybrid Quaternary SETMOS Operator is proposed with various logical and arithmetic operators and verified according to the truth table. Hybrid SETMOS quaternary gates such as MAX, MIN, XOR gate as well as TSUM. TDIFF. Level 3, Level 0 operator, and full adder is designed and verified. With use of these gates overall power dissipation of quaternary SETMOS operator gets reduced. Design of hybrid quaternary SETMOS operator is simple.

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Detailed Survey on Attacks in Wireless Sensor Network

A.R. Dhakne and P.N. Chatur

Abstract Now days, Wireless Sensor Networks (WSNs) have widespread applications in the areas of medicine, military etc. So, it is always important to think on the security of this technology. WSN security is having some scientific and technical challenges. Most existing security techniques need a lot of computation, memory and energy which are considered as limitations in WSNs. This paper gives broad overview on all the attacks (vulnerabilities) that can harm to any wireless sensor networking environment such as physical attacks, attacks that can affect the functioning of different layers of networking, attacks related to privacy, Secrecy and Authentication and at the end this paper tried to give overview on some recent attacks that are going to create problems whenever certain nodes wants to calculate trust value of some other node such as Bad mouthing attack, Good mouthing attack and on-off attack.

Keywords Wireless Sensor Network · Attacks · Security · On-Off attack · Wormhole · Sinkhole · Bad mouthing · Good mouthing

1 Introduction

A Wireless Sensor Network (WSN) is generally formed by number of small sensor nodes. These nodes are generally composed of four main components such as processor and memory (Microcontroller), Sender and Receiver (transceiver), power supply and sensor along with digital to analog converter (A/D converter). The simplified architecture of a sensor node is depicted in Fig. 1. As human organs such as eyes and ear have the ability to sense about surrounding environment, sensor nodes are considered similar to them as they gathers the information about

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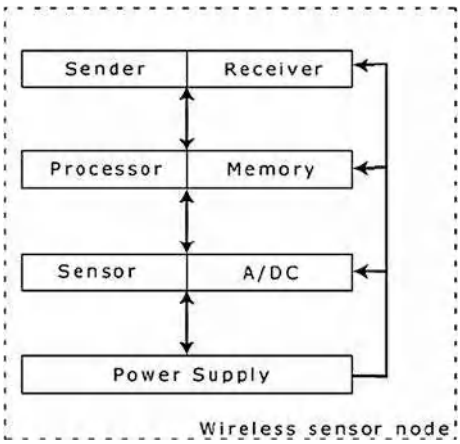

Fig. 1 Simplified architecture of Sensor node

surrounding environment, related to temperature, light, pressure, vibrations, velocity and magnetism. When these sensor nodes are implemented in systematic way, these sensors organize themselves automatically and built a dedicated ad hoc multi hop network and each node can communicate with other node within this network. At the sink, user remotely gives command to nodes via the wireless network and collect data after processing stored into a storage device. These nodes also receive the sensed data from the sink nodes [1].

There are various applications of wireless sensor networking that includes bushfire response, intelligent communications, wildlife monitoring, battlefield surveillance etc. The sensor nodes in network are generally exposed to open environment. Hence Security of such a network is crucial issue [2].

Paper has been organized in different parts. Section 2 will give overview of attacks based on different perspectives. Section 3 classifies attacks according to different layers of network, Sect. 4 focuses on Attacks related to Secrecy and Authentication, Sect. 5 gives overview of attacks that can harm the privacy of network, Sect. 6 gives overview on some additional attacks on wireless sensor network. At the end Sect. 7 conclude the paper and discusses the future issues of research on security in wireless sensor network.

2 Attacks in Wireless Sensor Network

Basically attacks in wireless sensor network can be classified in various ways based on the attacker location, level of damage and attacking devices used [3]. General classification of attacks is given as follows:

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2.1 Outsider Versus Insider Attacks

In outsider attack, attack is not arranged by network node but external node can be deployed in current network. They are not having access to cryptographic keys or rules as they are not from the network. In Insider attack, insider node is compromised due to some weakness in system. Insider attacks can have some partial keys with them and they are having trust of other sensor nodes. Detection of insider attack is more difficult than outsider attack.

2.2 Passive Versus Active Attacks

Passive attacks are somewhat eavesdropping kind and in this, unauthorized user attack tries to track sense and monitor the communication channel; the active attacks are responsible for major modifications of the data or they can create some false stream of data in a WSN.

2.3 Physical Attack/Node Capture Attack

In this, attackers get the full control on all the activities going through sensor node. Attackers capture the node itself by having full physical access, so called Physical attack [4, 5]. These attacks harm sensors permanently, so the losses cannot be overcome. Tamper proofing is one of the solutions to avoid physical attack but it is irrelevant in WSN.

3 Attacks According to Layers of Network

These are the attacks that take place at to affect different layers of network such as Physical, Network, Transport and Application layers. This section gives overview of these attacks.

3.1 Physical Layer Attacks

In networking, physical layer has different tasks associated with it. Some of the major task of physical layer includes signal detection, selection of frequency for data transfer, data encryption etc. As WSN is deployed in the remote locations, the

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attackers have a chance to access the physical layer of WSN. Jamming and Tampering are some examples of vulnerability of WSN.

(a) **Jamming**: If the adversaries just have the knowledge about wireless transmission frequency of network then this kind of attack can be done easily by them. The jamming source can either be a powerful or less powerful. Powerful jamming source is able to create traffic in the entire network, whereas less powerful jamming source is able to disrupt only smaller portion of the network. In this, the attacker tries to transmit radio signal arbitrarily with the same frequency as that of other sensor nodes in WSN.

As attacker tries to interfere with signal sent by some another node, receivers that are within radio range of attacker node, will not get any proper message. Thus, due to jamming signal, there no any exchange of message between affected node and other sensor nodes [6].

Frequency hopping can be considered as one of the mechanism for preventing from this kind of attack [7]. Ir is possible to change sequence of frequency in some predetermined way by using frequency hopping technique. But it is not suitable for WSNs because the range of possible frequencies for WSNs is limited and every extra frequency requires extra processing. Another solution to prevent from jamming attack is suggested in [8] called as Ultra Wide Band (UWB) transmission technique. This technique can be called as Anti-jamming solution. It is very difficult to detect jamming attack by this technique but this technique consumes low energy and that's why it is suitable for WSN.

(b) **Tampering**: In this type of attack a node can get altered by a fake node so that attacker can easily get sensitive information and data passing through it. Tamper proofing can be considered as one of the technique to avoid this kind of attack, but it can add additional cost to WSN.

(c) **Path based DoS Attack**: In this type of attack available resources are exhausted to victim node and it prevents original users to access services or resources that are applicable to them to use. DoS attack can undermine the power and authority of network, create disturbance in network, or destroy a network and at same time it diminishes networks capability to provide services.

3.2 Link Layer Attack

Whenever node stops its functioning then this situation is called as Node Outage. Node outage is harmful when there is outage of cluster node, at that time protocols should be designed in such a way that these will provide some alternate route for transmission of messages.

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(a) **Collision**: Whenever single transmission channel is overloaded by data from different senders at that time there is possibility of collisions. Whenever packets collide there are chances that it can change some data portion and thus destination will not receive data correctly. There can be collision from attacker in some specific packets such as ACK control message. Such kind of collisions can lead to costly exponential back-off in certain media access control (MAC) protocols [8].

Error correcting codes is one of the defence techniques against collision and these are best suited for the collisions that are happening due to environmental errors. Such kind of codes will need additional processing and communication overhead to overcome the collisions. But, we have to accept the fact that we will not be able to correct more than whatever has been corrupted. Even though it is not impossible to detect these malicious collisions, until now there is no any proper defence technique to completely overcome these attacks.

3.3 Network and Routing Layer Attacks

To improve power efficiency, awareness of location and addressing and to make sensor network more data centric, network and routing layer plays an important role. Major function of network layer is to route messages from one sensor node to another. Attackers can access routing paths to redirect the traffic and provide some wrong information about path to WSN or they can launch Denial-of-Service attacks. Some attacks on this layer are as follows:

(a) **Selective forwarding/Black Hole Attack**: In this type of attack, malicious nodes just drops packets that are to be damaged and selectively forwards other non interesting packets [3]. A black hole attack is one in which node drops all packets that it receives.

In Fig. 2(i) and (ii) selective forwarding attack are described. In Fig. 2(i), S is source node and B is destination, node A forward all packets coming from A but adversary node AD forwards only selected packets D1, D3 and drops D2, D4. In Fig. 2(ii), an adversary AD selectively drop all packets originated from node A and forwards packets that are coming from node B.

One can use multiple paths to end data to defend from selective forwarding attack [3]. Another defense technique is to detect malicious node as early as possible and it should be ignored for transfer of messages by considering some alternative route.

(b) **Sybil Attack**: Rather than having single identity, if node carries different identities to different nodes, then it is a Sybil attack [3]. This attack disrupts functioning of geographic routing protocols by being simultaneously at more than one place.

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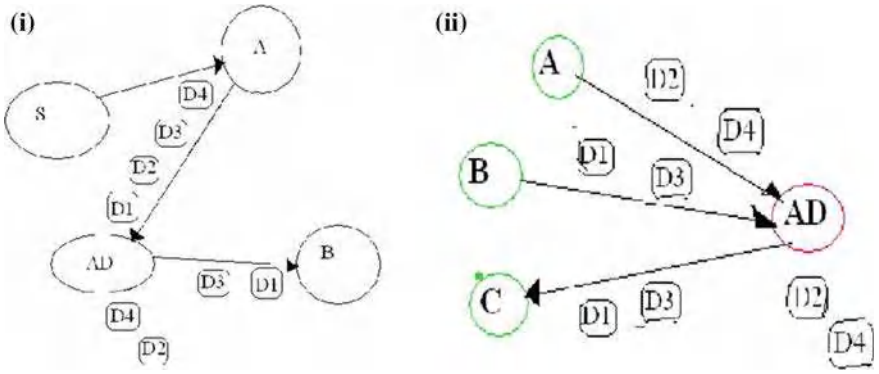
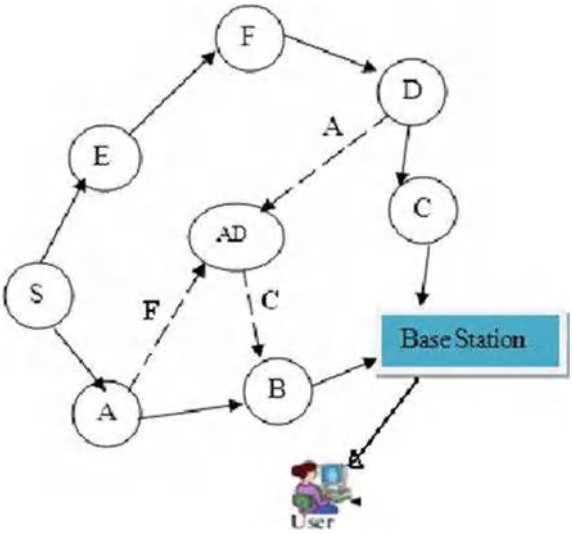


Fig. 2 (**i**) Adversary drops selected packet of a node (**ii**) Adversary drops all packets from selected node

In Fig. 3. Sybil attack is represented by adversary node AD which carries multiple identities. Here node A looks node AD as node F, node D as node A, so when node A wants to communicate with node F, it sends the message to adversary node AD. To defend from Sybil attack one should verify identity of nodes, but as WSN's have some computational limitations where traditional networks Symmetric key and public key algorithm cannot be applied to verify identity in WSN.

(c) **Sinkhole attack**: It is a kind of attack in which compromised node looks more attractive and most of the other surrounding nodes try to forward data to this compromised node as next node [3]. This type of attack is also responsible to boost selective forwarding attack as it is going to attract all traffic from large

Fig. 3 Sybil attack



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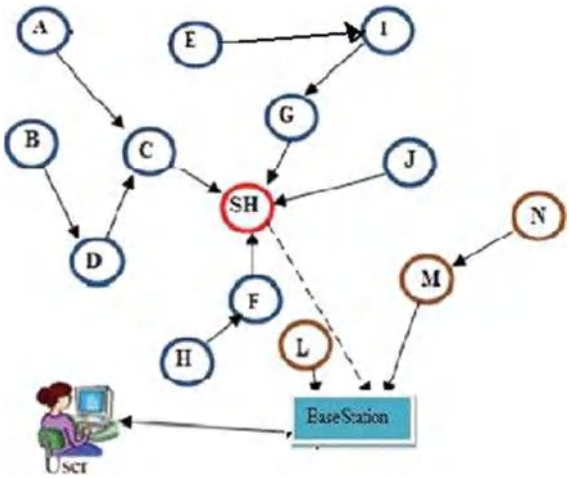

Fig. 4 Sinkhole attack

area in network and compromised node can only forward selected packets. In Fig. 4 SH denotes sinkhole attack. This sinkhole tries to attract all traffic from near about all the nodes to route through it except nodes N, L and M.

(d) **Wormhole attack**: In this, node at one end listens packets and transmits them through the tunnel to node at other end, where the packets are replayed to local area [9]. If these two ends forward messages without any change then it is helpful to accomplish faster transmission but most of times packets are dropped at end and selective packets are forwarded. As transfer is fast neighbour nodes can feel that these two nodes are neighbor of each other. If any of the tunnel ends is nearer to base station then it can attract a lot of traffic and it can act as sinkhole attack too.

Figure 5 demonstrates a Wormhole attack where WH is the adversary node that creates a tunnel between nodes E and I. Both Sinkhole and Wormhole attacks are difficult to detect, when routing protocols route packets based on advertisements on remaining energy remained or minimum hop count needed to reach base station. There are some geographic routing protocols that are providing some kind of resilience to these attacks [7].

(e) **Hello Flood attack**: In this attack attacker sends hello message to all surrounding nodes by using powerful transmitter due to which all other nodes that are not in radio range think that sender is in radio range. This makes node to send packets to adversary node rather than to base station.

Figure 6 show an adversary node AD which try to show other nodes that it is neighbor of them. There will be wastage of energy and there will be loss of data in this type because here adversary node will try to pretend other nodes that it is neighbour node, even if that node is far way from those. One partial defence to this attack is to do authentication of such node by some third party.

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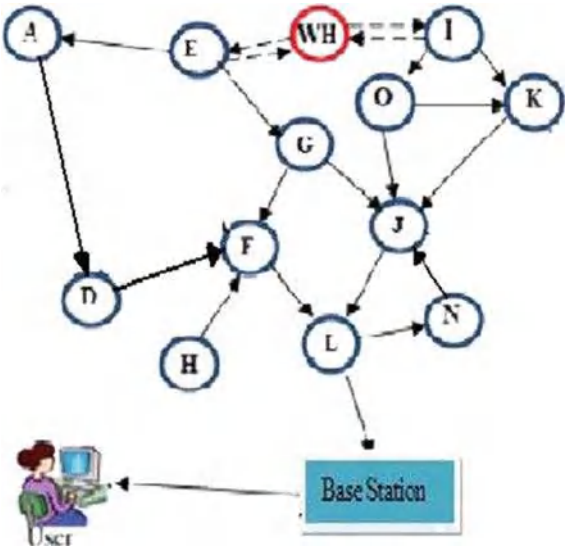

Fig. 5 Wormhole attack

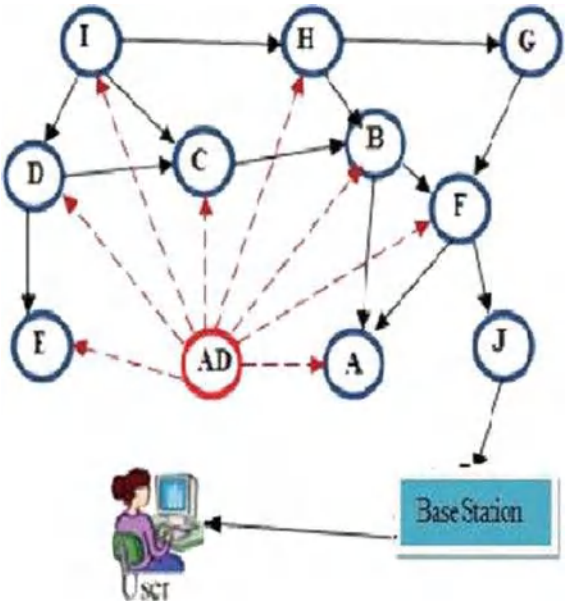

Fig. 6 Hello flood attack

(f) **Spoofed, altered and replayed routing information**: Spoof attack is one in which one person tries to conclude that he is some another one and thus falsifies another to take advantage. Such attacks are responsible to create routing loops to waste time, they can generate false error messages, increase end-to-end latency or they can extend or shorten service routes, [10] etc.

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(g) **Node Malfunction**: Node malfunctioning can generate inaccurate data and can expose integrity of data if it is node such as cluster head which is responsible to collect all data [11].
(h) **Acknowledgment Spoofing**: Sometimes acknowledgments are needed by the routing protocols in sensor network [12, 13]. Here attacking node get routing information and provide wrong information to receivers [12].

3.4 Transport Layer Attacks

Functionality of end-to-end communication between source and destination is generally provided by the transport layer. Some possible attacks on this layer are discussed below:

(a) **Flooding**: If source node receives many requests repeatedly, then its memory become exhausted through flooding. An attacker requests for new connection continuously till its maximum limit. In this situation sender decline all request including the genuine request of any node in WSN. Thus, attacker can waste resources of WSN and communication between nodes will stop. In this attack many connection establishment requests can be sent by attacker to victim node to use its resources causing flooding attack. Defence against flooding can include to limit number of connection that can be made by a node as well as one can make compulsory to solve certain puzzle before making connection to another nodes [14].
(b) **Desynchronization**: In this, an existing connection between two nodes get disturbed due to transmission of illegal control flags or fake sequence number messages. By this, other nodes which are transmitting packets will waste their energy due to lack of synchronization. It is better to turn on all control fields in transport header to prevent from this attack. Also, packets exchanged between two nodes can be authenticated to prevent from this attack.

3.5 Application Layer Attacks

This layer basically collets and manages the data. As information is revealed in this layer it can lead to compromise whole network. Exclusion of node is probable solution in this attack if node gets compromised. LEAP (Localized Encryption and Authentication Protocol) [4] can verify if a node has been compromised or not and if it is compromised then it can revoke that node by some efficient keying mechanism.

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4 Attacks on Secrecy and Authentication

Following are some attacks which can harm cryptographic techniques to explode secrecy of data and authentication of user:

4.1 Node Replication Attack

In this, attacker tries to have duplicate identity of node by copying identifier of another node. These nodes can disrupt networking by giving wrong information and wrong routes to another node. This can lead to partition the network and it will responsible to communicate false readings of sensor to another nodes. There is always possibility of copying cryptographic keys if attacker gain access to communication channel and these keys can be used by replicated node for communication. Attacker can also place replicated node at some specified location so as to partition network in some groups In Fig. 7, N is the identity of cloned nodes that are mounted in multiple places in the network to confuse the entire network. This kind of attack can be avoided by having single central data gathering mechanism such as base station; This attack can be detected by verifying the identities of these nodes by some trustworthy node [15].

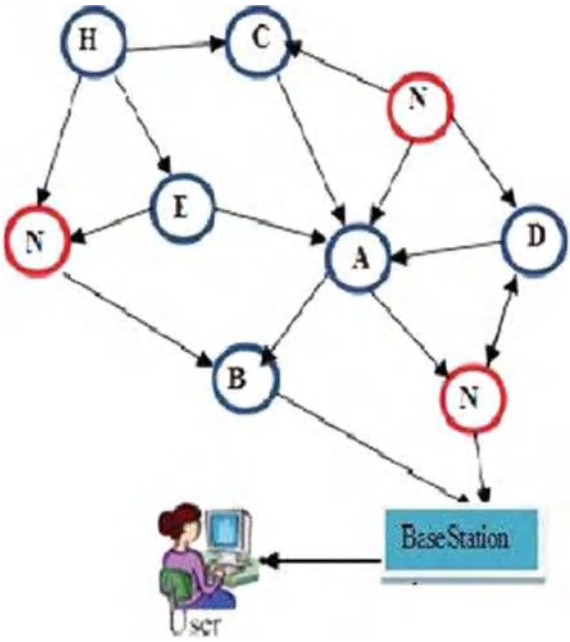

Fig. 7 Node replication attack

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5 Attacks on Privacy

Attackers need not be present to gather information, one remote access is sufficient for them to gather information from multiple sites at single instance [16]. Privacy of sensor node can be disturbed by following types of attacks:

5.1 Eavesdropping and Passive Monitoring

It is common attack on data privacy. The adversary could easily understand the contents, if cryptographic mechanism is not used for protecting messages. Most of times, more information is revealed by the packets having control information than information available at location server.

5.2 Traffic Analysis

Eavesdropping when combined with a traffic analysis, it makes an effective attack on privacy. Due to thorough analysis of traffic for adversary it is possible to understand the roles of nodes. For example, unfortunate increase in message communication can make adversaries to understand that there are some events to happen. Chan.et al., have demonstrated two attacks that can identify the base station just by analysing traffic without having access to contents of message [17].

6 Some Other Security Attacks

There are some less known attacks in WSNs. These mostly concentrate on service availability and sometimes these can occur to misguide the behaviour of neighbour nodes to its head node. We briefly describe them in the following section:

6.1 Bad Mouthing and Good Mouthing Attack

In bad-mouthing attack neighbor nodes of sensor node always give some wrong information to degrade trust of sensor node whenever cluster head wants to calculate trust of sensor node from surrounding nodes. For example, they can give less recommendation of other node at the time of calculation of trust value. Thus, these recommendations cannot reflect the real opinions of the recommender. As opposed to this, the sensor nodes which conduct good mouthing attack provide more trust value for malicious nodes intentionally to misguide other nodes.

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6.2 *On-Off Attack*

In this attack node can behave good or bad according to situation. When the trust values of malicious nodes are low, nodes can act well for some period to improve trust value of node. Therefore, it is difficult to detect these malicious nodes by conventional trust models.

Basically, an Off-Off attack works with other type of attack. For example, it can work with selective forwarding attack where most of times node can forward all messages but occasionally it can drop all packets too. In On state, attacker attacks node with help of other attack and is called as Attack State. In Off State, malicious nod behaves normally and is called as Normal State [17].

7 Conclusion and Future Scope

As sensor nodes are deployed in open environment they are vulnerable to different attacks. So, security of such network is always important aspect. This paper provides comprehensive survey on attacks in wireless sensor networks with respect to different layers of networking. This paper also gives overview on some new attacks that can harm most of trust models in WSN such as Good Mouthing attack, Bad Mouthing attack and On-Off attack.

This survey brings researchers an view of all attacks in wireless sensor network while designing any security mechanism at different layers of network. Detection of these attacks is important if data to be transmitted to different places in correct way. In future, by taking reference of these vulnerabilities, one can proceed to propose efficient intrusion detection mechanisms to overcome most of these attacks.

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Comparative Analysis of Frontal Face Recognition Using Radial Curves and Back Propagation Neural Network

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Abstract Person identification using face as a cue is one of the most prominent and robust technique. This paper presents 3D face recognition system using Radial curves and Back Propagation Neural Networks (BPNN). The face images used for experimentation are under various challenges like illumination, pose variation, expression and occlusions. The features of images are extracted using Eigen vectors. These features are compared using radial curves on the face starting from center of the face to the end of the face. Each corresponding curve is matched using Euclidean Distance classifier. The BPNN is used to train the features for face matching. The proposed algorithms are tested on ORL and DMCE database. The performance analysis is based on recognition rate accuracy of the system. The proposed radial curve system yields recognition rate accuracy of 100 % for images from the ORL database and 98 % for the images from DMCE database.

Keywords Face recognition · Back Propagation Neural Networks · Radial curves · ORL database

1 Introduction

From the last few decades, instead of PINs and passwords, biometric recognition systems have gained a tremendous significance far and wide. Generally people find it difficult to remember the passwords and PIN numbers. They can even be stolen, forged, or guessed by the intruder. On other hand, biometric recognition systems based on behavioral cues (keystroke, signature, and gait) and physiological cues of

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a human (face, finger geometry, fingerprints, palm geometry, palm veins, iris, iris veins, retina, ears, and voice). However an individual's biological features cannot be forgotten, misplaced, duplicated, or stolen.

Biometric-based recognition techniques, like fingerprint detection, palm matching, and iris matching have attained a high level of success in accuracy, but they are not used widely in non cooperative scenario. Besides, face is the non-intrusive method, used in such non-cooperative environment. Face is the natural assurance of someone's identity. Due to this widely accepted representation, face plays an important role in conveying the identity and emotions of a person. Even after many years we can recognize a number of faces that we have seen throughout our lifespan. The human tendency of identifying and recognizing person quickly despite large variations in the looks due to changing condition like aging, beard, glasses, or changes in hairstyle, etc., is the motivation behind development of face recognition systems. With every human, the variation in their fiducial parts such as varying size of nose, eyes, ears, lips, chin, forehead are used as features for perfect matching of the face. A computational framework of face recognition does the same using a proper mathematical calculation to identify a person.

Automatic face recognition technique has numerous applications now-a-days especially the websites hosting images like Picasa, social media like Facebook, Twitter, etc. Systems that can detect and recognize faces can be applied to a wide variety of tasks including criminal/fraud/theft identification, i.e., use of the system by forensic departments and crime departments when the face detected by the surveillance cameras is not so clear, security system by providing access to various control systems such as ATM machine, office entry. It also finds applications in image and film processing. Face recognition system is working at its best level by providing recognition rate of nearly 99 % at a False Acceptance Rate (FAR) of 0.01 %.

A Face Recognition System analyses individual's features and different characteristics to show assertion of one's identity. The generalized block diagram of face recognition system is as shown in Fig. 1.

A face recognition system is basically a two-step procedure in general; they are Training/Enrollment mode and Testing/Identification mode. They can be defined as follows:

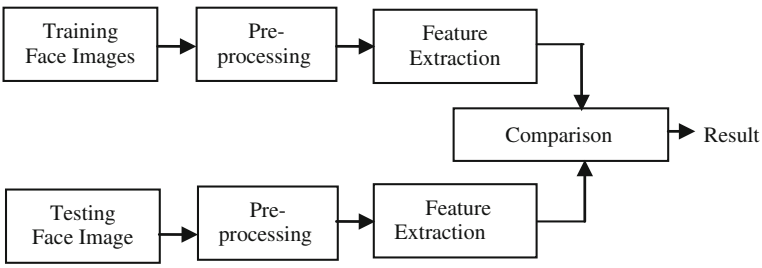

Fig. 1 General schematic of face recognition system

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Training/Enrolment mode: In this mode, images of various people are captured and a biometric feature of each person is obtained to be saved in the database. This stage can also be called as database creation stage.
Testing/Identification mode: Where a template is created for an individual and then a match is searched for it in the database of pre-enrolled templates.

The face recognition system starts with acquisition of the face images. If the images are blurred or not so clear, then the preprocessing stage does the necessary action and makes it suitable for further matching. The features of the face are extracted for the database image as well as the testing image. These features of the test image are compared with the features of all the database images. The result is a probable match at the output.

In real-time face recognition system comes across various challenges like pose variation, expression, occlusion, illumination conditions, and clutter. It becomes difficult to identify a person when the face image stored in the database is with a different pose, expression, and illumination conditions; and that for the testing is with a different pose, expression, and illumination condition. Face recognition system also faces difficulty when there is some presence of occlusion like wearing of glasses, growth of beard, change in hair style, etc., it may also happen that the image captured by the camera is not proper. This paper presents an algorithm which has a provision of identifying the person across various challenges viz. pose variation, expression, occlusion, illumination conditions, and clutter.

The content of this paper is organized as follows: Sect. 2 provides the literature survey related to face recognition system. Section 3 describes the in detail system components and algorithms used in proposed face recognition system. The experiment results and discussion is elaborated in Sect. 4. The conclusion and future scope is presented in Sect. 5.

2 Literature Survey

The 3D face recognition has been approached in many ways, leading to different levels of success. Some of the common approaches for face recognition are deformable template-based approach, deals with the matching of entire face, estimates the pose, and occluded areas. Kakadiaris et al. [1] makes use of annotated face model that is deformed elastically to fit each face thus matching different areas such as nose, eyes, mouth.

Local region/features approach handles expression and is based on matching only parts or regions rather than matching full face. Lee et al. [2] uses the ratio of distances/Euclidean distance and angles between fiducial points followed by SVM (Support Vector Machine) classifier. Surface distance-based approach also handles expression variation. It utilizes distance between points on facial surfaces to define features, i.e., the geodesic distance. The open mouth problem is well discussed [3].

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Dirira et al. had given emphasis on the elastic models and radial curve that maximally separates the interclass variability from the intraclass variability. Radial curves with the nose-tip detection have tremendous potential in detecting expression, occlusion to at a great extent [3, 4]. Queirolo et al. in [5] performs 3D face recognition using Simulated Annealing (SA) for range image registration and the Surface Interpretation Measure (SIM) as the similarity score between two 3D images. The authentication score is obtained by combining SIM values which corresponds to the matching of four different face regions: circular and elliptical regions around the nose, forehead, and entire face region [5]. Passalis et al. use facial symmetry to handle pose variation [6] in real-world 3D face recognition where automatic landmark detection is employed which estimates poses and detects occluded parts for each face scan. This method makes use of wavelet-based biometric signature as it requires only half of the face to be visible to the sensor [7].

A robust algorithm for 3D face recognition using curvelet transform is proposed in [8]. It detects the fiducial points on specific area of face by examining curvelet coefficient in each subband and builds multiscale local surface descriptors that can capture highly distinctive rotation/displacement invariant local features around the detected keypoints. The Iterative Closest Normal Point (ICNP) [9] method is introduced to find corresponding points between the reference face and every input face. These points are marked across all faces, enabling effective application of discriminant analysis [9]. A survey of various face recognition approaches along with neural networks implementation is presented in [10].

The face recognition is either feature-based, using shape and position of facial features such as eyes, nose, and lips or holistic using overall analysis of facial image. A comparative study of face recognition under varying expression is given in [11]. Erdogmus et al. give performance comparison based on Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA), and Local binary pattern (LBP) [12].

Alyuz et al. [13] introduced a new technique called as masked projection for subspace analysis with incomplete data. Fully Automatic 3D face recognition with occlusion handling is explained. [13]. Ali [14] proposed pose invariant Face Recognition at Distant Framework (FRAD), which introduces an automatic front-end stereo-based system. Once a face is detected by one of the stereo cameras, its 15 facial features are identified using facial feature extraction model. These features are used for steering the second camera to see the same subject. This system performs various steps either in online mode or off-line mode and finally face recognition is performed using nearest neighbor classifier.

The above all the face recognition techniques are implemented on the face database which is available online. This database is constructed using the specialized 3D sensor. While it is challenging in terms of cost to use this 3D sensor for high-resolution images, RGB-D images can be captured by low cost sensors such as kinect [15]. Face recognition with texture and attribute features [16] proposed an algorithm that computes a descriptor based on entropy of RGB-D faces along with the saliency feature obtained from a 2D face. And the attributes are extracted from the depth of the image. A recent advancement in single modal and multimodal face

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recognition is given in [16] that use various approaches like visual and 3D, visual and IR, visual and IR and 3D.

3 Proposed System

This paper presents a framework for analysis of an individual's face, in the process dealing with various challenges of large expressions, pose variation, and missing parts. The paper shows comparison between two techniques viz. Radial Curves, BPNN. We use the concept of matching radial curves for testing a frontal face. We also make use of variety of tools that help us for the computation of the facial modality. BPNN is used as another technique used for comparison of the system in terms of complexity and efficiency. The image acquisition is the first step, after which the database is created. The system then computes the algorithm in various steps.

3.1 Preprocessing

After the database creation, the frontal face images undergo through the face normalization step. In this step, the preprocessing of an image takes place. First, the RGB image is converted to gray scale image. The preprocessing step also uses Weiner filter for the removal of noise and sharpen the edges of the image which avoids deterioration in the output. The system also uses cropping filter which crops and returns a frontal face portion of face.

3.2 Feature Extraction and Classifiers

Every human face has distinct features. The system extracts the features of every face image. These extracted features play a vital role for matching the perfect face. The classifiers are used for the decision-making process. The classifiers are used to distinguish the image in interclass and intraclass variability. The proposed system uses PCA, Radial Curves, BPNN, and Euclidean Distance for the same. The feature extraction step is carried out during both, Indexing phase and Recognition phase of the face recognition system. The classifiers (based on similarity) are used only in the recognition phase to classify the output whether match found or not. The Indexing phase and Recognition phase is as shown in Figs. 2 and 3 respectively.

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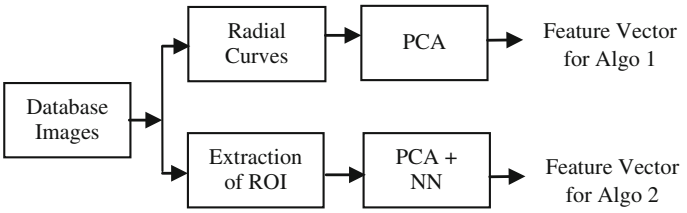

Fig. 2 Indexing scheme for feature vector creating for proposed system

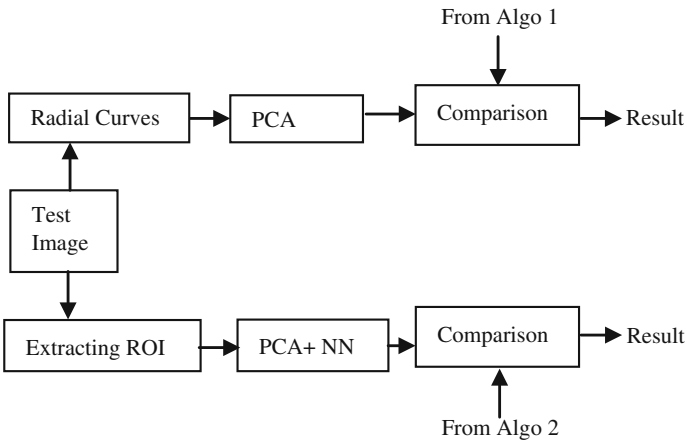

Fig. 3 Recognition scheme for comparing feature vector and obtaining probable matched result for the proposed system

3.2.1 Principal Component Analysis (PCA)

PCA is generally termed as dimensionality reduction technique. PCA also reduces significant redundancies in face images. PCA represents the facial image in the form of vector called feature vector/Eigen vector. This feature representation of image is comparably better than the original distorted images. PCA is applicable to represent the linear variations.

The goal of PCA algorithm is to capture the direction of maximum variance. The algorithm starts by capturing the variance between all images used for training and then creates a set of information in an orthogonal space which constitutes of weights called principal components, i.e., "Eigenfaces". PCA is also called as Eigenface approach. These weights thus obtained become the facial features for classifiers [17, 18].

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3.2.2 Radial Curves

Radial Curves are the circular curves drawn on the face of every database image. These curves are drawn by taking into consideration the Iterative Closest Point [19]. The radial curves are drawn during both indexing scheme as well as in the recognition scheme. The proposed system extracts, analyses, and compares the shape of radial curves. The problem of expression, pose variation, and occlusion is solved using radial curves [3]. Figure 4 depicts the face with radial curves.

Algorithm 1:

(a) The images from ORL and DMCE database are taken to form database of the proposed system.
(b) The proposed system draws five radial curves on every face image starting from small circular curve at the center of the face till the end of the face.
(c) The proposed system further uses PCA for feature extraction of each curve.
(d) The PCA used for dimension reduction gives feature vectors for all the database images. One feature vector for each subject
(e) The total number of feature vectors formed by the system is 40.
(f) These vectors constitute as the database for recognition phase.

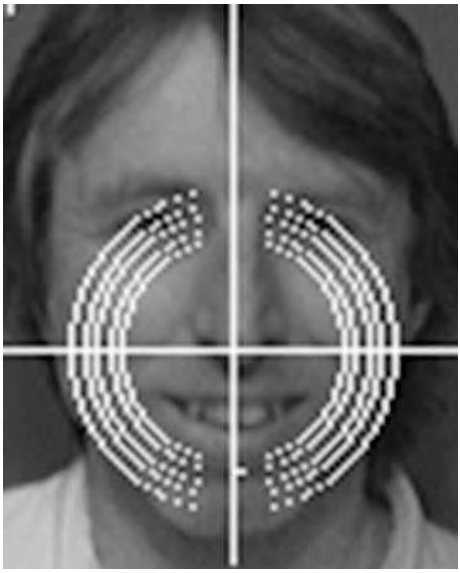

Fig. 4 Facial image with radial curves

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3.3 Back Propagation Neural Network (BPNN)

Back Propagation Neural Network (BPNN) is used to learn the patterns of PCA features and produce relevant client and imposter scores for verification [18]. BPNN is used to train multilayer feed-forward Neural Network to learn a complex mapping for classification. The BPNN is designed to adapt the weights based on the corresponding error. The goal is to minimize the output error of the network. The network executes the adaptation of weights throughout the epochs until the error reaches an accepted minimum level [18].

BPNN has an input layer, an output layer, and one or more hidden layers in between them. The training of a network by back propagation involves three stages: the feed-forward of the input training pattern, the calculation and back propagation of the associated error, and the adjustment of the weight and the biases [18].

Algorithm 2:

(a) The images from ORL and DMCE database are used for training the Neural Network.
(b) The proposed system extracts Region of Interest (ROI) like nose, eyes and lips from the database image as shown in Fig. 5.
(c) The system further uses PCA for feature extraction process.
(d) The PCA gives feature Vectors for all the database images. One feature vector for each subject.
(e) These images are used for training of the Neural Network.
(f) These feature vectors form the database for recognition phase

3.4 Euclidean Distance

The Euclidean Distance [18] is the most commonly used classifier for the matching of faces. The smaller the distance between two vectors, the higher the resemblance in the images. The measure of surface distance is computed by comparing the

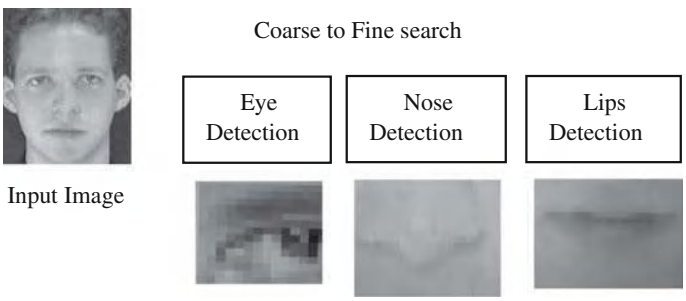

Fig. 5 Block diagram for database creation for Back Propagation Neural Networks

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Euclidean distance of radial curves of the all the database images with the test image. Depending on the value of Euclidean distance it is estimated that if there is any resemblance between any one pair of curves then that shows the similarity between the faces. The proposed system shows perfect match is found only when the distance is lower than the threshold.

4 Results and Discussion

The proposed system is evaluated using two databases viz. ORL and DMCE database. The ORL database contains 400 gray scale images of 40 subjects with 10 images per person. The images are taken at different times, varying illumination conditions and expressions (open/closed eyes, smiling/not smiling), varying poses (frontal view, slight left–right rotation) and facial details (glasses/no glasses). The image size is 112 × 92. The DMCE database contains 400 images, of 20 girls and 20 boys, which consist of 10 images for 40 subjects each. These database images are taken under various challenges of expression (smiling, laughter, fear, closed eyes, etc.), pose variation (facing left, right, down), occlusion (wearing spectacles, hat), and different illumination conditions. These database images are resized to 112 × 92 for the DMCE and ORL database.

All the input images are taken from the two databases, i.e., ORL readily available database and DMCE database. These images are selected as database. Then one image is taken as the test image and compared with the remaining all images. First of all, the image is converted from RGB to gray. In the next step, it is passed on to radial curves and extraction of region of interest. Radial curves are drawn on each face emanating from the center of the face to the end of the face in a circular manner. The feature extraction of image is done using PCA. The performance analysis based on different number of curves is carried out. We make the analysis using two, four, five curves. And the corresponding recognition rate is as shown in Table 1. The table shows that as we increase the number of curves, the recognition rate goes on increasing.

These radial curve features of test image are then matched with each database image features (from Algorithm 1) using the Euclidean Distance. Based on the score of Euclidean distance the probably matching faces are recognized as shown in Fig. 6. The same experiments are accomplished with Neural Network-based system.

In case of Neural Networks, the system extracts the ROI same as that done for the database images. The feature extraction done using PCA and the feature vector

Table 1 Comparison of recognition rate for varying number of radial curves

No. of radial curves	Recognition rate (%)
Two	64
Four	96
Five	100

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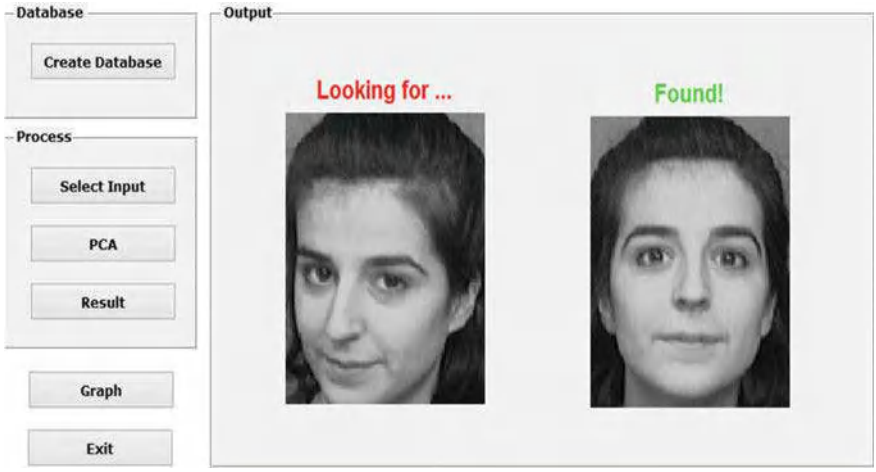

Fig. 6 A snapshot of tested facial image recognition by proposed algorithm

of test image is passed to the comparison block. The other input is given from the Algorithm 2 as shown in Fig. 3. The perfect matching image is thus found.

The resulting recognition rate using five Radial Basis Curves (RBC) and BPNN obtained from the proposed system is as depicted in Table 2. The accuracy is computed by considering the test image once from the database and other time out of the database. When efficiency calculation for image from database is taken into account then 400 images of ORL and DMCE database are used for training, and one out of them is used as query image. Whereas in efficiency calculation for image out of database, 320 images (eight images for each subject) are used for training and the remaining 80 images (two images for each subject) which are not a part of database are used for testing.

The results of the work computed on MATLAB shows that, by implementing Radial Basis Curves with the help of thresholding we can achieve 100 % accuracy for ORL database. The accuracy thus obtained for DMCE database is 98 %. The results show that radial curves prove to be more efficient than the Back Propagation Neural Network.

Table 2 Comparison of recognition rate for proposed system

Method	% Efficiency with image from database		% Efficiency with image out of the database	
	ORL	DMCE	ORL	DMCE
RBC	100	98	99	97
BPNN	99	96	87	86

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5 Conclusion

This paper presents a Radial Basis Curves Face Recognition system which can recognize the person even with expression, occlusion, pose variation, illumination, and clutter. The proposed system uses PCA, and Radial curves to achieve face recognition. The complexity and dimensionality is reduced by robust PCA and radial curve results in better performance useful in real-time face recognition systems. The system yields 100 % recognition rate accuracy for images from ORL database and 99 % recognition rate accuracy for images from DMCE database.

Declaration
Author declares that they have the permission for using the human faces for research and publication. Springer will not be held responsible in case of any consequences in future.

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Data Perturbation: An Approach to Protect Confidential Data in Cloud Environment

Dipali Darpe and Jyoti Nighot

Abstract Nowadays there is rapid growth in large-scale databases and cloud computing is becoming tempting key to host data query services due to its advantages in scalability and cost-economy. So organizations are moving towards cloud computing infrastructure. In the commercial areas use of cloud computing has increased due to its features like pay per use, fault tolerance, scalability, elasticity. Despite of these advantages some data owner hesitates to put their data on cloud which is confidential. Unless confidentiality of data and privacy in query processing are not guaranteed, some data owner does not want to move to the cloud. A secured query service should provide efficiency in query processing as well as it needs to reduce the workload of in-house infrastructure to gain the benefits of cloud computing infrastructure. RASP data perturbation is proposed to provide balance between security and efficiency of protected data. RASP method stands for Random Space Perturbation which combines injection of noise, preserving order of encryption. For enhancing performance indexing techniques are also used.

Keywords Confidentiality · Random noise injection · Range query · kNN query

1 Introduction

In cloud computing huge groups of remotely located servers which are networked for centralized data storage are allowed to access computer services or resources online. To accomplish coherence and economies of scale cloud computing rely on resource sharing. It also focuses on maximizing the value of the shared resources. Cloud resources are dynamically reallocated per demand. Cloud computing facil-

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itate users to retrieve and update their data without purchasing licenses for different applications by accessing single server. Nowadays organization are moving from traditional approach of buying enthusiastic hardware and decline it over a period of time to the new approach of using shared cloud infrastructure and pay per use it. Cloud data storage is one of the vital service offered by the cloud computing. In this service, subscribers use cloud service providers server to store their own data. Due to the unique advantage in scalability and cost-saving, to host data concentrated query services in cloud becomes popular now. The workload of query services is exceedingly dynamic and serving such workload with in-house infrastructure will be costly and ineffective. On the other hand, service providers do not have control over the data in the cloud query privacy, and data confidentiality becomes the most important issues. Some service providers can see the user's queries or make a copy of the database, which is not so easy to find and prevent in the cloud infrastructure.

Some new approaches are necessary which can ensure privacy of query and protect the confidentiality of data; efficiency in query processing with the advantages of using cloud should also be preserved. As an outcome of security and privacy assurance it is meaningless to provide slow query services. The intension of using cloud resources is to degrade the need of maintaining scalable in-house infrastructure, so it is not useful for the owner of data to utilize a significant amount of in-house resources. There are some approaches which try to solve some aspect of the problem but they do not address all aspect of problem. For example, the crypto-index and Order Preserving Encryption (OPE) are vulnerable to the attacks, the enhanced crypto-index approach puts heavy burden on the in-house infrastructure to improve the security and privacy, the New Casper approach uses cloaking boxes to protect data objects and queries, which affects the efficiency of query processing and the in-house workload [1]. Therefore, there is a complex connection among the data confidentiality, query privacy, the quality of service, and the economics of using the cloud.

A realistic query service in the cloud should satisfy the criterion which includes confidentiality of data, preserving privacy of query, efficiently processing query, and low processing cost of in-house infrastructure. If we consider all these requirements for constructing query services in cloud, it will increase complexity of the system.

2 Related Works

2.1 Protecting Outsourced Data

Order Preserving Encryption [2]: These schemes allow comparison operations to be directly applied on encrypted data, without decrypting the operands. After encryption dimensional value order is preserved and in these scheme to break the encryption of the attribute a bucket-based division grouping can be performed by

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the attacker if he knows the original distribution and manages to spot the mapping between original attribute and its encrypted matching part.

Crypto-Index [3]: It is based on the bucketization approach. In these schemes, an attribute domain is partitioned into a set of buckets. A tag is assigned to each bucket. These bucket tags are referred to as crypto-index for processing queries server uses these crypto-indexes. To protect the access pattern a bucket-diffusion scheme [4] was proposed. But it affects the precision of query results. So client side cost for filtering the query result is increased.

Distance-Recoverable Encryption: To preserve the nearby neighbor DRE is one of the intuitive methods. Many attacks can be applied [5–7] due to the exact preservation of distances. To find kNN instead of preserving distances of nearest neighbor Wong et al. [5] suggested preserving dot products, which is more resilient to distance-targeted attacks. Drawback of this approach is that the search algorithm is limited to linear scan only and we cannot apply any indexing method to enhance the search.

2.2 Preserving Query Privacy

In PIR, it tries to completely preserve the privacy of access pattern, but the data may not be encrypted. PIR schemes are usually extremely expensive. To implement efficient privacy preserving data-block operations Williams et al. [8] use a pyramid hash index which is based on the idea of Oblivious RAM. But it does not give high throughput range query processing. The query privacy problem is addressed by Hu et al. [9] and requires the authorized query users. However, most computing tasks are done in the user's local system, which does not meet the principle of moving computing to the cloud To enhance location privacy Papadopoulos et al. [10] use private information retrieval methods [11]. But in these, confidentiality of data is not considered. To preserve location privacy Space Twist [12] proposes a method to query kNN by providing a bogus user's place. However this method does not consider data confidentiality. Both data confidentiality and query privacy are addressed by Casper approach [13].

3 System Architecture

The reason behind using this architecture is to enlarge the *proprietary database servers* to the public cloud for hosting huge datasets and query services cloud computing infrastructure Amazon EC2 is used. This architecture is used to ensure confidentiality of the data while minimizing the cost and achieving scalable hybrid public-private cloud. Here the database is outsourced to the cloud. Each record in this database has two parts such as some attributes are perturbated using RASP and encrypted original records. To enhance the performance of query processing

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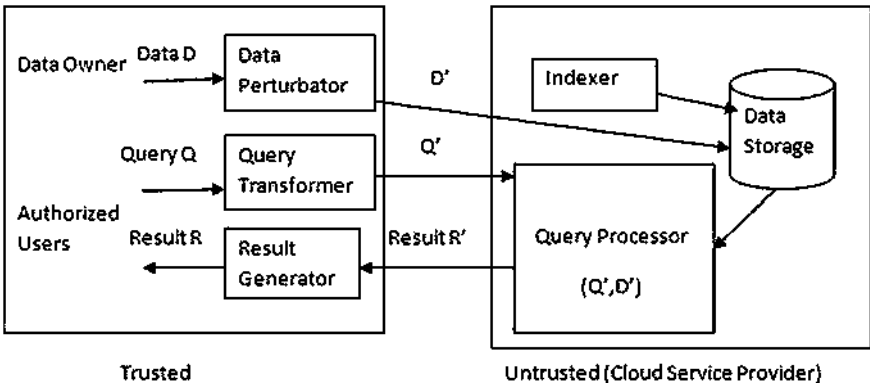

Fig. 1 RASP-based query service

indexing techniques are applied on database. For indexing RASP-perturbed data is used. This system architecture is used to process range queries and kNN queries based on RASP (Fig. 1).

In the system architecture, it has two visibly different parties in which one is trusted and other is not trusted. The trusted parties comprise of the data/service holder, the in-house proxy server, and the authorized users. The data owner store their confidential data on cloud on which RASP perturbation is performed. Users which are authorized only permitted to query the database. To find several records authorized users can submit range queries or kNN queries. The cloud service provider which may hack the confidential data are not trusted hosts the confidential database and query services. To enhance the good query performance indexing is used and to build indices RASP-perturbed data will be used.

3.1 System Module

3.1.1 Perturbation

RASP data perturbation technique is applied to data. After applying RASP original data is transferred to perturbed data. RASP combines different methods together which includes order preserving encryption, random noise injection. In secure transformation the topology of multidimensional range is preserved due to which indexing is applied on perturbated data which helps to efficiently process the query. OPE is encryption technique which allows comparison operation to apply directly on encrypted data where there is no need to decrypt the operands.

OPE: The proposed OPE Scheme is simple to use. It is based on linear expression such as x * y + z where coefficient x and z are kept secret and expression is public. Suppose input value is taken as v, then it is mapped to

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x * v + z + noise. Noise is some random value. For preserving order of input values noise to be selected properly. To deal with range queries over encrypted databases, OPE is used together with existing encryption algorithms (e.g., AES). For all input values v_1 and v_2 if $v_1 > v_2$ and $x > 0$ then $x * v_1 + z > x * v_2 + z$. The coefficients and input values can be integers or real number. After addition of some noise our expression becomes as

$$x * v_1 + z + \text{noise}_1$$
$$x * v_2 + z + \text{noise}_2$$

where value selected for noise is randomly sampled from some range. Range of noises is selected such as $v_1 > v_2$ and $x > 0$ then $x * v_1 + z + \text{noise}_1 > x * v_2 + z + \text{noise}_2$. If noise1 and noise_2 are both randomly sample from the range [0, x * 1] then $x * v_1 + z + \text{noise}_1 > x * v_2 + z + \text{noise}_2$ which holds even when noise_1 is minimum of noise_1, i.e., 0 and noise_2 is its maximum in [0, x * 1].

3.1.2 Query Transformers

In cloud environment, it is difficult to detect and prevent eavesdropped user queries. If the query is in encrypted form it is difficult to eavesdrop. Query transformer do the important task of transforming query, i.e., with the help of key query is encrypted. This transformed query acts on perturbed data.

3.1.3 Query Processor

It processes the encrypted query on protected database.

3.2 Range Query Processing

To minimize client side post-processing cost it is important to process queries efficiently which returns precise results. More common multidimensional tree indices are used for enhancing performance of search. For indexing multidimensional data the construction block used is the axis-aligned minimum bounding region (MBR). Range query on perturbed data is processed in two stages.

Algorithm
It works in two stages.

Proxy server is present at the client side. First it will perform the task of finding MBR of the submitted query. After finding MBR, it will gives this MBR and different query conditions to the server. The records which are enclosed within MBR are returned by the server using tree indexes. In the second stage exact range

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query result is returned to the server. In the second stage, initial results are filtered by the server using transformed half space conditions. In some cases initial result set is small which is filtered in memory such a case is called as tight ranges. In some cases, linear scan is performed when MBR will include entire dataset. Due to the exact result of the query obtained in second stage the client side post-processing cost is reduced.

3.3 kNN Query Processing

kNN query processing algorithm is based on range query algorithm, so to return faster results indexing is also used to process kNN queries. To find out the kNN candidates which are centered at query points, kNN algorithm is based on square ranges. We cannot directly process kNN query on perturbed database because RASP perturbation does not preserve distances. kNN query processing is combined with range query processing.

Working of kNN-R Algorithm
There are two rounds of interaction between client and server.

(1) The client will send the maximum-bound range and minimum-bound range to the server. Maximum bound range contains more than k points and minimum-bound range contains less than k points. Based on this minimum and maximum range server finds the inner range and it will return it to the client.
(2) Based on inner range client calculates outer range and returns to the server. The records which lie in the outer range are returned to the client by server.
(3) After decrypting the records top k candidates are returned as the final result by the client.

4 Experimental Results

In Fig. 2 it shows the fragment of perturbed database. In the above figure column value of Year_Of_Publication column, we applied OPE scheme which is highlighted. In proposed scheme we combine AES, OPE to secure our database. We considered book dataset from the http://grouplens.org/datasets/ link. On this database we perform equality, range, and kNN queries.

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ISBN	Book_Title	Book_Author	Year_Of_Publication	Publisher
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4foE4q/kgdhwvgZX+Xlig==	Ve/jVUERIga/MOaUHwyJKUdf3cHymRqcI6WyCAfxEE=	SJvcdAngre5D/1jYodAnQ==	400.62	zsTnwi9meAZw9rfO
5B1DEIL+6YWGmnDWRVwQ==	ha1JrSiNAFR9QM7YAUkJkRvMmVGv4rUcLJKPRDnDVbRRV/TqWuwaUnmC	R8JmnhSV2vW2dv4+mbKJ==	396.42	mZYnoJ6RCm8Fmg==

Fig. 2 A fragment of perturbed database

5 Conclusion

RASP is proposed to host query services in cloud. RASP combines noise injection, encryption, and order preserving encryption. RASP satisfies the need of hosting secure query services in cloud. RASP allows indices to be applied to improve performance of query. Range queries and kNN queries are considered. The kNN query is based on range queries. With the help of RASP perturbation, confidential data is protected in cloud environment.

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Biologically Inspired Techniques for Cognitive Decision-Making

Ashish Chandiok and D.K. Chaturvedi

Abstract In this paper, Artificial Biologically Inspired Techniques based on perceptions related to human cognitive decision-making is presented by proposing a novel BICIT (Biologically Inspired Cognitive Information Theory) architecture. These ideas openly associate neuro-biological brain actions that can explain advanced cognitive meanings comprehended by the mind. This architectural model on the one side elucidates inherent complications in human cognitive sciences, clarifying the behaviour of real-world interaction. On the other hand, points to prototypes of mind in the synergism of neural and fuzzy hybrid cognitive map systems. These structures can contend in forecasting, pattern recognition and classification jobs with neural networks and reasoning tasks with the fuzzy cognitive expert decision making.

Keywords Biological · Cognitive · Neural network · Fuzzy · Cognitive map architecture

1 Introduction

Symbolic and Emergent approach(Biologically Inspired techniques) are two different architectural models for resembling human intelligence and mind conceptual framework [1, 2]. Artificial General Intelligence objectives from starting are for constructing intelligent systems using the handling of significant propositions. Presently, there are critical complications at the groundwork of such an approach for building

Biologically Inspired techniques using BICIT architecture is propose in this paper to have cognitive decision making.

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model. Starting with the *knowledge acquisition bottleneck problem* (The knowledge components warehoused in the plastic model are in a significant capacity to signify real-world condition). The *symbol grounding problem* (explicit knowledge creates the system due to a symbolic representation of a real-world scenario in a hypothetical way). *Autonomy problem* (The models do not learn by themselves for handling real-world problem). Also the *learning problem* (For every task, insertion of a new knowledge is essential and thus increasing the complexity of data).

In Emergent approach, the system autonomously constructs itself and adapt by interacting with the environment using self-organization process of developing its network. First, in comparison to a Symbolic approach where knowledge acquisition is done by formulating new symbolic representation for every logic. While emergent systems have continuous skill-based learning where knowledge acquires by the impulses taken from the environment [1]. According to which the network, as well as network parameters, are reorganized to match the relationship, maintaining stability between the stimulus perception and the goal achieved. Therefore, the emergent approach can use Neural Network and Fuzzy cognitive mapping combinations for decision-making [3].

In this paper, authors proposes **BICIT** (Biologically Inspired Cognitive Information Technology) architecture for cognitive decision-making. Second, an example on neural-fuzzy system is introduced for knowledge development and Fuzzy Cognitive Map [4] for collaborative expert decision-making [5, 6]. The principal objective is to illustrate how to build a biologically inspired model that can be applied to form a Decision Support System.

Fuzzy Cognitive Map is a meta-rule system [7] such that it not only considers the associations between the causes and effects but also reflects the interactions among the overall cause entities [8–10]. Therefore, it provides a stronger reasoning ability than rule-based reasoning, and it can be used to model complex relationships among different concepts [4, 11].

The traditional decision support expert systems involve the building of a knowledge base; Biological Neural-fuzzy [12–14] cognitive mapping techniques are comparatively faster and easier to obtain knowledge and experience [9, 15]. Mainly using the human approaches that do not typically contemplate in mathematical calculations but in intuitive knowledge represented as natural language. Using the Biological techniques, models can handle distinct and numerous knowledge sources with a range of expertise [13, 16].

2 Biologically Inspired Cognitive Information Technology (BICIT) Architecture

Figure 1 shows the model of the biologically inspired cognitive decision-making system, that author proposes, which reflects that a human being is an intelligent organism cooperating with a society of entities for completing goals. In the equiva-

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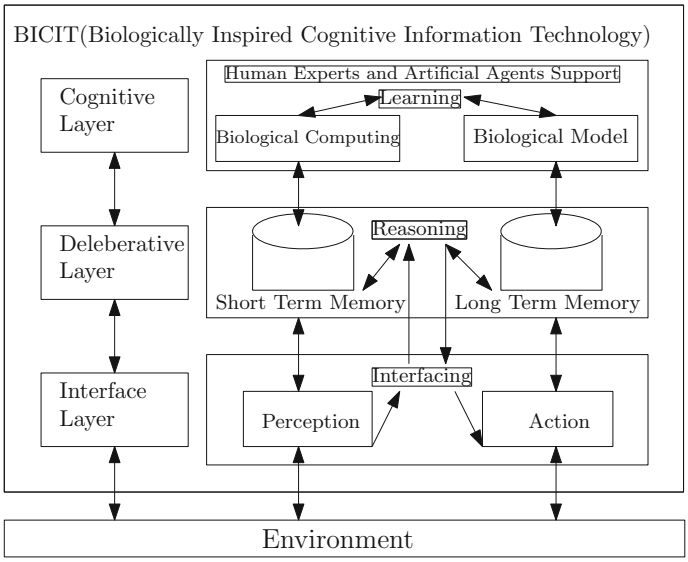

Fig. 1 Biologically Inspired Cognitive Information Technology (BICIT) architecture

lent approach, their artificial counterpart known as Biologically Inspired Cognitive Agents must follow goal completion by the interaction of human experts concious intuitions, machine agents skills, and its internal biological, cognitive powers. Agent trails its goal by interfacing with its external and internal environment. In internal, it interacts with its self-learning ability, emotions, knowledge, reasoning, and internal decision-making states. On the other hand, in the external environment, it cooperates with a human expert or its identical artificial agents. Whatsoever the situation we are bearing in mind, it can be altered, it is active; volatile environment significantly features the rational agent state and, therefore, their actions in reaching goals. Cognitive decision-making methodology shares the features of the symbolic, propositional logic procedures of conventional artificial intelligence, as well as parallel distributed, associative handling of biologically inspired cognitive machine intelligence. Combining the best of both worlds can be done by biological and rule base techniques. There are numerous approaches planned for decision-making like machine learning techniques, fuzzy logic, association rules, clustering, probabilistic networks, neural network, heuristic, and template pattern recognition. Figure 1 illustrates a model of Biologically Inspired Cognitive Information Technology Architecture. It comprises of three layers known as a cognitive, reflective, and interface layer.

Interface layers are unique, rapid decision-making that when at an instance learning performs the action spontaneously. The most common example of such kind of low-level intelligent decision-making is robotic collision avoidance.

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Deliberative layer involves additional knowledge and extra handling. It is the central layer of a BICIT system. The deliberative layer is utilized to make complex reasoning decisions that require biological models to handle the uncertain situation.

Cognitive layers represent biologically inspired cognition components that aim about the practical decisions delivered by the system. They are used to monitor biological learning or self-updated knowledge models using biological, computational tools. Biologically inspired techniques-based cognitive layer helps the system to have continuous online learning and improvement of its performance. It coordinates to seize features, in real-time and learn models storing satisfactory solutions and updating the models for this instance so that the best effective methods and training learned from them use again.

Short-term memory in biologically inspired cognitive systems stores features about the current state and present problem.

Long-term memory in a cognitive system is the realm and accurate biological knowledge models that the structure uses to inference. Nature-inspired technique-based models comprised human-like knowledge accessible to domain expert when making intelligent decisions.

2.1 Learning, Reasoning and Interfacing in BICIT Architecture

The biological inspired techniques [1] utilizes Neural Network, Evolutionary algorithm and fuzzy logic. In recent years, the researchers are using hybrid algorithm and techniques to solve problems. Nowadays, fuzzy cognitive map and Neuro-fuzzy [16] are seperately very popular. In this paper, the authors combine Neuro-fuzzy and Cognitive map to solve real-world expert problems based on BICIT architecture.

3 Related Work: Implementation of Biological-Inspired Techniques for Cognitive Decision Making

The selection is a fuzzy cognitive map for expert decision state and neural-fuzzy method for knowledge-based model building. The problem considered is teacher appraisal system.

In recent years, the research area of hybrid cognitive neural and fuzzy has seen a remarkably active development. Furthermore, there has been a massive upsurge in the successful use of hybrid intelligent in many diverse areas. Such as speech/natural language processing, robotics, medical; fault diagnosis industrial equipment, education, e-commerce, recommendation and information outrival. A cognitive neural-fuzzy-based expert system for evaluating teachers on the basis student feedback, examination results, peer feedback, and educational activities is proposed as shown

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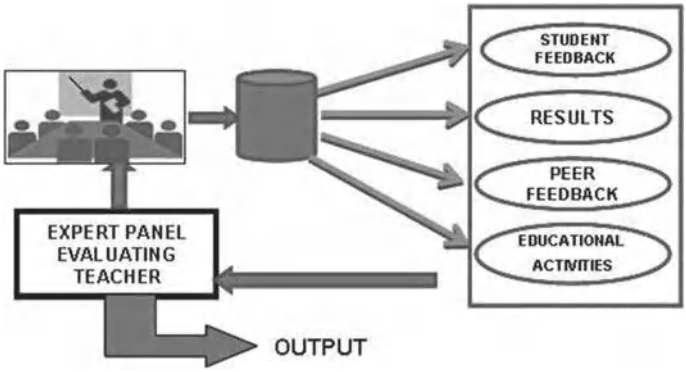

Fig. 2 Generic model of classical teacher evaluation system

in Fig. 2. This generic model of current teacher evaluation based on a static mathematical formula based on experts judgement. The generic model has the following problem that needs elimination. Each expert has intuitions for judgement often not taken into account. Different weights assign to parameters by each expert, but it is not considered. Many experts are getting bashed with one person who might result in wrong outputs. Mathematical computation is not fast and manual entering, and calculations may give an error.

3.1 Procedure for Problem Solving Using Biologically Inspired Techniques

Steps for Biologically Inspired Cognitive Decision

(1) Collect sample input parameter patterns.
(2) Create a cognitive fuzzy map of expert knowledge to get output decision.
(3) Combine input pattern and output decision to get complete training pattern.
(4) Generate the Neural-Fuzzy model and test the result.
(5) Apply to uncertain real-world situation.
(6) Regularly dynamic update fuzzy cognitive knowledge for new pattern obtains.

3.1.1 Sample Collection as Input Pattern

The sample collection is from the annual appraisal lead by the Sharda Group of Institutions, Agra where one of the authors worked as an Assistant Professor. The college holds total staff of 60. The authorized yearly appraisal has numerous sub-inquiries and measures. Therefore, the authors assembled all questions and combined the consequences into four major features as mention below. In facts collection, the

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Table 1 Concepts and its fuzzy linguistics

Concepts	Fuzzy semantic relation
Student feedback (C1)	Very Low, Low, Moderate, High, Very High
Examination results (C2)	Very Low, Low, Moderate, High, Very High
Peer feedback (C3)	Very Low, Low, Moderate, High, Very High
Educational activities (C4)	Very Low, Low, Moderate, High, Very High

Table 2 Result of various techniques used

Linguistic parameters	Fuzzy values	Classification
Very Low	0	0
Low	$1 \leq$ variable ≤ 3	1
Moderate	$3 \leq$ variable ≤ 6	2
High	$6 \leq$ variable ≤ 8	3
Very High	$8 \leq$ variable ≤ 10	4

feature data information comprises figurative as well as non-figured features. The handling and model development of such kind of structure is a difficult problem.

3.1.2 Cognitive Fuzzy Map of Expert Knowledge

In this research, the authors uses total four meta-concepts for decision-making of teacher appraisal. These concepts are listed in Table 1 with their linguistics variables. According to domain experts (Directors and Administration) assessments, input concepts representation is with the particular linguistic variables Very Low, Low, Moderate, High, Very High that lies in the fuzzy interval of [0, 10]. On the basis of the doctors intuitive decision, the eight relationships between concepts are shown using semantic variables (Negatively Strong, Negatively Moderate, Negatively Weak, Negatively Very Weak, No Relationship, Positively Weak, Positively Moderate, Positively Strong, and Positively Very Strong) where the values lie in the fuzzy range of $[-1, 1]$. In accordance to Domain Experts opinion, the Fuzzy values for the concepts variables for our system is shown in Table 2 and relationship between concepts with fuzzy weights in Table 3 below (the fuzzy values are tabulated and classified based on each Director and Management intuitive power). Similarly, Table 3 represent the association fuzzy strength values between concepts. These values are assigned by the experts and use it for representing the weights between two concepts edges.

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Table 3 Result of various techniques used

Linguistic parameters	Fuzzy values
Negatively Strong	$-1 \leq$ variable ≤ -0.8
Negatively Moderate	$-0.8 \leq$ variable ≤ -0.6
Negatively Weak	$-0.6 \leq$ variable ≤ -0.3
Negatively Very Weak	$-0.3 \leq$ variable ≤ -0.1
No Relationship	0
Positively Weak	$0.1 \leq$ variable ≤ 0.3
Positively Moderate	$0.3 \leq$ variable ≤ 0.6
Positively Strong	$0.6 \leq$ variable ≤ 0.8
Positively Very Strong	$0.8 \leq$ variable ≤ 1

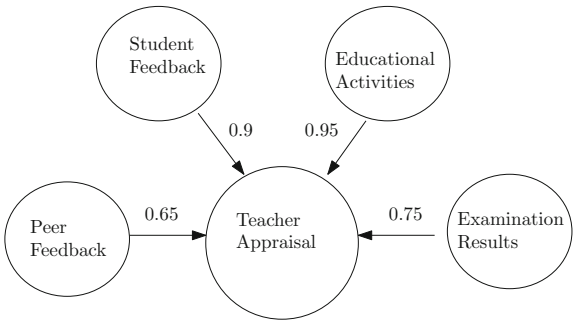

Fig. 3 Fuzzy cognitive map according to expert intuition

The experts Weight Matrix is formed by the intuitions of the each Directors and Management administrators and then authors construct overall weight matrix for the combined cognitive intuitive opinion as represented in the graph shown in Fig. 3.

3.1.3 Neuro-Fuzzy Model Development According to FCM Decision

The model is trained by neuro-fuzzy hybrid technique and can be updated time to time for better performance. The result shown in Fig. 4 concludes that fuzzy cognitive map knowledge combines the artificial cognitive mind of four experts and then training the input parameters and professional expertise output by artificial neural-fuzzy system representing a unique way of cognitive decision-making.

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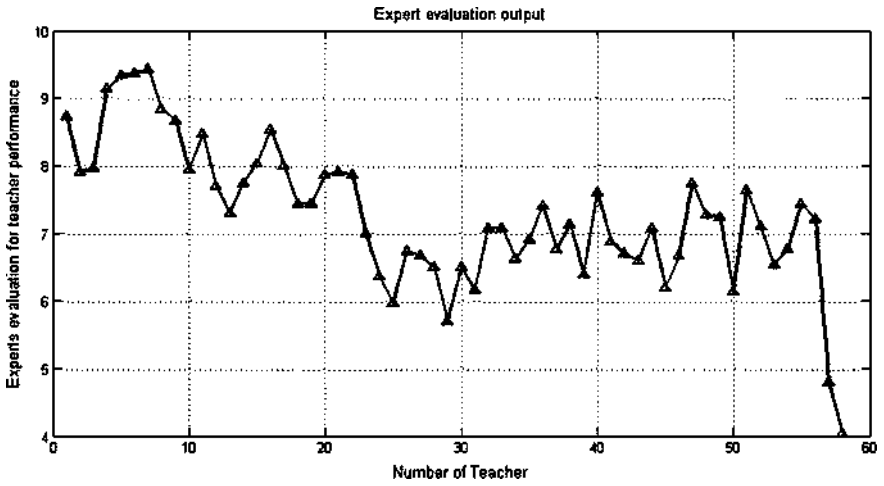

Fig. 4 Neuro fuzzy trained model output according to fuzzy cognitive map following expert intuition

4 Conclusions

The Cognitive Expert System based on BICIT architecture uses neural and fuzzy techniques as a unique technology that embraces the improvement of contemporary expert development for decision-making. The analytical minds of experts are combined qualitatively and quantitatively in a fuzzy cognitive map representing fuzzy and neural aspect respectively. The meta-mind uses to trained hybrid neuro-fuzzy artificial system developing artificial cognitive expert decision system. This era of expert system supports the improved biologically inspired intelligent expert system based on a study of mind.

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Analysis of Edge Detection Techniques for Side Scan Sonar Image Using Block Processing and Fuzzy Logic Methods

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Abstract Sonar images are generally used for the identification of objects under the sea. The images which are obtained by sonar technology are always gray scale images. For the identification of objects in images, the image processing technique is having some intermediate steps like filtering of noise, edge detection, and segmentation. Edge detection is one of the important steps for image segmentation and object identification. In this paper, edge detection using fuzzy logic technique and the block processing technique is compared. Subjective analysis of the result proves that the fuzzy method is better than the block processing for the identification of objects together with the shadow region in sonar images.

Keywords Side scan sonar image · Edge detection · Segmentation · Object identification · Fuzzy logic method · Block processing

1 Introduction

The technique which is used to navigate under the surface of sea water is called SONAR. Side scan sonar (SSS) is one of the categories of sonar system [1]. The main aim of the side scan sonar image processing is the classification of seafloor and the identification of target object. SSS consist of sensor array on a fish-shaped vessel known as sonar fish which is mounted on a ship hull and is towed deep into the water through some distance above the seabed. It emits fan-shaped sound pulse down toward the sea surface. The reflected pulses from seafloor are again recollected and the sonar imagery is formed finally [2].

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The quality of raw sonar image is not sufficient for the human intervention. Because it consists of ambient noise, electronic noise, loss due to absorption of sound pulses of the sea surface, reverberation noise, etc. The main components of a side scan sonar imagery system are [3, 4],

Step 1 Positioning of acoustic sensor array system
Step 2 Data acquisition and storage
Step 3 Data processing (Image processing)
Step 4 Interpretation

Image processing is the technique which converts image into a form suitable for specific application based on individual preferences. It consists fundamental steps such as image acquisition, storage, enhancement, restoration, morphological processing, segmentation, object identification, and classification. Many algorithms are available for the processing of each step. Among these edge detection is the primary step in segmentation process for finding the meaningful edges of objects present in an image. There are several operators are available to preserve different types of edges such as horizontal, vertical, and diagonal edges. During the process of edge detection in noisy sonar image, high frequency noise pixel can also interrupt along with edge pixel details. One of the preprocessing techniques called filtration is also included before edge detection in order to reduce the effect of noise pixel [5]. In side scan imagery, an object lying on the seafloor is followed by a shadow zone. But the echoes and shadow zone has different contrast levels [6–8].

In this paper, noisy sonar image filtration is followed by a subjective analysis of image segmentation techniques like fuzzy logic method and block processing are performed.

In Sects. 2 and 3 basics about the fuzzy logic method and block processing operator are discussed, respectively. Sections 4 and 5 converse about the proposed methodology and results obtained correspondingly.

2 Fuzzy Logic Method

In an image, when there is an abrupt change in pixel intensity, it is called as edge pixel [9]. But a minute difference between the pixels is not considered as an edge, because they may be noise effect. In fuzzy logic method, membership function is described in order to define each pixel that how much it belongs to a particular region. The fuzzy inference system designed here is having two inputs and one output that tells whether the pixel is a region pixel or a boundary pixel [10–12].

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2.1 Steps

1. Image gradient along x-axis (Ix) and y-axis (Iy) are calculated. The gradient values are in the range of (−1, 1).
2. Create a fuzzy inference system by giving these two (Ix and Iy) as input.
3. Assign membership function for both input and output. In this, Gaussian membership function is used for inputs and the triangular membership function is used for fixing the edge pixel output.
4. Create a set of rule for the system (Fig. 1).

In SSS image, objects are followed by the shadow region. Therefore the rule was formed as given below.

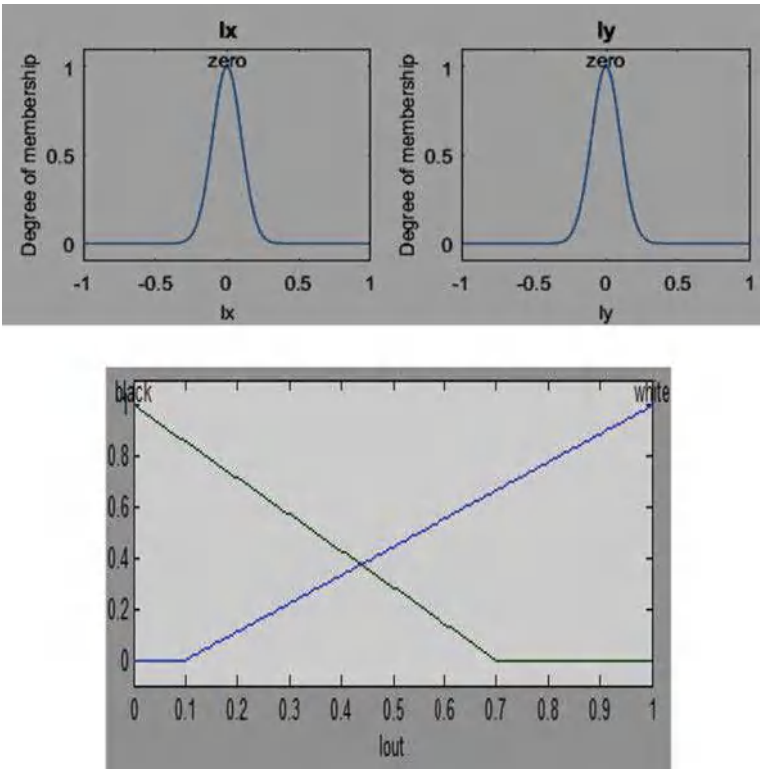

Fig. 1 Membership functions for input and output variables

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2.2 Rules

It consists of two main rules.

1. If (Ix is zero) and (Iy is zero) then (Iout is black)
2. If (Ix is not zero) or (Iy is not zero) then (Iout is white)

Further addition rules may improve the performance of edge detection.

3 Block Processing

Usually the larger size images are divided into small blocks and the edge operators are performed over it to get the result. This has been tried in our SSS image to get better results [13–15].

3.1 Steps

1. The input image is resized into 256 × 256.
2. The whole input image is divided into small blocks of size 50 × 50.
3. Apply canny edge detector operator using threshold value of 0.09 for each block.
4. Border size is also mentioned along with the border operator function in order to remove artifacts.
5. Finally the small blocks are combined by the operator and produce the result.

Instead of canny, we can use any edge detection operators. But canny was proved as a good one among other operators. Similarly 0.09 threshold value is also selected based on a number of trails.

4 Proposed Methodology

Algorithm:

1. Get a denoised (preprocessed) sonar image as input
2. Implement a fuzzy logic method of edge detection
3. Apply block processing method for the same input image
4. Subjective analysis of the outputs of both techniques is done.

The above algorithm is given as flow chart below (Fig. 2).

The flow chart of the proposed work is having two tasks. One same image is given as input to two methods which are mentioned above and the results are

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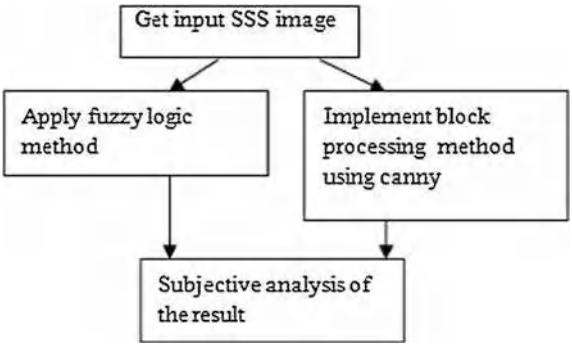

Fig. 2 Flow chart for the proposed work

subjectively analyzed, because there is no qualitative analysis of edge detection techniques.

5 Result and Discussion

In this proposed work, the SSS images along with shadow are taken for the analysis.

Samples of outputs are given below. Figure 3 represents an input image. Fuzzy method works based on FIS rules. The outcome of these methods based on FIS rule is specified in Fig. 4.

Fig. 3 Input image

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Fig. 4 Fuzzy logic method output

The shadow region of the image is represented as dark pixel and the object oriented pixels are looking brighter than the surrounding background pixels.

Figures 5 and 6 are the outputs of the second method called block processing. By comparing these two images, block processing along with canny give many details than conventional canny operator.

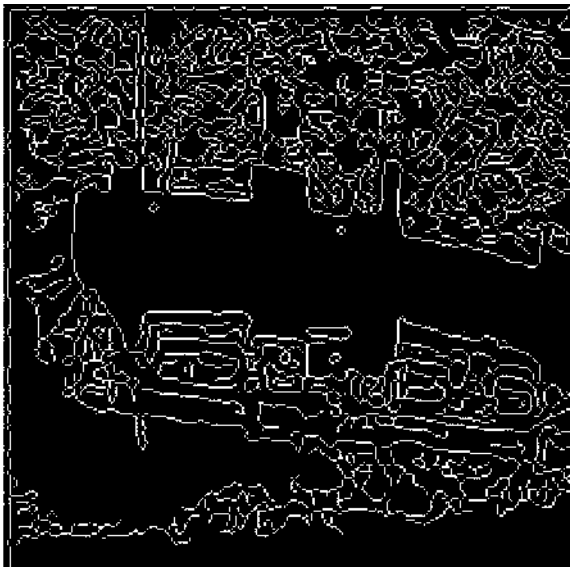

Fig. 5 Conventional canny edge detector

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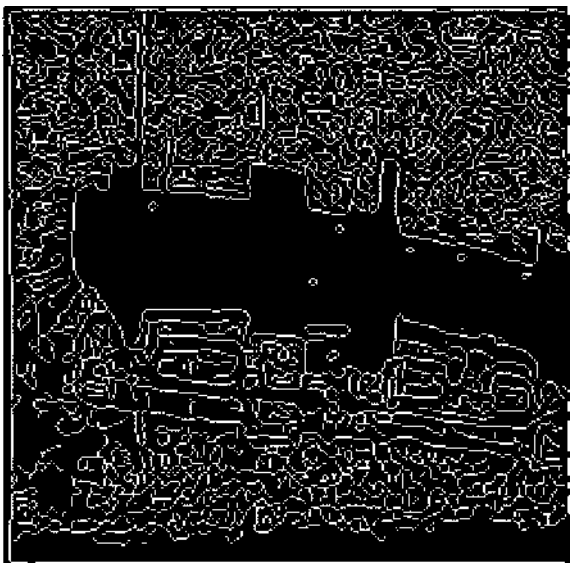

Fig. 6 Block processing with canny edge detector

So, using the block processing along with the standard edge detection operators gives better performance than normal edge detection operators. As per the proposed work by comparing fuzzy method with the block processing method, fuzzy gives improved performance than the other and is also more informative. Hence, the subjective analysis of the work tells that, the fuzzy logic method is suitable than block processing method for the SSS image with shadow region.

All this is done with the help of MATLAB software.

6 Conclusion and Future Work

Based on the height of the underwater object and the angle of the sonar devices, signal hit on the object, the width of the shadow region in SSS image varies. So the prediction of one best method for those images is impossible. As per these analyses, fuzzy results show good outcome. It isolates the object, shadow, and background of the image separately using different gray scale intensities. The identification of object area is easier in fuzzy, but in other methods, object area identification is more complicated. In fuzzy method by simply changing the rule or adding more rules can improve the performance. In the future, planned to implement pseudocoloring technique and also wavelet transform for this application.

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Leveraging Virtualization for Optimal Resource Management in a Cloud Environment

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Abstract Among the various enabling technologies for cloud computing, virtualization stands out high when it comes to optimizing a cloud provider's infrastructure. The success of a cloud environment depends to a large extent on how gracefully its resources are managed. The issue of resource management in cloud computing has been very popular among the researchers. In an IaaS service model, the various parties involved have different goals—the cloud infrastructure provider's objective is to maximize its ROI (return on investment) while the cloud user's intention is to lower its cost while delivering the desired level of performance. This is achieved by managing resources like compute, storage, network and energy in an efficient way. Through this paper, we try to bring out the state-of-the-art in cloud resource management area and also explore how virtualization can be leveraged to perform resource management in data centers during server consolidation, load balancing, hotspot elimination and system maintenance.

Keywords Virtualization · Virtual machine migration · Green computing · Data center

1 Introduction

Cloud computing has been around for a while and nearly every business has embraced it to exploit the benefits offered by it. In cloud computing, virtual machines are utilized to serve the demands of customers in a dynamic fashion by adhering to the service-level agreements (SLA) agreed upon by the service provider and consumers [1]. In the past, various definitions have emerged for cloud

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Table 1 Cloud service models

Service model	User	Services offered	Vendors/Players
IaaS	System managers/Administrators	VMs, Operating Systems, CPU, Memory, Storage, Network	Amazon EC2, Amazon S3, Joyent Cloud
PaaS	Developers/Deployers	Service/application test, development and deployment	Google App Engine, Windows Azure
SaaS	Business users	Email, CRM, Virtual Desktop, Website testing	Google Apps, salesforce.com

computing but all have certain characteristics common among them viz. virtualization, pay-per-use concept, elasticity and self-service interface. The emergence of cloud computing can be attributed to technologies like virtualization, internet, distributed computing and autonomic computing. Table 1 depicts the various aspects of cloud service models (Infrastructure/Platform/Software as a Service) in terms of its user types, services offered and major service providers.

In the context of cloud computing, resource management process involves managing various resources viz. compute, storage, network and electric energy in such a way so that the objectives of both cloud provider and cloud customer are fulfilled. Failure to do so efficiently can degrade the performance and in turn produces low ROI and make a provider lose its valuable customers. Management of resources in a cloud environment is not a trivial task. The process of resource management often gets tough due to increasing size and complexity of modern-day data centers to cope up with unpredictable workloads and adherence to the signed SLAs.

The rest of the paper is structured as follows. Section 2 presents various concepts related to resource management in cloud environment. Section 3 highlights the major contributions made in the cloud resource management area. Section 4 describes how virtualization can be exploited for resource management in cloud environment.

2 Resource Management in Cloud

To the users it seems as though a data center has unlimited resources to get their jobs done, but in reality it has limited resources. Resource management is an integral key task required of any cloud provider controlling the way common resources are accessed, making changes as and when required to improve performance/efficiency of data center [2]. The different aspects of cloud computing environment that influence the resource management task are discussed below.

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2.1 Entities Involved in a Cloud Environment

In a cloud environment, the various entities can be classified according to the roles assumed by them.

Cloud Infrastructure Provider—The responsibility of managing all the data center resources lies with the infrastructure provider who allocates resources to the requesting entity in a way that the SLAs are met.

Cloud Service Provider—This entity requests resources from the cloud infrastructure provider in order to host various application/services that it intends to offer to the end users. In some cases, the same entity assumes the roles of cloud infrastructure as well as cloud service provider.

End User—This entity has no role in resource management. The end user only generates requests either to the cloud infrastructure provider or cloud service provider.

2.2 Goals of Entities

To serve the computational/storage requests of cloud customers, the cloud infrastructure providers maintain large-scale distributed data centers containing thousands of nodes and lease out resources like CPU, memory, network bandwidth, and storage to customers on pay-per-usage basis. Cloud service providers rent resources from cloud infrastructure providers to run various users' applications characterized by unpredictable loads. The sequence of request/response operations between cloud service providers and cloud infrastructure providers is shown in Fig. 1. The client's experience is directly dependent on how efficiently the infrastructure provider manages and allocates its resources.

The ultimate concern for any cloud infrastructure provider is how to make the best use of underlying resources to increase ROI while respecting the signed SLAs. This can be achieved by:

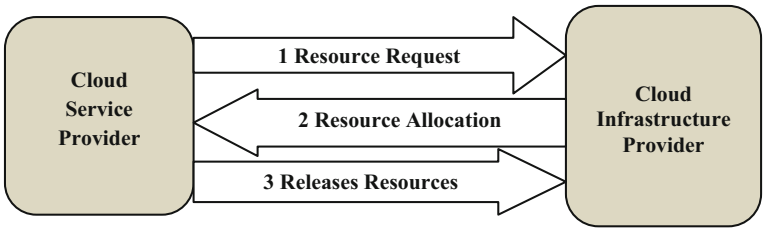

Fig. 1 Request/Response operations between an infrastructure provider and a service provider

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(i) Allocating and scheduling the requested resources to customers in an efficient way so that it provides better QoS as per SLAs signed with customers.
(ii) Reducing power consumption by using efficient resource management techniques.

While the target of a cloud service provider is to get various users' jobs done in minimum budget without sacrificing their performance requirements.

2.3 Resources in a Cloud Environment

To serve the unpredictable requests of various user/applications, cloud providers need to ensure that their data centers are equipped with the state of the art devices with a virtualization layer so to avoid any failure or loss of customers. The basic elements that go into the making of a data center primarily include physical servers (compute), storage, network and electric power.

Compute—It is the component that is responsible for the execution of users' task. It consists of physical and logical components. Physical components include hardware devices like Central Processing Unit (CPU), Memory, and Input/output (I/O) devices that communicate with one another using logical components like software/protocols. To further expand the limits of compute resource, features like hyper-threading and multiple cores are added.

Storage—It provides persistent storage of data created by individuals/businesses so that it can be accessed later on. Companies like Google, Amazon depend on data centers for storage, searching and computation purposes [3].

Network—Network is a data path that facilitates communication between clients and compute systems or between compute systems and storage.

2.4 Virtualization Technology

In cloud computing environment, a cloud provider provisions virtual resources to the users. To handle multiple requests using a single host, the provider has to produce a virtual environment that can be achieved by using virtualization technology. A virtualization layer placed on top of physical infrastructure gives an impression of unlimited computing resources to the end users by abstracting the underlying hardware layer from the host operating system and also allows running multiple guest operating systems concurrently on the same host to optimize system performance. This virtualization layer (also called as hypervisor or virtual machine monitor (VMM)) can be placed directly over the hardware or the host operating system. The former is called as Type-1 hypervisor while the latter one is called as Type-2 hypervisor. It is this hypervisor that partitions the physical machine (PM) resources to be allocated to various virtual machines (VMs). Examples of

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Type-1 hypervisor VMWare ESX/ESXi, Microsoft Hyper-V and that of Type-2 include VMWare Workstation and Microsoft VirtualPC.

The VMM encapsulates each guest operating system with its corresponding applications to create a logical entity that behaves like a physical machine. This logical entity is called as a virtual machine (VM). Virtualization allows the migration of VMs from one host to another in the same or different data center. A key feature of VMs is that the end-users are unable to distinguish them from actual PMs. Virtualization can be achieved in various ways. This is outlined briefly in Table 2 with their key points and benefits.

Virtual machine technology provides the feature to migrate a running VM across distinct PMs without having to shutting down the VM [4]. This concept of live migration is increasingly utilized in cloud computing environments to deal with these issues—online system maintenance, server consolidation, load balancing, and fault tolerance. In order to optimize resource utilization and save energy consumption, it is necessary to migrate these VMs to some other host in the same data center or an external one.

Table 2 Virtualization types

Type	Key points	Benefits
Server	Masks the physical resources like processor from the users	Server consolidation
	Enables running multiple operating concurrently on a host	Cost minimization
	Enables creation of VMs	Isolated VMs
Storage	Masks the underlying physical storage resources	Minimizes downtime
	Enables creating virtual volumes on the physical storage resources	Supports heterogeneous storage platforms and simplifies management
Network	Masks the underlying physical network hardware and presents multiple logical networks	Enhances performance
	Enables the network to support and integrate better with virtual environments	Enhances security
	Enables creation of overlay networks on top of physical hardware	Improves manageability
Desktop	Detaches OS and applications from physical devices	Enhances accessibility
	Enables desktops to run as VMs which can be accessed over LAN/WAN	Improves data security
	Can be implemented using Remote Desktop Services (RDS) or Virtual Desktop Infrastructure (VDI)	Simplifies backup task
Application	Offers applications to end users without any installation	Simplifies application deployment
	No dependency on the underlying computing platform	Eliminates resource conflicts

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3 Related Work

In the past, researchers have optimized data center efficiency by targeting different aspects and goals in mind. Table 3 highlights the main features, strengths and shortcomings of various approaches used by researchers in cloud resource management area.

4 Managing Resources Using Virtualization

A cloud data center must be flexible enough to deal with unpredictable user requests [2]. Virtualization technology provides the solution to most of the issues take place in a data center. The system administrators can utilize it for providing better customer experience and also for efficient management of data center resources. Here, we discuss the various ways in which virtualization can be leveraged for resource management in a cloud environment.

4.1 Server Consolidation

In a data center, server sprawl situation leads to inefficient resource utilization by not exploiting the full capacity of various physical servers. This problem can be overcome by first identifying the under-utilized servers and then migrating VMs from such machines to other machines selected to host the migrated VMs.

In a data center with VMs running on various under-utilized physical machines (PMs), server consolidation will migrate all such VMs on a fewer number of fully utilized machines so that the freed machines can be put to OFF or power-saving state [5]. This will reduce energy consumption and promote green computing. Such a scenario is shown in Fig. 2.

4.2 Load Balancing

In a cloud environment, virtual machines are continuously added and removed to cope up with the varying needs of customers. This dynamism creates imbalance in the resource utilization levels of different PMs across data center with the passage of time resulting in performance degradation. To address this problem, the resource utilization levels of PMs are constantly monitored and if there is a disparity in their utilization levels, load balancing is triggered using live virtual machine migration [6]. This involves migrating VMs from highly loaded PMs to lightly loaded ones. The use of virtualization for load balancing is shown in Fig. 3.

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Table 3 Various virtualization-related approaches used for resource management in the past

Author	Features	Strengths	Shortcomings
Zhen Xiao et al. [8]	Addresses the problem of server sprawl by minimizing skewness i.e. uneven utilization of servers	Supports green computing	Doesn't consider all resource types to determine skewness
	Supports dynamic resource allocation	Dynamic in nature	Eliminates hot spots partially
	Adapts to varying application demands		
Ibrahim Takouna et al. [9]	Provides support for detecting over-utilized hosts, selecting and placing VMs by taking into account energy-performance trade-off	Reduces energy consumption significantly	Focuses only on CPU utilization when selecting historical window
	Uses an adaptive window algorithm to minimize undesired VM migrations	Dynamic and robust in nature	More time consuming
Lei Wei et al. [10]	Utilizes Markov Chain model based dynamic resource provisioning approach to form resource groups of different resources types	Provisioning of resources is done according to users' needs	The process of flexible workload provisioning is complex as compared to single resource provisioning scheme
	Develops analytical models using the idea of blocking probability in order to predict suitable number of PMs taking into consideration the QoS requirements	Minimizes energy consumption	
Dong Jiankang et al. [11]	Targets compute and network resources to optimize their utilization to achieve tradeoff between energy efficiency and network performance	Supports green computing	To estimate migration costs, it doesn't take into account memory iterations or migration traffic distances
	To address energy issue, it uses a static VM placement scheme to reduce the number of PMs and network elements	Ensures optimal network resource for saving energy	Considers only maximum link utilization (MLU) network performance
	To address migration costs, it uses a dynamic VM migration scheme in order to optimize the link utilization		

(continued)

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Table 3 (continued)

Author	Features	Strengths	Shortcomings
Ning Liu et al. [12]	Provides an optimized task scheduling model based on integer-programming problem to reduce cloud data center energy consumption	Handles heterogeneous tasks	Suffers from energy-response time trade-off
	Uses a greedy task-scheduling scheme to respect the response time constraints of tasks	Consumes 70 times less energy than random-based scheme	
Mahyar Movahed Nejad et al. [13]	Proposes auction-based dynamic virtual machine provisioning scheme based on integer program	Takes into account multiple resource types	Not effective in situations in which VM instances have a high degree of heterogenity
	Uses a truthful greedy technique for multiple resource types, giving incentives to users who disclose true valuations for the requested VMs	Cost beneficial for the cloud providers	
Qingjia Huang et al. [14]	Proposes an elastic consolildation mechanism for scheduling based on VM migration to conserve energy while respecting the SLAs	Increased efficiency by considering the live migration and hotspot elimination overheads	Doesn't initiate migration on machines that are already busy
	Uses resource demand predictor to reserve in advance the minimum amount of resources to be allocated to VMs to satisfy users' requests		

4.3 Hotspot Elimination

Once VMs are provisioned to the requesting customers/application, constant monitoring is required to identify whether the allocated VM is able to satisfy its SLAs as per requirements [7]. When the performance of a VM/PM goes below a certain defined level, a hotspot occurs and must be addressed as it affects the performance of the system. For this, extra resources need to be provisioned to the degrading VMs so as to meet the QoS parameters as per SLAs.

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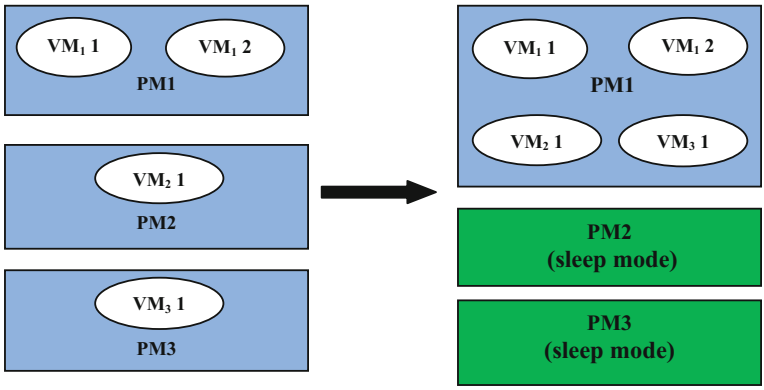

Fig. 2 Pre and post-server consolidation

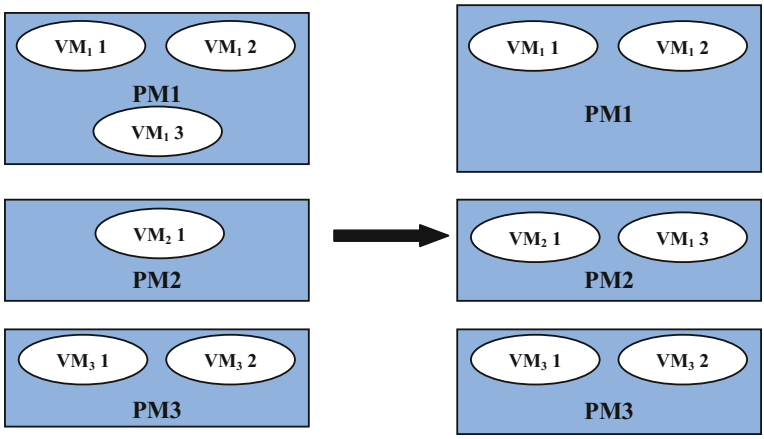

Fig. 3 Pre and post-load balancing

These extra resources can be allocated from within the same PM or from the some other PM. In the latter case, the VM has to be migrated to another PM within the same or different data center to reduce the hotspot. Figure 4 shows a situation where three PMs are hosting VMs on them. Since PM2 is overloaded, it is unable to allocate sufficient resources to its VMs namely $VM_2 1$ and $VM_2 3$. So VM migration takes place to eliminate these hotspots.

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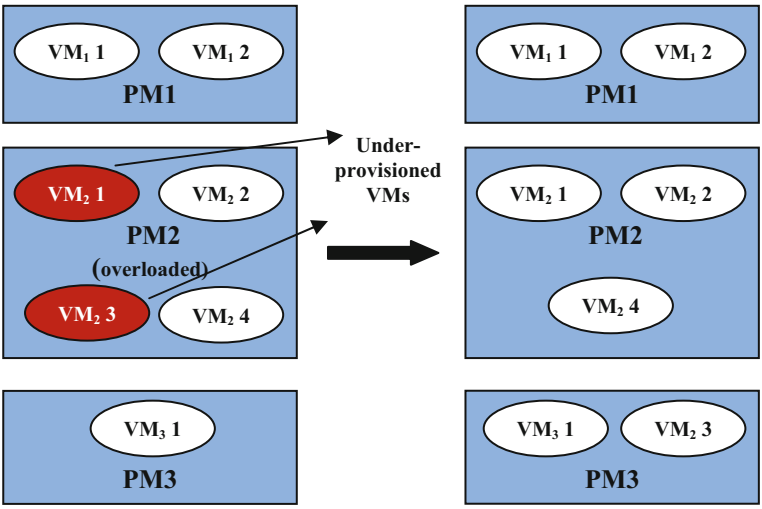

Fig. 4 Pre and post-hotspot elimination

4.4 System Maintenance

In a real cloud environment, frequent maintenance of PMs is required without interrupting the ongoing operations. To achieve this, the VMs hosted on such PMs are migrated to other PMs. This allows for continued execution of operations. In Fig. 5, PM1 needs to be undergo some maintenance task. To ensure continued execution of operations on $VM_1 1$ and $VM_1 2$ of PM1, these are migrated to PM2.

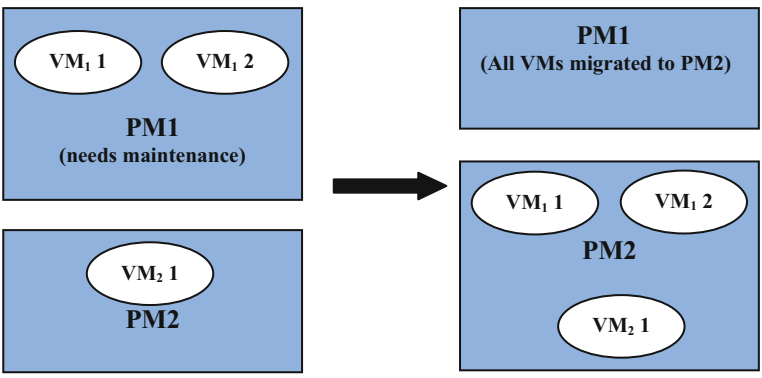

Fig. 5 System maintenance using virtualizaiton

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5 Conclusion

Efficient resource management in a cloud to address issues like performance and cost is a key factor that determines its success. Virtualization is the enabling technology for cloud computing. This paper examines the state of the art in resource management area for cloud computing with a focus on improving its performance and addressing the energy concerns. We also discussed how virtualization can be leveraged to perform key tasks like server consolidation, load balancing, hotspot elimination and system maintenance in data centers to exploit the resources to their full potential.

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Reconfigurable Circular Microstrip Patch Antenna with Polarization Diversity

Prachi P. Vast and S.D. Apte

Abstract Single-feed circular microstrip patch antenna with diagonal slot for polarization reconfigurability has been proposed. PIN diode can be used to achieve reconfigurability by placing it within the slot. Ideal diode that is diode size patch is considered in place of PIN diode for simulation and fabrication purpose. When diode is 'ON' and 'OFF', an antenna can switch between linear and circular polarization, respectively.

Keywords Reconfigurable circular microstrip patch · Circular polarization · Linear polarization · PIN diode

1 Introduction

Reconfigurable microstrip antennas due to their properties of adapting to change in environmental and system requirements is motivated a tendency to employ it in recent years [1]. For different wireless communication applications, different frequency bands with different types of radiation and polarization characteristics are required. Conventionally, this can be achieved by designing different antennas. However, practically the physical size of the system does not permit designing separate antennas for each application. Therefore, the design of reconfigurable antennas, which could integrate various operating characteristics in a single antenna, has opened an innovative research area for antenna researchers and engineers. It is well known that microstrip antennas can generate circular polarization (CP) radiation when two fundamental modes with orthogonal property are excited with the same amplitude and a phase difference of 90 [2]. For a single-fed

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microstrip antenna, the condition can be achieved by introducing perturbation segments into the antenna structure. With the perturbation segments, the original fundamental mode of the antenna is split into two orthogonal modes, which have different resonant frequencies, and one CP operating frequency can be found between the two resonant frequencies. Several antenna structures offering polarization diversity have been proposed in the literature. Single-feed Square Microstrip patch antenna with single notch for polarization reconfigurability has been proposed [3]. Reconfigurability can be achieved by placing PIN diode within the notch. Four identical notches with parasitic elements are embedded into the circular patch antenna [4]. The antenna can switch between linear polarization (LP), left-hand circular polarization (LHCP) and right-hand circular polarization (RHCP). PIN diodes are used to, respectively, reconfigure the coupling slot and the open stub of the feed line, the polarization of the microstrip antenna can be switched between vertical and horizontal polarizations [5].

In this paper, circular microstrip patch antenna (CMPA) for polarization reconfigurability with rectangular slot on it have been designed and fabricated to resonate at 2.4 GHz. To achieve the reconfigurability, the slot is filled with PIN diode. Switching the diode between ON and OFF positions, changes the polarization from linear to circular. For the fabrication purpose, the PIN diode is considered as ideal diode by placing it with small diode size patch.

2 Proposed Antenna Design

Figure 1 illustrates the geometry of the proposed circular microstrip patch antenna with reconfigurable polarization. The circular patch (radius = 17.1 mm) is implemented on a 1.6-mm thick substrate of relative permittivity 4.4 with loss tangent 0.002. A single slot (3 mm × 8 mm) is made on the circular patch. In Fig. 2, it can be seen that this slot is filled with rectangular parasitic element (1 mm × 4 mm) in place of PIN diode. Simulation is done on HFSS11 (Table 1 and Fig. 3).

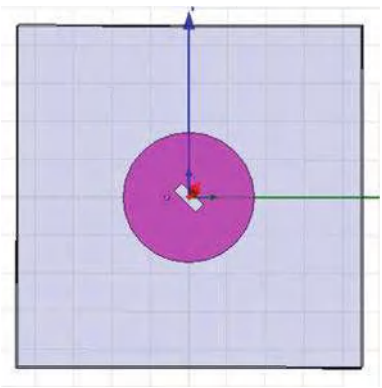

Fig. 1 CMPA in 'OFF' state

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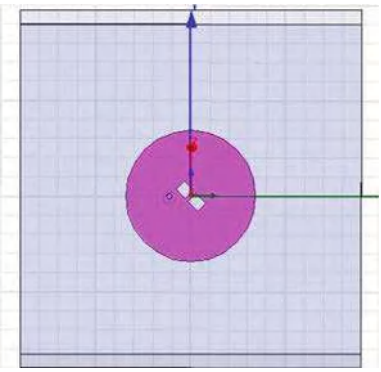

Fig. 2 CMPA in 'ON' state

Table 1 Design parameters of SMPA

Sr. no.	Parameter	Value
1	Frequency	2.4 GHz
2	Dielectric constant of substrate	FR4 (4.4)
3	Radius of patch	17.1 mm
5	Slot length	8 mm
6	Slot width	3 mm
7	Parasitic element width	1 mm
8	Parasitic element length	4 mm
9	Height of the substrate	1.6 mm

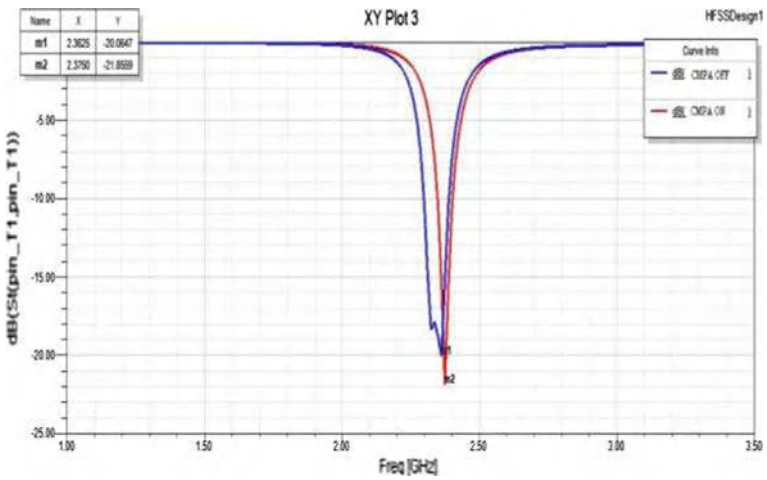

Fig. 3 Return loss of CMPA in 'ON' and 'OFF' state

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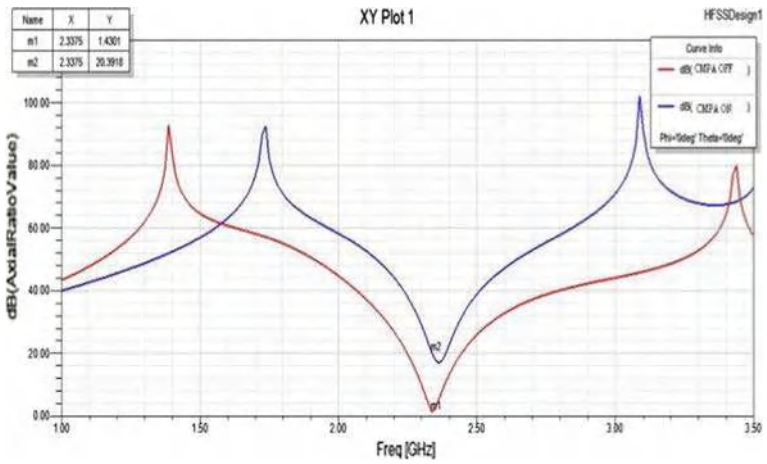

Fig. 4 Axial ratio of CMPA in 'ON' and 'OFF' state

3 Simulation Design and Results

Figures 1 and 2 are the simulated antenna with diagonal slot on CMPA and slot filled with the small patch, respectively. Figure 4 shows that when the diode is 'OFF', the antenna radiates at 2.33 GHz with axial ratio of 1.4301 dB, whereas it is 20.3918 dB when it is ON. That is when SMPA is in 'OFF' state gives Circular polarization, whereas it gives linear polarization when it is in 'ON' state. Both the antennas are radiating at 2.33 GHz.

4 Fabricated Antenna and Results

Figure 5 indicates the circular microstrip patch antenna with slot on it. Figure 5a, b shows that the Co- and Cross-polarization patterns. Received power of the antenna when it is co-polarized is –20 dBm, whereas –22 dBm when cross-polarized, giving the circular polarization.

In Fig. 6, it can be seen that the slot is filled with the PIN diode size small patch. Figure 6a, b shows the co- and cross-polarization patterns. Received power of the antenna when it is co-polarized is -22 dBm, whereas –42 dBm when cross polarized. Results of the pattern indicate that the CMPA in 'ON' state gives linear polarization (Fig. 7).

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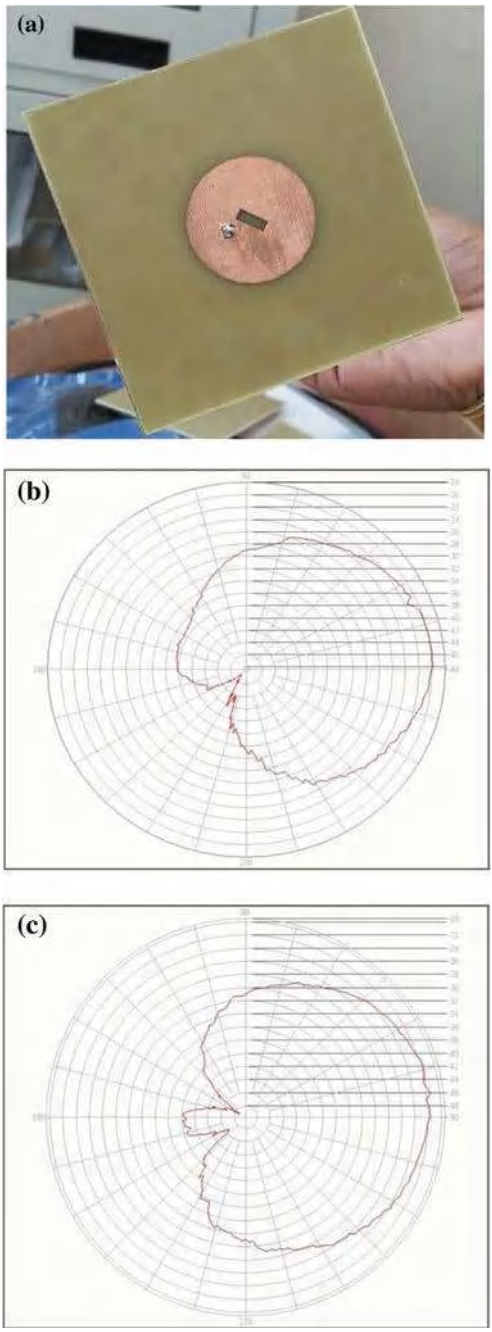

Fig. 5 CMPA in 'OFF' state **a** Co-Polarization of CMPA in 'OFF' state **b** Cross-Polarization of CMPA in 'OFF' state

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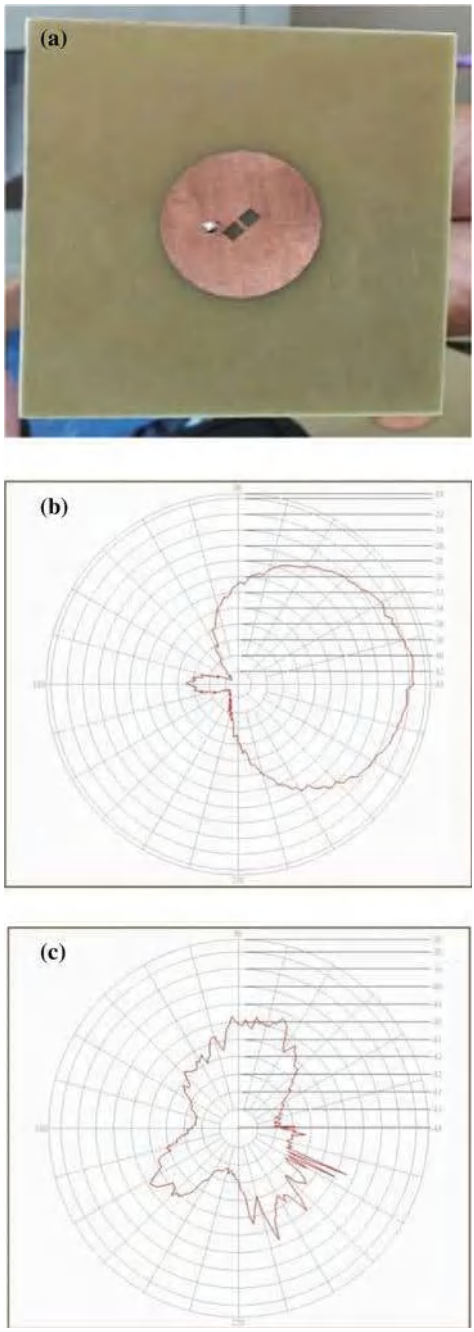

Fig. 6 CMPA in 'ON' state **a** Co-Polarization of CMPA in 'ON' state. **b** Cross-polarization of CMPA in 'ON' state

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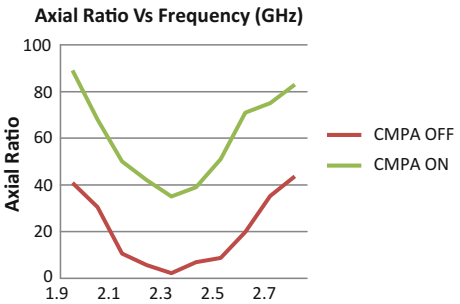

Fig. 7 Axial ratio

5 Conclusion

In this paper, single-feed circular microstrip patch antenna with diagonal slot for polarization reconfigurability has been designed, fabricated, and tested. The antenna can be electronically controlled by controlling the biasing of the PIN diode to switch the polarization mode (linear polarization, circular polarization). Axial ratio found for linear polarization when PIN diode in ON is 38.23 and for circular when PIN diode is OFF is 1.56. From Axial ratio measurement and polarization pattern, it can be seen that proposed antenna shows good polarization reconfigurability.

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Issues with DCR and NLSR in Named-Based Routing Protocol

Rajeev Goyal and Samta Jain Goyal

Abstract Content-based routing, which is under a category of sophisticated routing protocol, is used to propose a routing protocol that can replace Internet protocol. Content-based routing is used to querying, fetching, and finding desired information where in the other routing based system; they forwarded the packets on DNS or data senses. Main issues with the past were constraints of the storage. We have seen in some papers that name-based routing is feasible to achieve content-based routing.

Keywords Content based routing · Information centric network · Named based content routing · Fully qualified domain name · Distance-based content routing · Named-data link state routing protocol · Distributed hash tables

1 Introduction

Content-based routing is a powerful and flexible solution of sending messages, which are addressed to services or clients. It route the message based on the contents of the message [1]. Two types of entities are used to create content-based routing system. One is routers that route messages and other is services that are ultimate consumers of messages (Fig. 1).

This content-based routing has a typical example that represents the information of the content and its name is name-based routing. Based on [2, 3] this routing algorithm, FQDN(**fully qualified domain name**) database is used, which generally takes two entries: One for node ID and other is for routing or forwarding table entries. But sometimes it faces the problem of hardware space and search overhead. Also faces some scalability issues if FQDN is update more frequently.

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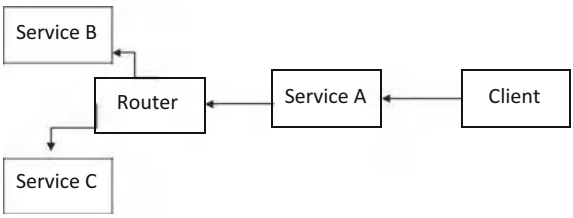

Fig. 1 Content based routing scenario

Basically, FQDN is the complete domain name for a specific machine on the internet, which consists of two parts: (1) host name (2) domain name. Since FQDN [4] is variable length, state-of-the-art memory is used. TCAM is used for routing or forwarding table on routers. It gives high speed during searching the contents. TCAM has excellent performance for the longest prefix match. It has more advantage than a normal RAM [5]. To reduce power consumption in content addressable memory CCAM, more flexible, efficient, and feature rich TCAM has driven by researchers. It is similar to CAM with additional state X, which used to search the given range of values. The TCAM are particularly useful for CIDR (classless inter-domain routing) [6–8]. In a single operation, for the longest prefix matching and for packet classification, CIDR is very particularly useful.

To solve the scalability issues with the FQDN, we implement DHT for storing hierarchically structured FQDN. DHT is used to manage data by using hash function also designed to be update more frequently than DNS-based approach [9]. DHT and cache sharing architectures balances the cost of communication between nodes of the platform and DNS resolution. This provides significant advantage for cache sharing and DHT architectures. DHT nodes routers have more processing ability than regular nodes [10, 11]. Hierarchical DHT specially designed for better fault tolerance, security, effective caching, maximize utilization of bandwidth, and hierarchical access control. In this proposed work, we use hash function to get physical position of node. For this, two measurements landmark clustering and RTT are used to generate proximity information, where landmark clustering is used to get proximity information about the closeness of nodes.

2 Name-Based Content Routing Protocols

For ICN architectures, name-based content routing protocols are essentials. Content-based routing protocols are based on content flooding where requested contents do not know the location [12, 13]. A approach named DIRECT uses for connectivity disruption, whereas direct diffusion was the first approach for the name-based content routing, which used named contents as request on the sensor network. By the means of link state and path vector algorithms, number of approaches is counted to maintain routing table information [14]. NBRP, CBCB, and DONA are some major routing approaches that use content-based routing

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principles. Those are specifically for multicasting. To accomplish name-based routing, ICN projects use DHT that is used to run over the physical infrastructure [15]. In DHT, destination is assigned to home location for determining namespace of nodes. To improve efficiency, DHT nodes are mapped and built using underlying routing protocols [16–18].

3 Components of DSR and NSLR

In DSR, every node maintains a route cache on the network. While sending data, intermediate node examines header and based on the information on header, forward to the next hop else obtain new route based on the broadcasting a route request within its transmission range [19]. Based on the address of source and destination nodes, route record is created by route request. Based on the received information if destination matches, "sent reply" packet is sent back to originator. Else with the help of intermediate node, "Intermediate node replies" sent to secure to get its destination. After that rebroadcasts the same request [20, 21], "Route error" packet is generated if source route is damaged or corrupted due to any unwanted system. DSR aggressively make use of "route caching". This protocol uses several optimizations like data salvaging, gratuitous replies, route-snooping, etc.

NSLK-This protocol is for named data networking, which is used to identify and retrieve data based on its name prefixes instead of IP prefixes [22]. NSLR protocol has directly benefited of NDN's data authenticity also it has no of forwarding strategies. To exchange sending message, NSLR uses data packet/interest packet of NDN's router to establish connection during failure or recovery of any link/neighbor, NSLR disseminates LSA for the entire network. Advertise name prefix for static or dynamic registrations NLSR provide name prefix to each node on multiple-route as well as it signing and verify of all routes [13]. Each NSLR node builds a network topology based on adjunct LSA's information. To produce multiple next-hopes for destination, use Dijkstra algorithm. To detect failure of processes, NLSR periodically sends INFO to each neighboring node. This "info" if it gets no response, it considered "down" else "active" [23].

4 Security and Performance Issues

DSR faces certain security issues like there is no effective mechanism to remote entries, which causes wastes network bandwidth and loss of data packets also under the guise of data salvaging a malicious node create mistake and gratuitous replies degrades performance of DSR also effects its security system, whereas NLSR is an intra-domain routing protocol. Here network administrator authenticates network with the help of key signing and verification. NSLR [24, 25] strictly follows trust model at the trust anchor. Security with NSLR is more original then the other

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protocols of content-based routing. NSLR security checks on a key level whether the key indeed belongs to the original routers or not. Once the thing is verified, record this information for future packets.

5 Evaluation

Results of our evaluation and analysis based on its processing time, convergence time, and messaging overhead are shown in Figs. 2, 3, and 4.

In the figures, standard deviation of the distribution of value is given. In each figure, the X-axis resents the number of replicas of name prefix and the quantity presented for each router. The results show that DSR perform operations and events in upper bound indicate our implementation sends all name prefixes instead the changes since the last updates.

Figure 2 shows initialization phase where routers do not have any topology information or prefixes except for those which are locally available. Router sends its

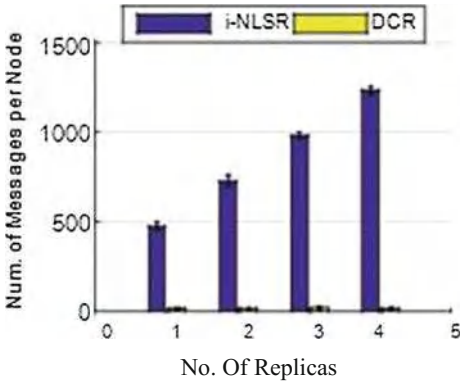

Fig. 2 Evaluation analysis 1

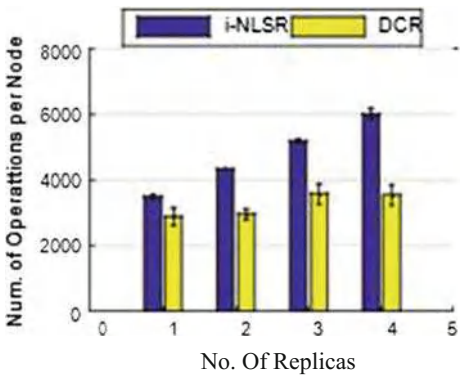

Fig. 3 Evaluation analysis 2

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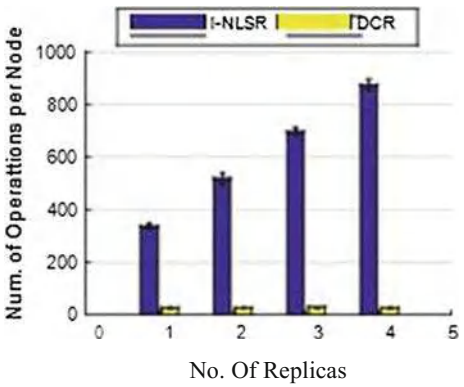

Fig. 4 Evaluation analysis 3

local information for a random number of times at the starting of simulation. In DCR, routers sends the closest anchor to each neighbor to the prefix that is why number of messages does not change for DCR [26] as increases the replicas number. But a number of prefix in NSLR increases the total number of prefixes as average per prefix anchor increase. The operation counts for Dijikstra algorithm are greater than the operation count for DCR.

In Fig. 3, the result shows adding a new prefix into the sensor network. An NLSR uses less number of replicas than DCR uses more messages to exchange. However, in DCR the replicas the number of messages is incomparable and the number of exchanges does not grow with the number of replicas. And Vice versa it happens with NSLR.

In Fig. 4, each router has to process LSA that corresponds to each direction of a link, where the number of messages exchanged per node is smaller than the NLSR. This is independent of the number of replicas of prefixes, maintained in the network.

6 Conclusion

The functioning of an enhanced version of NLSR and DCR was examined. This simulation shows that distances reporting to the closest replicas of prefixes for name is much proficient than preserving whole topology information and the routers information where the numerous replicas of name prefix inhabits. The operating cost in NLSR turns out to be a concern when the average a number of replicas per name prefixes increases further then two.

Our study advises many vital possibilities of fertile research. One, a routing approach based on link-state information in which routers interconnect information about only the prefix that is nearest replicas should be explored and its functioning should be matched against DCR that supports routing to prefix which is nearest replicas with distance information. Two, information routing approaches where

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routers are not required to send periodic updates should be examined for both distance-vector approaches and link-state approaches. The use of event-driven routing updates instead of periodic dissemination of LSAs or distance updates can reduce the overhead of signaling due to routing considerably. Three, the significance of sender-initiated signaling mechanics in ICN and NDN should be counted. The output also display that, for DCR to work competently, update messages in DCR should define updates made to name prefixes to distances as to send the last update, instead of having each update message comprise information about all prefixes for name.

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Design and Analysis of Quantum Dot Cellular Automata Technology Based Reversible Multifunction Block

Waje Manisha Govindrao and K. Pravin Dakhole

Abstract In the era of emerging trends quantum dot cellular automata has become very popular because of its extremely small size. In this paper logically reversible 4 × 4 block is proposed. This block is designed and simulated using Quantum Dot Cellular Automata technology. This QCA based 4 × 4 block named Reversible multifunction block is capable to generate different reversible functions like OR, AND, XOR, XNOR, Full Subtractor, Full Adder, Half Subtractor, Half Adder, code Converters like Gray to Binary and Binary to Gray, Pass Gate, Set, Reset and complement, by changing the inputs at different instants. Reversible Multifunction Block constituted of thirteen reversible functions. Performance analysis of this new design shows that using single block or single Gate, multiple functions can be generated whereas if we wish to design all these functions separately too many number of gates are required. This 4 × 4 reversible Multifunction Block is proved to be efficient in the literature. The proposed design is implemented using QCA-Designer 2.3.

Keywords (QCA) Quantum dot cellular automata · Reversible multifunction block · QCA cell, quantum cost, reversible logic

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1 Introduction

QCA is known as one of the nanotechnology which is efficient in area and power because of the smaller size of Quantum dot [1]. Demonstration of first QCA cell is done in 1997 [2]. Flow of current is not continuous in QCA devices as in case of CMOS devices. As a result power dissipation of QCA devices is very less. Hence QCA technology has the great advantage to scale devices and circuits in the world of quantum.

The QCA technology comprises a clocking means that can be considered same to that of power supply in CMOS technology [3]. Theoretical and experimental demonstration [4] shows that clock in QCA offers power gain and gives a means for memory characteristics in the cells. Different experiments have focused the important features of clocked QCA devices [5, 6]. Employment of reversible logic operations is one of the computing technologies, where information will not be lapsed [7]. Thus, virtually they disperse no heat. Since a QCA circuit maintains information with help of 4 phases of clock [8, 9], the dissipation of heat in a QCA logic circuit can be considerably lesser than kBT ln2. This characteristic favours the introduction of QCA paradigm in reversible logic design.

2 Quantum Dot Cellular Automata Terminologies

2.1 Quantum Cell

A cell comprises of four quantum dots, which are placed at the bend of a square box. It has two numbers of free electrons [1]. These free electrons can tunnel amongst the quantum dots. Two electrons established the polarization values as –1.00 i.e. binary value 0 or +1.00 i.e. binary value 1 as given in Fig. 1.

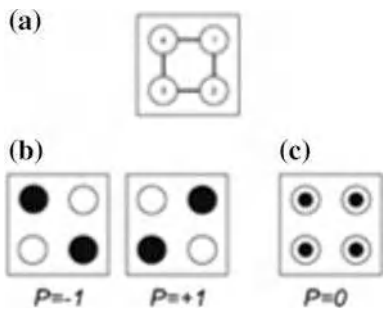

Fig. 1 **a** Structure of a cell **b** Logic '0' and Logic '1' Polarization, **c** Unpolarized cell

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2.2 QCA Clock

Four clock phases are there in QCA, namely Relax phase, Switch phase, Release phase, Hold phase [10, 11]. This clocking feature in QCA gives parallel operation also known as pipelining use to provide information in the form of bits for QCA. Clock in QCA technology is used to organize the signal flow. Clock plays a vital role in the QCA circuit for parallel as well as synchronized operation. Loop of QCA cells with different clock zones act as a memory cell (Fig. 2).

2.3 QCA Logic Gates

Basic components of QCA logic circuits are Majority Voter i.e. MV gate and inverter [11]. MV gate can be implemented using only five QCA cells. MV gate has one output and three inputs. With the help of MV gate QCA AND & OR gate can also be implemented just by changing the polarity of third input [12], as shown in Fig. 3. Equations of these gates are,

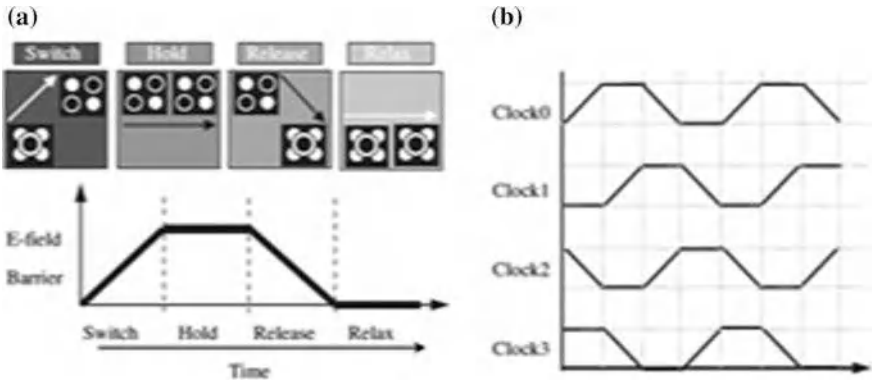

Fig. 2 QCA clock phases 1

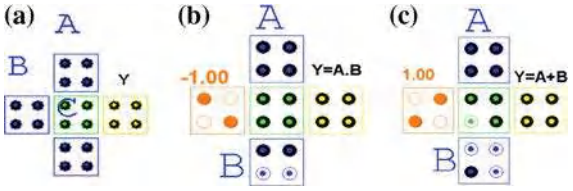

Fig. 3 **a** QCA MV gate; **b** QCA AND gate; **c** QCA OR gate

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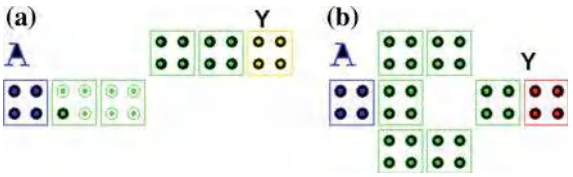

Fig. 4 **a** QCA based NOT gate with 45° rotated cell; **b** QCA based NOT gate

$$\text{MVGate:} \quad Y = \text{MV}(A, B, C) = AB + AC + BC;$$
$$\text{QCA AND Gate:} \quad Y = \text{MV}(A, B, 0) = A \text{ AND } B;$$
$$\text{QCA OR Gate: } Y = \text{MV}(A, B, 1) = A \text{ OR } B;$$

QCA based NOT gate can be implemented in two ways as in Fig. 4 [13]. Another important gate in QCA is the NOT gate. NOT gate is obtained with the help of QCA cell which is located 45° to a further QCA cell [14], Consider Fig. 4a, Y will have inverted value of input A. several methods are there to design the QCA inverter, one way of designing is given in Fig. 4b [12].

3 Reversible Logic Gates

Reversible gates are been deliberated since the 1960s [15]. The main motivation was that reversible logic gates dissipate a lesser amount of heat or ideally zero heat. In a typical gate, input binary combinations are lost, since little information is there in the output than that at the input. Any reversible logic gate ought to have the equal number of input and output bits [16]. Reversible calculation is achieved at a logical level by launching a one to one mapping among the input, output vectors in the circuit [17]. The quantity of energy dissipation in a device amplifies as the quantity of bits that are erased while computation increases [18]. Reversible operation in a device can be obtained if the device is comprised of reversible logic gates [19]. Various 3 × 3 reversible gates such as the Peres gate [20], Fredkin gate [21], and the Toffoli gate [22], are discussed in the previous work.

3.1 Toffoli Gate

The abbreviation of Toffoli Gate is TG. Size of TG is 3 × 3 [22] as given in Fig. 5a. The 3 × 3 Toffoli reversible gate gives fanout as 2 and quantum cost value

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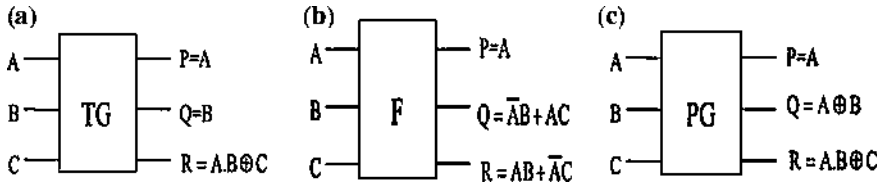

Fig. 5 Reversible Logic Gates **a** Toffoli; **b** Fredkin; **c** Peres

as 5, hence it is widely used gate. The quantum circuit of Toffoli gate is drawn using basic quantum circuits [18].

3.2 Fredkin Gate

Fredkin gate is widely used as it preserves the parity and hence it is also known as conservative as well as parity preserving gate [21]. Parity preserving gate is useful for fault finding thus anyone can design fault tolerant reversible circuit using Fredkin gate. Figure 5b gives the idea about Fredkin gate and it has 5 as a quantum cost.

3.3 Peres Gate

Figure 5c shows the Peres gate [20]. The Peres gate is drawn using two V+ gates, one CNOT gate and one V gate in the design. Peres gate's quantum cost is very less compared to other reversible logic gates.

4 Proposed Work

4 × 4 Reversible Multifunction Block [RMFB] is proposed in this paper. RMFB has four inputs and four outputs as shown in Fig. 6a; this block is capable of generating 13 functions as mentioned in Table 3.

Calculations for finding the value of quantum cost is done by making use of 1 × 1 and 2 × 2 quantum gates in the design [18]. Quantum cost of both the

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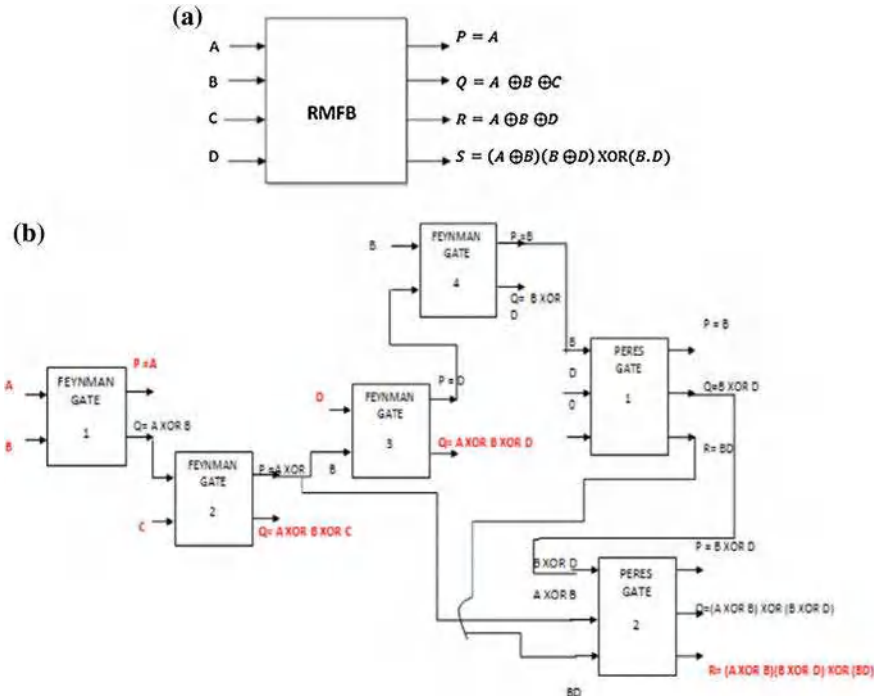

Fig. 6 **a** Block schematic of Reversible multifunction block. **b** Block schematic of reversible multifunction block using Feynman and Peres gates

reversible 1 × 1 and 2 × 2 gates are considered as one [23]. Circuit diagram of RMFB is shown in Fig. 6b

For the implementation of RMFB, 4 Feynman gates and 2 Peres gates are required. Feynman gate has Quantum cost as unity and 4 for Peres gate. Hence the quantum cost of RMFB is 1 + 1 + 1 + 1 + 4 + 4 = 12. By replacing the quantum correspondent of the entire gates and merging the circuit, Quantum cost will optimized to 8.

For the implementation of RMFB, 4 Coupled majority Voter Minority (CMVMIN) gates, 12 Majority Voter (MV) gates and 6 NOT gates are required, that is in total only 22 QCA gates are required for the implementation of all mentioned 13 functions. The quantum cost of RMFB is 8.

While drawing layout of QCA circuits, very important thing is the consideration of number of crossovers required for the design. For the logical schematic of RMFB shown in Fig. 7, the number of crossovers used is zero and the RMFB is known to

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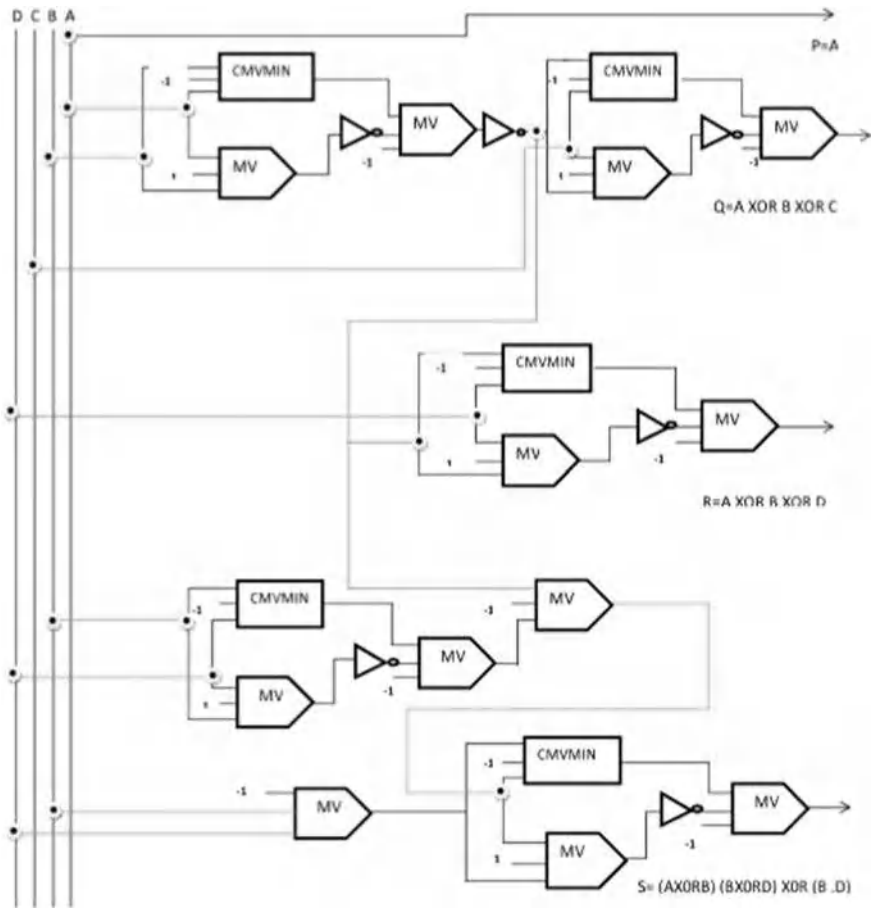

Fig. 7 Logical schematic of reversible multifunction block

be a single layered design. Truth table of Reversible Multifunction Block is as shown in Table 1. Inputs of RMFB are A, B, C, D and P, Q, R, S are the outputs. This block doesn't have information loss as all the input combinations are available at the output side and duplication of sequence is not there. If two RMFBs are connected in cascade, the same input combinations will be available on outputs A, B, C, D. In other words if outputs are considered as inputs, Block is capable to provide outputs where the inputs are located in the circuit. Hence the proposed

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Table 1 Input-output mapping of reversible multifunction block

S.N.	Inputs (4 bits) decimal	Outputs (4 bits) decimal
1	0	0
2	1	2
3	2	4
4	3	6
5	4	7
6	5	5
7	6	3
8	7	1
9	8	14
10	9	13
11	10	10
12	11	8
13	12	9
14	13	11
15	14	12
16	15	15

block is proved to be reversible and as it can perform multiple operations, it is known as multifunctional block.

5 Simulation Result

QCA based circuits and applications are simulated using QCADesigner version 2.0.3 [13].

Layout of Reversible multifunction Block is shown in Fig. 8. Instead of using multiple layers in QCADesigner tool, the use of 45° rotated cells are used with normal cells. As the number of layers increased the complexity of designing and manufacturing increases, so these 45° rotated cells are used for drawing the layout of RMFB.

In proposed reversible logic gate, four figure of merits i.e. various parameters of RMFB is studied as shown in Table 2.

Proposed 4 × 4 RMFB gate can perform total 13 functions. In reversible circuits or gate if the output is same as input, it is known as propagate. It can be use as a fanout. Hence propagate is not considered as a garbage output.

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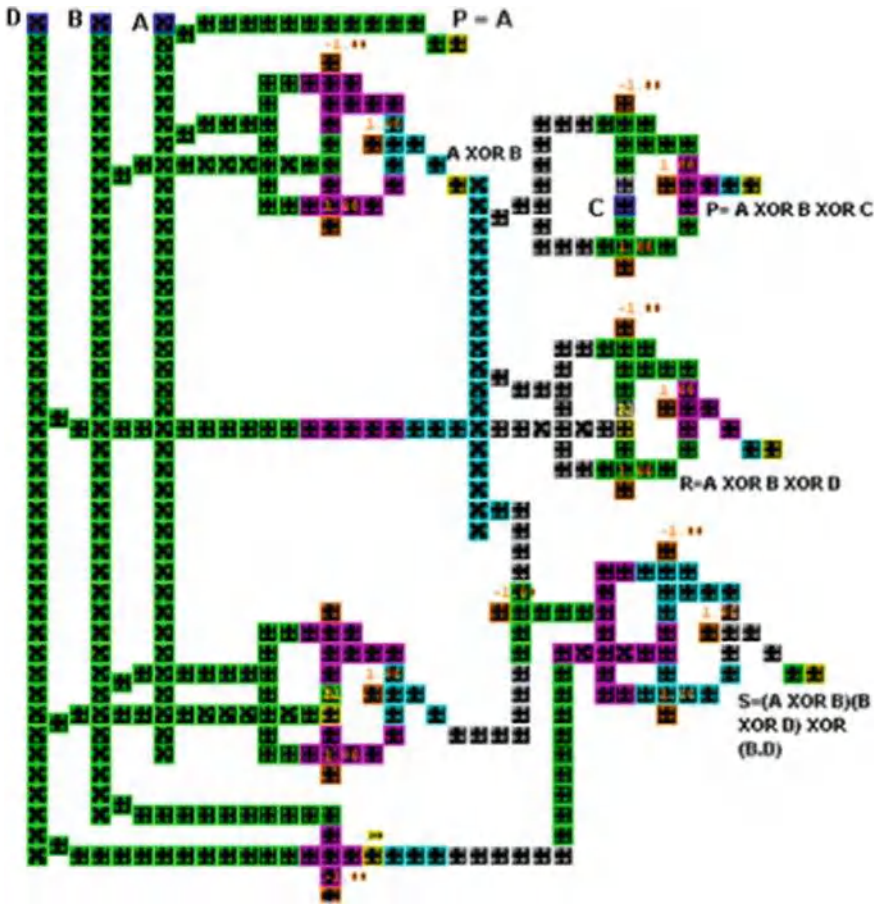

Fig. 8 Layout of reversible multifunction block

Table 2 Simulation parameters and figure of merits of reversible multifunction block

S.N.	Parameters	RMFB
1	Cell count (Complexity)	452
2	Latency (Delay)	1.75
3	Number of basic QCA Gates	22
4	Area	0.93 μm^2
5	Quantum cost	08
6	No. of quantum gates	06
7	Garbage output of RMFB using basic reversible gates	04
8	Constant input	01

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Table 3 Functional table of reversible multifunction block

S. No.	Function	Input conditions	Equation
1	OR	C = 0, D = 1	S = A + B
2	AND	B = C = 0, D = B [3]	S = A . B
3	XOR	C = 0, D = 1 [3]	$Q = A \oplus B$
4	XNOR	C = 0, D = 1 [3]	$R = A \odot B$
5	Complement/Negation	A = 0, B = 1, C = A, D = B	$Q = \bar{A}$ $R = \bar{B}$
6	Half adder	B = C=0, D = B	$R = A \oplus B$, S = A . B
7	Half subtractor	C = 1, D = 0	$R = A \oplus B$, $S = \bar{A}B$
8	Full adder	C = 0, D = C	$R = A \oplus B \oplus C$, $S = AB + AC + BC$
9	Full subtractor	C = 1, D = C	$R = A \oplus B \oplus C$, $S = \bar{A}B + \bar{A}C + BC$
10	Gray to binary Code converter	C = Don't care, D = C	P = A, $Q = A \oplus B$, $R = A \oplus B \oplus C$
11	Binary to gray Code converter	A = 0, B = B, C = A, D = C [3]	P = INPUT A, $Q = A \oplus B$, $R = B \oplus C$, S = B
12	Pass gate/buffer/ Fanout	B = A, C = B, D = C	P = A, Q = B, R = C, S = AC
13	Set, reset function	A = 0, B = 1, C = A, D = B	p = 0 S = 1

6 Conclusion

4 × 4 RMFB is proved to be efficient as discussed in Tables 2 and 3. Various parameters like total count of logic gates required and the number of garbage outputs while designing various digital applications are less. Quantum cost of proposed 4 × 4 reversible logic gate is only 8, which is very less in contrast to the previously presented 4 × 4 Reversible gates. Proposed design shows 66 % improvement in garbage output, 50 % improvement in the constant inputs. QCA layout of 4 × 4 RMFB is capable of performing total 13 functions. As shown in Table 2, for the implementation of 4 × 4 RMFB, area required is only 0.93 μm^2. This block is proved faster as its latency is 1.75. The reversible logic block and

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several applications and functions of the block is proposed in this block. Block is designed and implemented in this paper which outlines the basis for a reversible nature of Arithmetic Logic Unit of a quantum Nanoprocessors.

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Text-Independent Automatic Accent Identification System for Kannada Language

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Abstract Accent identification is one of the applications paid more attention in speech processing. A text-independent accent identification system is proposed using Gaussian mixture models (GMMs) for Kannada language. Spectral and prosodic features such as Mel-frequency cepstral coefficients (MFCCs), pitch, and energy are considered for the experimentation. The dataset is collected from three regions of Karnataka namely Mumbai Karnataka, Mysore Karnataka, and Karavali Karnataka having significant variations in accent. Experiments are conducted using 32 speech samples from each region where each clip is of one minute duration spoken by native speakers. The baseline system implemented using MFCC features found to achieve 76.7 % accuracy. From the results it is observed that the hybrid features improve the performance of the system by 3 %.

Keywords Speech processing · Dialect identification · MFCCs · Gaussian mixture models · Regional language processing

1 Introduction

Automated speech recognition (ASR) system recognizes dictation which involves the ability to match a voice pattern against already stored vocabulary. One of the main factors that impacts ASR systems is the accent. When a dialect is identified only in

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terms of pronunciation and prosody, the term accent may be preferable over dialect. Accent plays an important role in the classification of a speaker location, social class, and ethnicity. The dialect identification in Indian regional languages is a challenging task due to multilingual speakers across the country. Kannada is a language spoken in India, predominantly in the state of Karnataka along with the border regions of neighboring states such as Maharashtra, Tamil Nadu, Kerala, Andhra Pradesh, Goa, etc. Hence Kannada language have a dominant influence from these neighboring regions results in accent variation in these regions. Based on this Karnataka have different regions, namely, Mysore Karnataka, Mumbai Karnataka, Karavali Karnataka, and Southern Karnataka, where the language pronunciation properties are influenced by the other states. Even though Kannada is the official language of Karnataka; the accent, lexicon, and prosody of Kannada language varies across these regions.

The variation in accent affects the performance of speech recognition system as there is significant deviation in the pronunciation with respect to actual pronunciation. Hence results in degradation of the performance of the recognition. The regional influence in pronunciation may also affect nonnative language learning such as English, Hindi, etc. Where the pronunciation is affected by the substitution of native phoneme in place of actual phoneme or the actual phonemes are influenced by the native language phoneme. Hence accent identification is more essential in improving the performance of these systems. Based on the accent in pronunciation, it is very easy to identify the identity of a person and his/her native region. Hence this work aims at developing a model for accent identification in Kannada language.

This paper is organized as follows: Sect. 2 briefly outlines the literature in this area. Section 3 explains the proposed approach. The results are discussed in Sect. 4. Section 5 concludes the paper with some research directions.

2 Literature Survey

In recent years, automatic accent recognition and classification systems have become one of the popular research areas. Blackburnn et al. [1] proposed a text-dependent accent classification system for English language using continuous speech. Speakers are chosen from three regions having mother tongue Arabic, Chinese, and Australian, respectively. Hansen et al. [2] explored role of prosodic features in accent classification. Pitch contours and spectral structure for a sequence of accent sensitive words are considered as a feature. An accent sensitive database with four different accents is collected from American English speakers with the foreign accent. Accuracy reported for text-independent and text-dependent system is 81.5 and 88.9 %, respectively. Teixeira et al. [3] used parallel set of ergodic nets with context-independent hidden Markov models (HMMs) for accent classification in English language across six different European countries. The approach claimed 65.48 % accuracy. Hemakumar and Punitha [4] proposed text-dependent approach for speaker accent identification and isolated Kannada word recognition using Baum–Welch algorithm and Normal fit method. The average word recognition rate (WRR) claimed for known

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Kannada accent speaker is 95.5 % and unknown Kannada accent speaker is 90.86 %. Another HMM based text-dependent accent classification system classifies the native Australian and English speakers from migrant speakers with foreign accent [5]. The average accent classification accuracy reported are 85.3 and 76.6 % using HMM and HMM+LM, respectively.

Vieru et al. [6] employed machine learning techniques for the analysis of variation in the accent of French native speakers and migrated speakers. The French speech database is collected from the speakers of six different countries speaking French language: Arabic, English, German, Italian, Portuguese, and Spanish are considered for the experimentation. Hamid Behravan et al. proposed a hybrid approach for foreign accent identification in English language using phonetic and spectral features. The extracted speech features modeled with i-vector. The proposed hybrid approach found to outperform the spectral-based systems. Some of the approaches have used Gaussian Mixture Model (GMM) as a classifier for accent identification [7]. Lazaridis et al. [8] proposed an automatic accent identification system using a generative probabilistic framework classification based on GMMs with two different GMM-based algorithms; first is using Universal Background Model (UBM) and Maximum A Posteriori (MAP) and the second is i-vector modeling. Experiments are conducted on Swiss and French language. The accent dataset is collected from four different regions of Switzerland, i.e., Geneva (GE), Martigny (MA), Neuchatel (NE), and Nyon (NY). i-vector-based model is claimed to outperform baseline model. Accent identification systems is also evaluated on English language, other languages like Chinese, Japanese, Korean, and other foreign languages [9]. Accent identification on Indian regional languages such as Hindi, Tamil, Telugu, Punjabi, and Kannada are not explored much. Kumari et al. [10] proposed an accent identification system for Hindi language using MFCC features using hidden Markov model (HMM). An identification system for Telugu language implemented using prosodic and formant features [11]. The classification is performed using nearest neighborhood classifier. Experiments are conducted on speech samples recorded from Coastal Andhra, Rayalaseema, and Telangana regions of Andra Pradesh of India. The system is claimed to achieve 72 % accuracy. In acoustic phonetic-based accent identification system [12], the speech data collected from two regions of Karnataka, namely, South Karnataka often referred as Mysore Karnataka and Coastal Karnataka are used. Where speech recordings consist of 200 Kannada proverbs. HMM is used as a classifier. First and second formant frequencies extracted from vowel mid points are used as features for classification.

From the literature it is observed that most of the approaches are text dependent. These approaches do not consider the variations in the nature of the language due to accent. Also, a large number of word forms are inflected by Kannada language because of variation in accent. An inflected word starts with a root and may have several suffixes added to the right. Hence, it is difficult to consider all these variations for accent identification. In this paper, a text-independent accent identification system is proposed for the Kannada language.

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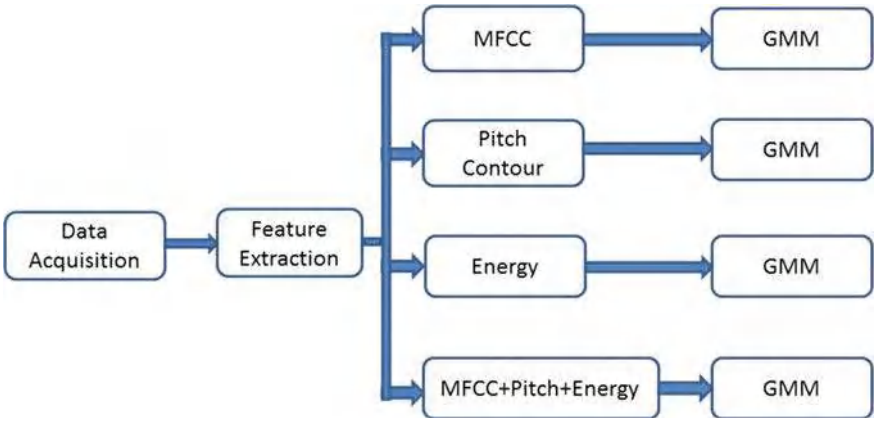

Fig. 1 Block diagram of accent identification system using GMM

3 Methodology

The proposed approach is divided into four steps as database collection, feature extraction, accent classification using GMMs as shown in Fig. 1.

3.1 Database

Accent classification study has been confined to sentences read by male, female, and child speakers from three different regions of Karnataka namely Mysore Karnataka, Mumbai Karnataka, and Karavali Karnataka (refer Table 1). For experimentation, natural database is required, hence the speech is recorded without the knowledge of the speakers. Recording such conversations is a very challenging task due to the background noise and other problem like superposition of voice of two different speakers talking simultaneously. For each region, data samples are collected from 32 speakers where each clip is of 1 min duration.

Table 1 Details of the database considered for accent classification

Sr. no	Region	Number of samples	Age range	Gender
1	Mysore Karnataka	32	15–70	Male, female
2	Mumbai Karnataka	32	10–45	Male, female
3	Karavali Karnataka	32	25–70	Male, female

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3.2 Feature Extraction

For the efficient implementation of any system, selection of proper features is an essential task. This section describes the features considered for the experimentation and their significance with respect to accent.

Mel-Frequency Cepstral Coefficient (MFCCs): MFCCs [13] are the most widely used features for the speech recognition. It mimics the human auditory system, i.e., it follows linear scale up to 1 KHz and logarithmic scale beyond it. The region of a person can be easily identified by listening to his/her speech, as there is a variation in the accent of people from different regions. Hence, MFCCs may represent the information in different accents and considered for the classification. 13 MFCC features are considered for the experimentation.

Following are the steps for the computation of MFCC Features:

1. Pre-emphasis: The goal of pre-emphasis is to amplify the high frequency formats and suppress the low frequency formats.
2. Frame blocking: The input speech signal is divided into frames of size 20–30 ms, as speech is assumed to be constant in this range.
3. Hamming windowing: In order to keep the continuity of the first and last frames, each frame is multiplied with a hamming window, i.e., $s(n) * w(n)$, where $s(n)$ is a signal frame and $w(n)$ denotes the hamming window. n varies from $n = 0, 1, 2, \ldots, N-1$,
4. Fast Fourier transform (FFT): The magnitude of frequency and frequency response of each frame is obtained using Fast Fourier Transform.
5. Triangular Bandpass filter: It is used to reduce the size of features involved in signal, and smooth the magnitude spectrum such that the harmonics are flattened to obtain the envelop of the spectrum with harmonics.
6. Discrete Cosine Transform (DCT): By applying DCT on the 20 log energy (E_k) obtained from the triangular bandpass filters to have K Mel-scale Cepstral Coefficients.
7. Log Energy: Log energy is the 13th feature of MFCC.

Energy: Short time energy [13] is one of the important characteristics of speech signal. The language spoken in different accents may reflect variation in the energy, hence it considered as a feature for accent detection. Formula for calculating energy $E(n)$ is given below:

$$E(n) = \sum_{m=-\infty}^{\infty} (s(m) * w(k-m))^2, \tag{1}$$

where $w(n)$ represent the windowing function and k is the shift in number of samples, $s(n)$ denotes the signal frame.

Pitch: Pitch is rate of vocal fold vibration and represents the fundamental frequency 'F0.' Pitch contains the speaker-specific information [13]. It may vary for

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the pronunciation of the same word in different accent of the language and may capture the accent specific information. Hence pitch is considered as a feature for the classification.

4 Results and Discussion

In this section, the results obtained using the MFCCs, energy, pitch, and combination of these features are presented. The database consists of samples recorded from native Kannada language speakers from three different regions, namely, Mumbai Karnataka, Mysore Karnataka, and Karavali Karnataka) (Refer Sect. 3). Gaussian mixture model(GMM) is used for accent classification. It is an unsupervised classification algorithm which does not require any transcriptions like supervised HMM, hence for text-independent accent identification system it is used as a classifier. Nineteen samples are considered for training the model, and 13 samples are used for testing from each region.

As MFCCs imitates the human auditory system, GMMs are trained to develop a baseline system using MFCCs. Table 1 shows the confusion matrix of classification using MFCC features. Out of 39 samples, 30 samples are correctly identified, hence achieves 76.7 % accuracy. Misclassification in each region is due to the variation in the speech of each speaker. Table 2 shows the confusion matrix of the accent classification using pitch feature. Out of 39 samples, 21 samples are correctly classified. The average accuracy achieved is 53.8 %. Table 3 shows the confusion matrix of classification using energy. Total 17 samples are correctly classified and the accuracy reported is 43.4 %.

From Tables 3 and 4, it is observed that Mysore Karnataka region accent is overlapped with Mumbai Karnataka and Karavali Karnataka region as speakers selected for recording from middle Karnataka usually interact with the people from both the

Table 2 Confusion matrix of the baseline system using MFCC features

	Mysore Karnataka	Mumbai Karnataka	Karavali Karnataka
Mysore Karnataka	9	2	2
Mumbai Karnataka	0	13	0
Karavali Karnataka	2	3	8

Table 3 Confusion matrix of the accent classification using pitch feature

	Mysore Karnataka	Mumbai Karnataka	Karavali Karnataka
Mysore Karnataka	9	3	1
Mumbai Karnataka	2	11	0
Karavali Karnataka	7	5	1

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Table 4 Confusion matrix of the accent classification using energy feature

	Mysore Karnataka	Mumbai Karnataka	Karavali Karnataka
Mysore Karnataka	7	4	2
Mumbai Karnataka	3	10	0
Karavali Karnataka	7	6	0

Table 5 Confusion matrix of the accent classification system using MFCCs + energy + pitch feature

	Mysore Karnataka	Mumbai Karnataka	Karavali Karnataka
Mysore Karnataka	9	2	2
Mumbai Karnataka	0	13	0
Karavali Karnataka	2	2	9

regions and have influence of these accent. It is observed that the recognition rate for Mumbai Karnataka accent is higher than other regions, as the energy and pitch of the speakers from these regions is higher than other two regions. The influence of Hindi and Marathi language in these region speakers (e.g., Mumbai Karnataka and middle Karnataka speakers pronounce plate as "taat" which is similar to Marathi language. In case of Mysore Karnataka the speakers from South Karnataka region pronounces plate as "tatte" which is similar to Karvali Karnataka). In Karavali Karnataka region, people speech have low energy and low pitch compared to other regions. It is also influenced by the local languages such as Tulu and Konkani. Hence, results in overlapping of the accent with other regions.

Table 5 shows the confusion matrix of classification using (13) MFCCs + (1) pitch + (1) energy features. The accuracy achieved is 79.5 % accuracy. It is observed that MFCCs achieves better results than pitch and energy features. Using hybrid features (MFCCs, pitch and energy) the accuracy is found to increase by 3 % as it captures the variation in the three regions of Karnataka.

5 Conclusion and Future Work

A text-independent accent classification system for Kannada language is proposed for regions, namely Mysore Karnataka, Mumbai Karnataka and Karavali Karnataka. MFCCs, energy, and pitch are considered as features. GMM is used as a classifier. The hybrid features have improved the accuracy of the classification by 3 %. There is a scope to evaluate the role of various spectral, prosodic, and excitation features in improving the classification accuracy. Also, this work can be extended for the identification of language like Havyaka Kannada in different regions of Karnataka. Such a study will not only enhance our knowledge of dialectal variations of Kannada, but also helps in developing an accent-based speech recognition systems.

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A Study on the Effect of Adaptive Boosting on Performance of Classifiers for Human Activity Recognition

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Abstract Nowadays, all smartphones are equipped with powerful multiple built-in sensors. People are carrying these "sensors" nearly all the time from morning to night before sleep as they carry the smartphone all the time. These smartphone allow the data to be collected through built-in sensors, especially the accelerometer and gyroscope give us several obvious advantages in the human activity recognition research as it allow the data to be collected anywhere and anytime. In this paper, we make use of publicly available dataset online and try to improve the classification accuracy by choosing the proper learning algorithm. The benchmark dataset considered for this work is acquired from the UCI Machine Learning Repository which is available in public domain. Our experiment indicates that combining AdaBoost.M1 algorithm with Random Forest, J.48 and Naive Bayes contributes to discriminating several common human activities improving the performance of Classifier. We found that using Adaboost.M1 with Random Forest, J.48 and Naive Bayes improves the overall accuracy. Particularly, Naive Bayes improves overall accuracy of 90.95 % with Adaboost.M1 from 79.89 % with simple Naive Bayes.

Keywords Human activity recognition (HAR) · Smartphone · Sensor · Accelerometer · Gyroscope

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1 Introduction

Human activity recognition is active research area since last two decades. Image- and video-based human activity recognition has been studied for a long time [1]. Nowadays, all smartphones are equipped with powerful multiple built-in sensors. People are carrying these "sensors" nearly all the time from morning to night before sleep as they carry the smartphone all the time. These smartphones allow the data to be collected through built-in sensors, especially the accelerometer and gyroscope give us several obvious advantages in the human activity recognition research as it allows the data to be collected anywhere and anytime. Increasingly powerful mobile phones, with built-in sensors such as accelerometer, gyroscope, microphone, GPS, Bluetooth, camera, etc., smartphone becomes sensing platform [2]. The information about mobile device and user activity, environment, other devices, location and time can be utilized in different situations to enhance the interaction between the user and the device [3]. Human activity has enabled applications in various areas in health care, security, entertainment, personal fitness, senior care, and daily activities [4]. Smartphone allows us to collect real data from real-world daily activities. Lab controlled data is not that represent the real world daily activities. The rest of the paper is organized as follows: Sect. 2 talks about the related work done by the earlier researchers. Section 3 emphasizes on the data collection. Section 4 presents the main approach we have utilized in the learning process. This section describes the performance matrix used to present our results. Section 6 presents and discusses our simulation results. Finally, we conclude our work in Sect. 7.

2 Related Work

In this section, we briefly describe the related literature. While studying the related literature within past few decades, many significant research literatures have been contributed, proposing and investigating various methodologies for human activity recognition such as from video sequences, from on body wearable sensors data or from sensors data on mobile device.

Human activity recognition is an active research area since last two decades. Image- and video-based human activity recognition has been studied since a long time [5]. Human activity recognition through environmental sensors is one of the promising approaches. In this approach, it uses motion sensors, door sensors, RFID tags, and video cameras, etc., to recognize human activities. This method provides high recognition rate of human activity and can be more effective in indoor environments (i.e., smart home, hospital and office), but requires costly infrastructure [6, 7]. In another approach, multiple sensors wear on human body which uses human activity recognition. This approach has also proved to be effective sensors for human activity recognition [5]. But this type of sensing has drawbacks that user has to wear lot of sensors on his body.

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In the literature, extensive study also found on the approach in which available smart mobile devices used to collect data for activity recognition and adapt the interfaces to provide better usability experience to mobile users. We found few similar studies to the one proposed in the paper [8, 9]. Mobile device becomes an attractive platform for activity recognition because they offer a number of advantages including not requiring any additional equipment for data collection or computing. These devices saturate modern culture, they continue to grow in functionality increasing security and privacy issues [10].

3 Data Collection

In the proposed research work, we have molded a context recognition problem as a six class classification problem. The benchmark dataset considered for this work is acquired from the UCI machine learning repository which is available in public domain [11]. In this dataset, the accelerometer and gyroscope sensor recordings are available for six human activities. The six activities are: walking, sitting, standing, stair-up, stair-down, and lying. After surveying the extensive literature, the methodology is adopted for the system. The system consists of acquisition, preprocessing, feature extraction, feature selection, classification, knowledge base, inference engine, action base, and finally user interface adaptation.

The feature extraction, we have used are statistical and transformed based features extracted. The Classifier is designed with the help of Adaboost.M1 with J.48, Naive Bayes and Random Forest.

3.1 Benchmark Dataset

The benchmark dataset considered for this work is acquired from the UCI machine learning repository which is available in public domain [11]. This dataset is recorded with the help of accelerometer and gyroscope sensors. In this dataset, the experiments were performed with 30 subjects. Each subject wore a smartphone on the waist and performed six activities. Six activities are: walking, sitting, standing, stair-up, stair-down, and lying. With the sampling rate of 50 Hz, the raw data from built-in 3-axial accelerometer and gyroscope were captured. In each record of the dataset following attributes are included:

- Total acceleration from the 3-axis accelerometer and the estimated body acceleration.
- Angular velocity from the 3-axis gyroscope.
- Total 561 features generated from raw data in time and frequency domain.
- Label for corresponding activity

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Table 1 Summary of features extraction methods used for accelerometer and gyroscope signals

Group	Methods
Time domain	Mean, SD, MAD, Max, Min, SMA, Energy, Entropy, IQR, Auto regression coefficient, Correlation, Linear acceleration, Angular velocity, Kurtosis, Skewness,
Frequency domain	FFT, mean frequency, index of frequency component with largest magnitude

1. Features are normalized and bounded within [−1,1].
2. Each row is representing feature vector.
3. The unit for acceleration is m/seg2.
4. The gyroscope unit is rad/seg.

3.2 Feature Extraction

The features selected for this dataset come from raw data captured from the accelerometer and gyroscope raw signals. These 3-axial raw signals are time domain signals prefix 't' to denote time. Before selecting features, raw sensor signals were preprocessed by using a median filter and a third-order low pass Butterworth filter to remove noise. Another low pass Butterworth filter with a corner frequency of 0.3 Hz had been used to separate body and gravity acceleration signals from the acceleration signal. Finally, frequency domain signals were obtained by applying a fast Fourier transform (FFT) [11]. To get feature vector for each pattern, these time domain and frequency domain signals were used. The set of variables that were estimated from these signals are shown in Table 1.

4 Classification

The AdaBoost Algo is shown in Fig. 1.

4.1 Adaboost.M1

How to improve the overall accuracy of any learning algorithm will be always an issue of research in soft computing. Boosting is a general technique for improving the accuracy of any learning algorithm [12]. Freund and Schapire [12] introduced adaptive boosting (Adaboost) first time in which boosting is to iteratively learn weak classifiers that focus on different subsets of the training data and combine these into one strong classifier. In Weka Adaboost.M1 is implemented.

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Algorithm AdaBoost.M1

Input: Sequence of N examples $\langle (x_1, y_1) .. (x_N, y_N) \rangle$ with labels $y_i \in Y = \{1, ...k\}$

distribution D over the N examples
weak learning algorithm **Weak Learn**

integer T specifying number of iterations

initialize the weight vector: $D_t(i) = 1/m$ for all i.

Do for t= 1,2,..,T

1. Call **Weak Learn**, providing with it the distribution D_t

2. Get back a hypothesis $h_t : X \to Y$.

3. Calculate the error of $h_t : \varepsilon_t = \sum_{i:h_t(x_i) \neq y_i} D_t(i)$. if $\varepsilon_t > 1/2$, then set T = t-1 and abort loop.

4. Set $\beta_t = \varepsilon_t / (1 - \varepsilon_t)$

5. Update distribution $D_t : D_{t+1}(i) = \frac{D_t(i)}{Z_t} \times \begin{cases} \beta_t & \text{if } h_i(x_i) = y_i \\ 1 & \text{Otherwise} \end{cases}$

where Zt is normalization constant chosen so that D_{t+1} will be distribution

Output the hypothesis:

$$h_{fin}(x) = \arg\max_{y \in Y} \sum_{t:h_t(x)} \log \frac{1}{\beta_t}$$

Fig. 1 A first multiclass extension of AdaBoost.M1 [12]

5 Performance Measures

To assess the neural network performance the following performance measures are used.

5.1 Confusion Matrices

The most common way to express classification accuracy is the confusion matrix which is used to display the percentage of accuracy of classification. In the confusion matrix, rows indicate desired or actual classification and columns indicate predicted classifications. Figure 2 shows the confusion matrix for two-class classification problem.

Fig. 2 Sample confusion matrix

True Positive	False Positive
False Negative	True Negative

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5.2 Overall Accuracy

To access the performance of classifier, the overall accuracy is the important measure. It is the ratio between the total number of correctly classified instances and the overall test set. This is a more informative measure.

$$\text{Accuracy} = \frac{\text{TruePositive} + \text{TrueNegative}}{\text{TruePositive} + \text{TrueNegative} + \text{FalsePositive} + \text{FalseNegative}} \quad (1)$$

5.3 Precision

It is the ratio between correctly classified instances to the total number of positive instances.

$$\text{precision} = \frac{\text{TruePositive}}{\text{TruePositive} + \text{FalsePositive}} \quad (2)$$

6 Experiment Results

Finally we used Weka tool to evaluate the performance of the classifiers. Activity recognition on these features was performed using the J.48, Random Forest and Naive Bayes classifiers. Classifier were trained and tested with tenfold cross validation. The confusion matrix was shown in Tables 2 and 3 of NaiveBayes classifier without Adaboost and with Adaboost.M1, respectively.

Tables 2 and 3 show that the misclassification rate was reduced drastically in case Adaboost.M1 with NaiveBayes. So boosting helps to reduce the error and improve the classification performance.

Tables 4 and 5 for J.48 Classifier without and with Adaboost.M1. Similarly, Tables 6 and 7 show the confusion matrix for Random Forest without and with Adaboost.M1 (Table 8).

Table 2 Confusion matrix for NaiveBayes

Output/desired	1	2	3	4	5	6
1	**1250**	283	189	0	0	0
2	37	**1395**	112	0	0	0
3	96	244	**1066**	0	0	0
4	0	25	0	**1575**	143	34
5	2	33	0	1202	**643**	26
6	0	16	1	143	0	**1784**

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Table 3 Confusion Matrix for Naive Bayes with Adaboost.M1

Output/desired	1	2	3	4	5	6
1	**1625**	52	45	0	0	0
2	1	**1521**	11	0	0	0
3	12	41	**1353**	0	0	0
4	0	4	0	**1465**	281	27
5	4	11	0	423	**1460**	8
6	0	1	0	0	0	**1943**

Table 4 Confusion Matrix for J.48

Output/desired	1	2	3	4	5	6
1	**1638**	52	31	0	1	0
2	59	**1440**	45	0	0	0
3	35	54	**1317**	0	0	0
4	0	1	0	**1636**	140	0
5	0	1	0	142	**1763**	0
6	0	0	0	1	0	**1943**

Table 5 Confusion Matrix for J.48 with Adaboost.M1

Output/desired	1	2	3	4	5	6
1	**1704**	9	9	0	0	0
2	7	**1527**	9	0	1	0
3	2	17	**1387**	0	0	0
4	0	1	0	**1686**	90	0
5	0	0	0	67	**1839**	0
6	0	0	0	1	0	**1943**

Table 6 Confusion Matrix for Random Forest

Output/desired	1	2	3	4	5	6
1	**1704**	11	7	0	0	0
2	6	**1524**	14	0	0	0
3	7	25	**1374**	0	0	0
4	0	1	0	**1703**	72	1
5	0	0	0	60	**1846**	0
6	0	1	0	0	0	**1943**

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Table 7 Confusion Matrix for Random Forest with Adaboost.M1

Output/desired	1	2	3	4	5	6
1	**1706**	7	9	0	0	0
2	3	**1529**	12	0	0	0
3	10	27	**1369**	0	0	0
4	0	1	0	**1703**	71	2
5	0	0	0	57	**1849**	0
6	0	1	0	0	0	**1943**

Table 8 Summary of classifier performance with Adaboost.M1

	RF	RF with Adaboost	J.48	J,48 with Adaboost	NB	NB with Adaboost
% Accuracy	98.01%	98.06%	94.54 %	97.93%	74.89%	90.95%
Kappa statistic	0.9761	0.9766	0.9344	0.9751	0.6987	0.8912
MAE	0.047	0.0466	0.0191	0.0069	0.0836	0.0431
RMSE	0.1056	0.1053	0.1328	0.0778	0.2876	0.1503
RAE (%)	16.95	16.83	6.90	2.48	30.18	15.56
RASE (%)	28.38	28.29	35.69	20.90	77.26	40.39
Coverage (%)	100	100	95.07	98.64	75.72	98.79
MRRS (%)	30.53	30.41	17.01	16.90	16.94	22.28
Total instances	10299	10299	10299	10299	10299	10299
Time taken	13.24	13.25	210	241	1.08	179.8

It was observed from the confusion matrix shown in Tables 4, 5, 6, and 7 that with the Adaboost.M1, misclassifications have reduced. Root mean square error also reduced in case of J.48 and Naive Bayes and percentage of accuracy as shown in Figs. 3 and 4, respectively.

In this paper, we have performed experiment with three classifiers. As shown in Fig. 4 and Table 9, we have received overall accuracy of 74.89 % with Naive-Bayes, 94.54 % overall accuracy with J.48, a decision tee classifier. With random forest, we have received overall accuracy of 98.01 %, random forest. While using adaptive boosting meta-classifier available in Weka tool, we have received overall accuracy of 90.98 % of Adaboost.M1. meta classifier with NaiveBayes. The overall accuracy of 97.93 % from Adaboost.M1 with J.48 decision tree. There is no much improvement of using adaboost.M1 with random forest where we received overall accuracy of 98.06 %. While comparing our results with the existing state of arts, Sharma et al. [13] achieved 84 % overall accuracy using neural network on data from a triaxial accelerometer sensor. Ronao and Cho received overall accuracy of 91.76 % by using two-stage continuous hidden Marko Model (CHMM) approach to recognize human activity using accelerometer and gyroscope sensory data collected

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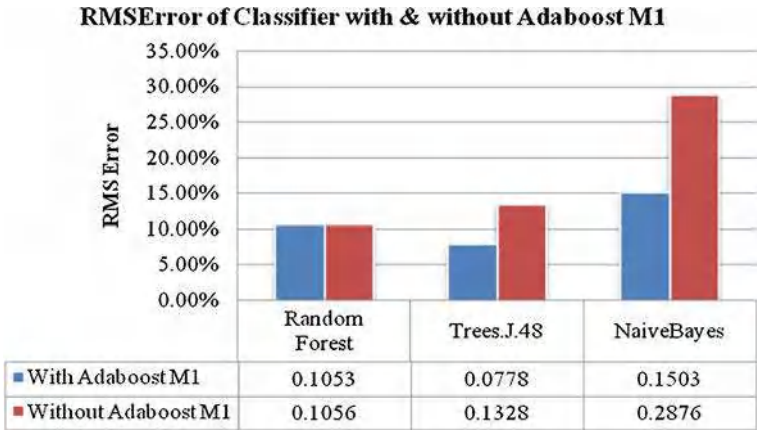

Fig. 3 of Accuracy of classifiers with and without Adaboost.M1

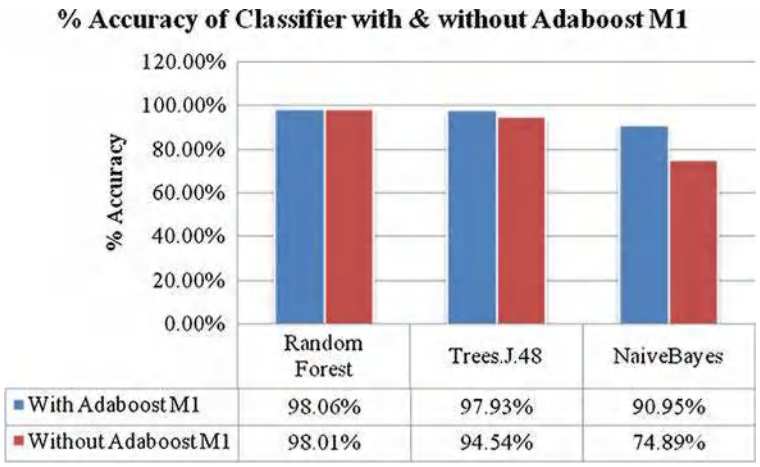

Fig. 4 % of Accuracy of classifiers with and without Adaboost.M1

through smartphone [14]. Anguita et al. [15] achieved an overall accuracy of 96 % for classification of six activities of daily living using the multiclass SVM (MC-SVM). Hanai et al. [16] obtained a recognition performance of 93.9 % for classifying five activities of daily living from data of chest-mounted accelerometer.

Table 9 Summary of classifier performance using experimenter in Weka

Random Forest	Adaboost.M1 with RF	J.48	Adaboost.M1 with J.48	Naive Bayes	Adaboost.M1 with NB
98.05	98.05v	94.40v	97.97v	75.02*	90.95
(v//*)	(0/0/1)	(0/0/1)	(1/0/0)	(1/0/0)	(1/0/0)

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Karantonis et al. [17] developed a system to collect data using waist-mounted triaxial accelerometer. They received over-all accuracy of 90.8 % on data collected by this system from six volunteers for the classification of twelve activities of daily living (ADL).

7 Conclusion

This paper presents the experimental work of Adaboost.M1 on the UCI HAR dataset for smartphone-based human activity recognition. Overall accuracy of Adaboost.M1 has been compared with others classifiers. We found that using Adaboost.M1 with Random Forest, J.48 and Naive Bayes improves the overall accuracy. Particularly, Naive Bays improves an overall accuracy of 90.95 % with Adaboost.M1 from 79.89 % with simple Naive Bayes. We found that AdaBoost.M1 algorithm with Random Forest, J.48 and Naive Bayes contributes to discriminating several common human activities improving the performance of Classifier.

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Toward Improved Performance of Emotion Detection: Multimodal Approach

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Abstract Emotion detection currently is found to be an important and interesting part of speech analysis. The analysis can be done by selection of an effective parameter or by combination of a number of parameters to gain higher accuracy level. Definitely selection of a number of parameters together will provide a reliable solution for getting higher level of accuracy than that of for the single parameter. Energy, MFCCs, pitch values, timbre, and vocal tract frequencies are found to be effective parameters with which detection accuracy can be improved. It is observed that results with the language are proportional with results with other languages indicating that language will be an independent parameter for emotion detection. Similarly, by addition of an effective classifier like neural network can further yield the recognition accuracy nearly to 100 %. The work attempts to interpret the fact that combining the results of each parameter has improved detection accuracy.

Keywords Feature extraction · Combination · Energy · Pitch · MFCC · Emotion detection

1 Introduction

Speech processing can be divided as speaker identification, speech recognition, and emotion detection [1]. Emotion detection is the part of speech processing in which information about the emotional content of the speaker can be retrieved. The emotional analysis will be helpful for getting the psychological condition of the

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person who is speaking. Knowing the same, one can communicate more effectively than that of, without knowing the same. It can also lead to an effective communication between man and machine if the machine is capable of understanding the emotions of the person in interaction. Speech recognition can find the exact words spoken by the person [2]. It needs a huge vocabulary which will help for getting the exact words being spoken. Emotion detection will not need such a vocabulary set but will need the threshold levels of range of values of some advanced parameters like MFCCs, energy, duration which can be framed for a certain emotion like happy, angry, sad, neutral, fear, or surprised.

Here some of hidden parameters like MFCCs, timbre, etc., can be found more important than that of the spoken words. The research work for adding emotions to a neutrally spoken speech sentence or removing emotions from sentence with emotion is an example of application of emotion detection. A spoken paragraph in happy emotion can be converted into neutral type or that neutral type can be converted to fear type of emotion content. Emotion detection may also be useful for knowing the psychological condition of the called person with which a company representative would like to communicate for business deal. This is possible only by knowledge about compressing, expanding, or changing attributes or specific parameters for the required change [3].

For the similar type of work with increased accuracy, emotion detection can be considered to be a basic step. The task can be completed with the knowledge of a single or by using a number of parameters together. Definitely, the detection accuracy will be higher if a number of parameters are selected for detection. For instance if energy content is the only parameter under selection, conflicts will be more as higher energy will be indication for happy, surprised, or angry emotions. If two or more parameters are selected for detection, a firm decision can be taken for exact emotion to be detected by virtue of different threshold levels of different parameters under observation. As different parameters will provide information in respective angle, the combination will give rise to higher accuracy. For detection of emotion, there is need of some effective parameters like energy, formant frequencies, vocal tract frequencies, MFCCs, pitch levels, timbre, duration, etc., that can provide efficient information about emotions from speech files. The work presented here is by use of database with one of the Indian language Marathi of 1200 speech files recorded by male and female professional actors for six different emotions happy, angry, neutral, sad, fear, and surprised. In near future, it may also lead to designing a system with capability to work by understanding human emotions.

Emotion detection is found to have increased accuracy level due to a number of factors. The job can be accomplished using image signal, speech signal, or the combination of both for better accuracy level [4]. In image processing, there is minimum scope for work under hidden parameters. The detection will be concentrated on observable parameters. This is not the case with speech signal. Speech signals consist of some additional information apart from the spoken information. Detection of emotion using speech is carried out specifically by retrieval of hidden information using advanced parameters as discussed above. Recently, considerable attention has been drawn by automated emotion detection with human speech and

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has found huge range of applications. The maximum work of emotion detection is carried over for number of languages like U. S. English, German, and so on, but a very less work is seen on Indian languages. Here, the language under study is Marathi as one of the Indian language. The language under study, i.e., Marathi is found to be the nearest language to south zone consisting of the languages from Dravidian family and can be grouped with Panjabi, Gujarati, and Hindi when grouping Indian languages using machine learning techniques [5]. Out of a number of Indian languages, Marathi is the language which has a special feature observed that, the language differs much by a distance of 20 km. It is also found to have a flexibility on language with a variety of tones and intensities. It can be added here that the language changes the meaning of a single sentence by adding a small pressure on a specific word.

2 Collection of Speech Samples

The database is one of the most important parts of the overall task. For the analysis here, a team of professional actor and actress was defined who have worked on effective emotions in Marathi. A database of 1200 audio files from male and female professional actor and actress is derived and has created 100 speech emotion files of male and female, for six emotions under study, i.e., happy, angry, sad, surprised, fear, and neutral. These speech files are of the duration 3–5 s. The voice segments are recorded in mp3 as well as wave file. The sampling rate is 44100 Hz, with stereo channel and bit rate of 128 kbps.

The reason behind forming such a database is clear that—the strength of database for different emotions will give rise to higher level of accuracy as if speech signal of sad signal may also indicate neutral or fear emotion [6] [7].

Different emotions are created with male and female professional actors and actress and emotions of six types, viz., happy, angry, sad, fear, surprise, and neutral are considered for analysis. The strength and naturalness of the emotions define the accuracy of the system [8].

The summary of implementation done is

1. Preprocessing: the conversion of a single speech input into pair wise speech blocks, noise reduction, and speech splitting.
2. Segmentation—the audio segmentation algorithm employed for splitting input audio into samples ready to be processed.
3. Feature selection: Introduces feature selection algorithm used to reduce number of features.
4. Feature extraction: MFCC, pitch, and energy and vocal tract frequency

The detection of emotion from speech recorded is accomplished by this stage gives features extracted.

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Front-end interface: Describes the implementation decisions for the front-end interface for visualizing the output.

Training and classification stage.

2.1 Algorithms in Work Done

The algorithm for the program consists of following stages:

1. Input audio/speech file as input
2. Retrieve effective parameters
3. Calculate MFCC, energy, VT frequency, and pitch value.
4. Store all values in excel sheet format.
5. Define logic to classify emotion
6. Indicate emotion effectively using defined logic.

3 Parametric Analysis

The design can be initiated by the selection of parameters, analyzing their results for different emotions and threshold selection of these parameters effectively so as to get correct level of accuracy in Marathi, which is the language under study. By coding, a set of comparative results can be obtained for different emotions like happy, anger, sad, neutral, etc. [9]. Threshold selection is range definition of minimum and maximum values for any specific parameter under selection. Initially, number of parameters can be considered for analysis of emotion detection like formant frequencies, loudness, timber, etc. Out of these, some of the parameters can be selected for further analysis found to be the effective for emotion detection by results of the analysis. It forms the basis of the good recognition accuracy for emotion detection for any language [10]. Most of the work seen yet today on emotion detection is found to have results derived by a single efficient parameter like MFCC, Pitch, formants, etc. Those systems are found to have an accuracy level up to 70–80 %. The concept of blending or fusion of results of the effective parameters is planned here for getting higher level of accuracy. By scaling of the results of these parameters, the most effective parameter can be scaled higher and the least with least value. Surely it will give rise to an accuracy level above 95 % approaching toward maximum level of accuracy.

The work can be said to help or reference for any other languages also because language is found to have independent over the emotions generated or detected. This is because; any emotion generated in any language may have similar emotion levels for a number of effective parameters. For instance, for angry emotion or sad emotion, though words are different but the energy levels, Pitch values, and similar parameters will be proportional which are the points of our interest here for emotion

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detection [11]. To get higher level of recognition accuracy, energy, MFCC, and pitch can be fused together. The database formed consists of emotion files of happy, angry, sad, fear surprise, and neutral. Using parameters like Pitch, energy, formant frequencies, speech rate, MFCC and similar, performance of system will increase in terms of accuracy of emotion detection and system will provide higher efficiency. Classifier selection is one of the important tasks. By calculating speech parameters, corresponding results can be provided to the classifier [12]. The database formed extracted feature set and classifier defines the accuracy and effectiveness of the system.

Starting with about 10 parameters, we have concluded to use four effective parameters, viz., energy, Pitch, and MFCC features for detection of emotion. These parameters are found to have good accuracy levels in comparison with other parameters. The strength and the effectiveness of emotions of recorded audio files to be given as input are the main important points for higher level of accuracy as only these files will provide the source input of emotions to be detected. Effectiveness in emotions from audio files will give rise to higher efficiency of system.

4 Comparison of Results

Results of the feature extraction are visualized as

4.1 Vocal Tract Frequency

The results of vocal tract frequencies as shown are as below indicating the emotions with discriminating vocal tract frequencies (Fig 1).

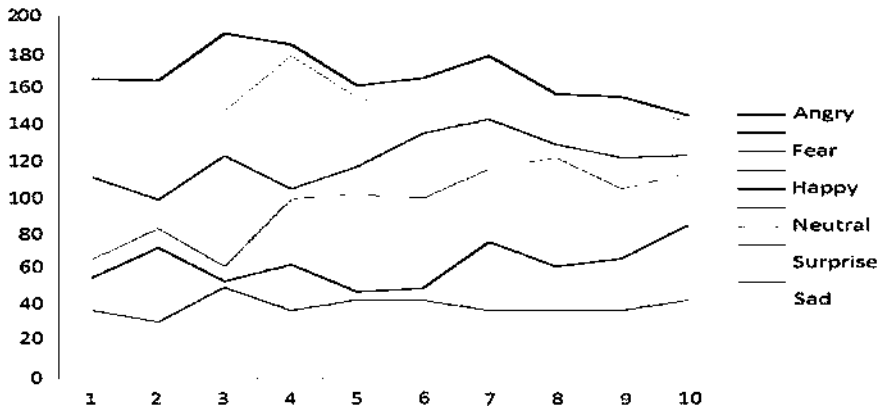

Fig. 1 Graph of vocal tract frequency values for different emotions with emotion files on horizontal axis

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The overview of statistical study of analysis indicates that emotions can be found to have distinct values with respect to other emotions in concern with a specific parameter like energy. Mean, variance, and deviation can be found to have a clear distinction for emotions under study.

4.2 Pitch

Basically pitch can be defined as the frequency sensation. Pitch can only be determined in sounds that have a frequency that is stable and clear to separate it from noise. For a sound wave, a lower frequency wave is low pitch wave and higher frequency sound indicates a high pitch wave. Considering loudness, timber, and duration, the major auditory attribute is pitch. Semitones correlate linearly to human's "perceived pitch."

$$\text{Semitone} = 69 + 12\log_2(\text{frequency}/440)$$

For females, the range of pitch values is 100–1000 Hz or 40–80 semitones where as for males, its 60–520 Hz or 30–70 semitones. The human ear has the capability to recognize pitch values and related frequency of the audio signal as longitudinal signals develop variations in pressure at a specific frequency. The frequency of audio signal entering the human ear provides its capability to perceive the pitch value associated with frequency. Figure 2 indicates the ranges of pitch values for different emotions expressing that different emotions will have a spectrum of pitch values. With the frames of speech, recording of the bandwidth and first five formants can be done. Emotional extraction can be done successfully by using formants. To model the change in the vocal tract shape, tracking formants over time can be used.

4.3 Energy

Any of the speech signals can be divided as silence region, unvoiced, and voiced regions. Naturally, silence region and unvoiced region will be consisting of minimum energy and voiced region will have considerable amount of energy. Also it will be a variable with respect to time. Therefore the extent of variation with time is the interesting part of automatic speech processing. Energy associated with short term region of speech is given as

$$\text{Energy} = 20\log_{10}\left(\text{Sum}\left(\text{abs}(y_1)^2\right)\right)$$

where y_1 indicates the correlation of the energy function.

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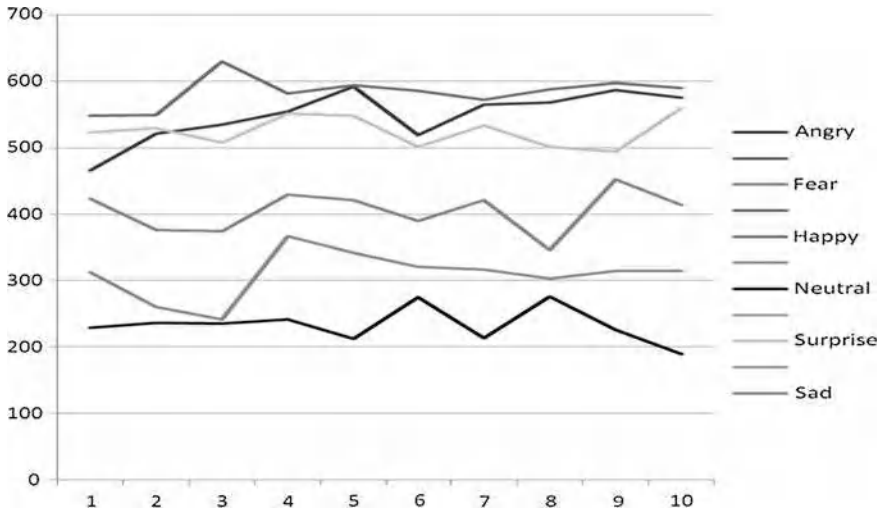

Fig. 2 Graph of pitch values for different emotions with emotion files on horizontal axis

Total energy relation for signal processing as indicated in Fig. 3 provides the relation for finding short time energy. The relation for finding the short term energy can be derived from the total energy relation defined in signal processing as indicated in Fig. 3. For voiced, unvoiced, and silence classification of speech, short term energy can be used.

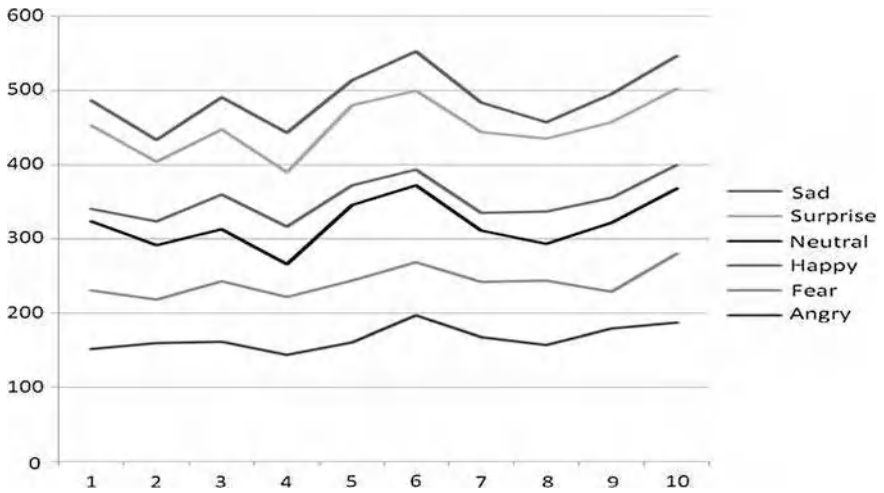

Fig. 3 Graph of energy values for different emotions with emotion files on horizontal axis

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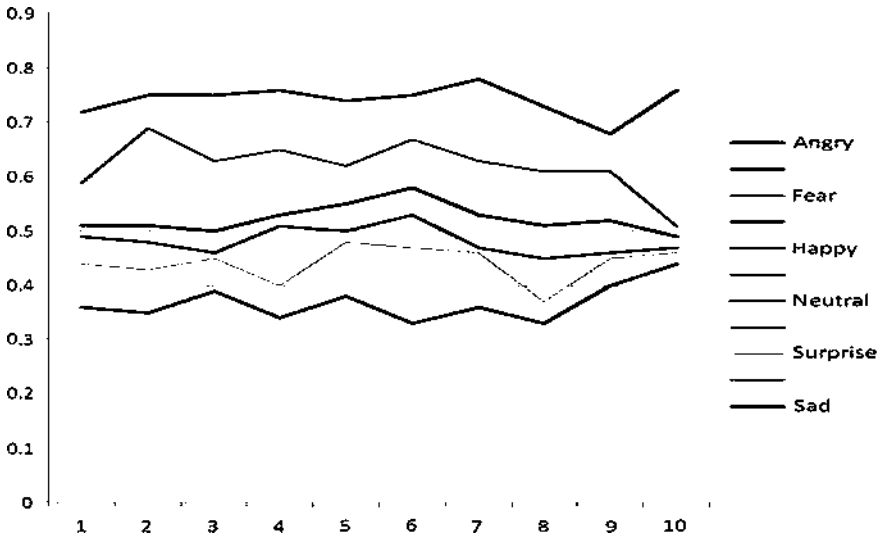

Fig. 4 Graph of MFCC values for different emotions with emotion files on horizontal axis

4.4 MFCC

These model the spectral energy distribution in a perceptually meaningful way, are widely used acoustic feature for speech recognition, speaker recognition, emotion detection, and audio classification. MFCC takes into account a band of frequencies and log power magnitudes of the human auditory system. The unique parameters of phonetics in speech can be captured using the subjective pitch on Mel-frequency scale. A log scale above 1 kHz and linearly spaced at low frequency, are the two types of filters for MFCC.

As MFCC depends on perceptions of hearing that cannot perceive above 1 kHz, the performance of this part is important for next phase as its behavior is affected. It indicates that MFCC is based on changes with frequency of critical bandwidth of human ears. For getting fine detection accuracy, separation of best parametric representation of acoustic signals is the important task. As the scale is based on comparison of pitch, the word Mel is derived from the word melody. The results of classification are shown as in Fig. 4.

The table shows the comparison of selected parameters for different emotions under study which is the basis of comparison of the emotions.

		Anger	Happy	Neutral	Sad	Surprise	Fear
VT. Fr	Min	55	40	30	42	75	40
	Max	190	205	125	155	180	155
Pitch	Min	335	325	225	260	290	145

(continued)

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(continued)

		Anger	Happy	Neutral	Sad	Surprise	Fear
	Max	600	590	650	445	560	725
MFCC	Min	0.55	0.25	0.35	0.42	0.4	0.5
	Max	0.8	0.58	0.56	0.58	0.62	0.7
Energy	Min	125	65	-55	50	110	55
	Max	200	130	35	115	145	140

The decibels of 40 db above the perceptual hearing threshold are defined as 1000 Mels, as a reference point the pitch of a 1 kHz tone. We can use the equation below, to compute the Mels for a given frequency in Hz.

$$\mathrm{Mel(F)} = 2595 \times \log 10(1 + \mathrm{f}/700)$$

Mel scale is used for measurement of subjective pitch and Hertz is the unit for measurement of actual frequency. A continuous speech signal is transformed in frequency domain after windowing, the logarithm of the Mel spectrum after inverse transform provides MFCC that are utilized here for classification of emotions.

Now, the logarithmic Mel-frequencies can be converted back to time. The result is called MFFC. These coefficients of the audio signal can provide a fine output for spectral properties of the analysis of selected frame as the coefficients are real numbers. By the use of direct cosine transform, these features can be converted to time domain [13]. Matching of patterns and signal modeling are the fundamental operations performed by emotion detection. Speech signal is converted into a set of parameters, is represented by signal modeling whereas the task of selecting the correct parameter from the database that approximately matches with the input pattern is called as pattern matching. The emotional content of the speaker, i.e., aspects of behavior from audio signal can be categorized after these two operations.

Different values of parameters like energy, formant frequencies, etc., provide ranges so that we can correlate them for getting higher accuracies for detection of emotions. For, e.g., if happy emotion indicates a specific range of values, it can be used as the general range for detecting happy emotion from unknown signal. Different threshold values can be defined to assign the specific range of values for a particular parameter.

5 Discussion

The design part is started with the calculation of energy levels, pitch values, MFCCs, and vocal tract frequencies. Parameters have been retrieved with the help of efficient programming. Collection of these values provides the range of values for a particular emotion for specific parameter. These ranges have provided the path

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forward for classification of different emotions. The basic of the whole research part is to be utilized for further processing. One can easily find here that any specific parameter is having different values of it but possess a specific range which can be utilized for detection of emotion. That is, for energy parameter, different speech signals may have different values in dB but energy levels for happy, sad, angry, fear, surprise, and neutral may have a particular range. This fact can be utilized for emotion distinction [14].

a< energy < b **&&** c < MFCC < d

&& e< pitch < f **&&** g < VT freq. < h

Result ===➔ Indication of a specific emotion

Along with the same, it is also observed that happy-angry-surprise and sad-fear-neutral emotions have closer ranges of values but they have distinct pitches or distinct MFCC values or distinct vocal tract frequencies. Using this factor, above sets can be separated using the ANDING of parameters values for different ranges so as to get unique emotion from the analysis.

The actual requirement of such a database is to get sufficient values of coefficients to compare different emotions. Also the huge database will also give rise to get the accurate value mean of the parameter of audio files. To avoid limited database and incorrect mean value, large database will generate effective values for getting desired accuracy for emotion detection. The classification done here is as

From the ANDING conditions, it is clear that a specific emotion will be detected if and only if all the above conditions are satisfied. If any of the above four parameters is not in the given range, it will not indicate the emotion under that specific category. The threshold levels defined are from the minimum and maximum values of the results of speech files for a selected parameter. It can be noted that for the corner values of some speech files, for energy, pitch, MFCC, or vocal tract frequency, about 10 % values are found with incorrect results which will be improved by a suitable classifier. The database newly formed is found to have many variations in different parameters but can be adjusted effectively to get proper results by setting of the threshold levels appropriately [15]. Using the database, minimum and maximum value of the range for any emotion file can be defined. When all the speech file ranges will be defined, we can have the higher accuracy for emotion detection. Also the accuracy can also be improved by addition of neural network.

This will be one of the most important steps of the overall design part as the criteria with which emotions will be detected is building up. Also here, this point can be noted that considering energy as one of the parameter emotions like happy, angry, and surprise will fall under one category and sad, fear, and neutral emotions will be falling under other category. Thus for first level, six emotions can be divided into set of 3–3 emotions. Further similar analysis will help us to distinguish exact

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emotion out of the set of three with the help of formant frequencies, MFCC, pitch, or similar parameters. All the parameters retrieved from the audio file given as input, collected together for analysis. The suitable coding will provide criteria to retrieve exact emotion.

The threshold values defined are considered from the values of result analysis. They are required to be varied as per the requirement to get higher accuracy. It is also found that independent of any language, emotions generated will be similar though words, sentences are different [16].

From the flowchart and code executed, we have formed tables from all the derived values of speech files. Along with the same, we have noted the minimum and maximum values of the specific range. From the graph shown, though all the emotion values are looking to be mixed, still execution have made it clear that all parameter will fall under a specific emotion result with approx. 90 % accuracy. It is because of the fact that four different parameters selected will not have mixed values. Due to this factor, emotions can be detected efficiently.

From the charts and discussion, it can be concluded that detection efficiency can be increased when different parameters are 'ANDED' together. The threshold levels decided can be retrieved from the tables of values from the analysis. The success of emotion detection is also dependent on the quality or naturalness in audio files recorded, appropriate selection of features and suitable classification range. The combination of results for a single parameter will boost the detection accuracy because for final detected emotion, result will be dependent on the results of 2–4 parameters to yield higher accuracy. This paradigm of combination of speech parameters has improved the detection accuracy by 20 %. By getting higher level of accuracy, research also may forward further for detection of unspoken emotions. It can be the blend of different parameters for emotion detection using speech as well as image to get the desired results [17].

Comparing with other methods, it is seen that most of the work done is by considering a single or two parameters for detection of emotion using speech. Many researchers have worked on the combination of speech and image as the input source. Here, the main emphasis is given by considering about four effective parameters for emotion detection. Also results are fused or combined so as to get higher accuracy. Work accomplished here is concentrated on one of the best Indian language—Marathi in concern with emotion detection.

6 Conclusion

Emotion detection yields good recognition accuracy by selection of suitable parameters like pitch, formant frequencies, energy of signal, MFCCs, and loudness. Accuracy can be increased by combination of results of different parameters together.

By analysis of all the parameter values, using a classifier, if suitable scaling is applied to those parameters which are showing good recognition rates, the detection

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accuracy can be improved further. The combination of result or suitable classifier can be planned for this purpose which will scale the parameters effectively and improve recognition rate at least by 15 to 20 %. The current recognition rate is approx. 80 % which can be improved by using a scaling method or by selection of suitable classifier, up to 90–95 %. The increase in accuracy is observed because of the fact that multimodal fusion of speech parameters increases the detection accuracy as higher weight can be added to more efficient parameters and least to those having minimum accuracy found. Strong database of speech samples will still improve the recognition accuracy as well as it will make the system for any unknown input signal which can be detected for emotion with improved recognition accuracy.

Energy, pitch, MFCCs, or vocal tract frequencies are independent of spoken words, i.e., spoken words indicate minimum or no impact on results of emotion detection. An effective system will detect emotions of an unknown speaker without consideration of the language he/she is speaking. Language can be considered to be independent for emotion detection as for any language, the parameters of analysis will be unchanged though words are changing.

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Priority Dissection Supervision for Intrusion Detection in Wireless Sensor Networks

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Abstract Wireless sensor networks are prone to failure as a simple attack can lead to damage the entire setup. Ad hoc nature, limited energy, and limited network lifetime are the major reasons that expose WSN's to many security attacks. Intrusion detection is the most important method to intercept all these attacks. In this paper, we propose a new method called Priority Dissection Supervision (PDS) for intrusion detection in WSN. The proposed PDS uses fuzzy logic for prioritizing the impact of distributed intrusion over line of control (LOC). Proposed PDS is a coherent system which models the key elements sensor deployment, intrusion detection, tracking, and priority list. PDS makes use of weight and impact factors which detects the influence field of different types of intruders and accordingly calculates the amount of deterioration. By the use of PDS system the operational and deployment cost can be decreased significantly. Simulation results on MATLAB exhibit the potency and precision of the proposed PDS.

Keywords Priority · Intrusion detection · LOC · Fuzzy · WSN

1 Introduction

Wireless sensor networks (WSN) are used for monitoring physical or environmental conditions like sound, weight, vibrations, velocity, etc. There are defined spatially distributed autonomous which pass their data through the predefined links to the

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station and then the data is processed out [1]. A node in a sensor network is capable of information, processing it and communicating with other connected nodes in the network. Nowadays, these are progressively utilized in homeland security, disaster recovery, data logging, area monitoring, and many other disciplines. In accordance with the nature of the military operations, we introduce a set of sensor nodes to collect and operate the data. This acquired data must maintain its accuracy when passed to the evaluation center and must reach in real time. The main contribution of our work is that it demonstrates prioritized list of intrusion activities to be handled and to be responded accordingly.

2 Literature Review

WSN has been utilized for solving challenges like energy efficiency, security, communication, and hardware reliability in military border patrol systems. A variety of different deployment approaches of WSN have been used in border surveillance and intrusions detection. Among the existing prototypes for deployment approach, unmanned aerial vehicles (UAVs) have been used to automatically detect and track illegal border crossing [2]. UAVs provide high mobility and coverage but these have to be paired with the Seismic and Fiber Optic Sensors and are quite costly in terms of deployment. Unlike the wired sensors, there are unattended ground sensors (UGSs) which can detect any kind of vibration/seismic activity or magnetic impact, which indicates crossing of vehicles or infantry at the LOC (line of control) [7–9]. The UGSs provide higher system robustness and are quite effective in detecting intrusion.

The Remotely Monitored Battlefield Sensor System (REMBASS) and Igloo White are the existing radio-based UGS used in intrusion detection [3]. But they have limited networking ability and communicate their sensor readings over relatively long and frequently unidirectional radio links to a central monitoring station.

3 Proposed Approach: Priority Dissection Supervision (PDS)

Comparing with existing intrusion detection techniques, PDS provides the following advantages:

- Ground sensors provide a benefit over multimedia sensors, e.g., [2] intruder hidden behind an obstacle can be detected by ground sensor that is not possible using imaging sensor.
- Underground sensors are less prone to attacks by intruders and provide accurate detection with large coverage area [2].
- Heterogeneous sensors simultaneously give an assurance of intrusion.

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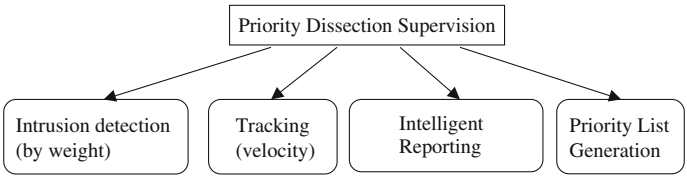

Fig. 1 Phases of proposed approach

Thus, using the proposed PDS system the operational and deployment cost can be decreased significantly [2]. Proposed PDS is divided in four stages as shown in Fig. 1.

3.1 Intrusion Detection

Intrusion detection works in two domains.

(1) **Deployment of Sensors**: The proposed PDS would be established for monitoring a large border area. But due to limited sensing radius of a sensor node, a large number of sensor nodes are required to be deployed to fulfill the coverage requirement. The sensor nodes will be embedded in a strip area at LOC (line of control) [2].

Supposition: Let S be the shortest path length of the region and R be the sensor's sensing range. Then, the required number of sensors to achieve k-barrier coverage in the region is [2].

$$k[D/R] \tag{1}$$

The proof of Supposition has been given in [4]. So, according to Supposition, given a border area with axial distance d, the minimum number of ground/underground sensors required to achieve k-barrier coverage is

$$k[D/R_{UGS}] \tag{2}$$

(2) **Intrusion Detection**: As the intruder enters the sensor coverage area, weight will be recorded [5, 6]. Classification of weight would be done using Algorithm 1.

Algorithm 1: Intrusion Type

```
if weight <= a
 IntrusionType = 'Infantry';
else if weight>a && weight<=b
 IntrusionType='LightWeighted';
else weight>b
 IntrusionType='HeavyWeighted';
```

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Algorithm 2: Distance Tracking

```
if IntrusionType='Infantry';
  distance = 0.05km;
else
  distance=0.5km;
Time=distance*speed;
```

3.2 Tracking

Sensor nodes will detect infantry within the range of 50 meters and light weighted/heavy weighted vehicle within the range of 500 m [8]. Accordingly the distance of various intruders and their speed [3] will be recorded.

Using the values of distance and velocity, time taken by intruders to reach the sensor node will be calculated by the Algorithm 2.

3.3 Intelligent Reporting Mechanism

This phase will generate a priority list conveying the severity of intrusion of all sectors on the border. The sector (fixed geographical area) with the most severe intrusion will be at the top of the list followed by other sectors with decreasing severity. Priority list would be depending on two factors:

(1) Time
(2) Impact Factor

where time is calculated as the time taken by the intruder to reach the sensor node from its recorded position. Time will be calculated using the distance and velocity recorded by WSN.

The term impact factor refers the impact or influence of intrusion on the border caused by intruder and depending on its value impact factor is further categorized into following:

(1) Low
(2) Medium
(3) High
(4) Very High

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Algorithm 3: Weight Factor

```
if IntrusionType='Infantry'
  WF=x;
else if IntrusionType='LightWeighted'
  WF=y;
else IntrusionType='HeavyWeighted'
     WF=z;
```

Algorithm 4: Impact Factor

```
AvgNo = (∑(Min,Max))/2;
IF=AvgNo*WF;
if IF>=p && IF<=q;
   set IF='Low';
else if IF>q && IF<r
         set IF='Medium';
      else if IF>r && IF<=s
         set IF='High';
else IF>s
         set IF='VeryHigh';
```

The Algorithm 3 assigns the value of weight factor to intrusion and accordingly value of IF will be calculated and categorized using Algorithm 4.

Figure 2 shows the overall flow of data.

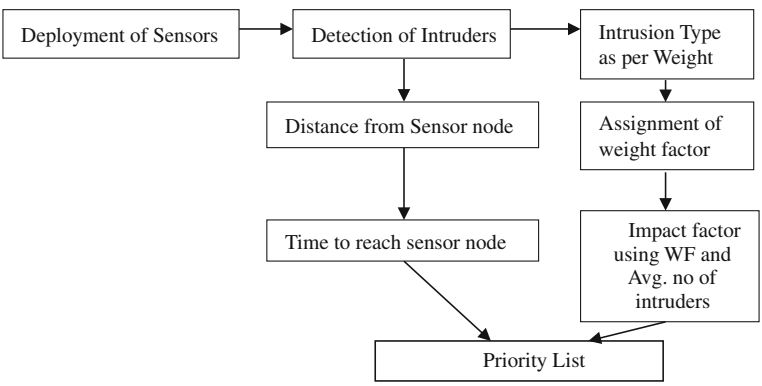

Fig. 2 Overall flow of data

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3.4 Priority List

Final output Priority List will be obtained by taking 'AND' operation on two inputs (TIME, IMPACT FACTOR). 'AND' operation gives the minimum value among these two inputs and then fuzzy logic applies the defuzzification to give the final value of the priority list.

$$\sum T_i \Lambda IF \tag{3}$$

The Priority List membership function is further being classified into five categories in a range of (0–1):

1. CRITICAL
2. HIGH
3. MEDIUM
4. LOW
5. LOWEST

4 Results

Priority list of the intruders is formulated in accordance to impact of attack. For generation of priority list following parameters are used: time required by the intruder to reach sensor node and impact factor.

Weights of intruders would be tabulated as per the data recorded by BVP [5, 6]. At last the calculated Impact factors are shown in Table 1.

Table 1 Classification of vehicles based on weights and impact factor

Name	Weight (kg)	Manufactured qty.	Avg no.	WF	IF
Heavy weighted					
Leopard1	40200	348	72	10	720
Leopard2	52000	450	225	10	2250
M48	45600	1200	650	10	6500
Jaguar	23200	543	25	10	250
Light weighted					
Wiesel	1927	522	98	5	490
MB1017	6800	7000	800	5	4000
Infantry					
Soldiers	100		16	1	16

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Table 2 Weight factors

Type	Heavy weighted	Light weighted	Infantry
Weight factor (WF)	10	5	1

Table 3 Time required to reach Sensor node

	Distance (km)	Speed (km/h)	Time (h)	Time (min)
Vehicle				
	0.500	25.00	0.02	1.20
	0.500	1.00	0.50	30.00
Soldier				
	0.05	20.00	0.0025	0.15
	0.05	1.00	0.05	3.00

Classification of Intruders as per their weight:

- Infantry: < 1700 kg
- Light Weighted: 1700–8000 kg
- Heavy Weighted: > 8000 kg

Weight factors in Table 2 are assigned to the intruders using Algo3 and keeping x = 1, y = 5 and z = 10.

Considering that the intruders are traveling with their maximum/minimum speed and thus time will be calculated using (4) to reach the sensor node and recorded (Table 3).

$$\text{Time} = \text{mean}((\sum \text{Distance})/(\sum \text{Speed})) \tag{4}$$

5 Simulation Results

Simulation dataset is implemented in MATLAB to generate Priority List (Figs. 3, 4, 5 and 6).

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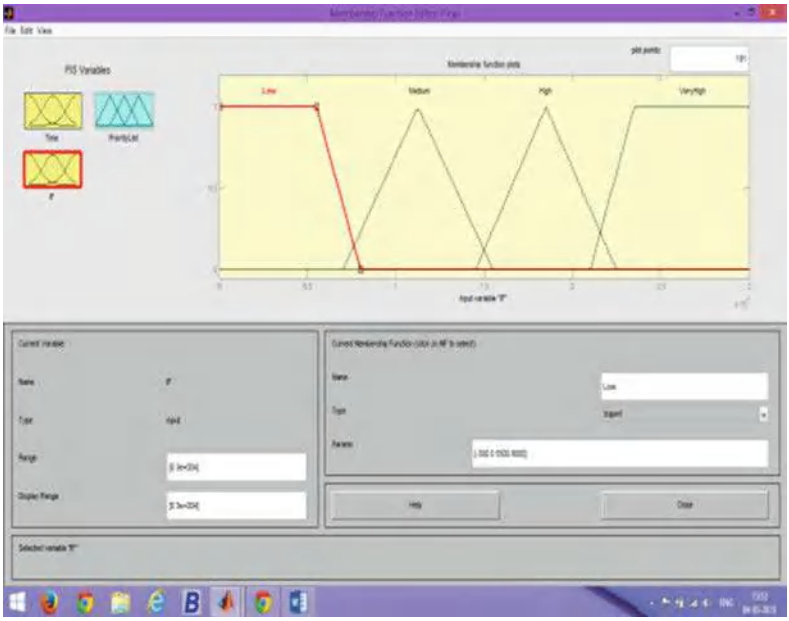

Fig. 3 Impact factor on MATLAB

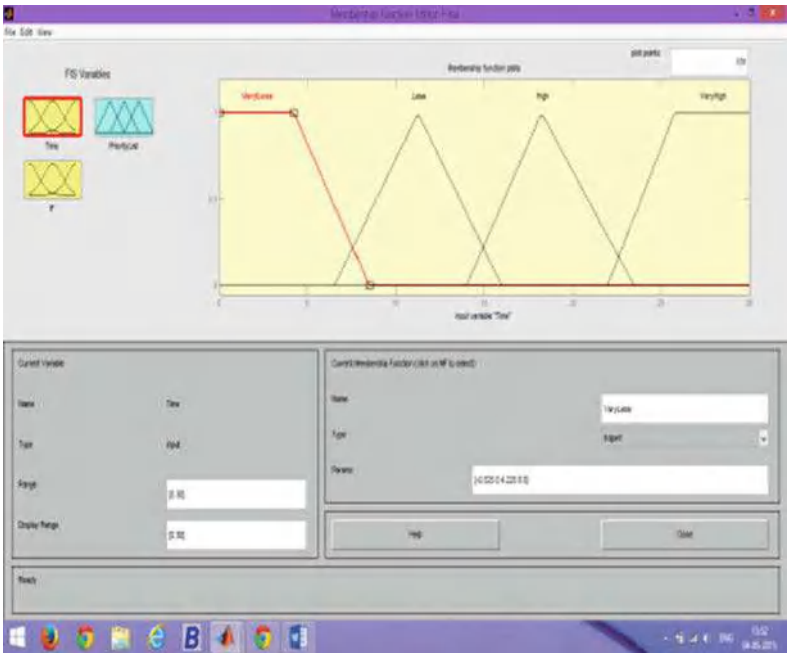

Fig. 4 Time on MATLAB

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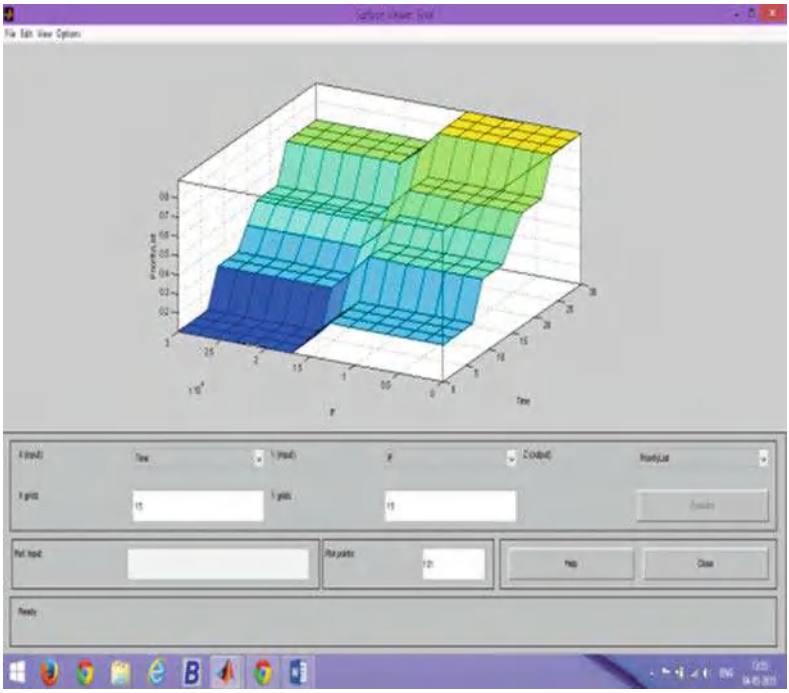

Fig. 5 Surface view of priority list

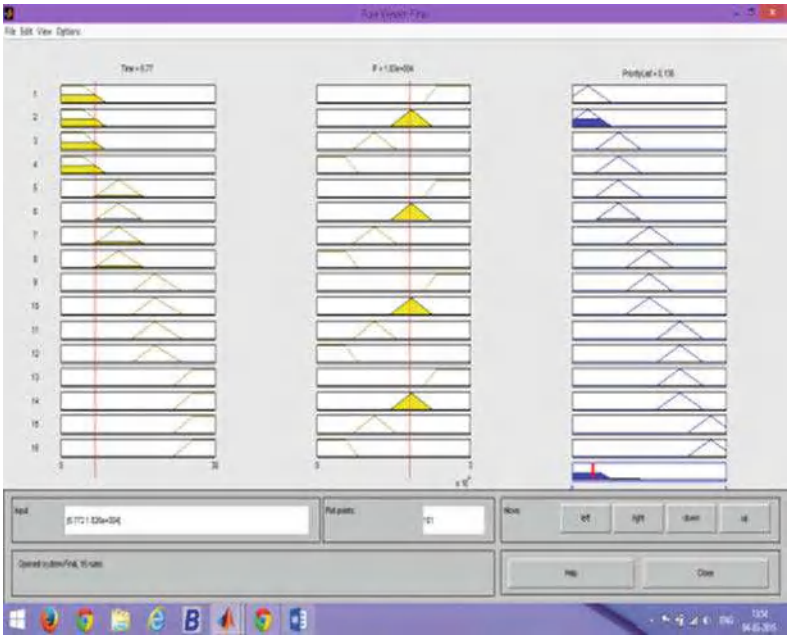

Fig. 6 Rule view of priority list

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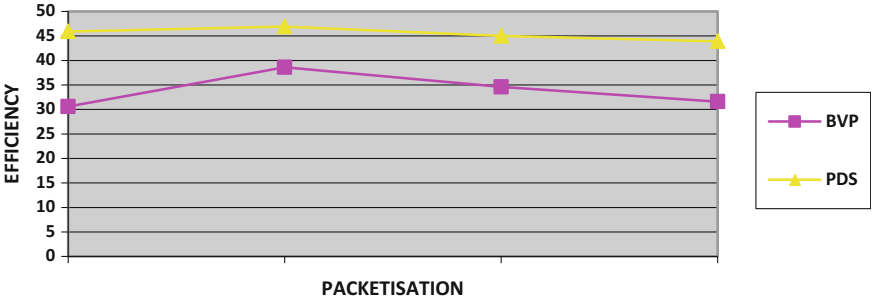

Fig. 7 Comparison between proposed approach and existing system

6 Conclusion

This paper presented a framework which combines the wireless sensor networks along with fuzzy logic-based algorithm for prioritizing the impact of distributed intrusion over line of control (LOC). Proposed PDS is a coherent system which models the key elements sensor deployment, intrusion detection, tracking, and priority list. A number of research efforts have been made for developing solutions for intrusion detection in WSNs. The proposed PDS makes use of weight and impact factors which detects the influence field of different types of intruders and accordingly calculates the amount of deterioration. The efficiency of proposed PDS is shown in Fig. 7. The resultant graph shows efficiency of PDS in terms of packetization over the existing BVP.

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Multi-objective Evolution-Based Scheduling of Computational Intensive Applications in Grid Environment

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Abstract Grid computing has been evolved as a high performance computing to fulfill the demand of computational resources among the geographically dispersed virtual organizations. Grid is used to provide solutions to the complex computational intensive problems. Scheduling of user applications on the distributed resources is an indispensable issue in Grid environment. In this paper, a speed-constrained multi-objective particle swarm optimization (SMPSO) technique-based scheduler is proposed to find efficient schedules that minimizes makespan, flowtime, resource usage cost and maximizes resource utilization in Grid environment. The work is integrated in ALEA 3.0 Grid Scheduling simulator. The results of the proposed approach have been contrasted with Grid's conventional scheduling algorithms like FCFS, EDF, MinMin, and other multi-objective algorithms like NSGA-II and SPEA2. The results discussed in the paper shows that SMPSO outperforms over other scheduling techniques.

Keywords Grid scheduling · Resource utilization · Makespan · Flowtime · Multi-objective · SMPSO

1 Introduction

Grid is a kind of distributed computing where resources are owned by multiple virtual organizations and follows common rules for sharing and selection of resources to execute the user jobs from diverse locations [1, 2]. Grid middleware allows the users to interact with Grid systems. The concept of computational grid has been evolved from power Grid. The computational grids are required to provide reliable and low-cost methods for sharing resources such as computers, storage and working memory, network bandwidth, and software applications across geographically distributed virtual organizations [3]. The resource providers advertise

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their resources on Grid using Grid information service and resource consumers execute their jobs on the advertised and available resources with the help of Grid resource broker.

In Grid scheduling, user jobs are to be scheduled on resources that belong to distinct administrative domains. Grid scheduling involves in gathering of information about resources that are capable enough to execute the user jobs, advance reservation of resources, submission of user jobs, and monitoring of user jobs [4]. The Grid scheduler is responsible for sending a user job to the best suitable Grid resource [5]. The grid scheduler matches the optimum resource to the user application. The objective of grid scheduling is to deliver QoS requirements of the grid users like minimum resource usage cost, job execution before predefined deadline and to raise the resource utilization [6].

1.1 Purpose of Research

The motivation behind this research work is to propose a multi-objective approach that is capable to find a diverse set of solutions to address multiple scheduling criteria problem in grid environment. Many researchers have adopted aggregating functions approach where weighted sum of fitness functions is taken to make a single objective function. There is a need of multi-objective optimization technique because grid scheduling criteria considers many conflicting objectives.

1.2 Contribution of the Proposed Work

In this paper, speed-constrained multi-objective particle swarm optimization (SMPSO) [12]-based Grid scheduling approach is proposed, where the user jobs and grid resources are mapped in such a way that maximum user jobs can be successfully scheduled and resource utilization can be increased. The scheduling criteria makespan, flowtime, resource usage cost, resource idle time is minimized in an optimal manner. The SMPSO-based multi-objective approach relies upon three mechanisms; the particle representation, use of leader particles that guide the search and fine tuning of parameters. This approach uses external archive that stores the nondominated solutions separately during the search and these solutions are used as leaders during updation of the positions of particles. The turbulence operator is applied that accelerates the velocity when movement of particles becomes zero to save the swarm from trapping into local minima. The proposed approach produces

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effective particle positions when the speed of particles becomes too high after applying turbulence to control the velocity of particles. The SMPSO-based scheduler produces evenly distributed solutions in Pareto Optimal. SMPSO produces phenomenal results in accuracy and speed.

In this paper, Sect. 2 highlights State-of-the-art works. Section 3 highlights the proposed approach for job scheduling. Section 4 shows experimental setup and results. The last section provides conclusion and roadmap to future work.

2 The State of the Art

Many researchers have used heuristic-based algorithms to address Grid scheduling problems. Tabu search (TS), simulated annealing (SA), genetic algorithms (GA), ant colony optimization (ACO), bee Colony optimization (BCO) are heuristic-based approaches that have been proposed to tackle Grid scheduling issues. Some of the works have been discussed below that considered multi-objective scheduling criteria. In [7], authors have proposed GA-based heuristic approach that minimizes flowtime and makespan. A single composite objective function is taken for addressing two scheduling criteria. Their work is based on one-to-one job-resource mapping assumption. In [8], authors presented TS algorithm for addressing the batch scheduling problem on computational Grids. The problem is bi-objective, consisting of minimization of makespan and flowtime. This approach is contrasted with GA [7]-based scheduling approach. In [9], DPSO approach is presented which also minimizes makespan and flowtime. However, the approach is new but the algorithm uses aggregation approach where two objective functions are combined into a single objective function and certain weightage is given to both objective functions. In [10], authors have proposed MOEA and minimized makespan and flowtime. The contrast of this approach has been made with single objective algorithms like GA, PSO, and SA. In [11], authors have proposed enhanced ACO-based approach that optimizes time and cost. The paper claims that this approach outperforms over MOACO and basic ACO.

Most of the works have presented grid scheduling problem as a single composite objective function. A few research works have been found in literature with Pareto front and crowding distance-based multi-objective approach that deals with multiple scheduling criteria in Grid environment by giving equal weightage to all criteria. Second, many authors have assumed that a single job is mapped to a single resource, while in real Grid environment; many jobs are mapped to a single resource. The proposed approach in this paper, is addressing four scheduling criteria. The problem formulation is multi-objective and using SMPSO [12] to provide optimum schedule. Many jobs are mapped to single cluster like real-life environment of Grids. The work is integrated in ALEA [13] that is extended from Gridsim, a well-established grid simulator that simulates Grid jobs and Grid resources.

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3 Proposed Multi-objective Particle Swarm Optimization-Based Scheduling Approach

In particle swarm optimization, any solution in the search space of the problem is presented by a set of particles (Doctor Kennedy and Eberhart in 1995). The swarm of particles evolves over the generations. The objective function ascertains the optimality of a particle and the fitness of a particle with respect to the near optimal solution. The scheduling problem is formulated as a multi-objective optimization problem in which a group of conflicting objectives are simultaneously optimized. Instead of a single solution, there are diverse set of potential solutions that are optimal in some objectives. An appropriate solution to the problem fulfills the objectives at a moderately good level and the solution is nondominant [14].

3.1 Problem Formulation

Grid scheduling is based on multi-criteria optimization problem. In this work, the focus is on the minimization of makespan, flowtime, resource usage cost and maximization of resource utilization. More precisely, the scheduling problem consists of the following:

- The *N* number of jobs can be represented as independent tasks.
- An *M* number of heterogeneous clusters are available to execute user jobs.
- Many tasks can be scheduled on one resource as one resource is represented as a cluster and one cluster can have many machines.
- The computing capacity of each machine is given in MIPS (million instructions per second).

3.2 Initial Swarm Formation

An initial swarm is used as a starting point to search from. The initial swarm is generated with the following constraints:

- Every job is presented only once in the SMPSO based schedule.
- Each job must be scheduled at one available time slot on a resource.

The first thing is to formulate the particle representation and dimension of a particle [15]. For scheduling, one particle represents the set of jobs that are required to be scheduled on resources; hence, the dimension of a particle is the same as that of total number of jobs. The single particle represents job-resource mapping. The swarm size is taken 50, archive size is 100 and maximum iterations are taken 500 on the basis of empirically driven results of the algorithm.

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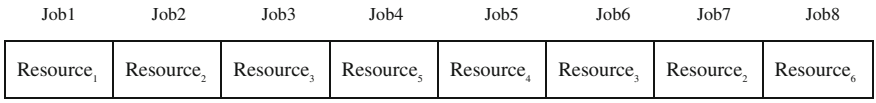

Fig. 1 Particle representation (job-resource mapping)

Let us say *Ti* be the independent jobs where $i = 1, 2\ldots, n$ and to execute these jobs, there is a need to map them with resources say *Rj* where $j = 1,2\ldots, m$.

If there are eight independent jobs and six potential resources then the initial particle's swarm would be shown below in Fig. 1:

After change in the position of particles, a time slot assignment algorithm is deployed to transfer job assignment string to a feasible schedule.

Algorithm 1: Time Slot Assignment to Jobs
Input: Job Assignment String(Job & Resource mapping)
Output: Job Execution Schedule on particular resource
T←Get the entry job from ready queue of scheduling order
While queue is not empty do
R← obtain the resource allocation from job-assignment string
Compute the execution time of T on R
Check and assign a free time slot on R for executing job T
T← get the next job from the ready queue
end while

3.3 Exploitation Using Velocity and Position Vector

PSO is a swarm-based heuristic optimization technique. First of all, it is initialized with a group of random particles. Each particle gets updated in each iteration by its personal best value, i.e., *pbest* and the global best value, i.e., *gbest*. After attaining these two best values, the particle modifies its velocity and position according to Eqs. (1) and (2) to exploit the search space (Doctor Kennedy and Eberhart in 1995). The position vector is represented by *Zi* and updating velocity vector is represented *Vi*. The particles update velocity by moving in the search space.

The velocity vector is represented by

$$v_i^{k+1} \rightarrow \omega v_i^k + C_1 r_1 \left(z_{pbest_i} - z_i^k\right) + C_2 r_2 \left(z_{gbest} - z_i^k\right) \quad (1)$$

where $\omega = 0.95, C_1, C_2 = \text{random}(1.0, 2.5)$, and $r_1, r_2 = \text{random}(0.1, 1.0)$.

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The momentum component represents the previous velocity. The cognitive component C_1, which depends heavily on the particle's current distance to the personal best position it has visited so far. The social component C_2, that depends on the particle's distance to the global best position where any of the swarm's particles has ever been.

v_i^k – ith particle's velocity at iteration k
v_i^{k+1} – ith particle's velocity at iteration $k+1$
x_i^k – current position of particle i at iteration k
x_i^{k+1} – position of the particle i at iteration $k+1$
p^{best_i} – best personal position of particle i
g^{best} – position of best fitness particle in a swarm

The position vector is represented by

$$z_i^{k+1} = z_i^k + v_i^{k+1} \tag{2}$$

As shown in Eq. (2), new position of the particle is determined by adding velocity factor to its previous position of the particle.

3.4 Objective Functions

The objective or fitness function is used to evaluate the current swarm to produce quality solutions. Mathematically, MOPs can be defined as

$$\text{Minimize} \quad f(x) = \{f_1(x), f_2(x) \ldots f_n(x)\} \tag{3}$$

Where $x \in S$ and S is a solution space. We can say that the solution is called dominant solution if it is equally good to the other solution and better in at least one fitness function.

Makespan: the time between start and end of all jobs in a schedule.

- Let n be the total number of jobs/tasks $T = \{t_1, t_2, t_3 \ldots. t_n\}$
- To execute job t_i on grid, computational node R_j is required.
- Total execution time $TE_{ij} = ET_{ij}$

The makespan is represented as follows:

$$M_{\max} = \max\{TE_{ij}, i = 1, 2, \ldots n, J = 1, 2, \ldots m\} \tag{4}$$

$$\text{The makespan fitness function } f_1(x) = \min_{t \in N} \{M_{\max}\} \tag{5}$$

where each job t belongs to schedule N.

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Flowtime: the flow time of a set of jobs is the sum of completion time of all jobs. Let us say S_t is the time in which job t finalizes and N denotes the set of all jobs to be scheduled. The flowtime is represented as follows:

$$\text{The flowtime fitness function } f_2(x) = \min\{\sum_{t \in N} S_t\} \tag{6}$$

Cost: The third fitness function is minimization of cost for job/task t_i for consuming computational node R_j.

- Processing time of t_i on R_j is TE_{ij} and $C(x)$ provides the total cost time for completion.
- The objective is to get the permutation matrix $x = (x_{i,j})$, with $x_{i,j} = 1$ if resource j performs job i and if otherwise, $x_{i,j} = 0$. The cost function $C(x)$ is represented as follows:

$$C(x) = \sum_{i=1}^{m} \sum_{j=1}^{n} TE_{i,j} * x_{i,j} \tag{7}$$

$$\text{The cost fitness function } f_3(x) = \min_{t \in N}(C(x)) \tag{8}$$

Resource Utilization: Maximizing utilization of resources, i.e., minimizing resource ideal time or minimizing $f_4(x)$.

The resource idle time minimizing function

$$f_4(x) = \frac{1}{m} \sum_{j=1}^{m} \left\{ e(l(R_j)) - u(R_j) \right\} \tag{9}$$

- Function l: provides the last grid job executed on resource R_j.
- Function e: provides the end time of grid job T_i that is mapped on resource R_j.
- Function u: provides the utilized time of resource R_j.

3.5 Turbulence Operator and Velocity Constriction

To avoid the convergence of swarm around local minima; a turbulence operator has been introduced in SMPSO. The turbulence operator is applied in terms of polynomial mutation to the 20 % of swarm particles with 1.0 probability. It allows the particles to explore new solutions in search space. In contrast, SMPSO adopts velocity constriction scheme to control the speed of particles and to let the particles

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move in bounded search area. The particle's velocity is reversed by multiplying the particle to 0.001 if the resulting position of particle goes out of the bounded search area.

4 Experimental Setup and Results

The proposed approach is implemented in ALEA 3.0 [16] Grid scheduling simulator which is extended from GridSim Toolkit [17]. The jobs are generated in MWF (Metacentrum Workloads Format) and 6 resources (Clusters) are generated with 5 nodes in each of them. The jMetal [20] libraries are used to implement SMPSO [12], SPEA2 [18] and NSGA-II [19]-based metaheuristics. For SPEA2, the population size is 50, the archive size is 100, and maximum iterations are 500. For NSGA-II, the population size is 50 and maximum iterations are 1000. Binary Tournament selection approach is implemented for selecting parents to generate offsprings. Two-point crossover with 0.95 probability, and move mutation with 0.1 probability is implemented for exploring the search space. Grid's conventional algorithm MinMin, EDF, and FCFS have also been integrated to contrast the results.

4.1 Results for Makespan

See Fig. 2.

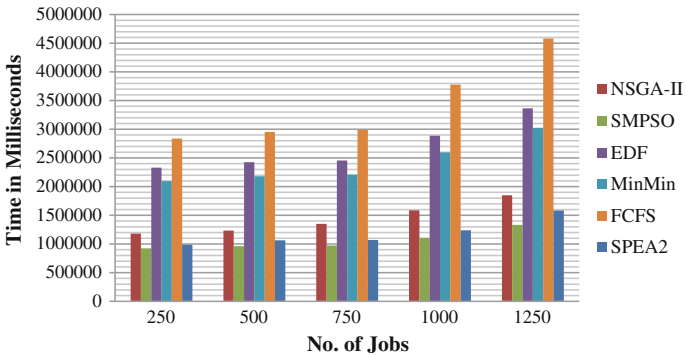

Fig. 2 Shows results for makespan. The jobs are presented along *X*-axis and execution time along *Y*-axis. The six grid scheduling techniques are contrasted with SMPSO-based grid scheduling approach. It is apparent that SMPSO gives minimum makespan or schedule length out of these approaches

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4.2 Results for Mean Flowtime

See Fig. 3.

4.3 Results for Resource Usage Cost

See Fig. 4.

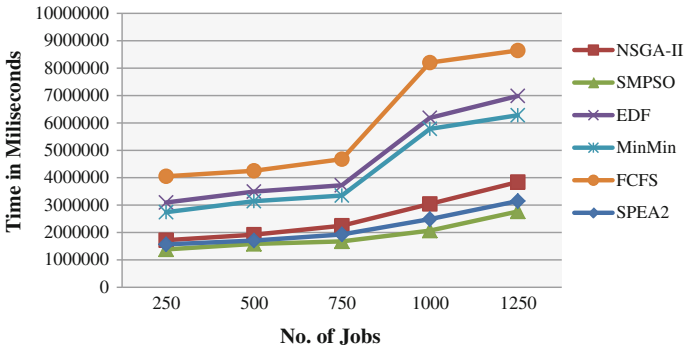

Fig. 3 Depicts that SMPSO gives minimum mean flowtime. The jobs are taken along *X*-axis and time is taken along *Y*-axis in milliseconds

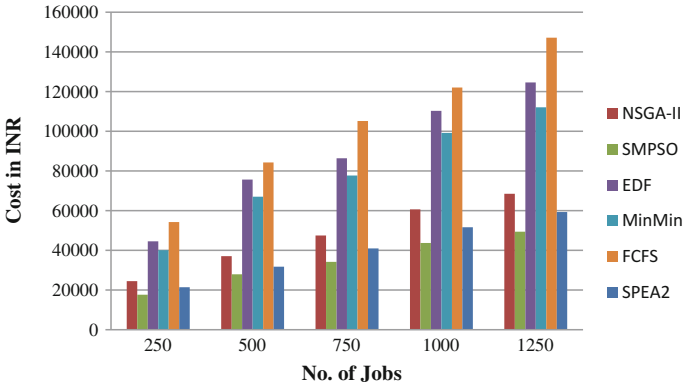

Fig. 4 It shows a comparison of resource usage cost for executing user applications among six Grid scheduling algorithms. The jobs are taken along *X*-axis and resource usage cost is taken along *Y*-axis in Indian rupees. The resource usage cost is also minimized with SMPSO-based proposed scheduling approach as shown in figure

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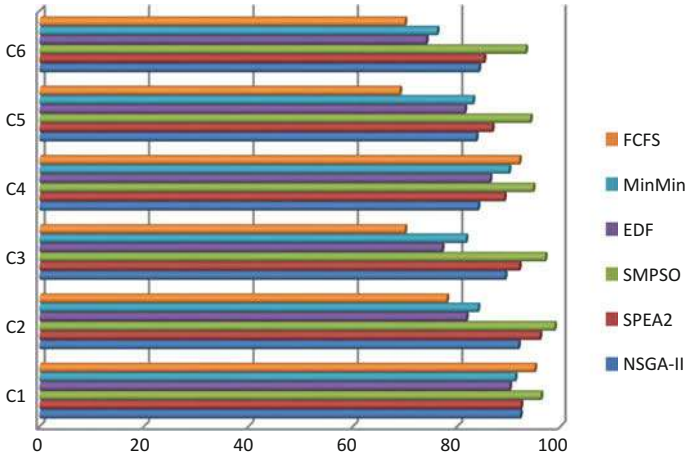

Fig. 5 It shows percentage of Resource Utilization. SMPSO-based Grid scheduling approach also maximizes resource utilization

4.4 Results for Resource Utilization

The results show that SMPSO scheduling approach outperforms over other multi-objective approaches like SPEA2 and NSGA-II as well as Grid's conventional mechanisms like EDF, FCFS, and MinMin by optimizing multiple conflicting scheduling criteria (Fig. 5).

5 Conclusion and Future Roadmap

The proposed heuristic-based Grid scheduler optimizes four conflicting objective functions to satisfy grid scheduling criteria. The SMPSO-based scheduler yields best scheduling strategies by adopting Pareto front optimal mechanism, crowding distance-based second discrimination factor, turbulence operator to move the still particles, and speed constriction factor to bound the particles within a bounded search space. All these features of SMPSO make it robust and remarkable in speed and accuracy. In future, a study will be carried out on fine tuning of parameters with respect to velocity updating schemes and position updating schemes of particles.

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Selective Encryption Framework for Secure Multimedia Transmission over Wireless Multimedia Sensor Networks

Vinod B. Durdi, Prahlad T. Kulkarni and K.L. Sudha

Abstract Video compression method such as H.264/AVC often causes huge computing complexity at the encoder that is generally implemented in various multimedia applications. In view of this an article on selective video encryption framework based upon Advanced Encryption Standard (AES) is suggested for prioritized frames of H.264/AVC to improve the multimedia security while maintaining the low complexity at the encoder. The experimental result demonstrates that the recommended technique contributes significant security to video streams while maintaining the original video compression efficiency and compression ratio. Moreover, the proposed scheme provides a good trade-off between encryption robustness, flexibility, and real-time processing.

Keywords Wireless multimedia sensor network · Video compression · Selective encryption · Cross layer · Key frame

1 Introduction

For the military, Internet, real-time video multicast applications the broadcaster needs to get the assurance that unauthorized users will not be able to gain access to its services. Hence multimedia signals need to be broadcast in an encrypted form

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and can be decrypted by means of authorized user. AES, IDEA, RSA, and DSA are some of the extensively used algorithms for preserving the privacy of the text or any binary data. However lightweight encryption algorithms are suitable for multimedia application as traditional methods such as DES are unable to meet the real-time requirements [1]. Also, it was discovered that the adoption of typical data encryption methods namely Advanced Encryption Standard (AES) and Elliptic Curve Cryptography (ECC) for preserving the privacy of video over wireless channels poses a difficulty, for which the reason is the huge amount of data and the difficulty involved in satisfying the conditions of real-time transmission.

This article introduces a distinct methodology for procuring the safety of multimedia data by regulating the sensitive portion of the multimedia flow, i.e., selective encryption has been proclaimed as a key for safeguarding the content with minimized computational complexity involvement. This paper proposes the framework of protection of key frame using AES from the compressed video. The article is further formulated like this. The multimedia security issues are specified in Sect. 2. In Sect. 3, effective selective encryption approach of multimedia compression is discussed. Various encryption schemes along with simulation scheme are depicted in VI segment. Outcome of the proposed scheme is mentioned in part V. Lastly, VI concludes this paper.

2 Multimedia Security Issues

Once a multimedia stream goes beyond simple public communications, then various issues have to be considered. One important major issue in multimedia wireless network is the security. The acceptable techniques for protected transmission of multimedia message above the networks, a number of cryptographic, steganographic and additional approaches are tried [2–4].

Most of these techniques try to optimize the authentication process in terms of the speed, and the display process. Some of the proposed video encryption schemes are reviewed in the section below. Kankanhalli and Guan [1] mentioned data authentication is very much required in favor of multimedia commerce on the Internet as well as video multicast. The authors proposed joint encryption along with compression. In this framework video data are shuffled into frequency domain.

Either allowing the system performance or defending the computational difficulty selective encryption on the compressed bit stream was proposed by Lookabaugh and Sicker [2] and this technique achieved adequate security.

Yang et al. [3] proclaimed that selective encryption is the key to accomplish multimedia protection and this has been the current topic of research.

The recent works reported in [4] summarizes the latest research related to video encryption and also focused on the widely used H-264 with scalable extension SVC.

The suggested scrambling methods appear to attain a best possible intermediate between many desirable characteristics such as speed, authentication, size of the file, and transcodability. Hence it is very suitable for network video applications.

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Podesser and Schmidt [5] propose some research regarding the video/multimedia selective encryption. Grngetto et al. [6] described the multimedia security scheme adopting the arithmetic encoder that is employed for encoding process in global image and video coding formats.

By adopting the method of bits scrambling selectively, shuffling the blocks along with rotating the blocks of the transform coefficients and motion vectors video data are scrambled in frequency domain, which presented encryption in addition to compression scheme jointly [7].

The suggested scrambling methods appear to attain a best possible intermediate between many desirable characteristics such as speed, authentication, size of the file, and transcodability. Hence it is very suitable for network video applications.

A partial encryption method [8] was put forth by Cheng et al. for ciphering a portion of the data which has already been compressed. With the purpose of decreasing the processing time, the complexity of computation and the power dissipation, selective encryption techniques have been put forward [9, 10] which can battle the security problems faced by video applications in real time. This methodology makes use of the characteristics of the MPEG layered structures to scramble various levels of selective portions of the MPEG stream. On the aspects of the frame structure of MPEG (*I*-frame, *P*-frame, also *B*-frames) the conventional selective encryption has been formulated. Only *I*-frame is subjected to scrambling, since *I*-frame comprises of most of the sensitive information. Similarly *P*-frames as well as *B*-frames do not facilitate with the relevant information with the absence of subsequent *I*-frame.

Selective encryption indulges in partial scrambling of compressed video stream to bring down the complexity involved in computation. This approach has already been discussed in several multimedia applications [11, 12]. A novel approach of partial encryption reduces consumption of power through the encryption function in favor of digital content.

On behalf of selective encryption to be influential, the aspects of the compression method are to be essentially taken into account in order to identify the significant information with reference to basic signal, considering a smaller part of the compressed bit stream. Therefore, it is likely to become the main research direction for the technology on video data security based on H.264/AVC.

According to Agi and Gong [13], there exists a fair balance (concession or trade-off) between increasing rate of occurrence of *I*-frames (and thus the level of security) and improving performance of encryption and increased ratio of compression(thereby decreasing the network bandwidth usage/utilization). Experiments usually prove the pattern shown in Fig. 1.

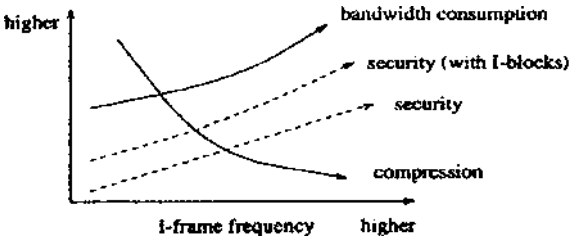

Fig. 1 Trade off between security, performance, and bandwidth consumption

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3 Effective Selective Encryption Approach for Multimedia Compression

In this section, a selective encryption approach on the compressed bit stream of the H.264 is discussed. The video sequence is subjected to compression at the encoder for producing *I P B*-frames. The prioritize block is then provided with this compressed data as the input. The prioritizer block has been adopted to judge the priority among the video frames. Therefore, we first carry out detailed examination to learn the dependency on frame level decoding. Analyzing of *I*-frame is not influenced by the decoding of any other video frame within the compressed video sequence.

In a Group of Pictures (GOP), it is *I*-frames that are given utmost prominence, be it in the case of error reduction or decoding dependency dominance. The decoding of *P*-frames relies upon the decoding of preceding *I*-frames as well as/or on *P*-frames, whereas the *B*-frame decoding is reliant on both the previous *I*- and *P*-frames and also the consequent *P*-frames. Let significant weight of a single video frame in a Group of Pictures (GOP) be represented as 'w' and is expressed as follows

$$w = \sum_{\forall \mathrm{i} \mid \mathrm{i} \in H} Di \tag{1}$$

where *Di* is the reduction in distortion, *H* represents the set of decoding subsequent video frames in GOP [14].

In this method, the video frames are arranged according to their weights which give an insight regarding the number of subsequent frames so as to rely on the interpreting of present video frames and the prominent contribution of those subsequent frames with regard to distortion decrement.

In case of selective encryption, the effective decoding of the encryption blocks has a great impact on the decoding of every frame which is possible on the condition that each bit in the code block succumbs to no fault during propagation. Mathematically the dependency is expressed as

$$E[D] = \sum_{i=0}^{N-1} Di(1-\rho i) \prod_{\forall k \mid k \in Gi} (1-\rho k) \prod_{\forall j \mid j \in Si} (1-\rho j) \tag{2}$$

where $E[D]$ is the end-to-end expected distortion reduction after decoding and decryption process [14]. G is the Ancestor frame set for a specific video frame in the decoding dependency graph. S is the association set of encrypted codewords for the *i*th video frame.

Using the frame span (L) and channel bit rate (e), the packet error rate (ρ) can be computed as

$$\rho = 1 - (1 \ - e)^{L + L_{\text{overhead}}} \tag{3}$$

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The term which is the decoding dependency also distortion reduction contribution

$$\sum_{i=0}^{N-1} Di(1-\rho i) \prod_{\forall k \mid k \in Gi} (1-\rho k) \tag{4}$$

are decided with the encoder along with the utilized video compression method like H.264/AVC.

The expected reduction in distortion is possible by maximizing the probability of successful transmission of encryption dependency frames, i.e.,

$$\max_i \left\{ \prod_{\forall j \mid j \in Si} (1-\rho i) \right. \tag{5}$$

In cross-layer way, the protection and energy levels are designated at both the application layer and the physical layer on the basis of priority thus ensuring the procurement of maximum number of successful transmissions of vital video frames. The selective encryption and resource allocation are easily compliant to wireless sensor network applications which suffer from restricted energy resources and computation.

4 Encryption Scheme and Simulation Model

Depending on the needs of the applications block ciphers such as AES (Advanced Encryption Standard) or 3DES are used. DES typically uses 56 bit key to encrypt data in 64 bit block size. In each of 16 rounds DES performs bit manipulation and permutation. DES is vulnerable to brute force attack as the 56 key is generating approximately 72 quadrillion possibilities which is not sufficient in today's computing world.

For implementation of content protection when considered together with the combination of authentication and performance AES is chosen as the appropriate algorithm. Similarly AES in terms of efficiency, implementability, and flexibility is made an appropriate selection. With respect to design, AES is also efficient in hardware and faster in software.

In the simulation model for WSN shown in Fig. 2, the H.264 encoder receives the video signal as the input which undergoes compression yielding *I P B*-frames. The prioritize block is then provided with this compressed data as the input. The application layer along with the physical layer with the cross-layer approach, the energy levels are designated at the resource allocator on the basis of priority which assures that the important information is never lost.

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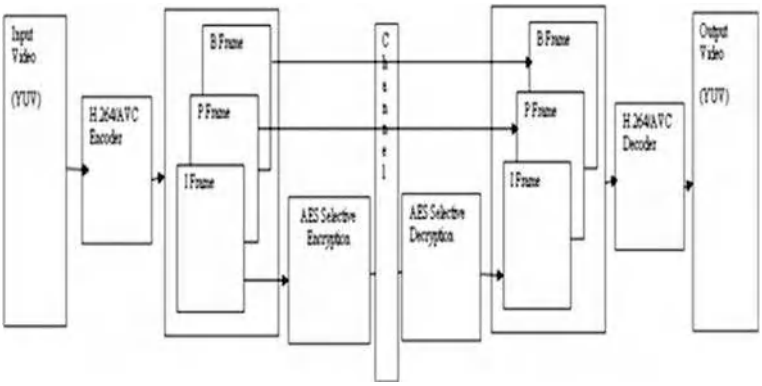

Fig. 2 Simulation model of proposed Selective Encryption method

For the simulation purpose the *I P B*-frames are generated by the H.264 encoder in our work and AES applied to the *I*-frames which are the key frames of the video data.

The kind of input video frame format that has to be given as the input to the encoder is judged with relevance to the specific application. The profoundly used frame format in mobile multimedia applications, QCIF format, has been utilized in our work as this research is concerned to transmission of video over wireless streams. Since H.264 procures greater robustness, efficient encoding, and syntax specifications and supported by most of the networks as well as application is the appropriate choice as the encoder in the implementation.

5 Results and Discussions

The experiments were conducted using JM 18.6 tool to observe the impact of the selective encryption on proposed model in wireless sensor networks using the AES with 128 key size. The simulation specifications are declared as follows. The H.264/AVC reference codec model was adopted at the application layer for compressing and packetizing 300 video frames. The well-known 4:2:0 format of foreman video sequence with preset size of 176X144 QCIF is selected as the sample input signal shown in Fig. 3.

This video signal is encoded with high profile by the frame rate of 30 frames per second (fps), the bit rate 45020 bps so that *I*-frames, *P*-frames, and *B*-frames are generated. Entropy coding method of CABAC with Group of Picture (GOP) of 10 as well as qpIslice and qp slice of 28 is used for the implementation. The encoder compressed the multimedia data with the compression ratio of about 0.0166.

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Fig. 3 Original Foreman QCIF video signal: YUV 4:2:0 sub sampled with 176X144

The paper showcases only few images of *I P B*-frames that are obtained as the output of H.264 with regard to the difficulty in displaying many frames in the limited space available.

Using AES selective encryption is performed on the *I*-frames provided by the priority block. Pertaining to earlier discussions, it is the *I*-frames that contribute in recognition of correct information bits in the decoding process. The selectively scrambled *I*-frames when subjected to decoding produces irrelevant codewords leading to erroneous video sequence.

For Encryption key in this framework it is assumed that does not have access to unauthorized users. The encoded bit stream values undergo decoding and the respective decrypted bits are influenced by previous results and hence damage the consequently required decoding steps. In accordance, the reconstructed video poses a pattern resembling the noise pattern.

Figures 4, 5, 6, 7, 8, 9, and 10 show the first, twentieth, thirtieth, fortieth, fiftieth, hundredth, and one hundred nineteenth frames, respectively, show frames decoded

Fig. 4 Frame_1 decoding with encrypted *I*-frame

Fig. 5 Frame_20 decoding with encrypted *I*-frame

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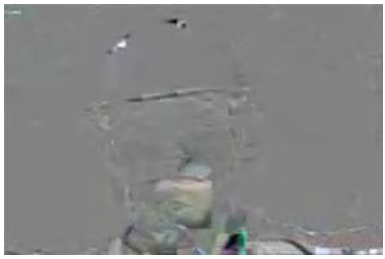

Fig. 6 Frame_30 decoding with encrypted *I*-frame

Fig. 7 Frame_40 decoding with encrypted *I*-frame

Fig. 8 Frame_50 decoding with encrypted *I*-frame

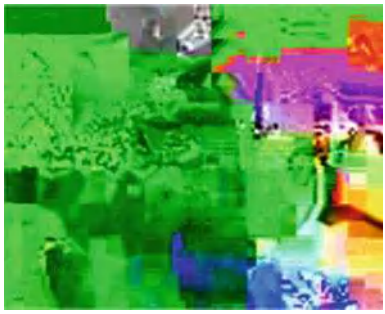

Fig. 9 Frame_100 decoding with encrypted *I*-frame

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Fig. 10 Frame_199 decoding with encrypted *I*-frame

with encrypted *I*-frames. From these results, we conclude that the content of every frame within the video clip is protected by ciphering the *I*-frame.

Figure 11 shows the recovered video signal by decoded with decrypted *I*-frames, Figs. 12, 13, 14, 15, 16, 17, 18, and 19 show the first, tenth, twentieth, thirtieth, fortieth, fiftieth, hundredth and one hundred nineteenth frames, respectively, show frames decoded with decrypted *I*-frames.

From these results, we observe that decrypting the *I*-frame with the authentication key generated the original video clip. Also from the proposed method it is observed that only the *I*-Frames bit streams were encrypted instead of the entire video which drastically reduced the processing time as well as it provided adequate security to video stream with no change in compression ratio and do not reduce the original video compression efficiency in applications like wireless sensor networks.

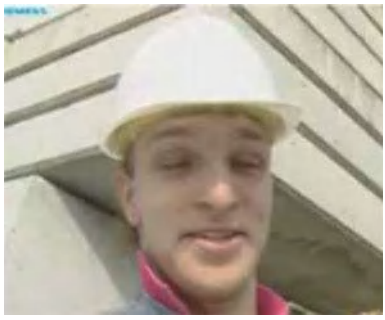

Fig. 11 Decoded received video signal with decrypted *I*-frame

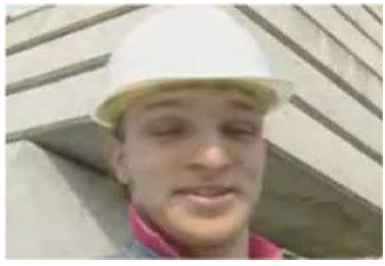

Fig. 12 Frame_1 decoding with decrypted *I*-frame

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Fig. 13 Frame_10 decoding with decrypted *I*-frame

Fig. 14 Frame_20 decoding with decrypted *I*-frame

Fig. 15 Frame_30 decoding with decrypted *I*-frame

Fig. 16 Frame_40 decoding with decrypted *I*-frame

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Fig. 17 Frame_50 decoding with decrypted *I*-frame

Fig. 18 Frame_100 decoding with decrypted *I*-frame

Fig. 19 Frame_199 decoding with decrypted *I*-frame

6 Conclusion

From the results of selective encryption, it has been found that ciphering *I*-frames of the video provided a meaningless video to the user that is not familiar with the authentication key and also in this event the complex overhead is greatly less compared with total encryption with no change in compression ratio as well as compression efficiency.

Improvement can be accomplished through various approaches. Incrementing the rate of occurrence of *I*-frames attains enhanced protection but at the cost of greater video size, increased consumption of network bandwidth, and intensive complexity involved in computation for encryption and decryption processes.

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Overall, it is suitable for secure transmission of videos where the processing time is crucial. Lastly, the proposed model will appear to achieve the solution for the critical issue related to multimedia content protection in wireless sensor networks.

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Mining Frequent Quality Factors of Software System Using Apriori Algorithm

Jyoti Agarwal, Sanjay Kumar Dubey and Rajdev Tiwari

Abstract Success or failure of any software system mainly depends on its quality. Quality plays a key role for determining the acceptability and adoptability of the software system among the users. Quality is the composite characteristic that depends on its different factors. The researchers have been focusing on different quality factors as per their research work requirement and various quality factors have been proposed by them in different quality models to assess the software quality. These models show that there are differences in the perception of the researchers regarding the important quality factors. Ample research work has been done in the field of software quality but till date no work has been done to prove as which quality factors are frequently used and have high importance. This paper is an attempt to find out the major key factors of the software quality. Various quality models have been considered for this purpose and accordingly data set is prepared. Apriori algorithm is used to generate the frequent quality factors. Experiment is performed in Java programming language. The aim of this research paper is to provide proper focus on the frequently used quality factors, which facilitate to improve the quality of software system. These quality factors will be useful to assess the quality of software system in a prudent manner.

Keywords Quality · Models · Factors · Software system · Apriori algorithm

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1 Introduction

In today's world, software has become an important part in all walks of life. Users are capable enough to select the best software as per their requirement. Selection of the best software mainly depends on the quality of the software system. According to IEEE 610.12 standard, quality is defined as "The composite characteristics of software that determine the degree to which the software in use meet the expectations of the customer" [1]. Composite characteristic means that the quality depends on its different factors and these factors can be used to assess the software quality. These quality factors have been defined in different quality models and the researchers have selected different quality factors as per the requirement of their research work. The question arises as to which quality factors should be focused more so that the researchers are able to move in right direction to assess the software quality.

The main objective of this research paper is to enumerate the quality factors that are most frequently used by the researchers in evaluating the software quality and assessing its efficiency. For finding the frequent quality factors data mining is used. Many algorithms are used in data mining for mining the frequent items sets from the transaction database. These algorithms can also be used for determining the frequent quality factors from the quality models. Apriori algorithm is the widely used data mining algorithm [2]. It is used to find the frequent item sets and association among the frequent item sets. In this research paper, the work is limited to generate the frequent quality factors. Association among the frequently used quality factors are not generated in this research paper because the objective is only to identify the frequently used quality factors.

The main contribution of this paper is that the suggested method will help to identify the significant quality factors which play important role to define the quality of the software system and also provide the correct roadmap for the future research on software quality.

This paper is divided into various sections. Research problem identification in Sect. 2. Section 3 is the brief review of the quality models and its different quality factors. Section 4 deals with the experimental work. Section 5 followed by the result of the research questions. The paper is concluded by describing its future scope in Sect. 6.

2 Problem Identification

To find the gap between the present and available research work on software quality, research papers from different sources have been selected and studied. After reading the research papers it is observed that lot of work has been done on

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software quality and its factors but no research work has been done for finding out the frequent quality factors to provide the right direction for the future research on software quality. It raises a question in the researcher's mind that which quality factor should be taken into account for measuring the quality for software system.

2.1 Inclusion and Exclusion Criteria

Research papers are collected from different digital libraries. Various keywords pertaining to software quality, quality models, quality factors are made used to search relevant papers. This paper includes those research papers and the articles which describe the quality models and the various quality factors. Research papers dealing with the evaluation of the software quality were weeded out, because the aim of this paper is to identify those quality factors which are frequently being used.

2.2 Research Questions

Two research questions are framed on the basis of the study of the research papers.

RQ1: How to determine frequently used quality factors?
RQ2: What all are quality factors being used frequently?

3 Related Work

This section is about the related work on software quality and its different factors. The first quality model was proposed in 1977 by McCall [3]. Research is continued since 1977 for improving the software quality. Number of quality models has been proposed by researchers [4–21].

Table 1 shows the 19 different quality models and the distribution of these quality models as per the nature of software system is shown in Fig. 1.

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Table 1 Quality models

Quality model	Symbol	Nature of software system	References
McCall (1977)	Q1	Traditional software system	[3]
Boehm (1978)	Q2	Traditional software system	[4]
ISO-9126 (1986)	Q3	Traditional software system	[5]
FURP (1987)	Q4	Traditional software system	[6]
Ghezzi (1991)	Q5	Traditional software system	[7]
IEEE (1993)	Q6	Traditional software system	[8]
Dromey (1995)	Q7	Traditional software system	[9]
ISO/IEC 9126-1 (2001)	Q8	Traditional software system	[10]
Goulao (2002)	Q9	Component based software system	[11]
Kazman (2003)	Q10	Traditional software system	[12]
Khosravi (2004)	Q11	Traditional software system	[13]
Alvaro (2005)	Q12	Component based software system	[14]
Rawadesh (2006)	Q13	Component based software system	[15]
Sharma (2008)	Q14	Component based software system	[16]
Kumar (2009)	Q15	Aspect oriented software system	[17]
Kumar (2012)	Q16	Aspect oriented software system	[18]
Pasrija (2012)	Q17	Traditional software system	[19]
Roy (2014)	Q18	Traditional software system	[20]
Tiwari (2015)	Q19	Component based software system	[21]

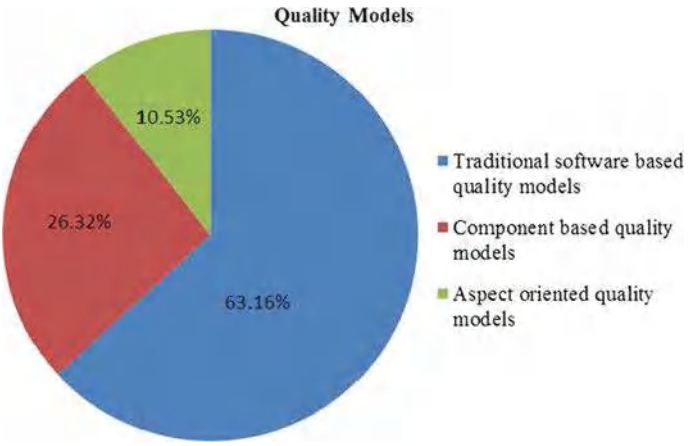

Fig. 1 Distribution of quality models as per the nature of software system

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4 Experimental Work

Experiment is performed in Java Programming language. Data set is prepared in two parts according to Table 3. Data set I, contains 19 rows and 25 columns. Row denotes the quality models and column denotes the quality factors of Table 3. Data set I contains two numeric values 1 and 0. Presence of any quality factor in a particular model is represented as 1 and absence of the quality model in the particular quality model is represented as 0. The data set I is shown in Fig. 2. Figure 3 shows the Data set II, in which the first row defines the number of quality factors, i.e. 25, second row defines the number of quality models, i.e. 19 and third row defines the minimum support (min_sup), i.e. 30 % (Table 2).

After preparing the data set, Java code of Apriori algorithm is executed to generate the result. The working of Apriori algorithm is not mentioned in this paper as the objective is to draw the conclusion regarding the frequent quality factors. Agarwal, Srikant [2] have explained the working of Apriori algorithm. The result

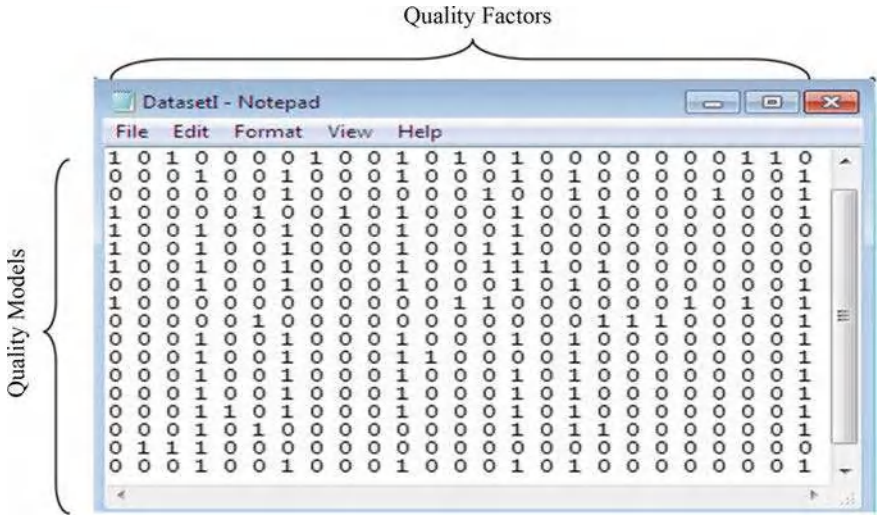

Fig. 2 Data Set I

Fig. 3 Data set II

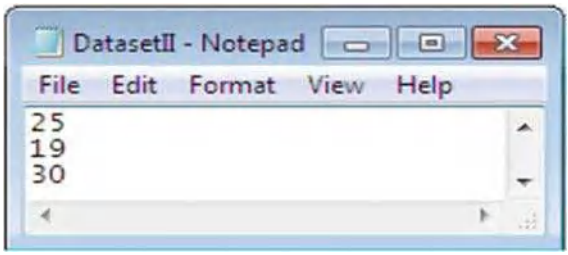

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Table 2 Quality Factors

Quality factors	Symbols	Quality factors	Symbols	Quality factors	Symbols
Availability	F1	Interoperability	F10	Reusability	F18
Correctness	F2	Maintainability	F11	Robustness	F19
Effectiveness	F3	Manageability	F12	Scalability	F20
Efficiency	F4	Modifiability	F13	Security	F21
Evolvability	F5	Performance	F14	Suppportability	F22
Flexibility	F6	Portability	F15	Testability	F23
Functionality	F7	Process Maturity	F16	Understandability	F24
Human Engineering	F8	Reliability	F17	Usability	F25
Integrity	F9				

shows the frequent-6 quality factors. These frequent factors are {F4, F7, F11, F15, F17, F25}. From Table 3 it is clear that the frequent quality factors are efficiency, functionality, maintainability, portability, reliability and usability.

5 Results

After applying Apriori algorithm on Data set I (Fig. 2) and Data set II (Fig. 3), answers to the research questionnaire are framed in this section.

RQ1: How to determine frequently used quality factors?

Frequent quality factors can be determined using data mining techniques. Association rule mining is the technique of data mining which describes various algorithms (Apriori, DHP, FP-Growth, etc.) for mining frequent items sets. These algorithms can be applied on the quality models and its factors to find out the frequently used quality factors. Apriori algorithm is not suitable for the large databases so other data mining algorithms can also be used for the same purpose in the future. In this research paper database of quality models is not too large, so Apriori algorithm is applied to find the frequent quality factors.

RQ2: What all are quality factors being used frequently?

Apriori algorithm is used to find out the frequent quality factors. Java code of Apriori algorithm is used on the data set (shown in Figs. 2 and 3) to find out the results.

Output of the Java code is also shown in Fig. 4. Result shows that {4, 7, 11, 15, 17, 25} are frequent-6 quality factors. After mapping of these quality factors from Table 2 it is easy to understand that {efficiency, functionality, maintainability, portability, reliability, usability} are the six frequently used quality factors. Result also shows the time for generating the frequent quality factors.

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Table 3 Quality factors in different quality models

Quality models / Quality factors	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19
F1	X	X			X	X	X	X		X									
F2	X																	X	
F3	X	X																X	
F4			X			X	X	X	X			X	X	X	X	X	X	X	X
F5																X			
F6	X				X						X						X		
F7			X	X		X	X	X	X			X	X	X	X	X			X
F8		X																	
F9					X														
F10	X																		
F11	X	X	X		X	X	X	X	X			X	X	X	X	X			X
F12													X						
F13		X								X									
F14				X			X	X		X									
F15	X	X	X		X	X	X	X	X			X		X	X	X	X		X
F16								X											
F17			X	X					X			X	X	X	X	X	X		X
F18	X				X			X			X						X		
F19											X								
F20											X								
F21	X									X									

(continued)

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Table 3 (continued)

Quality models / Quality factors	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19
F22				X															
F23	X	X								X									
F24		X																	
F25	X		X	X	X				X	X	X	X	X	X	X	X	X		X

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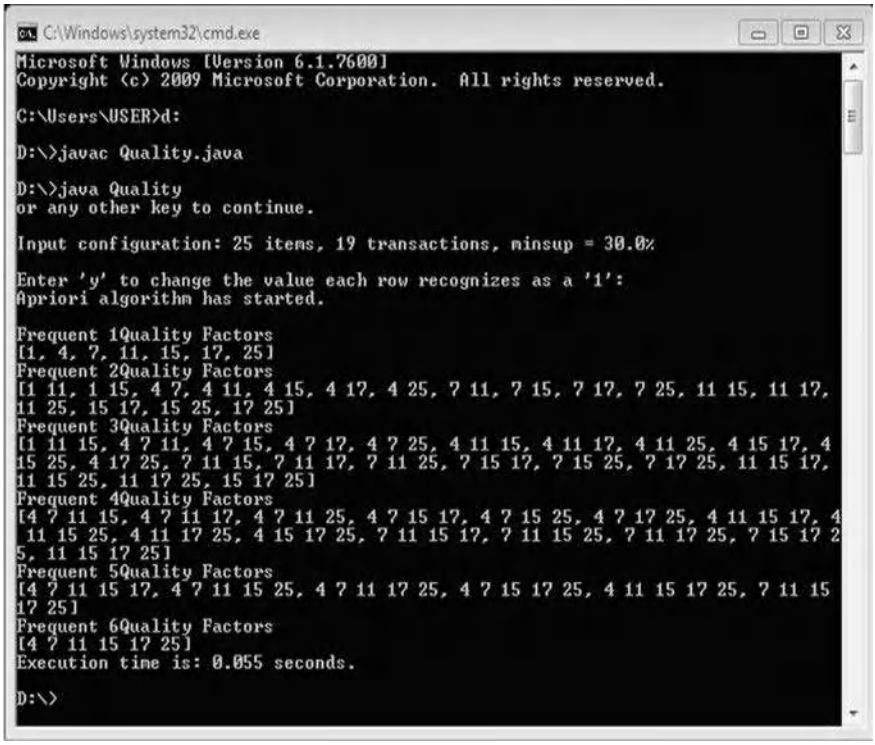

Fig. 4 Output of Frequent Quality Factors

6 Conclusion and Future Scope

Analysis of software quality is a pragmatic approach in the research work. Data mining also has its own importance. This paper presents the combination of data mining along with software quality to work out solution to the research questionnaire framed in this paper. Experiment is performed using Java code of Apriori algorithm and the result of the framed questions show that data mining algorithms can be used to generate the frequent quality factors. Frequent-6 quality factors are identified, viz. efficiency, functionality, maintainability, portability, reliability and usability.

This research work will be helpful to the researchers to measure the software quality in terms of the frequently used quality attributes. In future the objective would be to carry on the research work for the improvement of these frequently used quality factors. These factors will help to measure and improve the software quality, to enhance the acceptability and will also reduce the maintenance cost of the software system. In future work can also be done to identify the subfactors of these frequent quality factors.

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Algorithm for the Enumeration and Identification of Kinematic Chains

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Abstract The applications of kinematic chains are not limited only to mechanical engineering field rather the kinematic chains are used in almost many areas like mechatronics, robot design, medical applications mainly in orthopedics area, medical instruments, physiotherapy exercise machines, and many more. As the kinematic chain is the base for any mechanism, it becomes necessary to generate and identify the unique, nonisomorphic or distinct feasible kinematic chains and have the digital library of the collection of kinematic chains so that they can be retrieved as and when required during the design phase. The objective being identification and enumeration of each kinematic chain with an identification code (digital), canonical numbering being a unique digital code assigned to identify the kinematic chains. In the proposed paper the identification codes, i.e., maxcode and mincode are explained along with an example of Stephenson's chain.

Keywords Kinematic chain · Adjacency matrix · UTAM (Upper Triangular Adjacency Matrix) · Maxcode · Mincode · Decodability

1 Introduction

Structural enumeration of all the distinct feasible kinematic chains with specified number of links and degrees of freedom enables selection of the best possible chain for specified task at the conceptual stage of design. Kinematicians have synthesized kinematic chains unconsciously since time immemorial, Crossley [1], introduced simple algorithm to solve Gruebler's equation for constrained kinematic chains, the Romanian researchers led by Manolescu [2] have used the method of using the Assur groups, the method is based on visual inspection. Davies and Crossley [3] Franke's condensed notation and synthesized kinematic chains for 10-link, single-freedom

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chains and nine-link, two-freedom chains but the studies showed that Franke's diagrams were constructed manually using visual inspection to discard infeasible molecules and binary-link assignments as well as to discard isomorphic alternatives which is necessary test not the sufficient one. Mruthyunjaya [4] recast, the method of transformation of binary chains, to derive simple-jointed chains in a format suitable for computer implementation. Mruthyunjaya, [5, 6] came up with the first fully computerized approach for structural synthesis. Uicker and Raicu [7] proposed for the first time in kinematics literature that characteristic polynomial adjacency matrix (CPAM) of the graph, but for more number of links to find the solution to polynomials was very difficult. Dube and Rao [8] gave a method for isomorphism check to identify distinct mechanism. Rao and Raju [9], Rao [10] proposed the secondary Hamming Number Technique for the generation of planar kinematic chains which was accepted. A major problem is faced all these years has been the absence of a reliable and computationally efficient technique to pick the nonisomorphic chains. The reason why designers have been plodding through so many new routes instead of sticking to what ought to have been a 'straight-as-an-arrow' path is easy to visualize with an implied requirement of decodability.

Read and Corneil [11] remark that a good solution to the coding problem provides a good solution to the isomorphism problem, though, the converse is not necessarily true. This goes to suggest that a successful solution to the isomorphism problem can be obtained through coding. The concept of canonical numbers provides identification codes which are unique for structurally distinct kinematic chains. One important feature of canonical numbers is that they are decodable, and also promises a potentially powerful method of identifying structurally equivalent links and pairs in a kinematic chain. While describing a method of storing the details of adjacency matrix in a binary sequence, maxcode and mincode are the tools for the identification of kinematic chains. The test of isomorphism then reduces to the problem of comparing max/mincodes of the two chains.

1.1 Advantages of the Proposed Method Over Existing Method

A number of studies are made on the enumeration and identification of kinematic chains. A common limitation of the alternative approaches proposed so far, for kinematic chains is that none uses a graph invariant which is complete. Also, the identification codes, developed on the basis of coefficient of structural similarity are not decodable, i.e., for a given identification code, it is not possible to reconstruct the linkage topology on the basis of identification codes alone.

Thus, while using the existing methods one cannot be sure that all the pairs of cospectral kinematic chains can be differentiated successfully. Also Maxcode, a canonical number is never used till now for the enumeration of kinematic chain with which the digital representation of kinematic chain is possible which is very much convenient to have storage and retrieval.

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Hence, in the present paper, concept and algorithm is proposed for the computerized enumeration and identification problem of kinematic chains with the Maxcode, a canonical number. Canonical numbers provide identification codes which are unique for structurally distinct kinematic chains and also they are decodable, and promises a potentially powerful method of identifying structurally equivalent links (Isomorphoic) and pairs in a kinematic chain.

2 Canonical Numbering

According to Ambekar and Agrawal [12, 13] the concepts of maxcode and mincode were introduced as canonical number for the enumeration. For every kinematic chain of n-links, there are $n!$ different ways of labeling the links and hence, $n!$ different binary numbers are possible for the same chain. By arranging these n! binary numbers in an ascending order, two extreme binary numbers can be identified, as significant ones for the same chain. These two binary numbers are: the maximum number and minimum number designated, respectively, as maxcode $M(K)$ and mincode $m(K)$. Since $M(K)$ and $m(K)$ denote two extreme values of binary numbers for a given kinematic chain, and each has a unique position in the hierarchical order and is easily recognized, they are called as canonical numbers. Again each binary number of a given kinematic chain corresponds to a particular adjacency matrix, and hence it also corresponds to a particular labeling scheme.

The unique labeling scheme for the links of a kinematic chain, for which the binary number is in some (either maximum or minimum) canonical form, is called **canonical numbering** (labeling) of the chain. The adjacency matrix, which corresponds to canonical numbering, is said to be in some canonical form.

3 Property of Canonical Numbering

In a binary number an entry of '1' as an $(i + 1)$th digit, counted from the right-hand end, has a contribution to the decimal code equal to 2^i. Also, it follows from the basic property of binary numbers that

$$2^{\mathrm{i}} > 2^0 + 2^1 + 2^2 + 2^3 + \cdots + 2^{(i-1)}. \tag{1}$$

This is obvious because the right-hand side of the above inequality represents summation of terms in geometrical progression and hence, can be shown to be equal to $(2^i - 1)$. This goes to prove that a contribution of any '1', in a binary number, is more significant than even the joint contribution of all the subsequent 'ones' in that binary number. This is fundamental to a basic understanding of any algorithm on maxcode and/or mincode.

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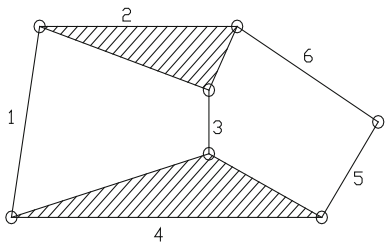

Fig. 1 Stephenson's chain

For the purpose of establishing a binary code one considers upper triangular adjacency matrix for the canonical labeling of the chain. Binary sequence is established by laying strings of zeros and ones in rows, '1' through (i – 1) row, one after the other in a sequence from top to bottom. This binary sequence may be regarded as a binary number illustrated by an example: Consider the **Stephenson's Chain** as shown in Fig. 1 with 6 links: 4 binary and 2 ternary links with single degree of freedom.

According to Bauchabaum and Freudenstein [14] the graphical method to represent kinematic structure consists of polygons and lines representing links of different degrees, connected by small circles representing pairs/joints. It is the powerful tool as it is well suited to computer implementation, using adjacency matrices to represent the graph. The graphical representation of the same chain with arbitrary labeling can be explained in Fig. 2.

For the arbitrarily labeled graph as shown in Fig. 2, the adjacency matrix and the corresponding UTAM (Upper Triangular Adjacency Matrix) is as under

$$A = \begin{vmatrix} 0 & 1 & 0 & 1 & 0 & 0 \\ 1 & 0 & 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 & 0 \\ 1 & 0 & 1 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 0 & 1 & 0 \end{vmatrix} \quad \text{Corresponding UTAM} = \begin{vmatrix} 1 & 0 & 1 & 0 & 0 \\ & 1 & 0 & 0 & 1 \\ & & 1 & 0 & 0 \\ & & & 1 & 0 \\ & & & & 1 \end{vmatrix}$$

There are fifteen entries in the UTAM which, if written consecutively by rows as 10100; 1001; 100; 10; 1; results in a binary sequence = 101001001100101.

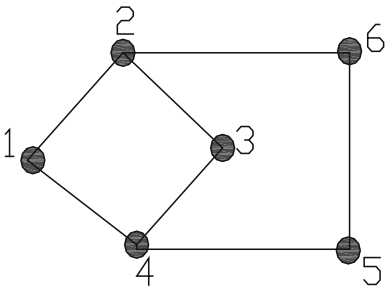

Fig. 2 Graph of chain (arbitrary labeling)

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4 Application of Canonical Numbering with Decodability

Intuitively, the labeling of the same graph can be as in Fig. 3, giving the max code $M(G)$ and the corresponding UTAM

Corresponding binary sequence is: $M(G) = 1110000\ 100\ 100\ 11$. One can look at the resulting strings of 'ones' and 'zeros' as representing digits a binary code. And then it is more convenient to express maxcode in corresponding decimal form as

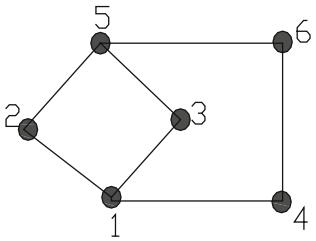
$$M(G) = 1.(2^{14}) + 1.(2^{13}) + 1.(2^{12}) + 0.(2^{11}) + 0.(2^{10}) + 0.(2^{9}) + 0.(2^{8}) + 1.(2^{7}) + 0.(2^{6}) + 0.(2^{5}) + 1.(2^{4}) + 0.(2^{3}) + 0.(2^{2}) + 1.(2^{1}) + 1.(2^{0}) = 28{,}819$$

Intuitively, the labeling of the same graph can be as in Fig. 4 giving the min code $m(G)$ and the corresponding UTAM

In Fig. 4, for min code $m(G)$ corresponding binary sequence is $m(G) = 000110011101100$.

And the corresponding decimal min code is

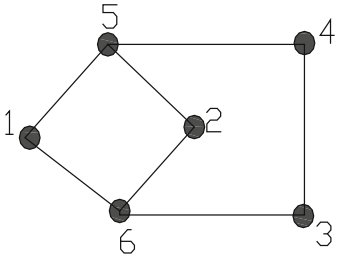
$$m(G) = 0.(2^{14}) + 0.(2^{13}) + 0.(2^{12}) + 1.(2^{11}) + 1.(2^{10}) + 0.(2^{9}) + 0.(2^{8}) + 1.(2^{7}) + 1.(2^{6}) + 1.(2^{5}) + 0.(2^{4}) + 1.(2^{3}) + 1.(2^{2}) + 0.(2^{1}) + 0.(2^{0}) = 3{,}308$$



Corresonding UTAM =

1	**1**	**1**	**0**	**0**
	0	**0**	**1**	**0**
		0	**1**	**0**
			0	**1**
				1

Fig. 3 Graph with maxcode labeling



Corresonding UTAM =

0	**0**	**0**	**1**	**1**
	0	**0**	**1**	**1**
		1	**0**	**1**
			1	**0**
				0

Fig. 4 Graph with mincode labeling

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4.1 Decodability

For the given identification code, it is possible to reconstruct the linkage topology on the basis of these identification codes alone. This is made possible by the division of the identification code by 2. The reminders are arranged sequentially to get again the binary number with which the linkage topology can be reconstructed.

5 Algorithm for Structural Enumeration

An algorithm aimed at providing a computerized approach for enumeration of kinematic chains. The proposed method is based on the concept that the same chain can be generated from any of the n! identification codes, possible for an *n*-link chain. A range of identification codes (*MAXU* ~ *MAXL*) is established on the basis of all possible ways of connecting all *k*-nary links ($k = 2, 3, 4, 5, \ldots$), available for a given permutation of links, to a link with highest number of elements. The range so established is then scanned for generating a valid chain, for every integer value in the range. The algorithm uses decoding process for each integer value, in the range of identification codes, to check as to whether or not it corresponds to a feasible chain. Modified maxcode algorithm has been used to verify whether or not the chain, so generated represents a distinct chain.

5.1 Assortments of Links

The outer bounds on identification numbers *MAXU* and *MAXL* are established based on number of links '*n*' and degree of freedom '*F*' using following relation:

$$F = 3(n-1) - 2\mathrm{T}, \tag{2}$$

where

T number of simple turning pairs
F Degrees of freedom
n Total number of mobile links
n_2 Total number of binary links
n_3 Total number of ternary links
n_4 Total number of quaternary links
n_5 Total number of pentagonal links

$$n = n_2 + n_3 + n_4 + n_5 + \cdots \tag{3}$$

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and

$$2L = 2n_2 + 3n_3 + 4n_4 + 5n_5 + \cdots \tag{4}$$

The link of highest degrees in the chains of this assortment is given by Eq. (4a) and (4b)

$$K = n/2, \quad (\text{when } F \text{ is odd}) \tag{4a}$$

$$K = (n+1)/2. \quad (\text{when } F \text{ is even}) \tag{4b}$$

From Eqs. (3) and (4) the possible combinations of n_2, n_3, n_4, n_5 are established for a given number of links 'n' and given degree of freedom 'F.'

Also it has been shown by Ambekar [15] that minimum number of binary links in a chain of 'n' links and F degree of freedom is given by

$$n_2 = (F+3) + (n_4 + 2n_5 + 3n_6 + \cdots). \tag{5}$$

6 Maxcode Algorithm for Enumeration of Chains

Step 1: Listing all assortments of binary, ternary, etc., links in the chains for given N and F. Assuming any of the link (amongst the available) of highest degree, as link 1 and write down first row of UTAM to extract maximum possible number.

Step 2: The range of Maxcode is established, i.e., upperlimit (MAXU) and lower limit(MAXL) are established.
MAXU—to link 1 connect all links of highest degrees from the remaining so as to produce feasible chains.
MAXL—To link 1 connect all binary links, so as to produce feasible chains.

Step 3: The range is then scanned for every digital number in it for generating feasible chain In the scanning process, the following steps are adopted

Step 3a: MAXL value is selected and its decoding is done to establish a binary code.

Step 3b: From the binary code adjacency matrix is generated which represents the kinematic chain.

Step 3c: To discard the adjacency matrix which does not give feasible chain (by eliminating the adjacency matrix which forms 3-links loop or open chain)

Step 3d: Once the adjacency matrix is selected then maxcode labeling scheme is used to identify the Kinematic Chain.
It is done in following way:

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Step $3d_1$: a single Kinematic Chain if number of schemes of labeling are existing they are printed.
Step $3d_2$: Then establishing the decimal code for each scheme of labeling and pick up only those having maximum value of decimal code for the same Kinematic Chain and that scheme of labeling is known as canonical scheme of labeling

Step 3e: A canonical matrix is derived from a canonical scheme of labeling of links of the given Kinematic chain which is unique for a given chain.

Step 3f: The test of isomorphism then reduces to the problem of comparing maxcodes of the two chains.

Step 3g: Then Kinematic Chain is defined completely with the unique code (maximum) which is further checked for its existence in the earlier trails, if not then it is stored.

7 Conclusion

The present work demonstrates the power and potential of canonical number, in identifying kinematic chains and mechanisms. The scheme of numerical representation of kinematic chains gives unique identification codes for all the chains and mechanisms and are decodable. Thus, the canonical numbering (either maxcode or mincode): being unique and decodable holds great promise in cataloguing (storage and retrieval) of kinematic chains and mechanisms.

The paper also provides a computerized methodology whose maxcode (a tool of canonical numbering) algorithm for enumeration of kinematic chains has been elaborated along with the logic involved in each step which has much faster processing time (by reducing the range of identification codes for limiting computation time) in Sect. 5. The advantage with the generated computer program is the enumeration of distinct kinematic chains with automatic check of isomorphism and the catalogue of kinematic chains with their identification codes. Hence, the difficulty in retrieving kinematic chain discarded erroneously as being cospectral but nonisomorphic, during the process of enumeration has been solved.

The paper presents a method aimed at establishing identification codes, in the form of canonical numbers, have the advantage of decodability and also, in that no two nonisomorphic kinematic chains can ever have the same identification code. Thus even due to errors in labeling, no kinematic chain is likely to be discarded unless it is isomorphic to any of the kinematic chains listed already in the process of enumeration. As the "Identification code", is the numeric value used to represent the kinematic chain, the cataloguing of chains, storage and retrieval of kinematic chains is made easier and faster.

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A New Congestion Avoidance and Mitigation Mechanism Based on Traffic Assignment Factor and Transit Routing in MANET

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Abstract Data communication through wireless channels faces a challenging issue toward congestion and link quality variation. Regardless of mobile or stationary nodes in the network, the link in between the nodes experiences a fluctuation in link quality. Congestion is an intriguing issue, which occurs when there is deterioration in QoS at the link which transports data. This paper describes that an Internet network which is basically a backbone network with wired connection can be utilized for not just Internet services availability but also for mitigating congestion in a network. Data traffic in between nodes in a Mobile Ad hoc Network (MANET) can also be diverted through this backbone network to opt congestion-less environment and higher throughput. This technique is called as transit routing. The proposed protocol is compared with the uniform traffic allocation scheme. The experimental results prove that the proposed method outperforms the existing ones against congestion. It also reduces the packet drop ratio and increases system reliability.

Keywords Congestion control · Multiple paths · Transit routing · MANET

1 Introduction

A MANET is made up of several nodes which are mobile in nature having infrastructure-less decentralize environment [1]. Every mobile node in the MANET having dual nature act as a computing device and a router as well. Routing in

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between a source and a destination node, however, they are not directly in the transmission range of each other, relies on the intermediate routers. MANET nodes lend their hands in data forwarding for special purposes. During route discovery and data transmission phase, a few nodes can find the duplicate data and forward to destination node by using a number of routes. Consequently, more crowd due to the competitions in the nodes and over provisioning in traffic [2–5]. Data can be stored in the node's buffer and hence it results in congestion [6] when insufficient bandwidth is available for data transmission. Thus, it is an area of great concern in MANET to control forwarding of data and congestion control and avoidance techniques. Since we were considering the MANET scenario that already connected with the internet via gateways, the primary goal of an Internet [7] is to offer Internet services to the nodes lies within integrated MANET. Since, the data traffic corresponding to the request and response (request is generated by a host in MANET is responded by a web server placed in the Internet) generated using inherent protocols is routed using the Internet backbone, while the traffic in between two nodes inside the MANET merely routed over wireless connection available in MANET.

This paper illustrates that, how an Internet backbone subnet can also be utilized for routing intra MANET traffic through congestion control. This is called transit routing. This feature has capability to improve the most of the performance metrics and control congestion occurred within MANET, because the Internet subnet is much more trustworthy and carries high bandwidth compared to MANET.

1.1 Theory of Congestion Control System

Congestion control mechanism worries in supervision of control and data traffic [8] within a network. It avoids congestive collapse of a network by preventing unfair allocation of any of either processing or capabilities of a network and also by dropping the rate of sent packets.

(a) **Goals and Metrics of Congestion Control Algorithms**:

Goals for evaluating congestion control mechanisms are:

To achieve fairness and better compatibility with widely used well established protocols.

To achieve maximum bandwidth utilization.

To gain fairness efficiently and effectively.

To sustain high responsiveness.

To reduce the amplitude of oscillations

The rest of this paper is organized as follows. In Sect. 2, related works were discussed. In Sect. 3, we present the congestion avoidance strategy. The simulation results and analysis is given in Sect. 4 and finally in Sect. 5 we conclude the work.

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2 Related Works

In wireless sensor network, congestion control mechanism plays an important role not only to ensure the non overflow environment over the reported samples but also to reduce the energy consumption in sensors so that the network lifetime increases.

Four different congestion control mechanism in the wireless sensor network are briefly described in this section.

In [9], a congestion control scheme is illustrated to control the congestion and to achieve efficient bandwidth allocation for data flow. Packet drop rate is used to detect the congestion on sink node. Since Fairness Aware Congestion Control (FACC) mechanism divided the nodes in two parts, near source nodes and near sink nodes based on their proximity to the source and sink nodes in network. Whenever a packet is lost, a near sink node sends a Warning Message (WM) to any node that lies in the near source region and then a Control Message (CM) is generated by that near source node to the source node after CM arrives to it. After getting the CM from the near source node, the source node adjusts its transmission rate based on the present traffic and newly calculated transmission rate.

An adaptive approach which relies on the learning automata for congestion control is discussed in [10]. The prime concern in this paper is to ensure a tradeoff in between data processing rate and transmission rate so that both are equivalent and hence the congestion occurrences decrease gradually. Each node enabled with an automaton that has ability to learn from existing scenario of network and can take decision based on the learnt information and network characteristics.

Another congestion control algorithm based on node priority index is described in [11]. Each node in the sensor network assigned a priority on the basis of their location and function within network. Nodes which lie near the sink assigned higher priority. The congestion detection in this paper relies on the factor calculated as a ratio of packet transmission rate to the packet arrival rate. If transmission rate is lower than the arrival rate then congestion would occur. The congestion-related information and priority index is piggybacked in the packet header of data packet. Adjustment of sending rate on each node is as per of the congestion at the node itself.

3 Congestion Avoidance Mechanism

In this section, we define some parameters that are used to assign traffic to the most prominent path among the number of paths available in between source and destination.

(i) **Buffer Occupancy (BO)**
The buffer occupancy ratio in node n is denoted as BUn; it is the ratio of the amount of buffered data to buffer size.

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$$\mathrm{BOn} = (\text{Size of buffered data})/(\text{buffer size}) \tag{1}$$

(ii) **Load Factor (LF)**
The load factor is denoted as LFn for node *n*.

$$LF_n = (\mathrm{InFlown}/\mathrm{OutFlown}\ ) \tag{2}$$

Where InFlown = Sum of Inflow velocity at node and OutFn = Sum of Outflow velocity at node *n*.

(iii) **Forwarding Capability Function FC(LF)**
Forwarding capability function is denoted as FC(LFn) for node *n*.

$$FC(LF_n) = \begin{cases} 0, & (1 - LF_n) <= 0 \\ (1 - LF_n), & others \end{cases} \tag{3}$$

where $FC(LF_n) \in [0, 1]$. It infers the node's capability to forward data.

(iv) **Frequency of Node Utilization (FU)**

Frequency of node utilization is represented as FUn, which is the number of paths that uses node *n*. For a number of paths from one source may encompass the node *n* at the same time. Hence, frequency never depends upon number of sources.

Now, suppose a path in MANET encompasses nodes 1, 2, …, *n*, …, *m*, represented as P = {1, 2, …, *n*, …, *m*}. Parameters comprise the occupied ratio of buffers, load factor and frequency of node utilization. The buffer occupancy in path P is denoted as BOP, which means the max of the buffer occupancy Bon

$$\mathrm{BOP} = \max\{\mathrm{BOn} | \mathrm{n} \in \mathrm{P}\} \tag{4}$$

And (1 − BOP) describes the entire path capability to forwarding data.

The value of load factor for path P is represented as LFP, which is the maximum value of the load factor LFn,

$$\mathrm{LFP} = \max\{\mathrm{LFn} | \mathrm{n} \in \mathrm{P}\} \tag{5}$$

Frequency of path utilization is denoted as FUp, Namely

$$\mathrm{FUP} = \max\{\mathrm{FUn} | \mathrm{n} \in \mathrm{P}\} \tag{6}$$

(v) Path Availability Period

Availability period of the path is calculated on the basis of route connectivity extrapolation, where TP denotes the minimum route availability period and Tu is the route availability period in between two intermediate neighborhood nodes in a path from a source (Src) in MANET to the gateway (Gtw).

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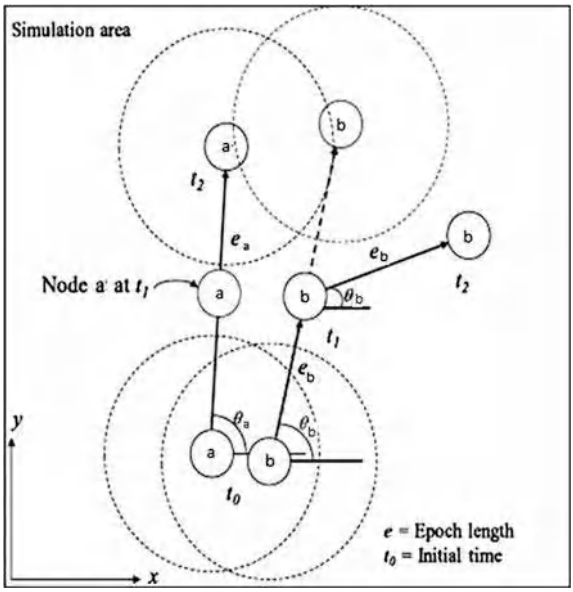

Fig. 1 Mobility pattern in MANET

$$\mathrm{TP} = \min\{\mathrm{Tu}\} \tag{7}$$

where u denotes the link between intermediate nodes in path *P*. In [3], connectivity period of a link Ltu, a link between node m and n, is computed as follows.

In Fig. 1, node *a* and *b* on path *P* are in the transmission range Tr of each other and the current positions of nodes *a* and *b* are (*Xa*, *Ya*) and (*Xb*, *Yb*), respectively.

Suppose θ*a* and θ*b* are moving directions and *va* and *vb* are speeds of node *a* and *b*, respectively. Then, Lu of node *a* and *b* is computed as

$$\mathrm{Lu} = \frac{-(\alpha\beta + \gamma\rho) \pm \sqrt{(\alpha^2 + \gamma^2)tr^2 - (\alpha\rho - \beta\gamma)2}}{\alpha^2 + \gamma^2}$$

where, $\alpha = va\cos\theta a - vb\cos\theta b$, $\beta = xa - xb$, $\gamma = va\sin\theta a - vb\sin\theta b$, and $\rho = ya - yb$.

Finally we compute the *CP* factor, and select the path with highest *CP* value.

$$Cp = \frac{Ep(1 - BOp)FC(LFp)Tp}{FUp} \tag{8}$$

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Source wants to sends traffic that is B bit, available paths are M and requisite paths are R. The traffic assign mechanism can be described as algorithm

Get BOp, LFp, EP, and FUp of every path; Computes Cp, and sorts Cp by desc; Selects R paths having max Cp from m, and assigns traffic as

$$\frac{Cp}{\sum_{1 \le p \le R}} * B \text{ for } p \text{ path.} \tag{9}$$

Traffic is routed through the path having highest value of Cp. With highest Cp value a path has excellent forwarding and receiving capability hence congestion can be reduced significantly. As energy reduces and source increases, congestion may occur in some regions. Hence, MANET required congestion detection and a congestion mitigation mechanism.

3.1 Congestion Detection Mechanism

From the above discussion, conclusion can be drawn as follows. Here we define another factor, i.e., communication capability CCn as follows:

$$CCn = (1 - BOn) * FC(LFn), CCn \in [0, 1] \tag{10}$$

$BOn = 1$ indicates the buffer is full, $LFn \geq 1$ represents that the outflow velocity is less than the inflow velocity which causes congestion within the network. When $BOn = 1$ or $LFn \geq 1$, $CCn = 0$. This will result congestion in the network which causes packet drops. $BOn < 1$ indicates that the buffer is empty, $LFn < 1$ means the outflow velocity is larger than the inflow velocity, which represents the buffer utilized ratio will shrink more. When $BOn < 1$ or $LFn < 1$, $CCn > 0$ then this will result a non congested scenario.

After forwarding the data, nodes lies in the route calculates CCn and send to upstream with PREP packet. If $CCn = 0$, the node prevents itself to receives data. After getting PREP by upstream nodes (not source), they do:

If CCn value in PREP is 0, it represents that nodes in downstream traversal are congested. The node then blocks to send data to downstream nodes and forwards Path Response (PREP) to upstream.

If $CCn > 0$, it represents that the downstream nodes are placed in order. The node starts forwarding data in downstream fashion, and forwards PREP towards upstream. If the CCn in PREP is greater than the CCn of node, the CCn of PREP is updated by the CCn associated with the node. Finally the source node is aware of the fact of congested node if any.

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3.2 Congestion Mitigation Technique

Now we focus on congestion mitigation technique which is based on transit routing. To mitigating the congestion detected in the path, a source node could divert the traffic to the external network via gateway and it is quite efficient and prominent way to mitigating the congestion resides in a particular path.

The basic idea is explored by using a scenario in Fig. 2. As per of scenario in Fig. 2 the actual flow of traffic is passed by internal MANET nodes but as soon as congestion is detected by the source node it make diversion in traffic through the external route, i.e., the internet backbone via gateways. Along with this the source node keep on checking the status of congested node, once the NCi of congested node is greater than zero again the traffic would divert through the inherent way (Internal MANET route). We have shown that the Internet backbone is used for intranet routing efficiently and effectively.

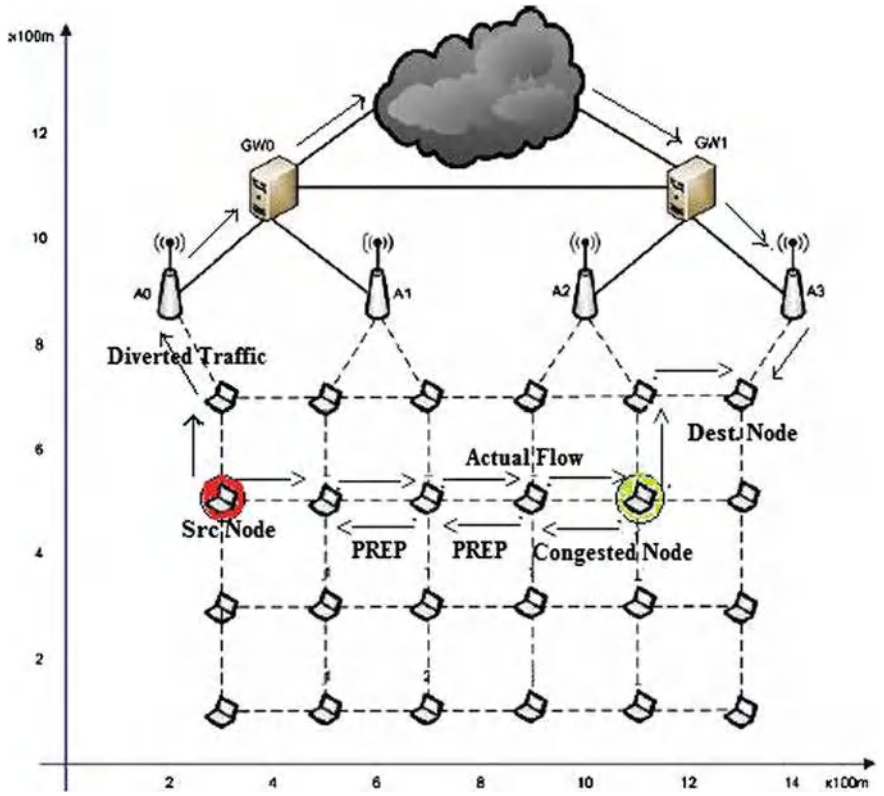

Fig. 2 MANET–Internet integrated scenario

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This is the theoretical approach we have followed to mitigate the congestion in MANET. The use of internet backbone not only for accessing internet services but also for routing the data b/w nodes resides in MANET is referred as a transit routing [4].

4 Simulation and Analysis

This work is simulated using NS2. In this, the mobile host's channel bandwidth is set as 2 Mbps. MAC 802.11 protocol layer is used in this simulation with distributed coordination function (DCF) feature, number of mobile nodes are 100 and the canvas size is 1500 * 1000 m^2. Nodes mobility is set for 100 s only. Transmission range of all nodes is 250 m. This protocol is compared with the Uniform traffic allocation [5]. The experimental results prove that the proposed method exceeds the performance against congestion. Our proposed protocol reduces the packet drop ratio and increases the reliability of system.

In simulation, each source node has a value for sending velocity as shown in Fig. 3. In 0–20 s and 80–100 s, sources are idle. Each source has data rate of 5 packets/s. The data are substantial for neighborhood detection, route maintenance, etc., to keep MANET in proper condition. In 20–60 s, the velocity increases monotonically and the max velocity is 150 packets/s.

Figure 4 is drawn in between our proposed mechanism with the uniform traffic allocation scheme. Packet drop ratio get increases with the increasing in data traffic flow. But the value of packet drop ratio in presented scheme is less than uniform traffic allocation scheme due to consideration of fair congestion state.

In Fig. 5, the reliability of existing and proposed algorithm gets compared. Initially, traffic is low; only one path chooses by source to send the data, so the reliability relies on the value of error ratio of channel and the path disturbances.

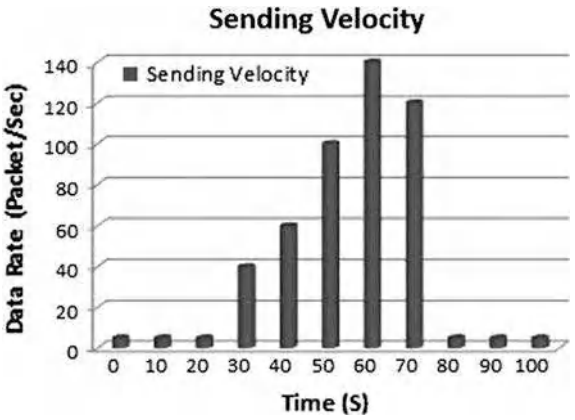

Fig. 3 Sending velocity

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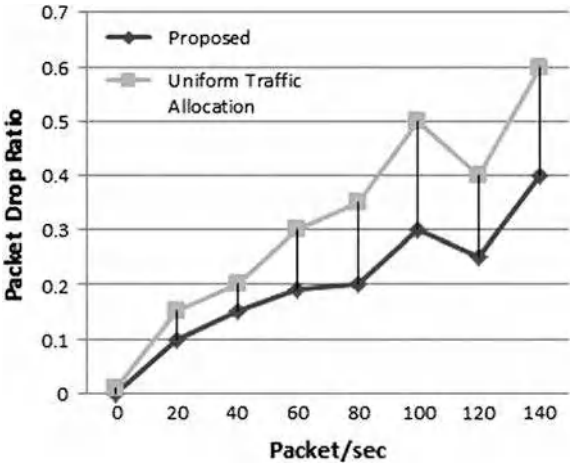

Fig. 4 Packet drop ratio

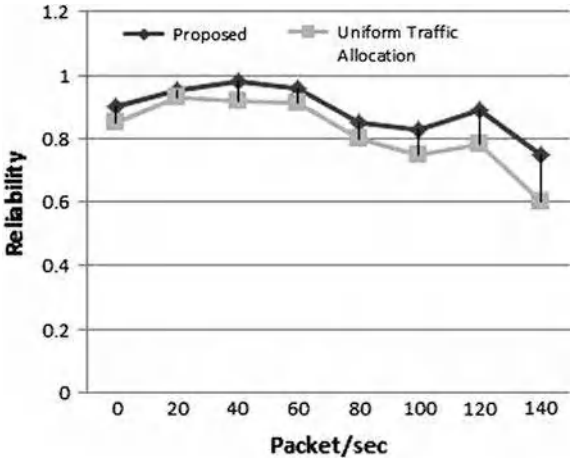

Fig. 5 Reliability

Reliability is increased till data traffic reached 40 packets/s because source adopting different routes in order to send the packets to the destination. Following the traffic is increased and it is reached above 40, the reliability started gradually descending due to the disturbance among paths is increases. Comparatively, the reliability of proposed system is higher.

In Fig. 6, as data rate increases, the throughput increases as well. Moreover, the throughput is higher in proposed system in comparison with existing mechanism.

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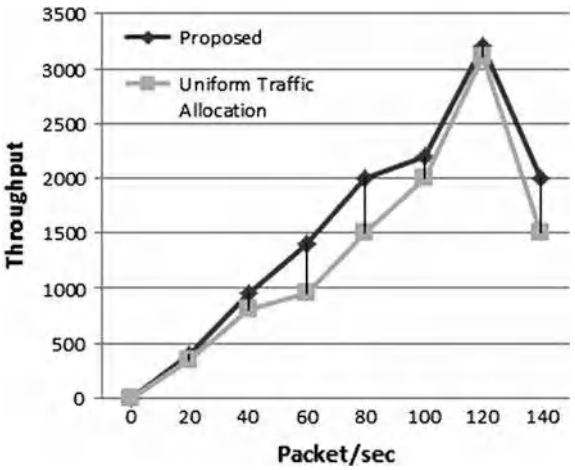

Fig. 6 Throughput

5 Conclusion and Future Directions

The proposed mechanism reduces the congestion within MANET. In this paper, congestion avoidance, detection and mitigation technique is proposed. The outcomes of simulations justify the proposed system and have satisfactory effect in reliability, packet drop ratio and throughput. It also mitigates congestion and provides fast and reliable Internet connectivity for MANET. The performance of the MANET–Internet integrated scenario also improves due to this approach. Results are outperforming to existing approaches.

The future work may include selection of optimal gateway discovery mechanism along with this existing congestion and mitigation scheme.

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MRWDPP: Multipath Routing Wormhole Detection and Prevention Protocol in Mobile Ad Hoc Networks

Ravinder Ahuja, Vinit Saini and Alisha Banga

Abstract A mobile ad hoc network (MANET) is a continuously self-configuring, infrastructureless network of mobile devices connected without wires. Ad hoc is Latin and means "for this" (i.e., for this purpose). The nodes also act as router. Routing is an important aspect of MANETs which is used to find the route which can be used for communication. Traditionally, routing protocols were focused on performance only. But security is also an important aspect. Due to limited bandwidth, limited storage capacity, dynamic topology, shared medium, open peer-to-peer communication, security in MANETs is difficult to implement compared to wired networks. There are number of attacks on routing protocols like routing table overflow attack, black hole attack, wormhole attack, route cache poisoning, sybill attack, modification, fabrication, location spoofing attacks, etc., which affect the functioning of MANETs and degrade the performance. So, there is need to secure routing protocols so that their functioning is not affected and performance is not degraded due to these attacks. A new way of detection and prevention of wormhole attack is proposed in this paper. Dynamic Source Routing (DSR) is converted into multipath routing protocol by changing the way intermediate node forwards the route request packet. The QualNet 5.0.2 simulator [1] is used to validate the proposed approach. Two new packets Dummy_Request and Dummy_Reply are introduced to check the vulnerability of the path. The format of these packets is same as route reply except the option type. The performance parameters used are packet delivery ratio and throughput. The results show that packet delivery ratio and

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throughput under wormhole attack is less compared to protocol without wormhole attack and theMultipath Routing Wormhole Detection and Prevention Protocol (MRWDPP) improves performance under wormhole attack.

Keywords MANETs · Wormhole · Split multipath routing · DSR · AODV

1 Introduction

Wireless networks use frequencies to communicate instead of using some physical cables. There exist two types of wireless networks: infrastructure network and infrastructureless network. MANETs is a type of infrastructureless network because there is no base station, no central administration authority, and no fixed routers. Each device acts as a router also. Security is a big issue for wireless networks in today's environment. Wireless devices usually has limited bandwidth, storage space, and processing capabilities due to which it is harder to reinforce security in wireless network. Routing in mobile ad hoc network is a fundamental task which helps nodes to send and receive packets. Traditionally routing protocols focused on the performance but nowadays security is also important. So either new protocols are being designed which includes security also or security feature is being included in the already existing routing protocols. There are number of attacks on the routing protocols like packet dropping, modification, fabrication, impersonation, Sybil attack, wormhole attack, etc. But wormhole attack is more dangerous and very difficult to find out because it may not modify the packets. For wormhole attack two or more nodes are required. Two nodes are connected via secret channel and communicate through this secret channel. In this attack, if two nodes are far apart, then also it seems that they are close to each other because they are connected through secret channel which is not known to other nodes. Whenever we find the route between source and destination these nodes provides shortest route between them. Once they are on the route between source and destination they can easily do anything on the data packets moving between source and destination. Channel between nodes can be specified by two methods.

Packet Encapsulated Channel: It is also called in-band channel. Two malicious nodes $m1$ and $m2$ create path in advance between them and when source node s broadcasts a routing message, it would be received by node $m1$ and then $m1$ encapsulates this message in payload of the data packet and transmit it using prebuilt path between $m1$ and $m2$. $m2$ after receiving encapsulated packet will extract the RREQ message and broadcast it until it reaches the destination node. Path through which this RREQ packet sent is the shortest path and that is why the destination will reply through this path only to source node.

Out-of-Band Channel: A wired network or private channel is used for communication between two malicious nodes.

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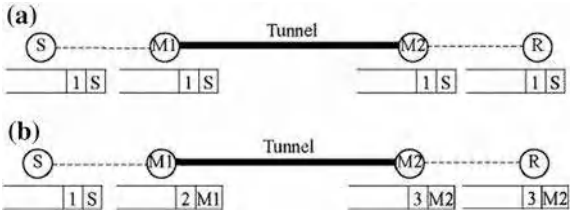

Fig. 1 Types of Wormhole attacks. **a** Hidden attack. **b** Exposed attack

There are two kinds of wormhole attacks [2]. One is hidden attack and the other one exposed attack. In hidden attack malicious node is hidden, legitimate node does not know their presence in the network; and in exposed attack legitimate node knows the existence of wormhole nodes. As shown in Fig. 1.

2 Literature Review

2.1 Packet Leashes [2]

Special information called leash is added in the packet to restrict the packets' maximum allowable distance. Leashes can be geographic leashes and temporal leashes. In geographic leashes each node must know its own location and loosely synchronized clocks. When a node sends packet it includes its location and time, the receiver will check the time and location of packet and calculates the upper bound on the limit between sender and himself. Other techniques of authentication can be used for verification of time and location. In temporal leashes, all nodes are equipped with tightly synchronized clocks. In this sender node, sending the packet includes the time when the packet was sent, *ts*; receiving node compares time t_s (time of sending the packet) with t_r (time at which packet is received). The receiver can calculate how far the packet has traveled. By including the expiration time in the packet temporal leashes can be constructed, after which receiver would not accept the packet. Other techniques of authentication can be used for verification of time.

2.2 WAP: Wormhole Attack Prevention Algorithm in MANETs [3]

This is based on Dynamic source routing (DSR). All nodes monitor their neighbor node behavior while sending RREQ (route request) packet using a special list called neighbor list. Source node receives route reply message from destination and checks whether the routes were under the attack or not. After detecting the wormhole node it is placed in the wormhole node list. In this, radio links are assumed to be bidirectional and wormhole nodes are also having same transmission

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range as normal node. Through route discovery procedure, node detects its neighbor node which is not within the transmission range of the node but pretends to be neighbors. In this protocol, a node cannot reply from cache if it is having route to destination. When a node A sends a RREQ packet to node B, it starts Wormhole Prevention Timer (WPT) and when node B receives RREQ, it broadcasts to all of its neighbors because it is not the destination. Node A can check whether the RREQ arrives within the timer, if node A receives the message after timer expires, it suspects B or one of its next nodes to be wormhole nodes. Each node is having neighbor node table containing sending time, receiving time, count, RREQ sequence number, and neighbor node ID.

2.3 WARP: Wormhole Avoidance Routing Using Anomaly Detection Mechanism [4]

This algorithm is an extension of AODV for security enhancement. It assumed link disjoint multipath into consideration in route discovery phase. During path discovery in WARP, an intermediate node will try to create a route which is not having hot neighbor on its path, which has a higher rate of route formation than a particular value. It may be that a node is placed at a particular position in the network but due to mobility it will not stay there for long time. In this protocol message format of RREQ has been modified and contains an additional field called first_hop which records the first node receiving the RREQ after leaving the source and a new message called RREP_DEC is also introduced whose format is same as RREP. As WARP is multipath, the node that sends RREQ after receiving back RREP sends a packet (RREP_DEC) on the same route to note down which nodes reside on the path. Every intermediate node creates one forward entry toward destination.

Routing Table Format: Routing table is modified and having additional fields (i) first_hop (ii) RREP count and (iii) RREP_DEC count. Anomaly value of neighbor node can be calculated from last two parameters.

$$\text{Anomaly value} = (\text{number of RREP_DEC})/(\text{number of RREP} + 1)$$

Anomaly value represents that a node is malicious node.

2.4 DelPHI: Wormhole Detection Mechanism for Ad Hoc Wireless Network [5]

Delay information and hop count of paths are collected at the sender and delay/hop information is used as a measure for detection of wormhole attack which provides solution to both types of attacks. Delay under wormhole attack is high compared to normal route delay. Path which has high delay/hop is having high probability of under wormhole attack. It consists of two phases such as data collection phase and

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data analyses phase. In this, receiver replies to each RREQ received. It consists of two messages DRREQ (DelPHI route request) and DRREP (DelPHI route reply) and includes a timestamp field, hop field, and hop count field previously. Sender broadcasts DRREQ and after receiving the DRREQ, the receiver replies it with the DRREP packet. Sender can receive multiple DRREP packets. Each DRREP contains the hop count information of the path that is associated with it. By calculating the difference between timestamp carried in DRREP and time at which DRREP is received, we can calculate round trip time of the path. Then sender is able to calculate the delay/hop value of corresponding path. DPH value is calculated and arranged in descending order and finds whether there is large gap between the two than a threshold value; then that path is under wormhole attack.

3 Proposed Methodology

This approach is based on DSR protocol.

Algorithm

Step 1: When a source node wants to send data packets to destination, it will check its route cache for the path to destination node; if valid route is available, then it will use valid route to send data packet. Otherwise, source node will broadcast a route request packet to find the routes to the destination; destination receives multiple route requests from the source and replies to each route request with route reply. Sender will receive multiple route reply from the destination and stores multiple paths to the destination in its route cache.

Step 2: After route setup, sender wants to send data packets to the destination before that it sends a Dummy_Request packet to check the vulnerability of the path. Now, sender will choose one of the paths whose hop count is minimum. It will set the number of packets before next Dummy_Request field in Dummy_Request packet, which will represent how many data packets will be sent before sending next Dummy_Request packet. Sender will set a timer and wait for Dummy_Reply packet.

Step 3: Destination node will receive the Dummy_Request packet and form a Dummy_Reply packet and set the number of data packets received till last dummy_request field. Destination node will reverse the path received in Dummy_Request and send Dummy_Reply packet on this path to source node.

Step 4: If source node receives the Dummy_Reply packet before timeout of Dummy_Request packet, then it will compare the number of data packets received till last dummy_request field received in Dummy_Reply; with set number of packets before next Dummy_Request field sent in previous Dummy_Request. If it matches, path is not under wormhole attack and it starts sending data packets. Meanwhile, if sender has to send data packets,

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then it will start buffering data packets until it receives wormhole free path from source to destination. If sender does not receive Dummy_Reply packet, then it will delete the path from its route cache and selects another path for checking the vulnerability of path.

Step 5: Source node will send fixed number of data packets to destination node which is contained in Dummy_Request packet and then whole process is repeated to check vulnerability of currently using path against wormhole attack.

This approach only checks whether the wormhole nodes are dropping the data packets or not. Detection of wormhole attack is done after few packets have been sent. This approach cannot identify the wormhole link on the route.

4 Simulation and Performance Parameters

The QualNet 5.0.2 simulator [1] is used to simulate and validate the proposed heuristics. Simulation Parameters taken are given below

Scenario-I	
Parameters	Values
Nodes	30
Maximum speed	10 mps
Traffic type	Constant bit rate
Terrain	1000 × 1000 m
Minimum speed	0 mps
Mobility model	Random waypoint
Number of Wormhole links	1
Packet size	512
Packet rate	4 Packets/s
Routing protocol	Multipath routing protocol
Wormhole link	18–19
Simulation time	300 s
Pause time	30, 60, 120, 240, 300

Scenario-II	
Parameters	Values
Nodes	30
Simulation time	100 s
Traffic type	Constant bit rate
Terrain	1000 × 1000 m
Mobility model	Random waypoint
Maximum speed	10 mps

(continued)

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(continued)

Scenario-II	
Parameters	Values
Pause time	30 s
Minimum speed	0 mps
Routing protocol	Multipath Routing Protocol, MPR with proposed approach
Packet size	512
No. of Wormhole links	1, 2, 3, 4
Wormhole link	4–19, 16–21, 23–30, 9–20
Packet rate	4 Packets/s

4.1 Performance Metrics

Packet Delivery Ratio (**PDR**): Packet Delivery is calculated by dividing the total data packets received at destination node to the total data packets sent by source node.

Throughput: Throughput is the successful transmission rate of the network and defined as number of data packets successfully transmitted to destination per time unit. *Throughput* = No. of bytes received * 8 * 100/(Time when last bytes received − Time when first byte received).

5 Results and Discussions

5.1 Results of Multipath Routing Protocol With and Without Wormhole Attack with Varying Pause Time

In this simulation pause time is varied. Pause time is used in random waypoint mobility model in which nodes move in a random direction and stay in a position for certain amount of time. This stay time is called pause time. Previously, performance is measured by varying the node mobility making the network unstable. In this, we have varied the pause time making the network stable. As we increase, the pause time network becomes stable. Threshold value of wormhole is taken 75.

(a) **Packet Delivery Ratio**: In this, only one wormhole link is created between node 18 and node 19. Number of nodes taken is 30. Figure 2a shows that in the presence of wormhole link, packet delivery ratio of multipath routing protocol are decreased. This is because the wormhole nodes drop the data packets passing through them.

(b) **Throughput**: Figure 2b shows that in the presence of wormhole link throughput of multipath routing protocol have been decreased. It is almost half

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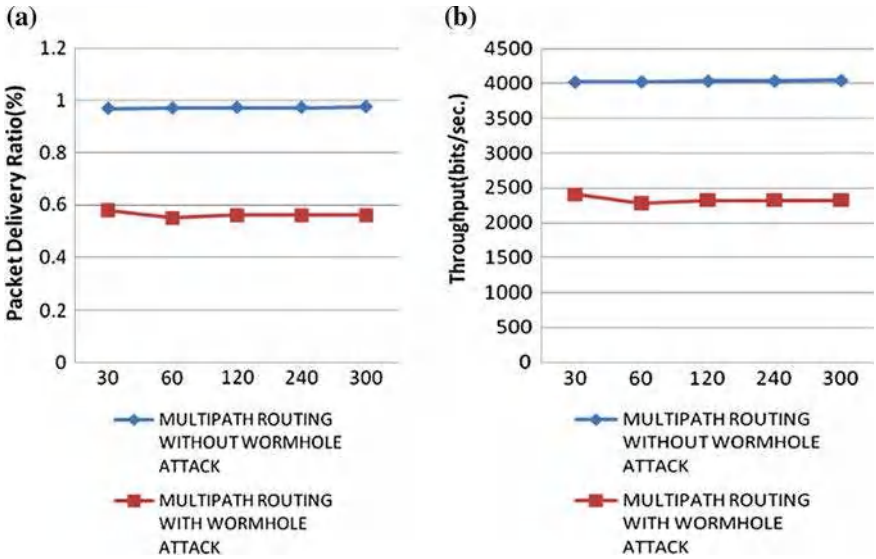

Fig. 2 **a** Packet delivery ratio. **b** Throughput for multipath routing with and without Wormhole attack

the throughput of the network without wormhole attacks. This is because the data packets are dropped by wormhole nodes and bandwidth available is not being used for transmission of data packets. So wormhole attack also decreases the performance of multipath routing protocol.

5.2 *Results of MRWDPP with Multipath Routing Under Wormhole Attack With Variable Wormhole Links*

Scenario-II is taken into consideration. One wormhole link is placed near the source and destination node. Other wormhole links are placed randomly in the network.

(a) **Packet Delivery Ratio**: Figure 3a shows the comparison of MRWDPP with the multipath routing protocol under wormhole attack. Figure 3b shows that multipath routing protocol with MRWDPDP delivers more data packets than multipath routing protocol without new approach; and as there is increase in wormhole links the performance of both is decreased but still MRWDPP delivers more data packets. So effects of wormhole attack on packet delivery ratio of multipath routing protocol are reduced with this approach.

(b) **Throughput**: Figure 3b shows the results of MRWDPP and multipath routing protocol. It shows that in the presence of one wormhole link, throughput of multipath routing is less compared to MRWDPP and as the number of

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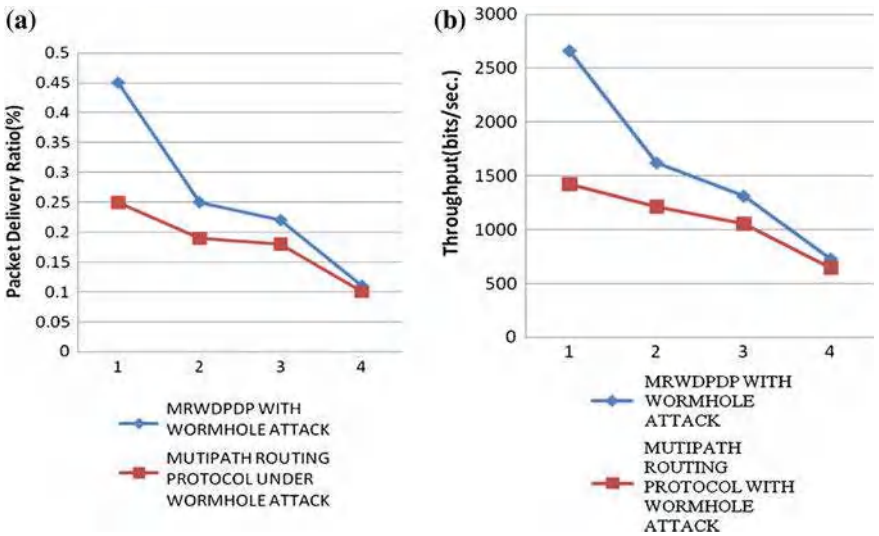

Fig. 3 **a** Packet delivery ratio. **b** Throughput comparison of MRWDPP with multipath routing protocol under wormhole attack with varying number of wormhole link

wormhole links increases throughput of both decreases but MRWDPDP still has higher throughput than the multipath routing protocol. So the solution has eliminated the effects of wormhole on the multipath routing protocol.

6 Conclusions

In this paper, approach for detection and prevention of wormhole attack on multipath routing protocol is proposed called MRWDPP. Two new packets Dummy_Request and Dummy_Reply are introduced. DSR protocol is first converted to multipath routing protocol by changing the way intermediate node forwards the route request. By changing DSR, it becomes multipath routing protocol and during discovery of route from source to destination multiple routes are collected. Performance of multipath routing is measured by changing the pause time (making the network stable) and performance of MRWDPP and multipath routing is evaluated and compared by varying the wormhole links. Results show that (i) Performance of DSR routing protocol is decreased by half under wormhole attack (ii) Performance of DSR routing protocol decreases with the increase in wormhole links (iii) Performance of multipath routing protocol also decreases under wormhole attack (iv) MRWDPP increases the packet delivery ratio and throughput of multipath routing protocol in the presence of wormhole attack compared to multipath routing protocol under wormhole attack.

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Comparison of Our Approach with Existing Approaches

Protocol	Based	Extra hardware	Clock synchronization	Mobility	QoS parameters
Packet Leashes [2]	None	Yes	Yes	No	No
Distance Verification and Hypothesis Testing [6]	None	Yes	No	Yes	No
WAP [3]	DSR	No	No	Yes	Throughput, PDR
WARP [4]	AODV	No	No	Yes	Packet loss rate
DelPhi [5]	AODV	No	No	No	No
SEEEP [7]	None	Yes	No	Yes	No
MHA [8]	AODV	No	No	Yes	Not considered
Wormeros [9]	None	No	Time synchronization not considered, RTT between nodes is considered	Topology change is not considered	Not considered
MRWDPP (Our approach)	Multipath routing	No	No	Yes	PDR, throughput

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Self-coordinating Bus Route System to Avoid Bus Bunching

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Abstract This paper elucidates the problem on bus bunching and the proposed solution to the problem. The motive is to consider the density of passengers and schedule the bus based on the density. The system is capable of considering the density by user-friendly mobile application. The mobile application is accessible within the personal area communication range of the bus terminus. The whole system is controlled by a low power, highly sustainable, and secured wireless technology. The main advantage of this proposal is to reduce unnecessary running of the buses, by which the fuel consumption is reduced and passengers need not wait for a longer time for the buses. The outcome of this result is to establish a well-maintained public transportation by reducing the problem of bus bunching.

Keywords Ad Hoc networks · WSN · ZigBee · IOT · Public transport · Bus bunching

1 Introduction

Traveling through buses is one of the main means of transport in our country. Population of over one million people chooses bus as the means to travel to different places in urban as well as rural areas. Buses take around 90 % of public transport in Indian cities, and serve a cheap and convenient mode of transport for all

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classes of society. To make the public bus service helpful for passengers, the proper bus schedule is maintained. However, it is impossible to maintain equal headways between buses because of variability in traffic and in the boarding and de-boarding of passengers, which leads to bunching of buses. This paper provides a solution to the problem of bus bunching, which is bothering both passengers and operators in public transportation system. The bus bunching problem typically means buses of the same service route getting too close together so that they "bunch" each other. It is undesired because it usually increases the waiting time of passengers before and after the arrival of the bunched buses. Several approaches have been proposed to reduce bus bunching, in particular bus routing, bus stop planning and bus scheduling. One of them is using GPS system [1] and another one is using IR sensors and Microcontroller [2]. In this paper cause of the bus bunching problem is analyzed, and proposed a new solution taking the density of people into consideration in scheduling the buses to different areas. This paper facilitates the use of reliable low power, self-healing, and highly secured personal area network wireless communication protocol [3].

2 Project Organization and Framework

The whole working system is organized in three stages: refer Fig. 1.

Stage A: Monitoring Department
This is the initial stage and here the role of monitoring department is to keep track of the information acquired from the other stages, until the assignment of locations to the bus, arrived at the terminal. The bus is detected, as it arrives at the bus terminus and the previous location tagline on the bus is erased and in concert the passenger density information from the successive stage is acquired.

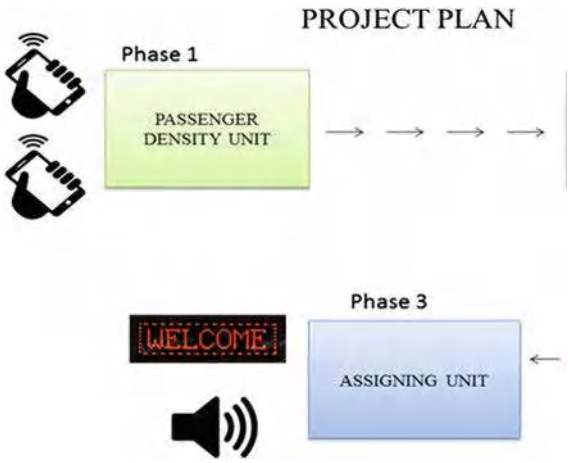

Fig. 1 Project framework

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Stage B: Bus terminus Wi-Fi range
This is the eminent stage, as the density of the passenger is conveyed to the stage A. The passenger density is monitored using an app, which is easily accessible by all the passengers. The mobile application can be easily accessible within the Wi-Fi range of bus terminus. The application has the list of locations and the information of lanes. The passengers have to select the locations. Based on the density of the passengers the buses are rescheduled.

Stage C: Assignment of locations
In this stage the information regarding the density of passengers is considered from the preceding stages and based on that the assignment of locations to the bus is done. The information of the passenger density from the different lanes is compared and the lane with the higher density is given the priority and the bus is allocated to that particular lane.

3 Proposed Methodology

3.1 ZigBee

ZigBee is a specification for set of high-level communication protocols using tiny, low-power digital radios based on IEEE 802 standard for personal area networks. For controlling of traffic management ZigBee has been implemented. ZigBee devices are suitable for providing wireless capability to any product with serial data

Table 1 ZigBee specification

Specifications	Range
Maximum transmit power	1 mW
RF data rate	250 kbps
Receiver sensitivity	−92 dBm
Serial interface data rate	Maximum 115200 baud
Antenna options	Chip & wire antenna
Operating temperature	−40 to 85 °C

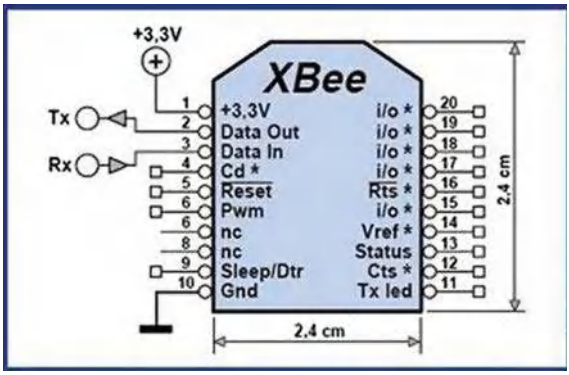

Fig. 2 Pin configuration of ZigBee

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interface. ZigBee is a low-cost, low-power wireless mesh network standard. The low cost allows the technology to be widely used deployed in wireless control and monitoring system. Low-power usage allows longer life with smaller batteries. The specifications of ZigBee are as follows (Table 1 and Fig. 2).

3.2 Arduino

The microcontroller is heart of the system which acts as a central controller for the different phases. In search of microcontroller which has low cost, high speed, reliable and is efficient in performing the defined task, we came across a flexible software programming, easy-to-use open-source prototyping Arduino board. Ardunio board is one type of a microcontroller board which comes with an easy provision of connecting with the CPU of the computer using serial communication over USB as it contains built-in power and reset circuitry. The reason for the selection of Arduino is in view of its attractive features and simpler process of work with microcontrollers. Arduino board basically includes the hardware architecture where the program code and program data have separate memory. Programs are stored in flash memory and data is stored in SRAM.

The hardware architecture has the best applications in embedded system, when things get complicated the process start getting quicker in such systems. The Arduino has a series of development boards of which the Arduino UNO is best suited for our purpose. The technical specifications of Arduino UNO board are as shown in Table 2.

3.3 Android Mobile Application

Nowadays number of passengers possessing and using smartphones is increased rapidly. While their interest for mobile applications that enable the storage, analysis, and visualization of the collected space time information is apparent.

Table 2 Arduino specification

Features specifications	
Microcontroller	ATmega328
Operating voltage	5 V
Input voltage	7–12 V
Input voltage (limits)	6–20 V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog input pins	6
DC current per I/O Pin	40 mA
Flash memory	32 KB of which 2 KB used by boot loader
SRAM	2 KB
EEPROM	1 KB
Clock speed	16 MHz

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There are many apps used for wireless technology. Some of the general purpose apps are “My Tracks” [4], “And Ando” [5], “GPS Tracker” [6], and “Every Trail” [7]. In our proposal we are going to develop an app with eclipse software as open source software development project, Eclipse focuses on providing a full functional platform for the integrated tool development. In this paper we develop an app based on the eclipse platform because it can work well in different systems, and it is an outstanding simulator management console. Eclipse uses plug-ins to provide all the functionality within and on top of the runtime system. Its runtime system is based on Equinox, an implementation of the core framework specification. In addition to allowing the Eclipse Platform to be extended using other programming languages, such as C and python, the plug-in framework allows the Eclipse Platform to work with typesetting languages like LaTeX and networking applications such as telnet and database management systems (Fig. 3).

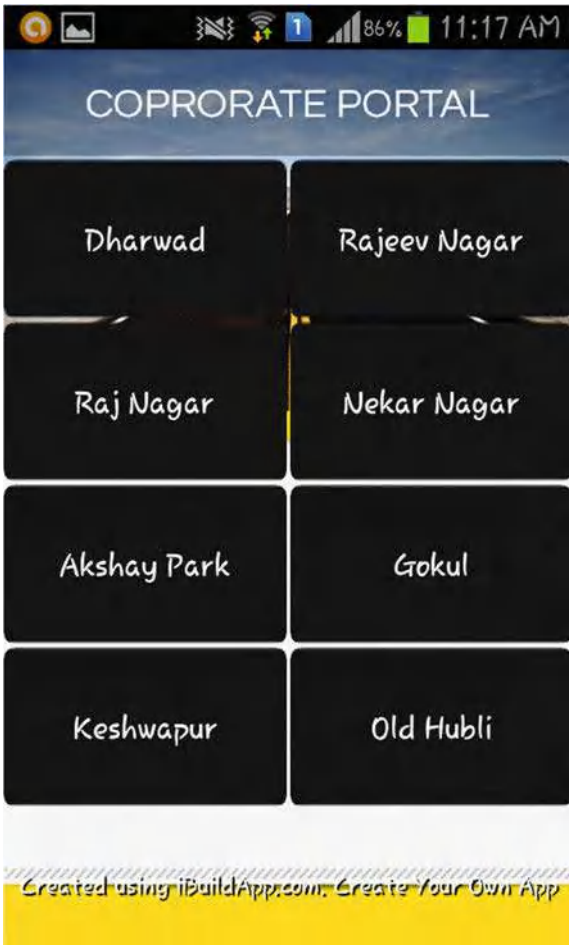

Fig. 3 Home screen of an application

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4 System Implementation

The project proposal is implemented using a low-power wireless technology ZigBee and Arduino UNO R3, and a mobile application which is accessible within the Wi-Fi range of the bus terminus. The Mobile App has the display of different locations; the passenger has to click on the destination location. One click depicts one passenger at the lane. One click through the app, the proxy of Ethernet gets connected in turn to the Arduino and the count gets incremented. The passenger gets the confirmation voice notification once his density count is considered. As explained earlier, the whole procedure is divided into three different stages, the flow of the system procedure is shown [8]. The passenger density information acquired from the mobile app is received by the Ethernet present at the monitoring department, the Arduino compares the densities of the different lanes, and the pin Tx [1] of Arduino triggers and the output signal from Rx is received by pin 3 of ZigBee that is data-in. From ZigBee data-out pin2 (Fig. 1), the information is sent to pin3 of the other ZigBee transmitter fit in the bus. The ZigBee is in turn interfaced with Arduino board which is connected to LCD. The location of the place is displayed on the LCD screen (Figs. 4, 5 and 6).

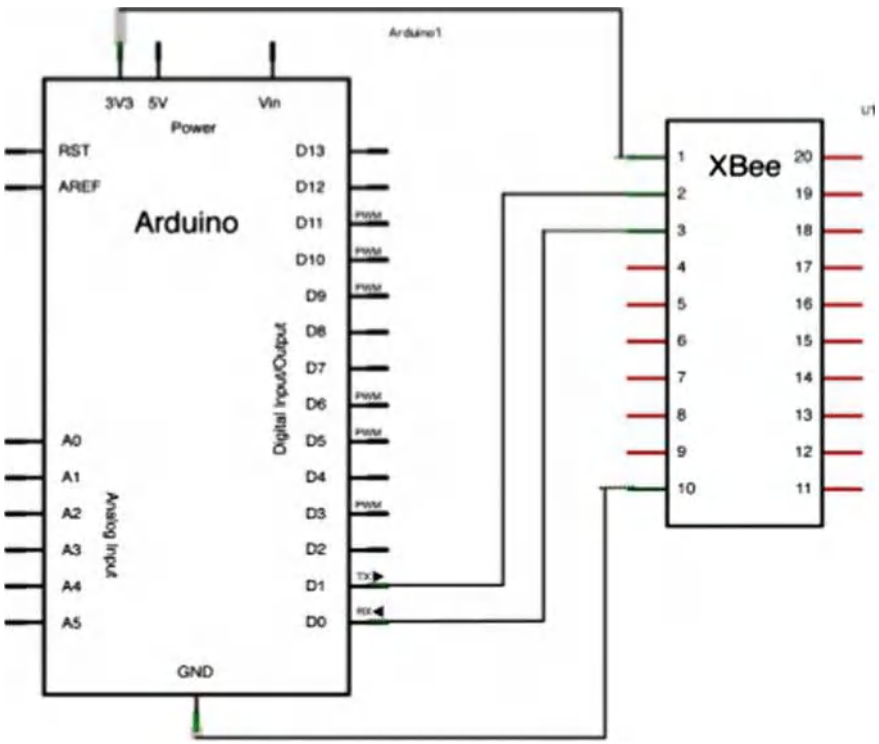

Fig. 4 Interfacing of Arduino and Xbee

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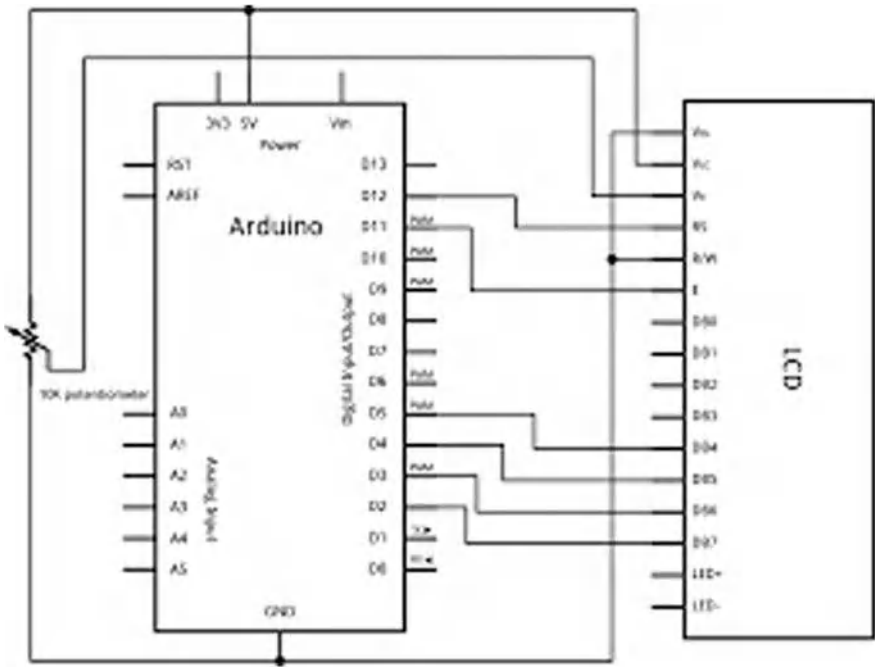

Fig. 5 Interfacing of Arduino and LCD

5 Results and Conclusions

- Delay time in the running of buses is reduced.
- Passengers need not wait for a long time at the terminus for buses, as buses are allocated based on the passenger density.
- Unnecessary running of the buses is reduced.
- Well-managed public transport system in the society. The traffic congestions, road blockages due to traffic and road accidents can be reduced.
- Circulation of buses in cities only when required reduces the amount of the fuel energy consumed.

This project proposal has a very promising future, the system can be extended to an extent where the passengers can get the tickets automatically at the lanes by providing the fixed fare, and even their bank accounts can be linked to the ticket generating system, so that the transactions take place automatically. It is efficient in terms of security also, as the monitoring or the controlling systems are

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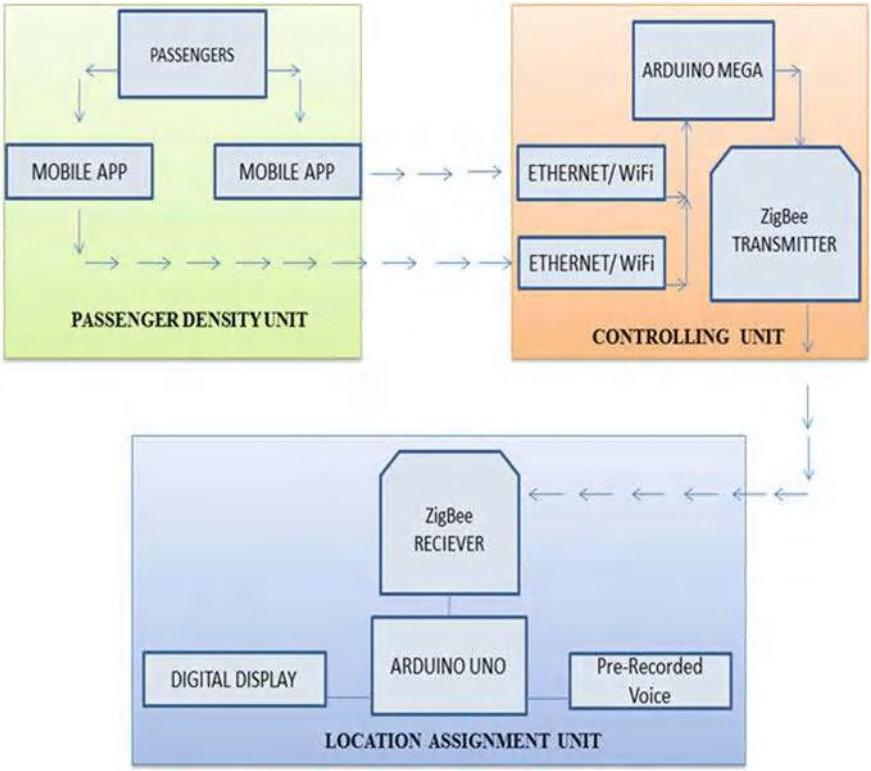

Fig. 6 Block diagram of the system

interconnected and in case of any consequences the passenger can contact the controlling department.

This paper provides the very efficient way of transport to public. It will play a very vital role in the field of Traffic and Transportation. In India bus transportation segment accounts for about 70 % of fuel consumption. In cities the Buses circulate according to the scheduled time, irrespective of the passenger density. Our project aims on scheduling the buses only when the density of passengers increases above the specified passenger density limit. Hence, the unnecessary running of scheduled buses and fuel consumption by them is reduced. The passengers can access the mobile application which is user friendly to know the status of buses. The density of passengers is obtained from the mobile application. The app is developed such that it displays different locations (Figs. 7 and 8).

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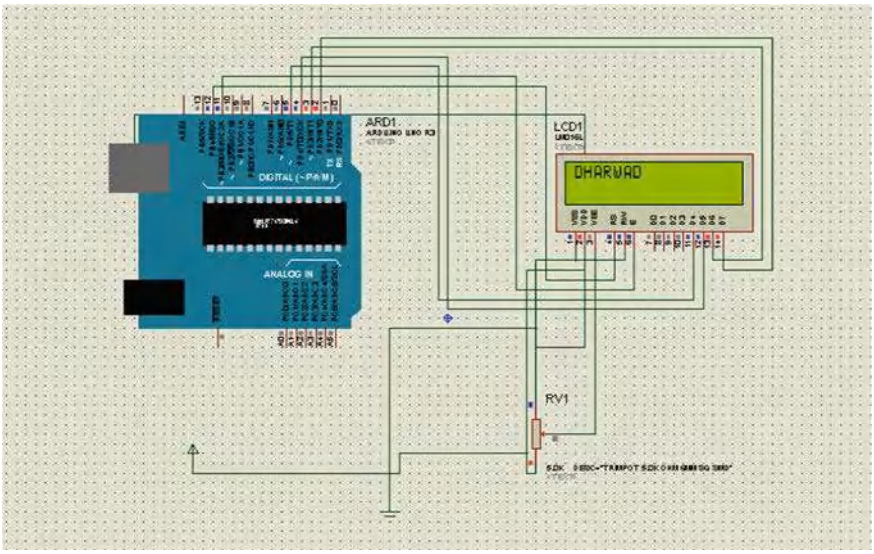

Fig. 7 Simulation results of Interfacing Arduino with LCD

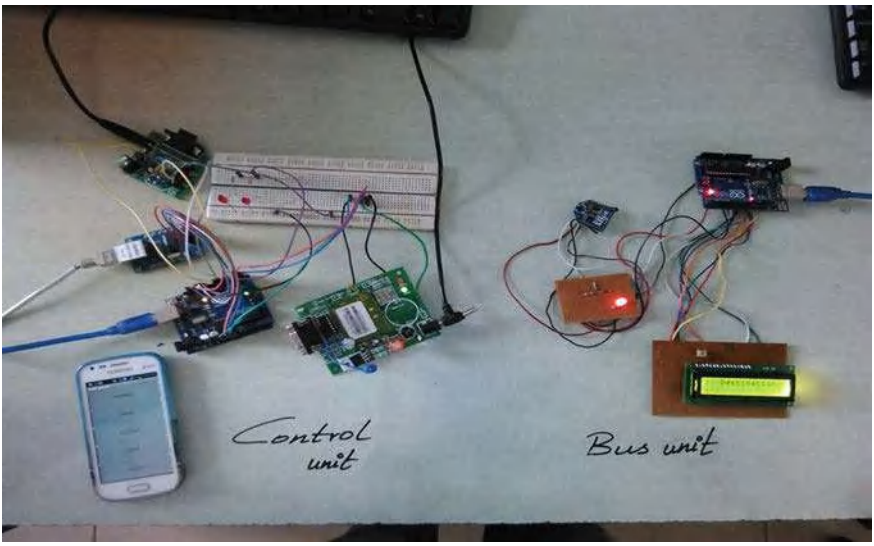

Fig. 8 Hardware implementation

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Review on Data Hiding in Motion Vectors and in Intra-Prediction Modes for Video Compression

K. Sridhar, Syed Abdul Sattar and M. Chandra Mohan

Abstract In this paper, the main objective is an inter-frame data hiding in motion vectors and data hiding through intra-frame prediction method. Data hiding in the compression video is through motion vectors, i.e., embedding data in phase angle between two successive CMVs, with the best matching macroblock-based search. Another method is through 4 × 4 intra-prediction macroblocks. In this paper, we proposed two new advanced embedding scheme and steganography. By the inter-frame motion vectors and through intra-prediction modes, we can embed with more efficiency. The main advantage of the proposed method is that data hiding video is stego video and cannot understood by any hackers and maintains good perceptual quality of video.

Keywords Data hiding · Motion vectors · CMV · Intra-prediction · Steganography

1 Introduction

For secrete communication copy right protection and authentication for new applications, data hiding is required for image and video processing, to avoid illegal activity or reproduce or manipulate them in order to change their owners identity. Digital water marking and data hiding are the techniques providing best embedding and copy right information in images and videos [1]. The aim of water marking is

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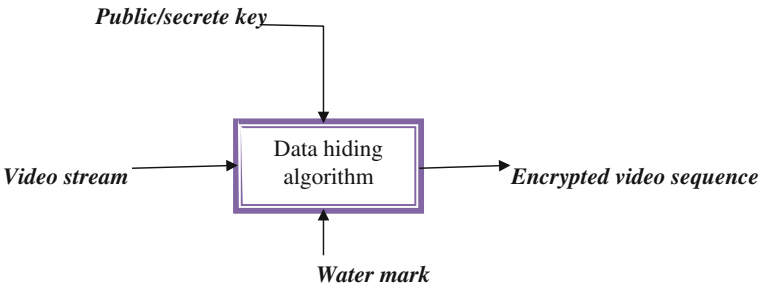

Fig. 1 Model of embedding technique

not to restrict to the original image to access and ensure that embedding data again recoverable [1]. Developers seeking for providing protection on top of data encryption and scrambling for content protection. Developers seeking to protect owner information (water mark) embedded in original image or video. Cryptography converts into cipher text and it cannot be understood as shown in Fig. 1. A basic model of embedding and steganography is shown below.

Data hiding techniques have become more important since two decades in various applications. For data hiding, so many techniques and algorithms introduced for digital images and videos. Nowadays, audio and video and picture frames with hidden copy right symbol help to avoid un authorized copying directly [2]. Hackers may modify the script of particular organization or revel the information to others. A lot of researches have been done in this field and many techniques are introduced, but due to drawbacks in techniques quality of video like sudden change in frames or noise is disturbed. All the above problems solved by high hiding techniques and steganography. Even though the host data is damaged, this steganography make more complexity to obtain the data.

2 Related Work

VIDEO COMPRESSION: Video compression techniques are used to minimize redundancy in video data with unchanged video quality, it mostly used in video conferences and military communication applications and real-time applications [3]. For motion-based video compressed process, motion estimation and motion compensation techniques are used for temporal redundancy in frames. We target the motion vectors to encode and reconstruct the video, both the predictive (p)-frame and bidirectional (b)-frames used for getting motion vectors to embed the secrete data by LSB method.

For motion vectors, we have two successive methods: one is associated macroblock prediction error and other is using magnitude and phase angle in motion vectors and before this the most common method is temporal differencing is used [4].

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It compares the current frame with previous frame then the current frame is threshold to segment out four ground object, but this technique also has disadvantages. Due to these reasons, authors suggested video coding by motion vectors. Basic idea behind these techniques is all consecutive frames are having same similarities both before and after frames.

The aim is to reduce this redundancy by block-based motions, for this approach motion estimation is required. The consecutive frame is similar but except some objects moving the within the frames. The most accurate motion is estimated and matched for residual error nearer to zero and coding efficiency will be high. In the motion vectors the predicted frame is subtracted from current frame, the data bits are hidden in some of motion vectors that too in CMVs. These CMVs magnitude is having an above a predefined threshold value.

Here we have two approaches,

1. ***Embedding in motion vectors*** (***i.e., candidate motion vectors***).
2. ***Intra-prediction modes***.

3 Embedding in Motion Vectors

We hide the data in video using phase angle between two consecutive CMVs, the data bit code is embedded depend up on phase angle criteria, depends on phase angle sectors [5]. This method is used for entire CMVs in all frames and also at data retrieving place.

The below figure explains each macr block in a predicted frame can be encoded as motion vector (Fig. 2).

Up to now, we know data hiding and water marking in digital [6] Images and raw videos data hiding in motion vector for compression. The message should be surviving video lossy compression and without loss extracted. A novel video water mark technique in motion vectors explained with simple diagram is mentioned in (Fig. 3).

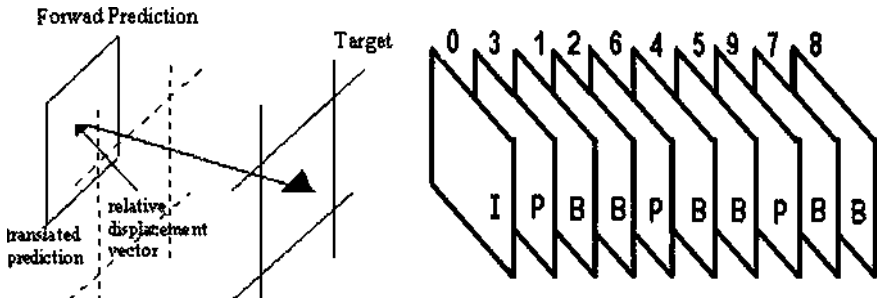

Fig. 2 Forward prediction and GOP in compressed video

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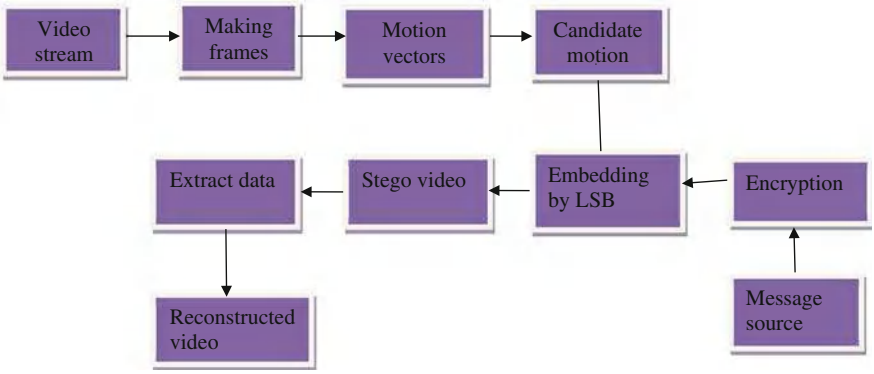

Fig. 3 Advanced data hiding scheme

Figure 3 explains that for video compression basic step is continue video and is converted into number of frames, which depends up on mpeg format; we have predictive (p)-frame and bidirectional (b)-frame. After conversion of frames with motion estimation process, we can reduce temporal redundancy. Motion estimation compares adjacent frames, the displacement of macroblock from reference frame to current frame called motion vector [7] by motion compensation an algorithm employed for video compression.

In general, the video format have 'IPBBPBBPI' of frames, we select p-frame and b-frame for embedding. In intra-frame, we need no remember search area that is limited for best match. In general MBs are usually multiple of 4(16×16, 16×8, 8×16, 8×8), and further dividing into transform blocks, and again subdivide into predictive blocks, after making fixed transform blocks, block search starts in reference frame with current frame, search is continues for best matching for least prediction error. If matched block is found, it is it is encoded by vector called motion vector.

1. ***Candidate motion vectors*** (***CMVs***): candidate motion vector means encoder find best matched block for encode by vector for motion vector [8], in those motion vectors some of the motion vectors having magnitude greater than threshold value called candidate motion vectors. We find that best motion vectors are arranged as set ***S***, which is having magnitude greater the threshold ***T***. Embedding single bit in phase angle between two successive CMVs. Embedding is done using least significant approach.

$$S = \{MV0, MV1 \ldots .MVn-1\}, |S| = n$$

where $\left| MVi \right| \geq T, 0 \leq i \leq n$, we can compute phase angle $\theta i = \arctan(\frac{MViv}{MVih})$, where *MVi* and *MVih* are vertical and horizontal components.

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ALGORITHM:

Step 1: *Video is converted into frames (frame separation).*
Step 2: *Select P-frame and B-frames for embedding.*
Step 3: *Performing motion estimation and motion selecting best match block motion.*
Step 4: *Embedding bits in phase angle between two successive CMSs.*
Step 5: *Apply secrete key for encryption.*
Step 6: *Generate stego video.*

For encryption, steganography is the process to convert message into cipher text, [9]. The advantage of steganography is that data keeps in secrecy key is need in encryption process. RSA algorithm is the best suitable for data secrecy we get good PSNR value after extraction.

2. ***Another Advanced Method***: Because of data size increased at extraction time for video [2], the new method explains as up to now we are considering p-frame and b-frame for embedding now I-frame is also encoded for using regular method like jpeg, At decoder will extracted independently I-frame, p-frame, and b-frame. We know that video is making like no of group of pictures in each GOP I-frame-frame and P-frame will be there as for mpeg format. The relative information or redundancy is employed by temporal redundancy by using block-based motion estimation, here also single bit hidden in CMVs. In this scheme, data bits will increase by block size decreasing, here code efficiency is increasing because microblocks increased in intra-frame, it is increasing the more searching option for best match, it increases best video quality.

4 Intra-PredictionModes

Another important data hiding technique is data hiding using intra-prediction modes. For video coding, several methods have been proposed in H.264/AVC compressed video standard. Coding efficiency is compare more with previous standards. For this standard, the 4×4 spatial intra-predictions provide good quality at decoder.

Some works have been done [10]' on data hiding with the Intra-prediction modes. Authors have penned the data hiding methods by modifying the intra 4×4 prediction modes with a technique that is mapping between the modes and hidden private data. For this in the H.264/AVC standard, the intra-prediction uses in the spatial correlation method. A desired macroblock can be predicted from macroblocks, which have been encoded and decoded [11]. The subtraction from the current macroblock is coded and represented with a few number of bits analyzed with the macroblock used for the processing of the macroblock itself. In all modes, we need to select one 4×4 mode for embedding and coding.

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This intra-prediction mode shows convenient for area of significant details in the picture. One block divide into 16 4 × 4 macroblocks in that A TO M are the already encoded samples and other are to be encoded. The modes are decided by formula called rate distortion optimization (RDO).

$$J = d + \lambda \, \mathbf{mode} * R$$

where R and D represent bit rate and distortion, λ mode represents lagrangian multiplier which represents quantization parameter (Fig. 4).

The modes classified an groups listed below

In Group one: Mode 1 and mode 8.

In Group two: Mode 3 and mode 7.

In Group three: Mode 2, mode 4, mode 5 and mode 6.

In Group four: Mode 0 and mode 2.

The embedding process as follows for group 1 the horizontal mode unchanged by embedding 1. Same way if we embed 0 to mode 8, its remains same. Similar way by modification '00' to mode 4, it becomes 2, '01' to mode 4 it is equal to 6. In this way embedding and extraction takes place.

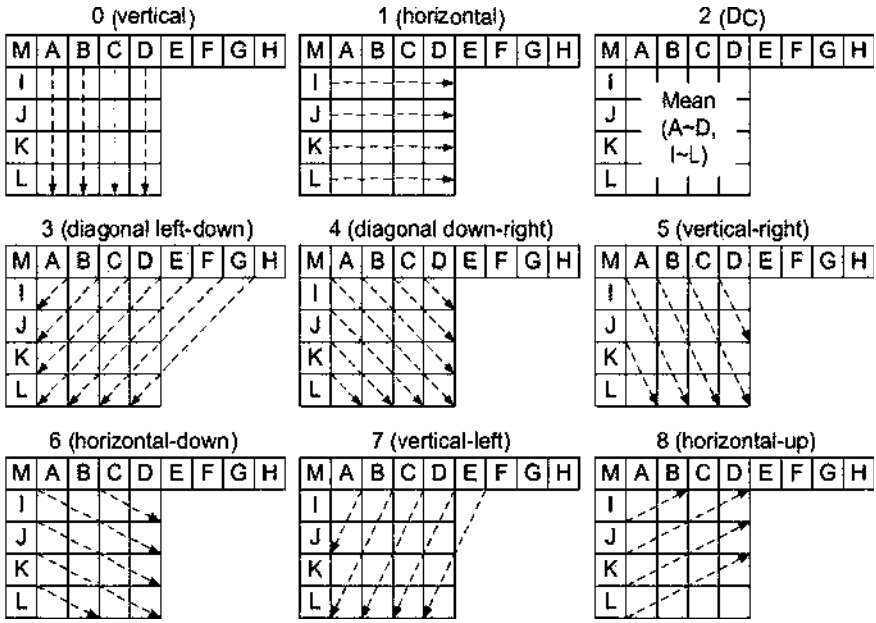

Fig. 4 Types of modes in intra-prediction

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5 Conclusion

We discussed in this chapter the improved methods for data hiding. Depending up on macro block size and best matched motion vectors, we can embed single bit in phase angle between two successive CMVs and also suggested popular steganogrphy method for data secrecy. We can decrease bandwidth of video by small microblock intra-frame for the best match block. This algorithm can extend in future for different transform domain with embedding techniques for good perceptual quality.

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Generation of Product Cipher for Secure Encryption and Decryption Based on Vedic Encryption Ideology and Using Variable and Multiple Keys

Vaishnavi Kamat

Abstract Information Security in the recent years has become an important area. There is always a necessity for exchanging information secretly between the sender and the receiver. Cryptography reveals its deep roots of history in providing a way to transmit the sensitive information across networks, so that only the intended recipient can read it. There are several methods of encryption and decryption developed to improve the security of the information being transmitted over last few years. Evidence of encryption is evidently present in the Ancient-Vedic Indian period for example in Sri Ram Shalakha, the placement of couplets. In this paper, a contemporary approach is developed, i.e., a "product cipher" to harness the dominant features of Vedic encryption style as well as incorporate the classic behavior and feature of modern cryptographic algorithms.

Keywords Encryption · Decryption · Sri Ram Shalakha · Random number · Substitution · Transposition · Product · Symmetric key

1 Introduction

Cryptography is the practice of mathematical scrambling of word. Encryption being one of its special case, which transforms data into cipher text, so that it is difficult or impossible for the unauthorized users to decipher it. Ancient India, especially during its Vedic period, has witnessed use of encryption for its scriptures. In this paper, an attempt has been made to utilize the Vedic encryption ideas and modern cryptographic algorithms, to produce a secured cipher. The book titled "Ram Charit Manas" authored by Saint Tulsidas, depicts the life of Lord Shri Ram. In this book, we will find a "Sri Ram Shalakha Prashnavali". The "Prashanavali" is an extract from Shri Ram Charit Manas. "Ram-shalaka Prashnavali" used to get an answer or

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indication to the question proposed. The answers/indications are based on Chopais (couplets) from the book "Shri Ram Charit Manas". The technique encrypts as well as encodes the information from the book into the "Prashnavali" [1]. An overview of this technique is given in the sections below. This technique in this paper is modified and tried for different numbers. Apart from the encryption and decryption algorithm, this technique uses multiple keys for the ciphering and deciphering, which makes the cipher text passed through the channel more secured. As we mentioned in the abstract, both privacy of communication and authenticity of entities involved can be achieved with symmetric cryptography, so this technique falls under symmetric cryptography category and it processes plain text as a stream cipher. Here, a combination of substitution and transposition techniques is used to generate the cipher. In the concluding part we can see that, it is difficult to decrypt the cipher by unauthorized users, without the appropriate keys.

2 Cryptosystem

Cryptosystem is a complete package of all the algorithms required to implement the security for the message transferred. As shown in Fig. 1, a message source stores the message which is to be encrypted, i.e., X. This message X, is sent as input to encryption algorithm block, where different techniques like substitution are used to encrypt the data; that message is termed as Y. Y travels through the channel and reaches the destination side, where it has to be decrypted; decryption algorithm blocks and is made visible as X to the receiver. Meanwhile, the keys are transmitted over secured channel as per the agreement between sender and receiver.

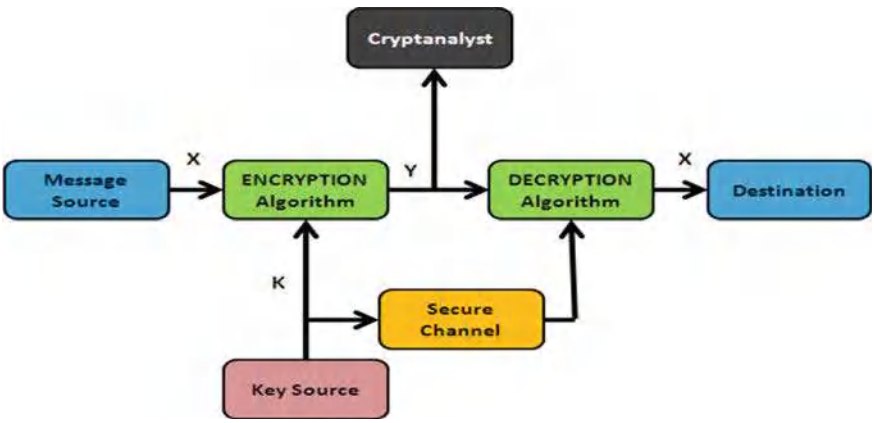

Fig. 1 Model of conventional cryptosystem

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2.1 Symmetric Cryptosystem

In this paper, a symmetric cryptosystem model is implemented. A symmetric encryption model has five components [2]

(1) **Plain Text**: the original message that is given as input.
(2) **Encryption Algorithm**: it performs various substitutions and transformations on the plain text.
(3) **Secret Key**: is a value independent of the plain text and of the algorithm. The exact substitutions and transformations performed by the algorithm depend on the key.
(4) **Cipher text**: it is the scrambled message produced as output. It depends on the plain text and the secret key.
(5) **Decryption algorithm**: it takes the cipher text and the secret key and produces the original plain text Fig. 2.

In symmetric cryptography, first each pair of communicating entities needs to have a shred key. Second these keys must be transmitted securely

2.2 Characteristics of Cryptographic Model with Respect to the Proposed Algorithm

A cryptographic model can be characterized by describing **three** parameters [3]

(1) **The type of operations used for transforming plain text to cipher text.**
- *In the encryption algorithm used in this paper, first applies transposition technique to the plain text and then performs substitution on it.*

(2) **The number of keys used**.
- *This algorithm uses two keys of variable length and a single value key.*

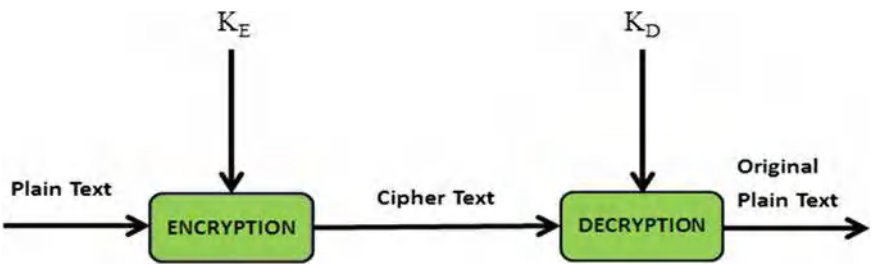

Fig. 2 Symmetric cryptosystem: KE = KD

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(3) **The way in which the plain text is processed**.

- *The plain text is processed as a stream cipher.*

3 Sri Ram Shalaka Prashnavali

Sri Ram Shalaka Prashnavali is a matrix of 15 × 15 squares. Each square in the grid has one Akshar (alphabet) from nine Chopais (couplets) of Shri Ram Charit Manas.

To use the Prashnavali, think of a question in mind and select any one of the squares randomly Fig. 3.

Now proceeding further, count the ninth square from the one initially picked and then another ninth, i.e., counting every ninth square till all the letters collected from the squares complete a chaupai. The couplet thus formed will provide the answer to the question in mind [4]. Couplet formed is given in the Figs. 4 and 5.

One should remember that in certain squares only the sign standing for a vowel sound has been given. Such squares must not be left out nor should those squares be counted twice which contain two letters.

सु	प्र	उ	बि	हो	मु	ग	ब	सु	नु	बि	घ	धि	इ	द
र	रु	फ	सि	सि	रहिं	बस	हि	मं	ल	न	ल	य	न	अं
सुज	सो	ग	सु	कु	म	स	ग	त	न	इ	ल	था	बे	नो
त्य	र	न	कु	जो	म	रि	र	र	अ	की	हो	स	रा	य
पु	सु	थ	सी	जे	इ	ग	म	सं	क	रे	हो	स	स	नि
त	र	त	र	स	हुँ	ह	ब	ब	प	चि	स	हिं	स	तु
म	का	ा	र	र	म	मि	मी	म्हा	ा	जा	हू	हीं	ा	ा
ता	रा	रे	री	इ	का	फ	खा	जू	ई	र	रा	पू	द	ल
नि	को	जो	गो	न	मु	ज	य	ने	मनि	क	ज	प	स	ल
हि	रा	मि	स	रि	ग	द	न्मु	ख	म	खि	जि	म	त	जं
सिं	ख	नु	न	को	मि	निज	कं	ग	धु	ध	सु	का	स	र
गु	ब	म	अ	रि	नि	म	ल	ा	न	ढ	ती	न	क	भ
ना	पु	व	अ	ा	र	ल	ा	ए	तु	र	न	नु	वै	थ
सि	हु	सु	म्हा	रा	र	स	स	र	त	न	ख	ा	ज	ा
र	ा	ा	ला	धी	ा	री	ा	हू	हीं	खा	जू	ई	रा	रे

Fig. 3 Sri Ram Shalaka Prashnavali

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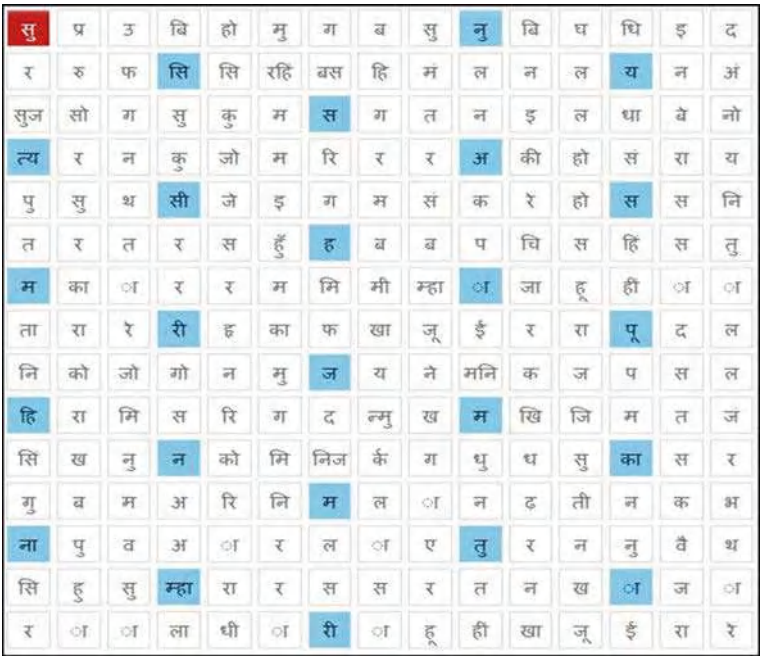

Fig. 4 Result from Sri Ram Shalaka for a couplet after clicking on the character with red background

Fig. 5 Couplet formed after selecting a random character from the grid

The vowel symbol when reached in the relevant square should be added to the preceeding letter, and where the square with two letters is reached both letters should be written together as part of the couplet to be formed.

4 Substitution and Transposition Techniques

A substitution cipher changes characters in the plain text to produce to cipher text, i.e. a substitution technique is one in which the letters of plain text are replaced by other letters or by numbers or symbols, for example, Caesar cipher. A transposition cipher, rearranges in the plain text to form the cipher text. The letters are not changed. Example: Rail fence cipher. Substitution and Transposition technique together are the building blocks of several encryption and decryption algorithms.

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When Substitution and Transposition Techniques are used together, the resultant in called as **Product cipher**.

5 Character Set Used in the Proposed Algorithm

Character set used in the algorithm is illustrated in the Fig. 6

6 Proposed Encryption Algorithm

Step 1 **Take input string to be encrypted and find its length in terms of characters, excluding blank spaces** Figs. 7 and 8.

Step 2 **Select nearest possible symmetric matrix**.
In the given example, total number of characters is 59, and the nearest possible symmetric matrix will be 8 × 8, that gives a total of 64 squares. Row wise we arrange the input text in this symmetric matrix. 8 × 8 is the initial size of the matrix. As we proceed to step 3, we will notice that, the size of the matrix increases.

Step 3 **Randomly select any number between 2 and 10**.
Since the size of the text transmitted is small, we select any number between the above given range. If the limit of text size is increased, this

a	0	k	10	u	20	#	30	[	40	+	50	2	60						
b	1	l	11	v	21	$	31	]	41	-	51	3	61						
c	2	m	12	w	22	%	32	|	42	*	52	4	62						
d	3	n	13	x	23	^	33	\	43	/	53	5	63						
e	4	o	14	y	24	&	34	:	44	<	54	6	64						
f	5	p	15	z	25	(	35	;	45	>	55	7	65						
g	6	q	16	`	26	)	36	"	46	=	56	8	66						
h	7	r	17	~	27	_	37	'	47	'	57	9	67						
i	8	s	18	!	28	{	38	?	48	0	58								
j	9	t	19	@	29	}	39	,	49	1	59								

Fig. 6 Character set used for substitution

The world is the great gymnasium where we come to make ourselves strong

Fig. 7 Input text

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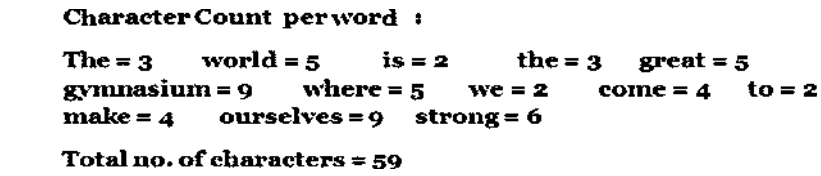

Fig. 8 Character count

range also can be increased. This range is fixed currently using trial and error method. For transposing text of small size, any number between 2 and 10 is sufficient.

Step 4 **Transpose the characters from the input string by 'n' places as selected in Step 3**.

Consider Fig. 9, first word to be placed is "the" from plain text. We place character 't' in the first square of the matrix. Leaving the next six squares from 't', we place character 'h' and again leaving six square from 'h', we place character 'e'. The placement of the characters 't', 'h', 'e' are highlighted with yellow background color. Now while placing the next word, i.e., "world", look out for the first empty space from start of the matrix. We see that second square is free, so we insert character 'w' in that square and accordingly space the remaining characters of the word in the matrix with a space of six squares in between.

Next we place word "is" → "the" → "great" → "gymnasium" → "where" → "we" → "come" → "to" → "make". After placing all these words we see that, when we insert the characters from the next word, the size of the matrix starts increasing row wise, as all the spaces in 8 × 8 matrix have been full or it cannot accommodate the character at the location where it is free. We observe that, when we place the word "ourselves", it starts from one of the free locations inside 8 × 8 matrix, but ends up increasing the number of rows, so that all its characters can be placed by a gap of six squares in between. This is one of the important

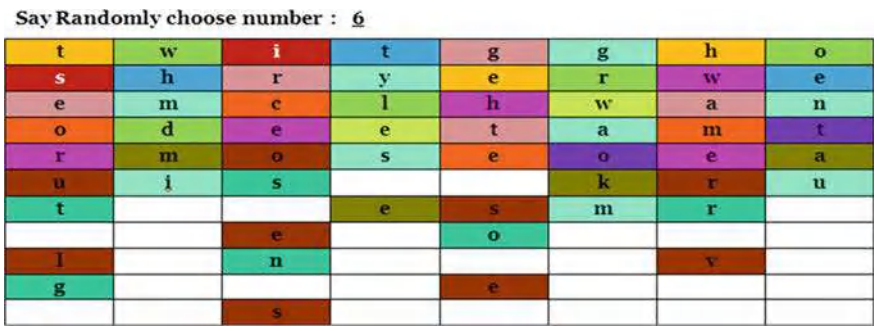

Fig. 9 Transposed text with number 6

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points, which highlight the dynamic nature of the algorithm. Because, for every text wordings will be different, so matrix size also will be different. This hides the actual length of the text. And based on the size of the final matrix, key size is determined. Every time we encrypt, we will get a variable length key. This is Key number 1. Similarly, we place all the characters in the matrix and final matrix size is 8 × 11.

Step 5 **The Substitution step**.
Substitute each character, with its equivalent substitution code from the given set of data characters in Fig. 6. This substitution process will be carried out on the matrix received as output form Step 4. Figure 10, displays the substituted output for the transposed text. Squares which are empty will be substituted with 0(zero).

Step 6 **Generate the Key number 1**, of variable size, i.e., in this example, size of the key will be "8 × 11". For generation of key, numbers are randomly selected (Fig. 11).

Step 7 **Add the key generated in Step 6 to the product matrix**, which is resultant of transposition and substitution methods. New matrix after result of addition is given below in Fig. 12.

Step 8 **Since, the cipher text generated has to fit within the character set given, we perform "mod" operation on the matrix received from** Fig. 12. Result of "mod" operation is shown in Fig. 13 below.

Step 9 **Substitute in the given matrix, whatever the numbers are pointing**.
i.e., characters, alphabets, symbols, etc., to generate the cipher text. Matrix with substituted characters, symbols, etc. is illustrated in Fig. 14 below.

19	22	8	19	6	6	7	14
18	7	17	24	4	17	22	4
4	12	2	11	7	22	0	13
14	3	4	4	19	0	12	19
17	12	14	18	4	14	4	0
20	8	18			10	17	20
19			4	18	12	17	
		4		14			
11		13				21	
6				4			
		18					

Fig. 10 Result of substitution

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93	70	115	153	73	86	197	145
214	156	216	126	310	471	287	469
387	411	374	455	184	89	163	99
236	241	322	379	419	487	394	463
488	361	383	242	251	144	490	364
94	75	111	158	142	357	455	476
257	380	280	484	366	183	169	279
374	316	418	435	356	274	299	444
72	93	447	164	196	348	406	204
402	500	470	243	248	371	382	455
431	331	231	320	347	281	161	113

Fig. 11 Key number 1

112	92	123	172	79	92	204	159
232	163	233	150	314	488	309	473
391	423	376	466	191	111	163	112
250	244	326	383	438	487	406	482
505	373	397	260	255	158	494	364
114	83	129	158	142	367	472	496
276	380	280	488	384	195	186	279
374	316	422	435	370	274	299	444
83	93	460	164	196	348	427	204
408	500	470	243	252	371	382	455
431	331	249	320	347	281	161	113

Fig. 12 Resultant matrix after addition of key 1 and product matrix

Step 10 **Now read the matrix row wise, to generate the cipher text**. Cipher Text to be sent over the insecure channel is displayed below.

:y >)lyax! ~ @o|m_7-p)0 >\~:"[<\#l8 g@^' = -wsy"p3wg ~ 6ue[im:l + h&: o ~#c ~)pz*!2itaay4}?$l'xl;?hjz;

Step 11 Now cipher text is ready to be sent over the channel, but for the receiver to decrypt, the cipher text, an additional key is required. That key will be based on the length of each word present in the input string. We know that, we have 13 words in the plain text and the nearest possible symmetric matrix used to accommodate length of each word is 4 X 4 matrix, which contains maximum of 16 squares (Fig. 15).

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44	24	55	36	11	24	0	23
28	27	29	14	42	12	37	65
51	15	36	58	55	43	27	44
46	40	54	43	30	11	66	6
29	33	57	56	51	22	18	24
46	15	61	22	6	27	64	20
4	40	8	12	44	59	50	7
34	44	14	27	30	2	27	36
15	25	52	28	60	8	19	0
0	24	62	39	48	31	42	47
23	59	45	48	7	9	25	45

Fig. 13 Resultant matrix after mod operation

:	y	>	)	l	y	a	x
!	~	@	o	|	m	_	7
-	p	)	0	>	\	~	:
"	[	<	\	#	l	8	g
@	^	'	=	-	w	s	y
"	p	3	w	g	~	6	u
e	[	i	m	:	l	+	h
&	:	o	~	#	c	~	)
p	z	*	!	2	i	t	a
a	y	4	}	?	S	|	'
x	l	;	?	h	j	z	;

Fig. 14 Substituted back to character set matrix: Cipher Text Matrix

Fig. 15 Length of each word from plain text

3	5	2	3
5	9	5	2
4	2	4	9
6	0	0	0

We use simple Caesar Cipher Substitution technique to encrypt the key. This is Key number 2. This key will also be of variable length, as number of words in each plain text varies. Using Caesar cipher to encrypt the key values provides it with additional security. Here, we select Caesar cipher Key to be 14. New encrypted Key 2 is shown in Fig. 16.

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Fig. 16 Encrypted Key number 2

17	19	16	17
19	33	19	16
18	16	18	33
20	14	14	14

Step 12 Now both the Keys are agreed upon and transferred to the receiver through a secured channel. Then cipher text is sent over the insecure channel to the receiver.

7 Proposed Decryption Algorithm

Step 1 **Receive the Cipher Text**. Based on the first key size receiver we will know that size of matrix to be created.

In our example, size of the matrix is 8 × 11. Once matrix is created arrange the characters row wise in the matrix known as the Cipher Text Matrix as displayed in Fig. 14

Step 2 **Replace the characters by numbers from the data set**.

We will see matrix formed as in Fig. 13.

Step 3 **Now to the matrix obtained from Step 2, add the total count of the dataset, to each and every element in the square**.

In this example, since our dataset size is 68, it will be added to each and every element from the square (Fig. 17).

112	92	123	104	79	92	68	91
96	95	97	82	110	80	105	133
119	83	104	126	123	111	95	112
114	108	122	111	98	79	134	74
97	101	125	124	119	90	86	92
114	83	129	90	74	95	132	88
72	108	76	80	112	127	118	75
102	112	82	95	98	70	95	104
83	93	120	96	128	76	87	68
68	92	130	107	116	99	110	115
91	127	113	116	75	77	93	113

Fig. 17 Matrix after adding 68, to matrix from Step 2

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Step 4 **Next we subtract matrix obtained from Step 3 by the matrix containing Key 1**. Key 1 matrix is given in Fig. 11. By performing this subtraction, we are trying to get back the original substituted matrix for transposed characters.

If we look at the contents of Middle Matrix in Fig. 18, we see that some of its squares are matching matrix from Fig. 10, as a result of substitution. Comparing the squares, squares which are empty in Fig. 10, are filled with 0

We see that, the first, second and third squares are matching, while the fourth square is not. Similarly, we can see that, there are many squares where the value is negative. All the squares with the negative values have to be worked upon to get the right substituted text. So, we go on adding 68, as many times it is required to get the number in the square to a positive value. We need to add 68 only once for the fourth square to get a positive number in that square. When we add 68, as many time required, we finally get the original substituted text back. In this case, fourth square value will be 19. Similarly, if we consider the seventh square, we need to add 68 twice, to get the seventh square on the positive side. The procedure looks simple, but it is difficult to do so, as Key 1 value is required and length of the dataset is required. Matrix displayed in Fig. 19 shows all the corrected values.

Step 5 **Subtract the corrected value matrix by Key 1 again. Result is shown in** Fig. 20.

Now perform a mod operation on the matrix from Fig. 20, to get the original substituted matrix as shown in Fig. 10 earlier and from that we replace them by the corresponding characters from the dataset as illustrated in Fig. 9. As we decrypt, we can see that there are lot of character 'a' present in the matrix. Some are genuine and some are placed to fill up the empty square. Next task is to identify the genuine text square and at the same time get back the original plain text. For this we require, the value of second key that will tell us about the length of each word in the text. Remember, it is also in the encrypted form, so first decrypt the key and then apply it. (Refer to Figs. 15 and 16 for Key 2). Next the receiver has to compute what will

19	22	8	-49	6	6	-129	-54
-118	-61	-119	-44	-200	-391	-182	-336
-268	-328	-270	-329	-61	22	-68	0
-122	-133	-200	-268	-321	-408	-260	-389
-391	-260	-258	-118	-132	-54	-404	-272
20	8	18	-68	-68	-262	-323	-388
-185	-272	-204	-404	-254	-56	-51	-204
-272	-204	-336	-340	-258	-204	-204	-340
11	0	-327	-68	-68	-272	-319	-136
-334	-408	-340	-136	-132	-272	-272	-340
-340	-204	-118	-204	-272	-204	-68	0

Fig. 18 Middle matrix

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112	92	123	172	79	92	204	227
232	163	233	150	314	488	309	473
391	423	376	466	191	111	163	112
250	244	326	383	438	487	406	482
505	373	397	260	255	158	494	364
114	83	129	158	142	367	472	496
276	380	280	488	384	195	186	279
374	316	422	435	370	274	299	444
83	93	460	164	196	348	427	204
408	500	470	243	252	371	382	455
431	331	249	320	347	281	161	113

Fig. 19 Corrected values

19	22	8	19	6	6	7	82
18	7	17	24	4	17	22	4
4	12	2	11	7	22	0	13
14	3	4	4	19	0	12	19
17	12	14	18	4	14	4	0
20	8	18	0	0	10	17	20
19	0	0	4	18	12	17	0
0	0	4	0	14	0	0	0
11	0	13	0	0	0	21	0
6	0	0	0	4	0	0	0
0	0	18	0	0	0	0	0

Fig. 20 Result of subtraction of corrected value by Key 1

be value of 'n' for the given matrix, using the formula mentioned below (x in the formula represents n).

$$(((1+x)\text{No.of Rows}) + \text{No.of Columns}) - \text{Total count of characters in the input text} = \text{total no.of squares in the actual cipher text matrix.}$$

$$(((1+x)11+08)-59=88 \quad \text{therefore, } x=06$$

Once we have the decrypted key and value of n, we can reconstruct the original plain text. **"*The world is the great gymnasium where we come to make ourselves strong*". Note: For decryption, we require Key 1 twice, Key 2 once, Key to decrypt Key 2 and value of n**.

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8 Results and Discussion

The method proposed in the paper uses the combination of two classic techniques, i.e., substitution and transposition, which generates a product cipher, which is more secure and strong cipher, which makes it difficult to break. From the initial matrix, we generate a transposed matrix and from the transposed matrix we generate the substituted matrix.

To convert initial matrix to transposed matrix, we require the knowledge of "spacing of characters", i.e., given by variable 'n'. Once, the transposed matrix is completely ready, it is substituted with corresponding characters form the dataset. Key 1 is used to encrypt the text once, and that matrix which stores the cipher text is the "Product Cipher Matrix". Key 2 is also generated depending upon the input text.

It is difficult to break the cipher generated by this technique. With respect to the example illustrated in the paper, if Brute force attack is tried, and since the unauthorized user does not have direct knowledge of mapping of character substitutions, he will have to try first **68!** combinations. Suppose, he is able to get the corresponding mappings right (practically very difficult to achieve), then at the next level, the unauthorized user will have to guess all numbers between 2 and 10, to find out 'n'. It is easy to calculate 'n' if we know what is the actual length of the input string, from the cipher text actual length of the input string cannot be known. So, the unauthorized user has to make **08 attempts**. If say value of 'n' is known to him, he will have the knowledge how it is spaced. But **without the key 1, it is difficult to get the substituted text for transposition because (1) key 1 size is variable (2) key 1 is randomly generated, so it is difficult to guess the values of the key and without this key we will not know whether the substitutions are correct or incorrect as a two-level check is done with this Key 1 in the proposed algorithm.** If key 1 values are known, then without key 2 values it is difficult to get what it is made up of, as key 2, first has to be decrypted using another key which can take another **n!** attempts to break it. Even after getting the substituted text using key 1, and if Key 2 is not known, say for example input string in this example has 13 words made up of 59 characters, then the unauthorized user will have to try and find out combinations of words that make up 59 characters with the help of a dictionary and if we consider even the latest edition of the Concise Oxford Dictionary, it contains more than 2,40,000 entries.

9 Conclusion

From the Sect. 8, we can observe that we make use of multiple keys both having variable length. Key 1, since it contains randomly chosen numbers is difficult to guess and without use of that key, we cannot get the substituted matrix during decryption.

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Future improvements can be made to improve the encryption provided to the Key 2 as well as keys can be made more stronger by performing permutations on them. This method will perform well on small text size, but can be improved to work on block ciphers. "Prashnavali" displayed one of the techniques how a large text was encrypted into a small grid of 15×15 matrix. Similarly, other techniques in Vedic Scriptures also can be explored and mixed with modern cryptographic algorithms to generate a strong cipher and provide a secure communication.

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A Novel Integer Representation-Based Approach for Classification of Text Documents

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Abstract Text Classification approaches are gaining more and more attention due to the exponential growth of the electronic media. Text representation and classification issues are usually treated as independent problems, but this paper illustrates combined approaches for text classification system. Integer representation is achieved using ASCII values of the each integer and later linear regression is applied for efficient classification of text documents. An extensive experimentation using nearest neighbor supervised learning algorithms on four publically available corpuses are carried out to reveal the efficiency of the proposed technique.

Keywords Document classification · Integer representation

1 Introduction

Due to the exponential increase in the popularity of the Internet and the World Wide Web text data has became the most common types of information store house. Most common sources are web pages, emails, newsgroup messages, internet news feeds, etc., [1]. Many real-time text mining applications have gained a lot of attention due to large production of textual data. Many applications of text classification are spam filtering, document retrieval, routing, filtering, directory maintenance, ontology mapping, etc.

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The main objective of the text classification algorithm is to identify text documents with the ontology of domains defined by the subject experts. A classifier can be designed systematically by training it using a set of training documents. Generally, literary information being unstructured in nature, contains more number of issues like selection of desired representation model, high dimensionality, semanticity, volume, and sparsity. Solutions for these issues are found in [2].

In this article, an integer representation model for text document which requires minimum amount of memory to store a word which in turn reduces the processing cost is presented. Text representation algorithm works on the principle that, an integer number requires minimum memory when compared to store a word. Integer representation-based classification of text documents is an unconventional approach for classification of text documents.

The remaining part of the paper is planned as follows. In Sect. 2 a brief literature survey on the text classification is provided. In Sect. 3, a proposed model for the compression-based classification of text document. Section 4 discusses about experimentation and comparative analysis performed on the proposed models. Paper will be concluded in Sect. 5.

2 Literature Survey

In literature, few works of compression-based text classification can be seen. Generally, text compression involves context modeling which assigns a probability value to new data based on the frequencies of the data that appeared before. But, context modeling algorithms requires more running time and large amount of main memory for processing. Mortan [3] proposed a modeling-based method for classification of text documents. A cross entropy-based approach for text categorization is presented in [4]. It is based on the fact that the entropy is the measure of information content. Compression models are derived from information theory, based on this theoretical fact, language models are constructed for text categorization problem. Authors have also illustrated that, character-based prediction by partial matching (PPM) compression schemes have considerable advantages over word-based approaches. Frank [5] considered classification task as a two class problem. Different language models such as Ma and Mb are constructed for each class using PPM methods. Test document will be compressed according to different models and gain per model is calculated. Finally, class label will be assigned based on the positive and negative gain. Modeling-based compression for low complexity devices is presented in [6]. This method is based on the fact that, PPM-based approaches require high computational effort which is not practically advisable for low complexity devices such as mobile phones. Algorithm makes use of static context models which efficiently reduce storage space. Similar type of work for low complexity devices are found in [7]. This approach split the data into 16 bit followed by the application of Quine-McCluskey Boolean minimization function to find the minimized expression. Further static Huffman encoding method is used for text compression. Dvorski [8] proposed an indexed-based compression scheme for text retrieval

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systems. A document is considered as a combination of words and non words. Similarly, Khurana and Koul [9] considered English text as a dictionary where each word is identified by a unique number in which a novel algorithm is proposed which consists of four phases, where each phase is for different type of input conditions along with a technique to search for a word in the compressed dictionary based on the index value of the word. Word-based semi-static Huffman compression technique is presented [10] in which algorithm captures the words features to construct byte oriented Huffman tree. It is based on the fact that byte processing is faster than bit processing. Automaton is constructed based on the length of search space. End tagged dense code compression is proposed in [11]. Though the proposed method looks similar to tagged Huffman technique, the algorithm has the capacity in producing better compression ratio, constructing a simple vocabulary representation in less computation time. Compressed strings are 8 % shorter than tagged Huffman and 3 % over conventional Huffman. Another word-based compression approach is found in [12]. This method compresses the text data in two levels. First level is the reduction which is through word lookup table. Since word lookup table is operated by operating system, the reduction is done by operation system only. In this technique, each term will be represented by its address index. Next stage is the compression stage. Four different Huffman, W-LZW, word-based first-order and first-order context modeling methods for text compression are presented in [13]. All the word-based compression techniques discussed above, maintain two different frequency tables for words and nonwords.

In the literature, many approaches are found for classification of text documents. They are naïve bayes [14, 15], nearest neighbor [16, 17], decision trees [18], support vector machines [19], and neural network [20] approaches.

3 Proposed Model

The proposed model can be categorized into two different stages, such as text representation stage and regression-based searching stage.

3.1 Text Representation

It is theoretically verified that a sequence of characters requires more memory than an integer number. Based on this, a novel text representation algorithm is proposed, which has the facility of representing character string (a word) by a unique integer number. It is verified that, terms are the set of alphabets, which denote a specific meaning. Similarly, a document is collection of such strings which represent a specific domain. Terms from each document are extracted and then subjected for compression algorithm and then it is represented by an integer number. The whole procedure is algorithmically represented in the algorithm 1 and pictorially represented in Fig. 1 and the proposed method are explained in illustration 2.

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Cumulative sum of ASCII value is determined for given textual word using the equation (1)

$$Cw = \sum_{k=1}^{n} a_k b^k \quad \ldots(1)$$

Where,

C_w = Cumulative sum of ASCII values

w = length of the document. (Number of words in the documents).

k = number of alphabets in the word.

a = ASCII value of alphabet.

b = base.

Illustration : 1

Input word: **heart**.

ASCII values: 104,101,97,114,116.

$= 104 \times 2^4 + 101 \times 2^3 + 97 \times 2^2 + 114 \times 2^1 + 116 \times 2^0 =$ **3204.**

Data	Before Compression	After Compression
heart	5 bytes	2 bytes

heart will be represented by an integer number **3204**.

Fig. 1 Pictorial representation of compression algorithm

3.2 *Regression-Based Searching Stage*

Now, the text document can be viewed as a collection of integer vales. As a result text classification problem got reduced into integer searching problem. Once the data is represented by an integer value, it is sorted and linear regression is applied using the Eq. 2.

$$a_0 = \frac{\sum x_i y_i \sum x_i - \sum x_i^2 \sum y_i}{(\sum x_i^2 - n \sum x_i^2)}$$
$$a_1 = \frac{n \sum x_i y_i - \sum x_i \sum y_i}{n \sum x_i^2 - (n \sum x_i^2)} \quad (2)$$

where, x = Positional Value, and y = word.

Once the regression algorithm is applied, the data will represented by a straight line, as shown in Fig. 2 using the Eq. (3)

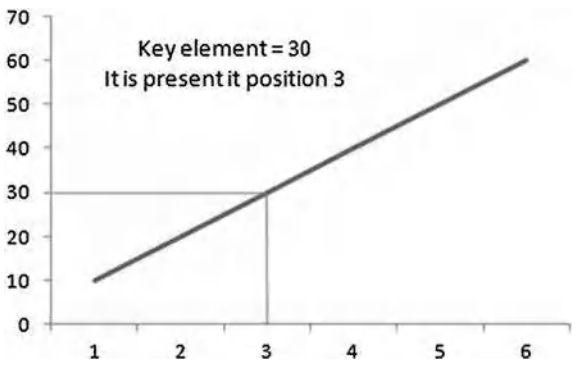

Fig. 2 Regression-based searching

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$$y = a_1 x + a_0. \tag{3}$$

where x gives the appropriate position of the search key element as shown in Fig. 2.

Classification of text documents will be accomplished by subjection training documents to representation algorithm. Once the data representation stage is accomplished linear regression is calculated for each class. Effect of this process, training phase will be seen as collection linear regression values. Then, query documents will be subjected to the compression algorithm. As a result, test documents will be collection of integer number. Each integer number from testing document is considered and is fed to regression-based searching algorithm. The main advantage of the regression is that, it takes minimum computational unit to search an integer number from the database. Similarly, the procedure is carried out and class label will be given to all the integer values. Test document will be assigned a class label based on the maximum class label assigned each integer. Figure 3 present the block diagram of the proposed method.

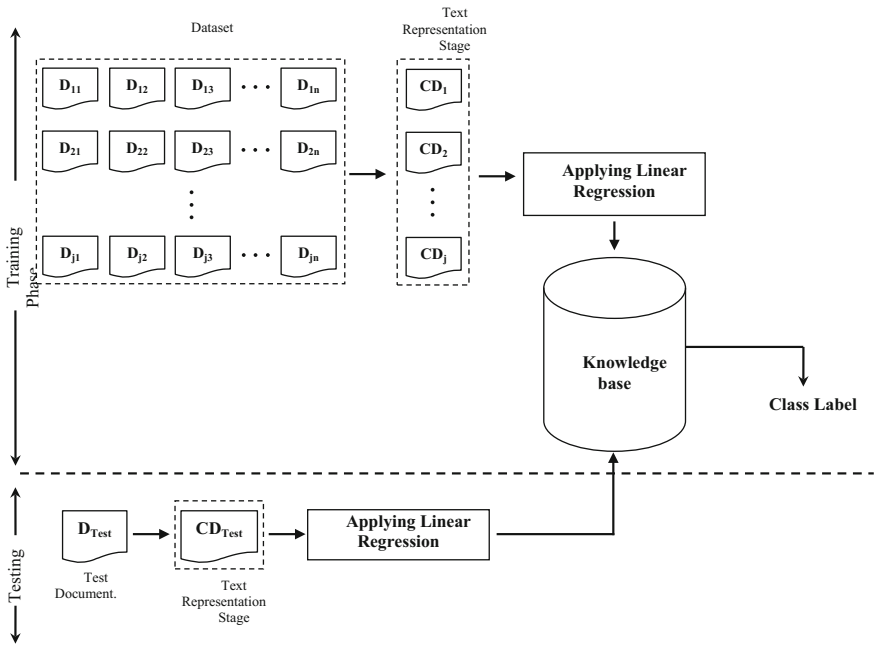

Fig. 3 Block diagram of the proposed approach

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4 Experiments

To assess the efficiency of the proposed technique a well-known classification algorithm namely nearest neighbor classification technique is considered. Four publicly available corpuses are considered as databases where the first dataset is from Wikipedia pages which contain the characteristics of the automobiles. The second dataset includes 10 different classes for 1000 documents are from Google newsgroup data. The third and fourth is from 20 Mini newsgroup and 20 newsgroup datasets. Two different set of experiments are conducted are demonstrate the performance of the proposed technique. First set of experimentation consists of 40 % training and 60 % testing on all the four datasets. Second set of experimentation consists of 60 % training and 40 % testing on all the four datasets. The details of the first and second set of experiments are shown in Table 1.

F measure is considered for the evaluation of the proposed methods, precision, recall and class accuracy (CA) for each set of experiments using the Eq. (4)–(7). Let a, b, c, and d, respectively, denote the number of correct positives, false negatives, false positives, and correct negatives.

$$fMeasure = \frac{2PR}{P+R} \tag{4}$$

where,

$$\mathrm{P\,(Precession)} = \mathrm{a}/(\mathrm{a}+\mathrm{c}) \tag{5}$$

$$\mathrm{R\,(Recall)} = \mathrm{a}/(\mathrm{a}+\mathrm{d}) \tag{6}$$

$$\mathrm{CA\,(Class\ \ Accuracy)} = (\mathrm{a}+\mathrm{d})/\mathrm{N} \tag{7}$$

Table 1 Classification result of the proposed method

Datasets	40 % : 60 %		60 % : 40 %	
	f measure	Class accuracy	f measure	Class accuracy
Vehicle wikipedia	0.9273	92.61	0.9476	94.70
Google newsgroup	0.9205	92.00	0.9321	93.16
20 mini newsgroup	0.9003	90.00	0.9184	92.25
20 newsgroup	0.8873	88.62	0.8960	89.47

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5 Conclusion

This paper illustrates a method of providing an integer representation of text documents and regression for classification of documents. Proposed model has the facility of representing character string (a word) by a unique integer number representation. It is verified that, terms are the set of alphabets, which denote a specific meaning. Similarly, a document is collection of such strings which represent a specific domain. Later on the concept regression is explored for classification of text documents. An extensive experimentation is carried on four publically available datasets to demonstrate the efficiency of the proposed models. The performance evaluation of the proposed method is carried out by performance measures such as f-measure and class accuracy (CA). The proposed model is very simple and computationally less expensive. One can think of exploring the proposed model further for other applications of text mining. This can be one of the potential directions which might unfold new problems.

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Communication Device for Differently Abled People: A Prototype Model

Rajat Sharma, Vikrant Bhateja, S.C. Satapathy and Swarnima Gupta

Abstract The process of communication between marginalized communities like deaf-blind-dumb people has always been a matter of great concern and these differently abled people are not able to easily communicate their thoughts and talks with other people as normal people does by using mobile phones, etc. So, it is the greatest need of this hour to think and act upon the development of such people as they are also the equal part of our society. The proposed model in this paper, proposes a finely tuned solution to mitigate this problem of ever increasing communication gap between differently abled people and normal people. The architecture of this portable device is presented and its operations are discussed via three embedded algorithms for faster, easier, and accurate message communication.

Keywords Differently abled people · Hardware prototype · Communication · Machine model

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1 Introduction

The existing ways followed by differently abled people to communicate with each other till date has been by mere gestures, physical touch, finger sensations and stimulations on the skin of the sufferer and a multitude of techniques that did not find its existence on the grounds of technicality [1]. When a deaf-dumb person speaks to a normal person, the normal person seldom understands and asks the deaf-dumb person to show gestures for his/her needs [2]. While many deaf persons communicate effectively using a form of sign language or the fingerspelling alphabet, problems arise when a hearing person, who does not know sign language, attempts to interact with a deaf individual. For deaf-blind persons, they must be able to touch the hand of the person with whom they wish to interact. Thus, there is a great need for a portable communication aid which would permit deaf, deaf blind, and nonvocal individuals to engage in conversation among themselves and with hearing, vocal persons [3, 4]. The existing works done in this domain for differently abled people include: an instrumented glove by Rehman et al. [4], Choudhary et al. [5], developed a smart glove translating braille alphabet into text and vice versa. U. Gollner et al. [6] developed a Mobile Lorm glove which will act as a common form of communication to be used by people with both hearing and sight impairment. Ohtsuka et al. [7] developed a jacket consisting of vibrators which will be worn by deaf-blind person and non-disabled person will be having electronic device with LCD display. Therefore, there is a requirement of such a model which would be faster, easier, and economical to develop for facilitating a faster communication between disabled people. The prototype model consists of RF transmitters and receivers working on WI-FI protocol for establishing on-spot network for faster transference of messages. We have used parallel working methodology technique of three algorithms to establish a faster and more accurate connection link for easy transference.

2 Methodology and Implementation

The hardware architectural prototype is shown below in Fig. 1 along with component description as:

2.1 Component Description of Hardware Model

The machine architecture is described with the following components and functionalities as is shown in Table 1.

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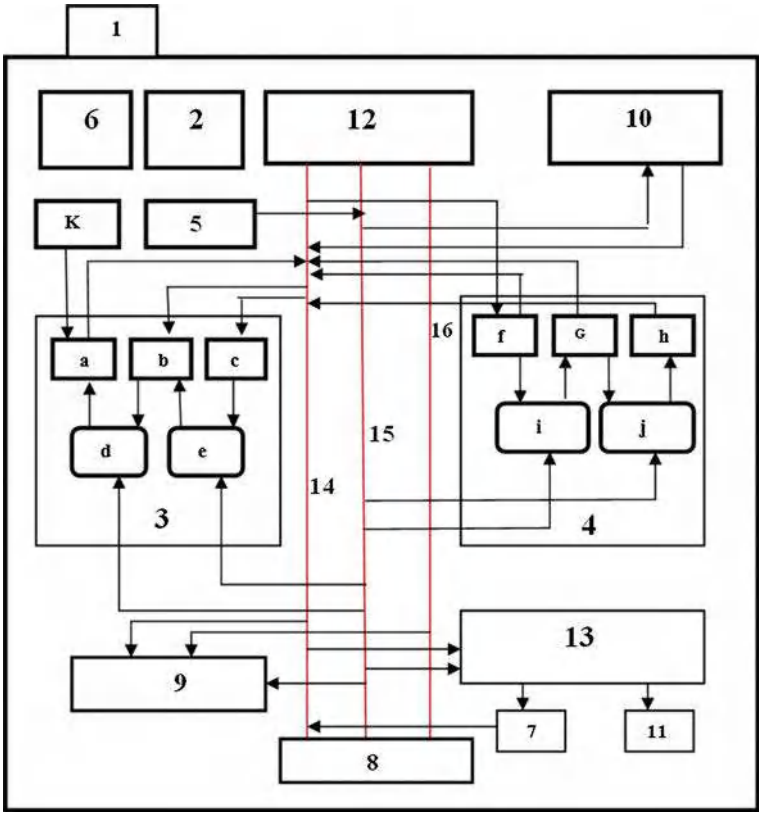

Fig. 1 Hardware architecture of proposed prototype model

2.2 Proposed Methodology

When machine model will be purchased from manufacturer then for the very first time it will be started by switching on the power button, provided in machine architecture. As soon as the machine will start-up, the uniquely identifiable chip embedded in the machine will get activated and will set a unique code for all time recognition purposes of the machine. Once machine is set in active mode for the first time, Algorithm 1 will be executed so as to set the formats to input the message on machine by the holder and to set receiving message format coming on the machine in an understandable format depending on the disability, respectively. Now, using this unique identifiable code, the process of connection establishment between sufferers will be initiated as—The communication link between the two machines will be set up by using RF transmitter and receiver working on WI-FI protocol embedded with IEEE 802.1X for establishing a secured network for data communication. The uniquely identifiable code will be used to form a network

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Table 1 Components of hardware model

Sr. no.	Component	Description
1	Power button	Used for switching on/off the machine as well as some confirmation process will be initiated in sequential order to check the identity of the machine holder for starting the communication procedure
2	Uniquely identifiable chip	It is embedded in the machine that will serve the motive of uniquely identifying the machine with a hardwired code
3	3-pin device A	It consists of following things
3.1	Audio format reader (a)	It reads the audio message
3.2	Text format reader (b)	It reads the text input given by the user
3.3	Braille format reader (c)	It reads the Braille input given by the user
3.4	Text to audio converter (d)	To convert text message into audio message by using speech synthesis tool algorithm
3.5	Braille to text converter (e)	To convert Braille format message to text format by using respective conversion algorithm
3.6	Electret microphone (k)	It will read the voice input given by the user
4	3-pin device B	It consists of following things
4.1	Audio format reader (f)	It will receive message in audio format
4.2	Text format reader (g)	It will receive the message after its conversion in text from audio via speech synthesizer
4.3	Braille format reader (h)	It will receive the message after its conversion in Braille format from text
4.4	Audio to text converter (i)	It will convert audio format message to text format by using respective conversion algorithm
4.5	Text to Braille converter (j)	It will convert text format message to Braille format by using respective conversion algorithm
5	Modem	It is assembled so as to modulate the signal during the time of transmission process and to demodulate the signal while receiving process
6	GPS tracker	It is embedded in the machine that will be used to track the machine by the use of uniquely identifiable chip already inserted into the machine
7	Display screen	It will be partitioned into two halves—one half showing virtual keypad and the other half showing Braille keypad
8	Battery slot	The batteries will be fitted to operate the whole functional mechanism of the machine
9	Transmitter/modulator	It is used to carry forward the message in audio format to the receiver/demodulator on the receiver's machine
10	Receiver/demodulator	It is used to receive the message in audio format from the transmitter/modulator of the sender's machine

(continued)

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Table 1 (continued)

Sr. no.	Component	Description
11	Speaker	It will convert the audio signal received by the sender's machine into sound that can be heard at specified volume rate
12	Microcontroller	It is CONTROL UNIT of the machine included to perform all the operations on the three algorithms hardcoded
13	Interface unit	It will take the data from 3-pin device B in the form of either audio, text or Braille. It will be connected to two output devices of the machine, speaker and the screen
14	Data bus	All the inputs (in any form i.e., either in Braille/text/audio) coming from the user are fed into the data bus. The message that will be received by the receiver will also be fed into the same data bus
15	Control bus	All the algorithm that will be responsible for data conversion purpose(s) into required message formats either into audio or into text or into Braille are embedded into the control bus
16	Address bus	It will be used to transfer data to desired address (uniquely identifiable code received from other machine)

created on the spot by using this protocol and the connection will be established as the address bus of the machine will receive that particular address for connecting link. Once the connecting link is established the signals can be easily transferred. Once the input formats (speak, type in text, type in braille) are set and connection is established then Algorithm 2 will be executed for internal format conversions to make the message ready for transmission. Now, discussing about the sending phase of message by machine as—for the all purposes required to do the work of generating a message, are done by 3-pin device A and by using its five components it can be used as—there are three cases to be considered for better understanding—Case 1: The user will give the audio input to the electret microphone present on top surface of the machine model which would be then sent to the audio format reader to recognize the audio input. Now the received audio message will be directed to data bus of the controller so as to redirect the signal to modem for message modulation purposes. Case 2: The user will give the input in text format by directly typing on the virtual keypad and this input will be received by the text format reader present in the device from data bus and it will be sent into text to audio converter (speech synthesizing tool) by control bus as final message sending mode is audio format as output. Now, this audio message will be directed to data bus of the controller. Case 3: The user will give the input in braille format by typing on the braille keypad which will be present on the architectural model screen and this input will be received by the braille format reader from data bus and it will be sent into braille to text converter (first) by control bus and then again with help of data and control bus, message is converted from text to audio format (second) as discussed in previous case. Now, the received audio message will be directed to data bus of the controller. To bring these tasks of message format conversion easily by

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microcontroller [8], Algorithm 4 is used for above three cases and by undergoing the process executed by Algorithm 4, message is finally transmitted by transmitter on the destination machine as It receives the message to be sent from the data bus of the controller and the address (uniquely identifiable code) of the receiver's machine from the address bus. Now, once the message is sent by sender, then it is received by receiver machine as—the demodulation activity of modem is performed on received message by using Algorithm 5 so as to remove all the extra noise and attenuation from speech signal and to maintain its quality without any degradation, after which it is redirected to data bus. Now, Algorithm 3 is executed so as to fulfill the purpose of showing a message into the understandable format set as default on start-up(may be as audio on speaker or text on screen or braille on screen). As soon as he message is received by receiver, it is redirected to data bus for taking the message to audio reader of 3-pin device B comprising of five components as were present in above discussion of 3-pin device A. By checking the conditions of understandable format of suffer in Algorithm 3, data bus with help of control bus will send the data (may be to amplifier speaker in case of audio) or audio will go in one conversion step of text by audio to text converter or audio will first be converted to text and then to braille by using text to braille converter depending on the condition checks. The final format of the message will travel via data bus to interface unit and by help of control bus it will be either listened on speaker (if audio) otherwise it will be shown on screen (if text or braille). All the components of machine will work finely as battery will complete the purpose of providing current.

2.3 Description of Algorithms

The below section will give the information of all the algorithms hardcoded in the microcontroller. Algorithm 1 will be executed at the first time start-up of the machine only. Here, we check the condition of the sufferer and accordingly set the format for inputting the message as well as the format in which the sufferer wants to receive the message.

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2.3.1 Algorithm 1

BEGIN:

Step 1:- Operate the function of "ON" to the power button of the machine for the first time (only applicable for the machine which is newly purchased from the market).

Step 2:- There are some required settings that are to be done by the helper for the first time to give the required instructions at the time of initialization process.

Step 3:- Initialize the value of flag variable with zero i.e., FLAG<- 0.

Step 4:- Set the date, time and format of the input to be given and output to be seen on the machine screen after receiving the message from sender machine as –

IP is a variable whose value is set according to the disability of the sufferer for inputting the message.

```
If (sufferer==blind)
      Set  :   IP<-1
Else if (sufferer==dumb ||sufferer==deaf && dumb)
      Set  :   IP<-2
Else if (sufferer==blind && dumb ||sufferer==blind && deaf && dumb)
      Set  :   IP<-3
```

Step 5:- OP is a variable whose value is set according to the disability of the sufferer for receiving the message.

```
If (sufferer==blind|| sufferer==dumb ||sufferer==blind && dumb)
      Set  : OP<-1
Else if (sufferer==deaf && dumb)
      Set  : OP<-2
Else if (sufferer==blind && deaf && dumb)
      Set  : OP<-3
```

Step 6 :- Check that

```
 If (OP==1)
      Set  :  audio format as default output message mode.
  Else if (OP==2)
      Set  :  text format as default output message mode.
  Else
      Set  :   braille format as default output message mode.
```

Step 7:- After setting the required input value in input variable and output value in output variable set the value of FLAG variable as one

i.e. FLAG<-1.

Step 8:- Check that

```
If (IP==1)
      Set    :   audio format as default input format.
Else if (IP==2)
      Set    :   text format as default input format.
Else
      Set    :   braille format as default input format.
```

END

Algorithm 2 will be used during the sending phase of the machine i.e. when the user's machine is sending the message to another machine.

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2.3.2 Algorithm 2

BEGIN:
Step 1:- Switch 'ON' machine.
Step 2:- if (flag==0) [Input, output formats are not set]
{
Execute Algorithm 1;
}
Step 3:- if (IP==1)
{
Disable : Input pins of text and braille format reader.
Direct : Message from microphone to audio format reader.
Direct : Audio message from audio format reader to data bus.
Send : Audio signal from data bus to transmitter.
}
Else if (IP==2)
{
Disable : Input pin of braille format reader.
Disable : Microphone input pin.
Direct : Message from screen (interface unit) to text format reader.
Take : Input message from text format reader.
Activate : Text to audio converter.
Pass : Message through text to audio converter.
Direct : Output message to audio format reader.
Direct : Audio message from audio format reader to data bus.
Send : Audio signal from data bus to transmitter.
}
Else
{
Disable : Input pin of text format reader.
Disable : Microphone input pin.
Direct : Message from screen (interface unit) to braille format reader.
Take : Input message from braille format reader.
Activate : Braille to text converter.
Pass : Message through text to audio converter.
Direct : Output message from braille format reader to text format reader.
Take : Input message from text format reader.
Activate : Text to audio converter.
Pass : Message through text to audio converter.
Direct : Output message to audio format reader.
Direct : Audio message from audio format reader to data bus.
Send : Audio signal from data bus to transmitter.
}
Step 4:- Direct: address (uniquely identifiable code) of receiver's machine from address bus to modem (transmitter).
Step 5:-Transmit by using modulator function of modem.
END.

Algorithm 3 will be used for directing message from 3-pin device B to the interface unit and from interface unit to the output devices, i.e., speaker and screen.

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2.3.3 Algorithm 3

BEGIN:
Step 1:- Switch 'ON' machine.
Step 2:- if (flag==0) [Input, output formats are not set]
{
Execute Algorithm 1;
}
Step 3:- Demodulate: received signal from receiver.
Send: demodulated signal to data bus.
Step 4:- Send: signal from the data bus to the audio format reader of the 3-pin device B.
Step 5:-if (OP==1)
{

Disable	:	Output pin of text format reader.
Disable	:	Output pin of braille format reader.
Send	:	Signal from audio format reader to data bus.
Direct	:	Signal from data bus to interface unit.
Direct	:	Signal from interface unit to speaker.

}
Else if (OP==2)
{

Take	:	Input from audio format reader.
Disable	:	Output pin of audio format reader to data bus.
Activate	:	Audio to text converter.
Pass	:	Message through audio to text converter.
Direct	:	Output from converter to text format reader.
Send	:	Signal from text format reader to data bus.
Direct	:	Signal from data bus to interface unit.
Direct	:	Signal from interface unit to screen.
Show	:	Text message on selected area of screen.

}
Else
{

Take	:	Input from audio format reader.
Disable	:	Output pin of audio format reader to data bus.
Activate	:	Audio to text converter.
Pass	:	Message through audio to text converter.
Direct	:	Output to text format reader.
Disable	:	Output pin of text format reader to data bus.
Activate	:	Text to braille converter.
Pass	:	Message through text to braille converter.
Take	:	Input from text format reader.
Direct	:	Output to braille format reader.
Send	:	Signal from braille format reader to data bus.
Direct	:	Signal from data bus to interface unit.
Direct	:	Signal from interface unit to screen.
Show	:	Braille message on selected area of the screen.

}
END.

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So, in this manner all three algorithms will be loaded so as to perform the function of communication between two devices.

3 Conclusion and Future Scope

The proposed model can be successfully used for communication purpose by differently abled persons with mono dual or multiple defects. The fundamental model of the proposed machine along with running algorithms has been designed. A differently abled person carrying the machine could send message in pre-set input format to another person (carrying the machine and linked with the sender machine) with similar or dissimilar disability and the other person would receive the message in pre-set output format. The proposed machine serves as easy-to-use and with negligible time delay communication medium between disabled people. The work can be further extended to facilitate some of the applications like—a section for storing the chats could be added up and an android application can be designed to be used by the guardian of the disable person to track his path so that security of the person can be ensured at every point.

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Combination of PCA and Contourlets for Multispectral Image Fusion

Anuja Srivastava, Vikrant Bhateja and Aisha Moin

Abstract Multispectral image fusion proceeds to combine images from diverse modalities to congregate the expedient information, while abandoning the redundant information from the input images. The aim is to realize a single image holding anatomical information without compromising on the functional information. This paper presents a principal component analysis (PCA)-based multispectral fusion framework for medical images acquired from two different sensor modalities using the contourlet transform. During the process, the input multispectral image is transformed from the *RGB* to *YIQ* color space in order to provide better retention of functional information. Subband decomposition of source images is employed with contourlet transform; to impart anisotropy and seizing of better visual geometrical structures. Further, PCA provides the dimensionality reduction followed by application of min-max fusion of subbands. The superiority of the fusion response is depicted by the comparisons made with the other state-of-the-art fusion approaches.

Keywords PCA · Multispectral · Contourlet · *YIQ* color space

1 Introduction

With the advent of diverse sophisticated imaging modalities, image fusion is gaining considerable importance in both medical and non-medical domains. Image fusion in medical domain has enticed researchers from all over the world as it

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facilitates in accurate and easier clinical diagnosis of numerous diseases. Few of the common imaging modalities used for medical imaging are: computer tomography (CT) scan, MRI (magnetic resonance imaging) scan, SPECT (single positron emission tomography) scan, and PET (positron emission tomography) scan. But these modalities often provide complementary and redundant information about the same Region of interest (ROI). Hence, there comes a need for an efficient fusion process that not only integrates the complementary and disparate information but is also effective in discarding the superfluous information in order to confer a final fused image which is more reliable and informative than the individual source images. Out of the aforementioned modalities, CT and MRI scans provide panchromatic images detailing only into the anatomical information (spatial features), whereas PET and SPECT scans provide multispectral images emphasizing only on functional information (spectral features). Hence, for a compendious view in neuroimaging, multispectral fusion of SPECT/PET with CT/MRI is considered to give a final fused image which details into both anatomical as well as functional information [1]. Moreover, it is visually convenient to interpret features with high spatial resolution and multispectral content than a single high resolution panchromatic image. Further, PET/SPECT scans are considered as advancement to other scans, thus, fusion of CT/MR with PET/SPECT provides better insight into various diseases [2]. But, medical images are often superimposed by noises during acquisition or transmission. Thus, image prefiltering is necessary to suppress the erroneous intensity fluctuations caused due to imperfection of imaging devices or transmission channels [3–5]. Fusion algorithms can be cataloged into three levels: pixel, feature, and decision level. In this paper, pixel level fusion is used [6, 7]. Among different types of transform bases, the most prominent ones are discrete wavelet transform (DWT) [8–11], ridgelet transform [12], curvelet transform [13], and contourlet transform [14–17]. Xu [6] performed pixel level fusion based on local extrema of CT scan and MR source images. The authors' in this work decomposed source images into coarse and detailed layers followed by application of local energy and contrast based fusion rules. Liu et al. [8] proposed a compressive sensing approach to multimodal fusion. During the fusion process, the sparse coefficients were obtained by DWT and then two different fusion rules were applied to fuse the low and high frequency components. But, this leads to non-satisfactory robustness of the fusion method due to the constraint of uncertainty as it utilizes the random measurement matrices. Contourlet transform proves to stand out among these transforms in representing signals by capturing the 2D geometrical structures in visual information. It captures sharp transitions like edges, geometrical structures more efficiently than any other transform. Moreover, to enhance the quality of image fusion, PCA algorithm is applied followed by min-max fusion rule. The remaining part of the paper is organized as follows: Sect. 2 details the proposed fusion methodology. Section 3 discusses the obtained results and conclusions are drawn in Sect. 4.

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2 Proposed Fusion Methodology

This section details about the steps required for multispectral fusion of CT/MR images with PET/SPECT images in Contourlet domain. The processing has been carried out in specifically in Contourlet domain due to the aforesaid advantages. But as Contourlet transform captures limited directional information, it has been hybridized with principle component analysis [18]. PCA not only counters the limited directionality limitation of Contourlet transform, but also enhances the fusion of medical images. It is important to note that as a multispectral source image is used for fusion process, color transformation is an integral part of the whole fusion methodology. The fusion methodology can be better explained with the help of proposed block diagram (refer Fig. 1). Here, it is assumed that the input images are noise free and preprocessed.

2.1 Color Transformation

Multispectral Image fusion takes into account the fusion of a panchromatic and a multispectral image. Since, one of the input image is multispectral, color transformation becomes an integral part of the fusion process. SPECT and PET images are inherently *RGB* but medical image fusion in *RGB* color space is not desirable because in *RGB* model it is difficult to determine specific color and it is not useful for object specification and recognition of colors. Thus, there is a need to transform *RGB* to a different color model. One of the widely used transform in image fusion is IHS transform, but there are certain problems while using it in the medical domain. Hence, to preserve both spatial as well as spectral features *YIQ* color model is considered over IHS color model. In *YIQ* color model *Y* corresponds to

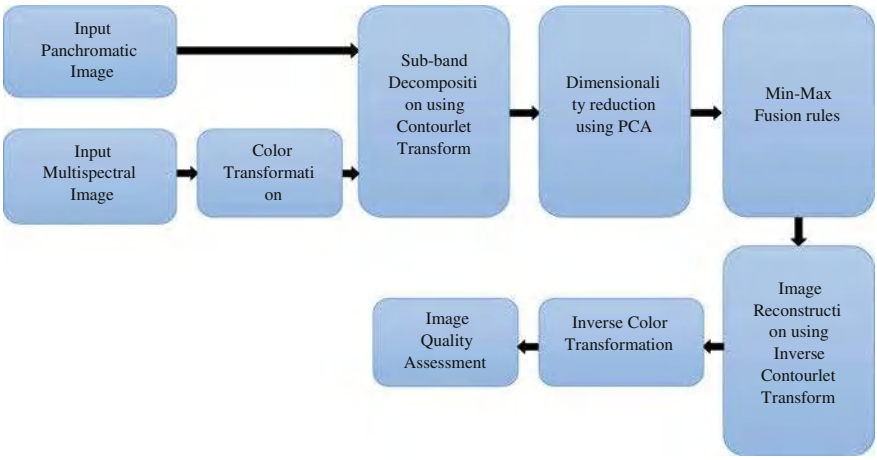

Fig. 1 Block diagram of proposed fusion methodology

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luminescence (lightness), *I* and *Q* contains the chrominance information. *I* corresponds to orange-cyan axis, whereas *Q* corresponds to magenta-green axis and represent the hue and saturation, respectively. The relation between *YIQ* and *RGB* is shown by Eqs. (1) and (2) [19]. Once the input images are preprocessed, the multispectral image is converted to *YIQ* color space and its *Y* channel is fused with the input panchromatic image.

***RGB* to *YIQ* conversion**:

$$\begin{bmatrix} Y \\ I \\ Q \end{bmatrix} = \begin{bmatrix} 0.299 & 0.587 & 0.114 \\ 0.586 & -0.275 & -0.321 \\ 0.212 & -0.528 & 0.311 \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix} \tag{1}$$

***YIQ* to *RGB* conversion**:

$$\begin{bmatrix} R \\ G \\ B \end{bmatrix} = \begin{bmatrix} 0.300 & 0.600 & 0.210 \\ 0.590 & -0.280 & -0.520 \\ 0.110 & -0.320 & 0.310 \end{bmatrix} \begin{bmatrix} Y \\ I \\ Q \end{bmatrix} \tag{2}$$

2.2 *Decomposition into Subbands Coefficients*

The contourlet transform consists of two steps namely subband decomposition and the directional transform. First, Laplacian pyramid (LP) performs subband decomposition and generates a low-pass version of the original image. Implicit oversampling occurs in LP decomposition thus directional filter bank (DFB) is applied to capture the high frequency components of the source image. But as DFB alone cannot provide sparse representation of the images, it is combined with LP (a multiscale decomposition). This combination is known as pyramidal directional filter bank (PDFB), which decomposes images into multiscale directional subbands. In contourlet transform, first, multiscale decomposition is achieved by the Laplacian pyramid, and then a directional filter bank is applied to each band pass channel as shown in Fig. 2.

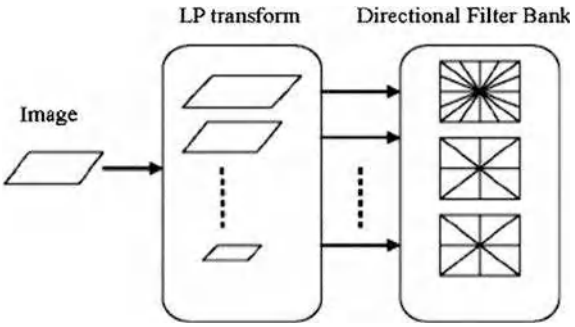

Fig. 2 Contourlet transform framework

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2.3 Dimensionality Reduction Using PCA

Real-world data such as speech signals, medical images, etc., generally have very high dimensionality or redundancy. Various methods therefore are used to reduce the dimensions of these high-dimensional data. Most popular among them is PCA. PCA being an orthogonal transform helps to reduce the redundancy present in both the source image. PCA is a classical method that provides a sequence of best linear approximations to a given high-dimensional observation. It is one of the most popular techniques for dimensionality reduction. The subspace modeled by PCA captures the maximum variability in the data, and can be viewed as modeling the covariance structure of the data [20–23].

3 Simulation Results and Discussions

To evaluate the effectiveness of the proposed fusion methodology, this section analysis the fused image both quantitatively and qualitatively.

3.1 Fusion Metrics for IQA

The main aim of image fusion is to preserve the complementary and discard the superfluous information and distortion present in the individual source images. Performance measures are thus essential to measure the fruitfulness of the fusion methodology and compare the results from different algorithms. Relevant studies show that a single quality measure cannot be fully sufficient to quantify the performance of the fusion approaches as a particular metric can assess a particular aspect of the fused image [24, 25]. Therefore, IQA metrics like entropy (E), edge strength ($Q^{AB/F}$), and SSIM are employed to assess the effectiveness and efficiency of the fusion methodology. Higher values of each of these indices demonstrate the effectives of the fusion. These metrics are explained in Table 1.

Table 1 IQA of proposed fusion method using different metrics

Metrics	Formulae
Entropy	$E = \sum_{l=0}^{L-1} P_1 \log_2 P_1$ Higher value indicates more information in the fused image
Edge strength	$Q^{AB/F} = \frac{\sum_{m,n} Q^{AF}(m,n)_{W_A}(m,n) + Q^{BF}(m,n)_{W_B}(m,n)}{\sum_{m,n} W_A(m,n) + W_B(m,n)}$ Higher value indicates higher degree of edge preservation
Structural similarity index	$\text{SSIM} = \left(\frac{\sigma_{xy}}{\sigma_x \sigma_y}\right)\left(\frac{2\bar{x}\bar{y}}{(\bar{x})^2+(\bar{y})^2+K_1}\right)\left(\frac{2\sigma_x \sigma_y}{(\sigma_x)^2+(\sigma_y)^2+K_2}\right)$ Higher value indicates preservation of luminance, contrast and structural content

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3.2 Simulation Results

The test images in the present work include three sets of CT/MR and SPECT/PET images (namely Test Image 1, Test Image 2, and Test Image 3). Figure 3 shows the fusion response on these three test image sets. It can be inferred from obtained results that both the anatomical (soft and hard tissues) as well as functional (blood flow activity depicted by different colors) are visible in the composite fused images. It can be therefore concluded that the fusion response in Fig. 3 effectively demonstrates the features of both the modalities. High values of the IQA metrics as shown in Table 2 denote the high quality of the obtained fusion responses. The high entropy values indicate that high amount of information content is present in the fused images. On the other hand, higher values of *SSIM* indicate the preservation of luminance, contrast and structural content. Above all, the amount of edge

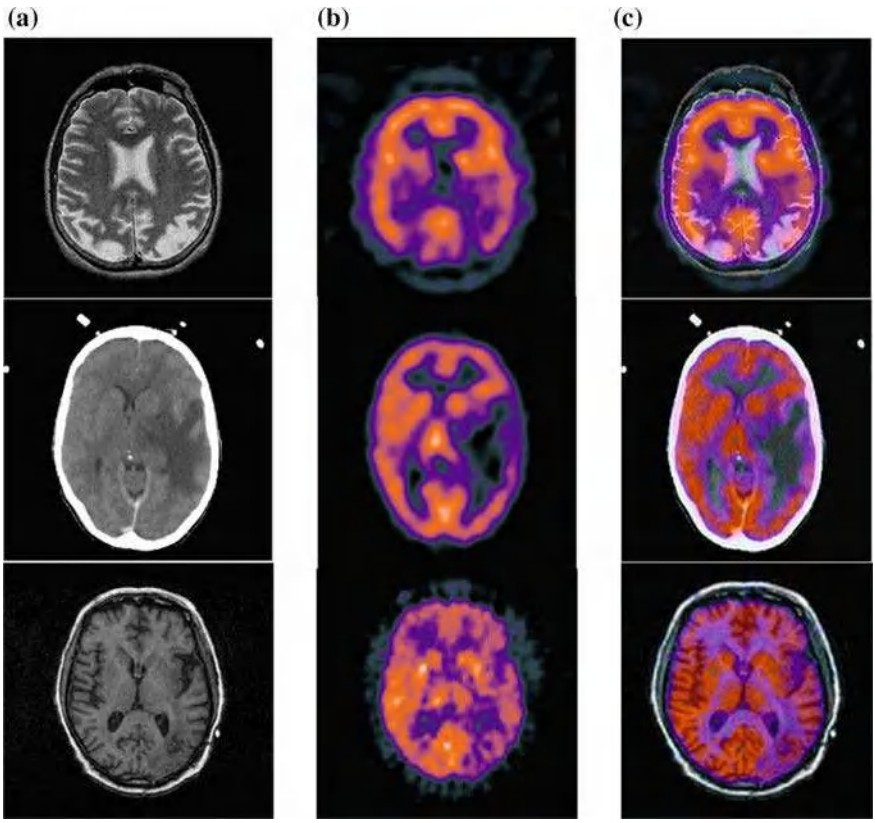

Fig. 3 An Illustration showing fusion of different modalities. **a** Panchromatic images. **b** Multispectral images. **c** Fused images

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Table 2 Image quality evaluation of proposed method using different metrics

Data set	E	SSIM	$Q^{AB/F}$
Image set 1	5.7389	0.8388	0.6276
Image set 2	5.8711	0.8259	0.6246
Image set 3	5.6885	0.8458	0.6337

preservation in the fused images determines the major quality aspect of image fusion. Thus, higher value of $Q^{AB/F}$ indicates higher degree of edge preservation.

The proposed fusion response is further compared with other state-of-art methods (refer Fig. 4). It is clearly evident that the proposed fusion response is superior to other methods as it is capable of preserving both spatial as well as spectral features. The high values of entropy (refer Table 3) indicate that the final fused image contain high information and is more beneficial than the individual source images.

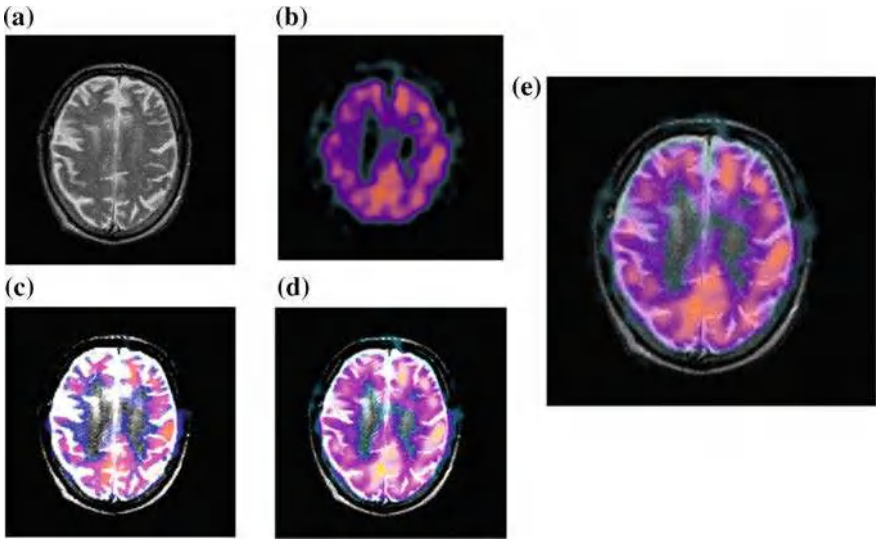

Fig. 4 A comparative analysis of proposed fusion methodology with other state-of-art method. **a** Input MR image. **b** SPECT-image. **c** Curvelet [13]. **d** Contourlet [14]. **e** Proposed method

Table 3 IQA of proposed fusion method compared with other state-of-art approaches

Approaches	E
Curvelet [13]	5.326
Contourlet [14]	5.481
Proposed method	5.723

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4 Conclusion

A contourlet-based approach in combination with PCA for the fusion of multi-spectral medical images is presented in this paper. Contourlet is selected as the decomposition transform owing to its properties like anisotropy and better visualization of the geometrical structures present in the input images. The redundancy of the input medical images is reduced using PCA as the technique. Min-max fusion rules are employed to fuse the decomposed coefficients. The final fused image obtained from the proposed fusion approach shows both anatomical and functional information and provide a better visual perception. The values of the quality parameters are indicative of an effective fusion with all the desirable information present in the fused image. The results achieved are better than the previously proposed fusion approaches both visually and quantitatively.

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A Behavioral Study of Some Widely Employed Partitional and Model-Based Clustering Algorithms and Their Hybridizations

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Abstract The present work experiments with the K-means (partitional), expectation-maximization, and fuzzy C-means (model-based) techniques, and some of their hybridizations to study their behavior. Experiments are carried out on three different datasets of which one is synthetic dataset. On each dataset, experiments are carried out with varying number of clusters. To measure the clustering performance, the experiments compute *clustering fitness* and *sum of squared errors* (SSE). Execution time is also taken into consideration for all the algorithms with all the datasets. Though the algorithm for K-means (StKM) is taking less execution time as it involves in computing only one parameter, i.e., cluster means, the algorithm for K-means followed by standard fuzzy c-means (KMFCM) may be preferred when we consider high intracluster similarity with a good separation of clusters also.

Keywords Clustering · K-means · EM algorithm · Fuzzy C-means · Hybridization · Clustering fitness · Sum of squared error

1 Introduction

Cluster analysis is the identification of groups of observations that are cohesive within the same group and are separated from other groups [1]. Clustering methods can be partitional [2] (like K-means, PAM, CLARA, CLARANs, etc.), or model-based [3] (like expectation-maximization, fuzzy c-means, SOM, and mixture model clustering) classes. Partitional clustering methods attempt to break a population of data into k clusters such that the partition optimizes a given criterion [2].

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Model-based or prototype-based clustering methods attempt to optimize the fit between the given data and some mathematical model [1].

This work experiments with the algorithms for K-means, expectation-maximization (EM), fuzzy C-means (FCM), and some of their hybridizations. While clustering the data, the K-means algorithm aims at the local minimum of the distortion [4]. EM is a model-based approach, which aims at finding clusters such that maximum likelihood of each cluster's parameters is obtained. Introducing the fuzzy logic in K-means clustering algorithm is the Fuzzy C-means algorithm [5]. In Fuzzy C-means, every object belongs to every cluster with a membership weight that ranges from 0 to 1. Clusters are treated as fuzzy sets. The EM and Fuzzy C-means techniques belong to the same category of clustering techniques. However, they differ in the way they assign data points to the clusters. The EM technique assigns the data points to the clusters based on their probabilities belonging to the clusters, whereas the Fuzzy C-means technique assigns them based on their cluster memberships [6, 7].

Along with the standard K-means, EM, and fuzzy C-means algorithms, experiments are carried out with the proposed hybridizations and finally performance comparison is made among all the algorithms. The same termination condition (8) is used for all the algorithms. Though the algorithm for K-means (StKM) is taking less execution time as it involves in computing only one parameter, i.e., cluster means, the algorithm for K-means followed by FCM (KMFCM) is showing better performance with acceptable clustering fitness value and the algorithm for standard FCM (StFCM) is showing better performance with acceptable SSE.

2 Standard K-means (StKM)

The k-means algorithm is a simple iterative method to partition a given dataset into a prespecified number of clusters, k [8]. The K-means algorithm can be used to simplify the computation and accelerate convergence as it requires only one parameter to compute, i.e., cluster means. The algorithm for conventional K-means is given below.

Select k vectors randomly from the dataset as the initial cluster means, μ. Set the current iteration $t = 0$.

Repeat

Assign each vector X_i from the dataset to its closest cluster mean using Euclidean distance.

$$\text{dist}(X_i, \mu_j) = \sqrt{\sum_{l=1}^{d} (x_{il} - \mu_{lj})^2} \tag{1}$$

where X_i is the ith vector in the dataset, μ_j is the mean of the cluster j, and d is the number of dimensions of a data point.

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Recompute the cluster means and set $t = t + 1$.
Compute *percentage change* using (8).
Until *percentage change* is <3.
End of K-means

3 Standard EM (StEM)

The expectation-maximization (EM) is a probabilistic clustering method, where each observed vector is probabilistically assigned to the k clusters by estimating the respective parameters [9]. The EM algorithm iteratively refines initial mixture model parameter estimates to better fit the data and terminates at a locally optimal solution. For each of the input vectors X_i, $i = 1, \ldots, N$, the algorithm calculates the probability $P(C_j|X_i)$. The highest probability will point to the vector's class. The EM algorithm works iteratively by applying two steps: the Expectation step (E-step) and the Maximization step (M-step).

Formally, $\hat{\theta}(t) = \{\mu_j(t), \Sigma_j(t), W_j(t)\}$; $j = 1, \ldots k$ stands for successive parameter estimates. Given a dataset of N, d-dimensional vectors, the EM algorithm has to cluster them into k groups.

The multidimensional Gaussian distribution for the cluster C_j is parameterized by the d-dimensional mean column vector μ_j and $d\ x\ d$ covariance matrix Σ_j is given as follows [9]:

$$P(X_i \mid C_j) = \frac{1}{\sqrt{(2\Pi)^d \left|\sum_j\right|}} e^{-\frac{1}{2}(X_i - \mu_j)^T (\sum_j)^{-1} (X_i - \mu_j)} \tag{2}$$

where X_i is a sample column vector, the superscript T indicates transpose of a column vector, $|\Sigma_j|$ is the determinant of Σ_j and $(\Sigma_j)^{-1}$ is its matrix inverse of covariance matrix Σ_j.

The mixture model probability density function is

$$p(X_i) = \sum_{l=1}^{k} W_l P(X_i \mid C_l) \tag{3}$$

where W_l is the weight of cluster C_l.

In E-step, the algorithm estimates the probability of each class C_j ($j = 1, 2, \ldots, k$), given a certain vector X_i ($i = 1, 2, \ldots, N$) for current iteration t using the following formula and assign X_i to the cluster with the maximum probability.

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$$P(C_j \mid X_i) = \frac{W_j P(X_i \mid C_j)}{P(X_i)} = \frac{\left|\sum_j (t)\right|^{-1/2} \exp^{\eta_j}.W_j(t)}{\sum_{l=1}^{k} \left|\sum_l (t)\right|^{-1/2} \exp^{\sigma_l}.W_l(t)} \tag{4}$$

where

$$\eta_j = -\frac{1}{2}\left(X_i - \mu_j(t)\right)^T \sum_j^{-1}(t)\left(X_i - \mu_j(t)\right)$$
$$\sigma_l = -\frac{1}{2}\left(X_i - \mu_l(t)\right)^T \sum_l^{-1}(t)\left(X_i - \mu_l(t)\right)$$

Each of the k clusters has its mean (μ_j) and covariance (Σ_j); $j = 1, 2, \ldots, k$. W_j is the weight of jth cluster.

In M-step, for jth cluster, the algorithm updates the parameter estimation for the iteration $t + 1$ as follows:

$$\mu_j(t+1) = \frac{\sum_{i=1}^{N} P(C_j \mid X_i) X_i}{\sum_{i=1}^{N} P(C_j \mid X_i)} \tag{5}$$

$$\sum_j (t+1) = \frac{\sum_{i=1}^{N} P(C_j \mid X_i)\left(X_i - \mu_j(t)\right)\left(X_i - \mu_j(t)\right)^T}{\sum_{i=1}^{N} P(C_j \mid X_i)} \tag{6}$$

$$W_j(t+1) = \frac{1}{N}\sum_{i=1}^{N} P(C_j \mid X_i) \tag{7}$$

The algorithm repeats through the E-step and M-step till the termination condition.

A. *Termination Condition*

As the termination condition, percentage change is computed using the following formula:

$$\text{Percentage change} = \frac{|\Psi_t - \Psi_{t+1}|}{\Psi_t} \times 100 \tag{8}$$

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where Ψ_t is the number of vectors assigned to new clusters in tth iteration and Ψ_{t+1} is the number of vectors assigned to new clusters in $(t + 1)$th iteration. The algorithm terminates when the percentage change <3.

4 Fuzzy C-means (StFCM)

Given a dataset, the aim of Fuzzy C-means algorithm is to produce fuzzy c-partitions [5]. A fuzzy c-partition of the dataset is the one which characterizes the membership of each data point in all the clusters by a membership function which ranges between 0 and 1. The sum of the memberships for each data point must be unity.

The FCM algorithm for Gaussian Mixture Models [6] proceeds as follows:

1. Initialize parameters: set current iteration $t = 0$; set membership weight $m = 1.25$; select k vectors randomly as cluster means; compute global covariance matrix and set it to be the covariance matrix for all clusters; set initial membership matrix $U_{k\times N}^{(0)}$ with all $u_{ji} = 1/k \quad \text{for } j = 1, \ldots, k, \ i = 1, \ldots, N.$
2. Initially, assign each data vector X_i to clusters using the initial membership matrix.
3. Compute mean of jth cluster as follows:

$$\mu_j^{(t+1)} = \frac{\sum_{i=1}^{N} (u_{ji})^m X_i}{\sum_{i=1}^{N} (u_{ji})^m} \tag{9}$$

4. Compute new membership matrix using

$$u_{ji}(t+1) = \left[\sum_{l=1}^{k} \left(\frac{||X_i - \mu_j(t)||^2}{||X_i - \mu_l(t)||^2} \right)^{2/m-1} \right]^{-1} \tag{10}$$

5. Assign points to clusters based on their memberships.
6. Compute new covariance matrix for each cluster.
7. Compute percentage change using (8).
8. Stop the process if the percentage change is <3. Otherwise, set t = t + 1 and repeat the steps 3–7 with the updated parameters.

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5 Hybridization of K-means, EM and FCM Algorithms

Along with the standard K-means, EM, and Fuzzy C-means algorithms, this work experiments with several hybridizations of those algorithms. The algorithms for hybridizations are briefly discussed below. In all the experiments, same termination condition, Eq. 8, is used.

A. *KMFCM*
This method performs clustering, which first runs the standard K-means algorithm completely on the given dataset and then runs the standard Fuzzy C-means algorithm till termination on the results of K-means.

B. *KMandFCM*
This method performs clustering running K-means and fuzzy C-means techniques in the alternative iterations till termination. For Fuzzy C-means step, the membership matrix and cluster means are calculated using the results of K-means step.

C. *EMFCM*
This method performs clustering, which first runs the standard EM algorithm completely on the given dataset and then runs the standard fuzzy C-means algorithm till termination on the results of EM.

D. *FCMEM*
This method performs clustering, which first runs the standard fuzzy C-means algorithm completely on the given dataset and then runs the standard EM algorithm till termination on the results of Fuzzy C-means.

E. *EMandFCM*
This method performs clustering running expectation-maximization and fuzzy C-means techniques in the alternative iterations till termination. For maximization step for EM, cluster weights, means, and covariance matrices are calculated using the results of Fuzzy C-means step, and for Fuzzy C-means step, membership matrix is calculated using the results of EM step.

6 Clustering Performance Measures

As a measure of clustering performance, the *Clustering Fitness* [10] and the sum of squared errors are computed for all the algorithms. The calculation of clustering fitness involves in computing intracluster similarity and intercluster similarity.

A. *Intracluster Similarity for the Cluster C_j*
It can be quantified via some function of the reciprocals of intracluster radii within each of the resulting clusters. The intracluster similarity of a cluster C_j $(1 = j = k)$, denoted as $S_{tra}(C_j)$, is defined by

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$$S_{tra}(C_j) = \frac{1+n}{1+\sum_1^n \text{dist}(I_l, \text{Centroid})} \tag{11}$$

Here n is the number of items in cluster C_j, $1 = l = n$, I_l is the lth item in cluster C_l, and dist(I_l, Centroid) calculates the distance between I_l and the centroid of C_j, which is the intracluster radius of C_j. To smooth the value of $S_{tra}(C_j)$ and allow for possible singleton clusters 1 is added to the denominator and numerator.

B. *Intracluster Similarity for One Clustering Result C*
Denoted as $S_{tra}(C)$, it is defined by

$$S_{tra}(C) = \frac{\sum_1^k S_{tra}(C_j)}{k} \tag{12}$$

Here k is the number of resulting clusters in C.

C. *Intercluster Similarity*
It can be quantified via some function of the reciprocals of intercluster radii of the clustering centroids. The intercluster similarity for one of the possible clustering results C, denoted as $S_{ter}(C)$, is defined by

$$S_{ter}(C) = \frac{1+k}{1+\sum_1^k \text{dist}(\text{Centroid}_j, \text{Centroid}^2)} \tag{13}$$

Here k is the number of resulting clusters in C, $1 = j = k$, Centroid_j is the centroid of the jth cluster in C, Centroid^2 is the centroid of all centroids of clusters in C. We compute intercluster radius of Centroid_j by calculating dist (Centroid_j, Centroid^2), which is distance between Centroid_j, and Centroid^2. To smooth the value of $S_{ter}(C)$ and allow for possible all-inclusive clustering result, 1 is added to the denominator and the numerator.

D. *Clustering Fitness*
The clustering fitness for one of the possible clustering results C, denoted as CF, is defined by

$$\text{CF} = \lambda \times S_{tra} + \frac{1-\lambda}{S_{ter}} \tag{14}$$

Here $0 < \lambda < 1$ is an experiential weight. To make the computation of Clustering Fitness unbiased, the value of λ is taken as 0.5.

E. *Sum of Squared Errors*
The experiments also compute the Sum of Squared Error (SSE) for the results of all the algorithms as a measure of performance [3]. The SSE is computed using the following formula.

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$$\text{SSE} = \sum_{j=1}^{k} \sum_{X_i \in C_j} (X_i - \mu_j)^2 \tag{15}$$

Here X_i is a vector in the dataset, μ_j is the means of the cluster C_j, k is the number of clusters, and N is the number of vectors in the dataset. The objective of clustering is to minimize the within-cluster sum of squared errors. The lesser the SSE, the better the goodness of fit is.

7 Experiments and Results

Experimental work has been carried out on the system with Intel(R) Core i7-3770 K with 3.50 GHz processor speed, 8 GB RAM with 1666FSB, Windows 7 OS and using JDK1.7.0_45. Letter recognition and magic gamma datasets are used for the present work from UCI ML dataset repository [11]. The present work also uses one synthetic dataset that is generated by an algorithm [12] that generates multivariate normal random variables.

Table: Dataset Description

Data set	No. of points	No. of dimensions
Magic Gamma data	19020	10
Poker Hand data	1025010	10
Synthetic data-1	50000	10

All the algorithms are studied by executing on each dataset by varying number of clusters (k = 10, 11, 12, 13, 14, 15). The details of execution time, clustering fitness, and SSE of each algorithm are separately given in the tables below for each dataset (Tables 1, 2, 3, 4, 5, 6, 7, 8 and 9).

A. *Observations on Magic Gamma dataset*
   See Figs. 1, 2 and 3.
B. *Observations on Poker Hand dataset*
   See Figs. 4, 5 and 6.

Table 1 Execution time of each clustering method in seconds (Magic Gamma dataset)

K	StKM	StEM	StFCM	KMFCM	KMandFCM	EMFCM	FCMEM	EMandFCM
10	0.0420	2.8100	0.2440	0.4580	0.3960	3.2120	4.9760	0.4160
11	0.0820	3.7480	0.1070	0.5400	0.0990	4.3610	1.9920	0.4210
12	0.0630	3.5110	0.1150	0.5710	0.1010	4.1750	1.2920	0.3960
13	0.0370	4.7470	0.1240	0.5890	0.1120	5.4530	3.6350	0.4220
14	0.0470	5.1190	0.1350	0.6400	0.1160	5.8870	5.2640	0.4550
15	0.0800	7.3250	0.1400	0.7210	0.1230	8.1230	4.8980	0.4960

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Table 2 Clustering fitness of each clustering method (Magic Gamma dataset)

K	StKM	StEM	StFCM	KMFCM	KMandFCM	EMFCM	FCMEM	EMandFCM
10	47.8101	37.8917	47.7119	53.4277	39.0281	61.3841	37.5678	35.1167
11	59.3189	38.1009	59.3537	69.4608	47.7191	64.3828	42.3031	41.8048
12	63.3480	39.7301	63.4965	72.5162	49.0666	62.1473	53.3417	35.6841
13	58.5164	39.9926	58.5447	69.1421	48.5111	59.1161	40.8975	37.6999
14	58.2683	36.5958	58.9229	70.2297	49.6919	61.6858	43.5824	41.2995
15	59.2917	38.9988	59.4293	67.5864	41.2602	66.7143	43.1607	34.3483

Table 3 SSE of each clustering method (Magic Gamma dataset)

K	StKM	StEM	StFCM	KMFCM	KMandFCM	EMFCM	FCMEM	EMandFCM
10	0.2709	0.4689	0.2704	0.4863	0.3426	1.2949	0.4355	0.5449
11	0.2375	0.4703	0.2374	0.7438	0.3182	1.5331	0.3887	0.4938
12	0.2210	0.4930	0.2209	0.6285	0.3418	1.5624	0.2931	0.5131
13	0.2241	0.4698	0.2240	0.6725	0.2983	1.1293	0.4085	0.5172
14	0.2204	0.4945	0.2196	0.6985	0.2724	1.4690	0.3893	0.4386
15	0.2035	0.4856	0.2034	0.7124	0.3195	1.7427	0.3483	0.5400

Table 4 Execution time of each clustering method in seconds (Poker Hand dataset)

K	StKM	StEM	StFCM	KMFCM	KMandFCM	EMFCM	FCMEM	EMandFCM
10	6.9080	136.1450	7.0590	34.4880	6.2200	170.3420	127.8200	20.3520
11	2.2410	131.8070	7.3520	32.2050	6.3400	168.2180	316.2970	21.9780
12	5.6940	90.8490	7.7300	38.6630	7.1280	133.3780	154.8670	24.5970
13	2.4580	176.5590	8.1080	38.0740	7.8100	221.7310	185.9840	26.3670
14	8.7340	126.0720	8.5870	46.3580	8.0800	174.7470	52.0460	28.2390
15	8.6800	133.2020	8.8500	48.4580	8.1750	183.7710	187.4290	29.6410

Table 5 Clustering fitness of each clustering method (Poker Hand dataset)

K	StKM	StEM	StFCM	KMFCM	KMandFCM	EMFCM	FCMEM	EMandFCM
10	2.9468	1.6980	2.9468	3.0560	2.7986	1.8286	2.6911	2.1501
11	2.9783	1.4581	2.9805	3.1157	2.9024	1.5524	2.7246	2.1078
12	3.0783	1.4558	3.0784	3.2057	3.0428	1.6016	2.8647	2.2930
13	3.0997	1.7492	3.1010	3.2455	3.0469	1.8026	2.8564	2.3098
14	3.1992	1.4818	3.1993	3.3436	3.0328	1.6388	3.0577	2.1669
15	3.2574	1.6981	3.2574	3.4091	3.1035	1.8455	3.0276	2.3583

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Table 6 SSE of each clustering method (Poker Hand dataset)

K	StKM	StEM	StFCM	KMFCM	KMandFCM	EMFCM	FCMEM	EMandFCM
10	38.4061	60.3787	38.4061	38.7991	45.5360	62.3060	41.3860	58.6724
11	38.1672	65.1422	38.1304	38.8203	41.9040	66.2561	41.3724	59.4302
12	35.9512	63.0996	35.9499	36.3821	41.8733	66.5395	38.4630	57.9042
13	35.7055	61.4338	35.6877	36.3774	40.9324	63.9005	38.6120	57.0821
14	33.4674	61.8512	33.4660	33.9366	41.1059	63.6446	34.2793	58.9143
15	32.1261	59.0757	32.1256	32.6212	38.7390	61.2613	34.9232	55.3141

Table 7 Execution time of each clustering method in seconds (Synthetic dataset)

K	StKM	StEM	StFCM	KMFCM	KMandFCM	EMFCM	FCMEM	EMandFCM
10	0.1370	6.4000	0.2680	1.2980	0.2340	7.8620	2.8460	0.8690
11	0.1000	6.3360	0.2950	1.3610	0.2540	7.9500	3.1280	0.9550
12	0.1360	5.3840	0.3080	1.5080	0.2790	7.1280	2.6300	1.0320
13	0.1490	4.9920	0.3310	1.6400	0.2890	6.8870	3.6700	1.1100
14	0.1470	8.0410	0.3600	1.6990	0.3170	10.0690	4.8530	1.1990
15	0.1850	8.6250	0.3730	1.8840	0.3260	10.8060	4.2190	1.2840

Table 8 Clustering fitness of each clustering method (Synthetic dataset)

K	StKM	StEM	StFCM	KMFCM	KMandFCM	EMFCM	FCMEM	EMandFCM
10	1076.0893	775.4051	1076.6322	1124.1167	1126.0081	852.0542	977.2159	1049.3886
11	1088.8953	661.5773	1090.2945	1134.7413	1077.0396	756.1819	992.7452	981.0285
12	1122.4485	819.4942	1123.2434	1186.0276	1137.7077	898.2294	1035.3235	1080.4385
13	1151.4744	695.0268	1151.8879	1195.7001	1156.3846	835.6280	1058.7946	1068.5140
14	1167.9671	841.5911	1168.9156	1213.7886	1241.8767	925.9731	1067.6871	1145.8648
15	1195.8812	780.9271	1196.1747	1235.8618	1197.1809	844.9339	1094.3546	1101.4708

Table 9 SSE of each clustering method (Synthetic dataset)

K	StKM	StEM	StFCM	KMFCM	KMandFCM	EMFCM	FCMEM	EMandFCM
10	229.5530	272.0786	229.5315	234.8056	247.3580	277.4283	233.9949	264.3630
11	226.9850	289.0519	226.9133	231.9029	252.8353	291.9495	231.3350	274.9175
12	223.1056	271.9045	223.0528	227.3112	245.0971	277.9409	226.6494	262.4669
13	219.0802	272.4666	219.0384	225.0529	236.5526	273.6704	223.8112	256.1266
14	216.5148	273.5514	216.4372	220.0887	239.1548	275.1162	223.2097	263.3026
15	213.9715	269.8829	213.9480	218.5386	234.9775	273.5891	219.3681	257.1976

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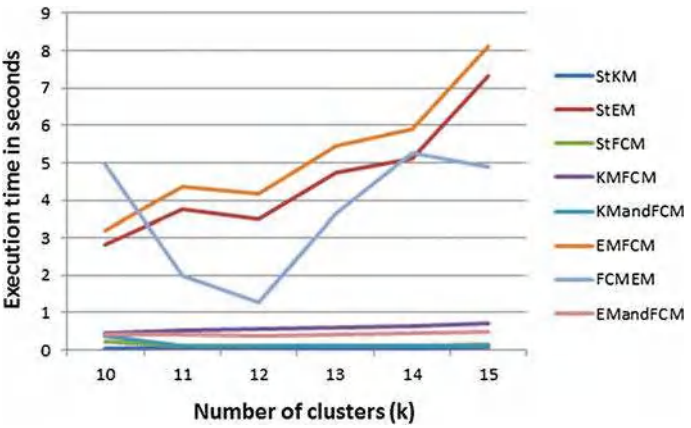

Fig. 1 Execution time (Magic Gamma dataset)

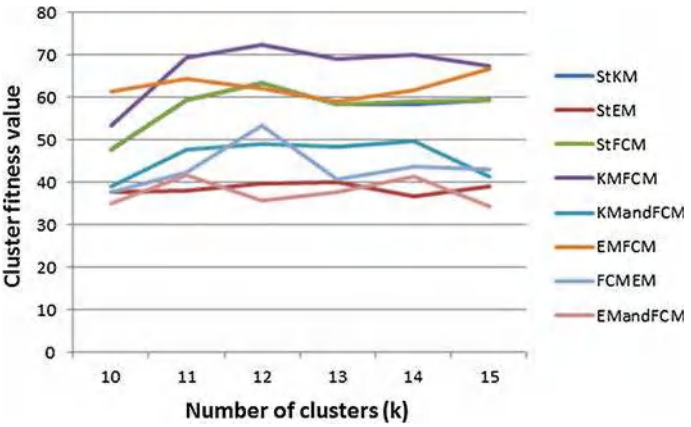

Fig. 2 Clustering fitness (Magic Gamma dataset)

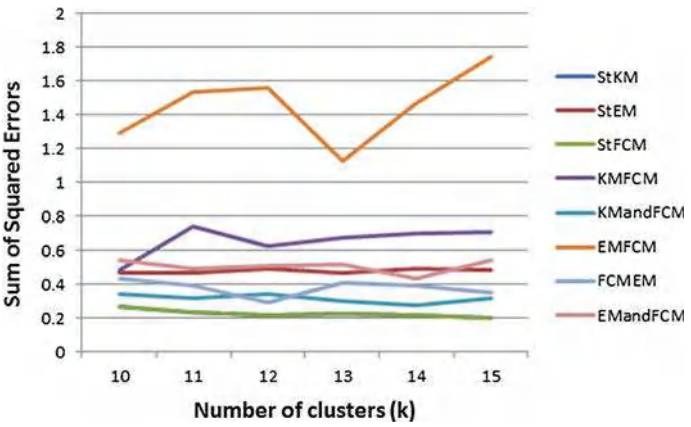

Fig. 3 Sum of squares errors (Magic Gamma dataset)

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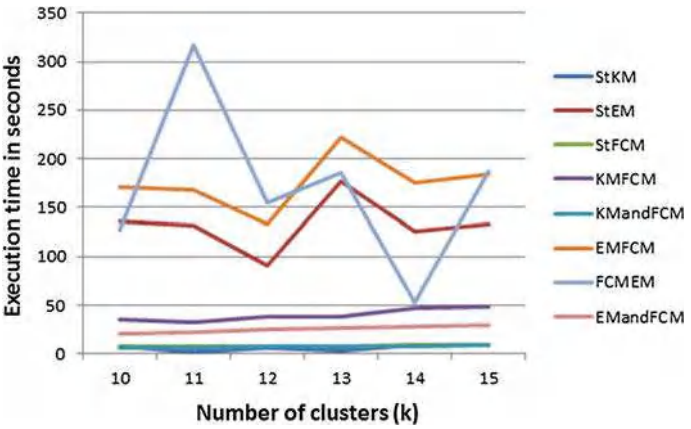

Fig. 4 Execution time (Poker Hand dataset)

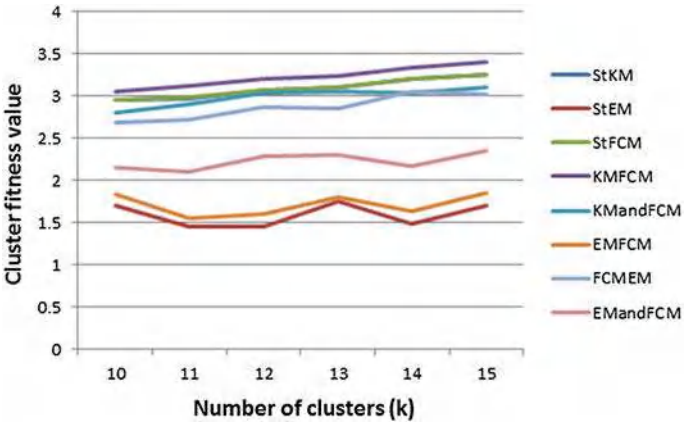

Fig. 5 Clustering fitness (Poker Hand dataset)

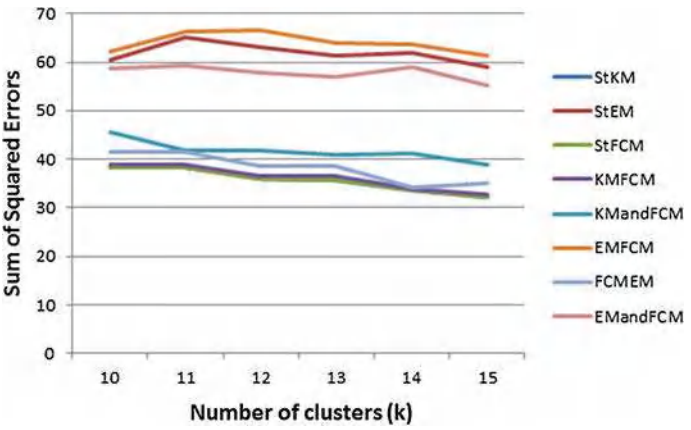

Fig. 6 Sum of squares errors (Poker Hand dataset)

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C. *Observations on Synthetic dataset*
See Figs. 7, 8 and 9.

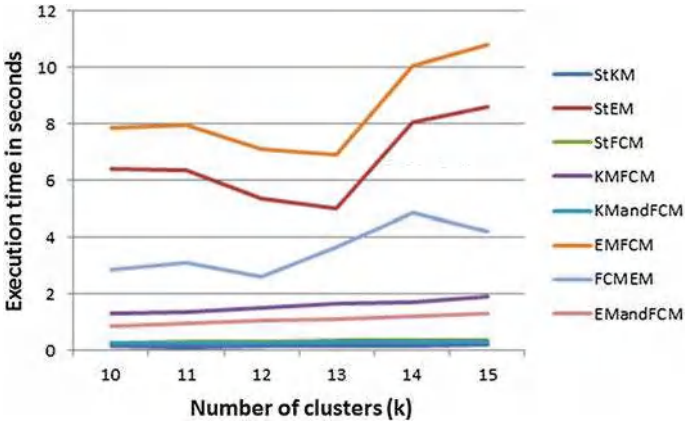

Fig. 7 Execution time (Synthetic dataset)

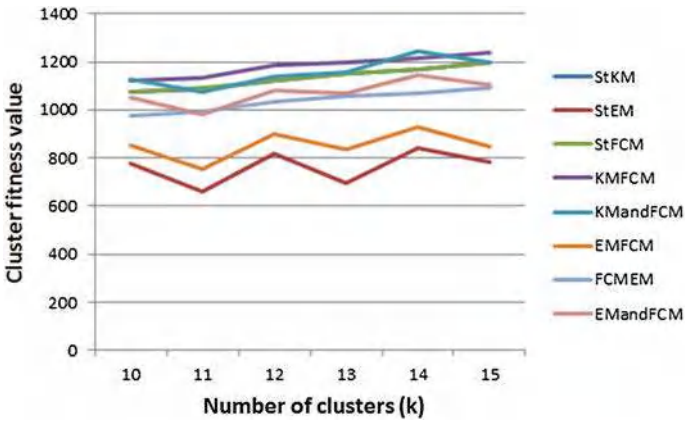

Fig. 8 Clustering fitness (Synthetic dataset)

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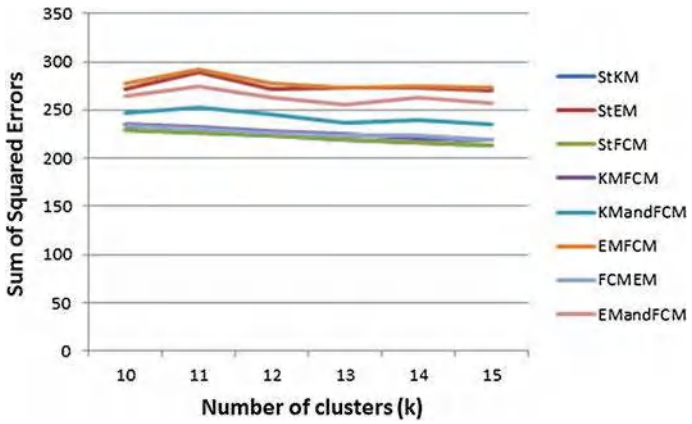

Fig. 9 Sum of squares errors (Synthetic dataset)

8 Conclusion

In all the experiments, it is observed that the algorithm for standard K-means (StKM) is taking less execution time as it involves in computing only one parameter, i.e., cluster means. When the sum of squared errors is considered, the algorithm for standard FCM (StFCM) is showing better performance. However, when clustering fitness is considered the algorithm for K-means followed by FCM (KMFCM) is showing better performance. So from the present experiments, it could be concluded that the algorithm KMFCM may be preferred when we consider high intracluster similarity with a good separation of clusters also.

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An Adaptive MapReduce Scheduler for Scalable Heterogeneous Systems

Mohammad Ghoneem and Lalit Kulkarni

Abstract Hadoop MapReduce has been proved to be an efficient model for distributed data processing. This model is widely used by different service providers, which create a challenge of maintaining same efficiency and performance level in different systems. One of the most critical problems for this model is how to overcome heterogeneity and scalability in different systems. The decreases of performance in heterogeneous environment occur due to inefficient scheduling of Map and Reduce tasks. Another important problem is how to minimize master node overhead and network traffic created by scheduling algorithm. In this paper, we introduce a lightweight adaptive scheduler in which we provide the classifier with information about jobs requirement and node capabilities. The scheduler classifies jobs into executable and nonexecutable according to the nodes capabilities. Then the scheduler assigns the tasks to appropriate nodes in the cluster to get highest performance.

Keywords Hadoop · MapReduce · JobTracker · TaskTracker · Heartbeat message · Heterogeneous environment · Task assignment · Classifier

1 Introduction

Hadoop is a MapReduce-based paradigm that support distributed data processing. This model is widely used in cloud computing to process big data applications in the cloud. The MapReduce receive the jobs from the users and divide each job into a number of Map and Reduce tasks as shown in Fig. 1. The Map tasks process the data blocks at each node in the cluster and produce a sub result. These sub results are combined using Reduce tasks to get final result [1].

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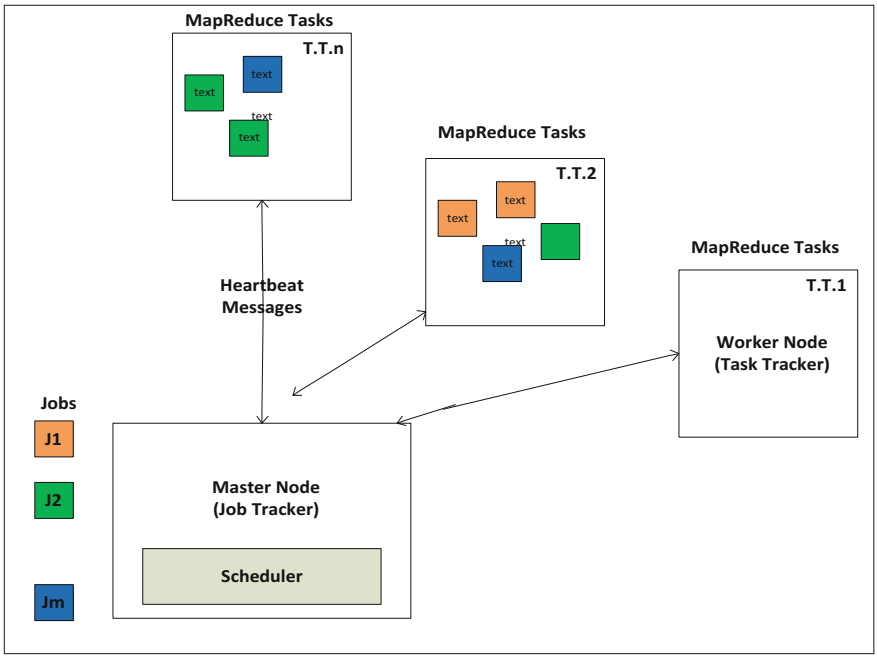

Fig. 1 MapReduce scheduler

MapReduce scheduler is considered as one of the critical elements in Hadoop environment, which can significantly increase or decrease the performance. The scheduler performance might get affected by different factors such as heterogeneity of the cluster, scalability, and variety of Hadoop applications. The current Hadoop schedulers perform well in homogeneous Hadoop environment [1]. However, these schedulers do not take into consideration the heterogeneity and scalability of the cluster [2]. As a result, these issues might significantly degrade the performance of MapReduce model when it is used in the cloud [3]. The performance decreases in such a case due to mismatch between job requirement and node capabilities, which led to a task failure at that node and relaunch of the task at some other node [4]. As a result, the execution time of a job will increase, and node utilization will decrease [5].

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led to a task failure at that node and relaunch of the task at some other node [4]. As a result the execution time of a job will increase, and node utilization will decrease [5].

One of the emerging problems in Hadoop environment is to make scheduler a ware about node capabilities and job requirement in order to increase utilization of the resources in the cluster [6]. This can be achieved by providing the scheduler with a classifier. The input for this classifier will be the node capabilities and job features. The output of the classifier will be whether this job is executable or nonexecutable at a specific node.

2 Background

2.1 Heterogeneity and Scalability in MapReduce Environment

Heterogeneity and scalability in MapReduce paradigm can be summarized in three main categories: Cluster, jobs workload, and users.

- Cluster resources might have different capabilities in heterogeneous environment such as node processing unit, RAM size, and storage unit [7].
- Jobs workload including the arrival rate of jobs, number of task in each, computation requirement, and execution time [7].
- Users' priorities and number of slots assign for each user which is known as minimum share.

2.2 MapReduce Schedulers

Different schedulers have been introduced by different companies to meet specific requirement. Here we briefly described these schedulers and find out the common problems between these schedulers.

FIFO scheduler is the default Hadoop scheduler, which is provided by apache Hadoop. The scheduler assigns jobs to the nodes according to its arrival time. This scheduler performs well in low load cluster [5].

Fair scheduler introduced by Facebook. Fair scheduling tries to assign a pool for each job. This pool consists of a number of Map and Reduce slots [7]. The job can use its pool slots and whenever the pool is free these slots can be used by other jobs.

Longest approximate time to end (LATE) scheduler uses the speculative execution concept [8]. Speculative execution tries to detect the slow running tasks and create a backup copy of this task to run at different node. If the backup copy completes before the original copy then the execution time is improved and the result of original copy ignored.

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2.3 Performance Metrics

Performance of MapReduce model can be measured using different metrics. Here we cover some of the most popular metrics. These metrics are:

- Completion Time: is the time to complete all tasks belonging to same job [9]. Average completion time is the average time to complete all jobs belongs to same category.
- Scheduling time: is the time taken by master node to schedule job submitted by users [10]. It also measures the overhead on master node to schedule all jobs in term of RAM usage, and processor usage.
- Locality: means the number of tasks that are scheduled at the nodes which contain the block of data to be processed.

2.4 Performance Issues

All of the current schedulers have been designed by different companies to meet different goals. But each one of these schedulers has its own drawbacks as follow:

- Small job delay: in FIFO scheduler, the tasks to be executed are scheduled in the cluster according to their arrival time. This means that small jobs might get stack until large jobs are executed successfully which degrade the performance [9].
- Sticky node: Fair scheduler assigns a pool of slots for each job. These jobs will be dedicated to this job only and cannot be used by other jobs [11]. The problem happens when node capabilities are less than job requirement which increase average completion time [5].
- LATE scheduler issues: the default speculative execution in LATE scheduler makes assumption that the jobs and clusters are homogeneous which is not true in case of cloud computing. As a result these wrong assumptions will degrade the performance when the cluster is heterogeneous [5].
- One of the critical problems common for all current schedulers is the mismatching between job and resource in heterogeneous environment [12]. To overcome these problems we propose an adaptive scheduler that can schedule jobs at proper nodes according to job requirements.

3 Proposed Implementation

Our implementation will include three nodes that will form our cluster. One of the nodes will play the role of master node (JobTracker) and the other two nodes will be the slave nodes (TaskTracker). Our adaptive scheduler will be implemented throughout three steps:

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- The scheduler will use a classification algorithm to classify jobs into executable and nonexecutable according to job processing requirement and node available resources.
- To classify jobs we need to provide the classifier with job processing requirement which will be stored as a log file at JobTracker as shown in Fig. 2.
- Also we have to provide the classifier the nodes current available resources to choose the TaskTracker which will minimize execution time.

To classify tasks we will use support vector machine classifier (SVM) which will differentiate tasks into two classes executable and nonexecutable as shown in Fig. 2. SVM is a single layer neural network algorithm for supervised learning of task classification. The advantage of this classifier is that the prediction accuracy is generally high with less computation. This implies less overhead on master node. Also SVM is considered as online algorithm which can accept input at real time and adapt the classification of the tasks based on results of execution.

The jobs processing requirement will be first input to the SVM classifier. This information will be stored as a log file at JobTracker. The JobTracker maintain this information by receiving the heartbeat message from the TaskTrackers. This message contains the task processing requirement, execution time, current status of the node, and some other information.

The second input to the classifier is the available resources of nodes. These resources have two types: static resources and dynamic resources. Static resources can be the number of processors in each node, total memory, total storage, and processing speed. The dynamic resources include CPU usage, free memory, and

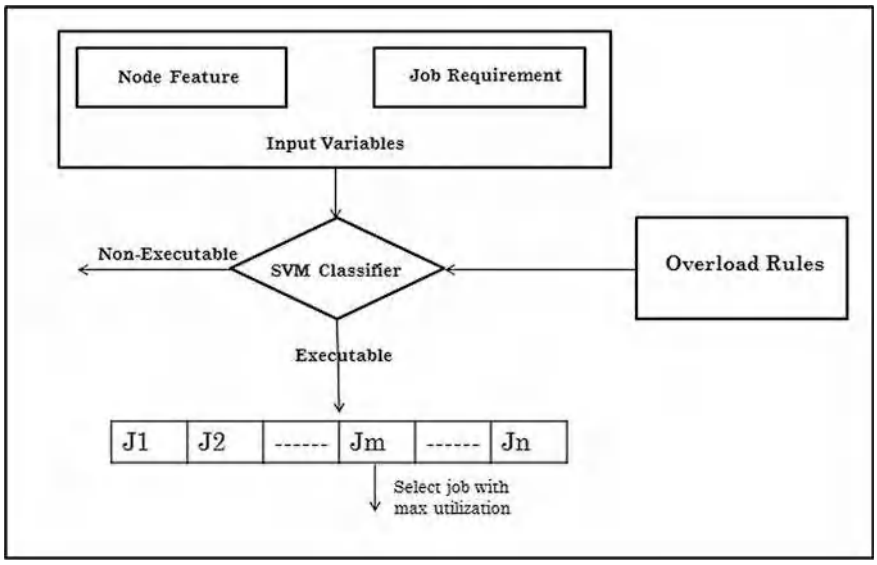

Fig. 2 Task assignment in Hadoop scheduler

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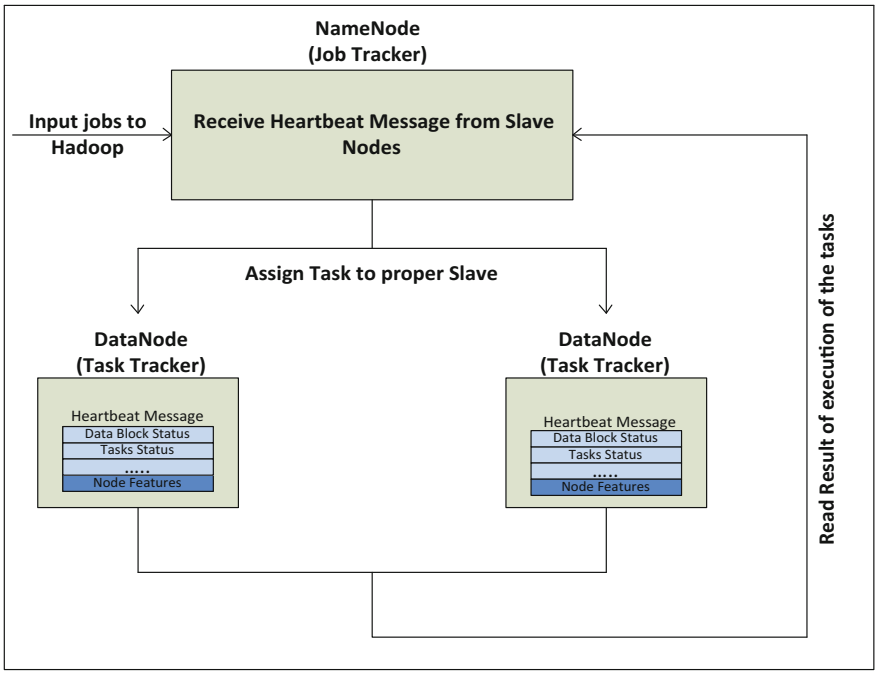

Fig. 3 Heartbeat message details

disk space left. We have two solutions to provide the JobTracker with this information. The first solution is to use a distributed monitoring tool such as Ganglia but this solution implies extra overhead on network and increase complexity of our system. The second solution is to include the node features inside the heartbeat message as shown in Fig. 3. The heartbeat message will be sent periodically to JobTracker, which make the classifier a ware about status of the TaskTrackers at any point of time. Using this solution, we will minimize the network traffic and system complexity.

4 Implementation and Results

Our cluster has three nodes one of them is the JobTracker and the remaining two nodes are the TaskTrackers. These nodes have the following configuration as shown in Tables 1 and 2.

Our Hadoop cluster will have the following configuration. A block size of 64 bit as it is in default Hadoop configuration. The heartbeat message interval will be 5s. The number of the replicas in the cluster will be 2 (Table 3).

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Table 1 Master node configuration

Master node	
Hard disk	50 GB
RAM	4 GB

Table 2 Slave nodes configuration

Slave node 1		Slave node 2	
Hard disk	50 GB	Hard disk	50 GB
RAM	4 GB	RAM	2 MB

Table 3 Hadoop configuration

Hadoop configuration	
Replication	**2**
HDFS block size	64 MB
Heartbeat interval	5 s

In our cluster implementation, we will run WordCount example and monitor the results of execution with the new scheduler. Four jobs will be under execution while monitoring the system. These jobs will be processed in throughout two phases. In the first phase, the four jobs will be further subdivided into N number of Map tasks. These Map tasks will be processed by TaskTrackers to get the sub results. In the second phase, the Reduce tasks will merge the sub results of all Map tasks in the Cluster to get the final result.

The overload rule for our scheduler is that the CPU usage should not cross 80 %. After the execution, we can see that we have achieved a very high CPU and memory utilization as shown in Fig. 4.

Some exceptions are there during the execution when the CPU usage slightly crosses 80 % as shown in Fig. 4. This is normal because our SVM classifier still in the learning phase. When the usage of CPU cross the threshold the monitoring system should update the logs at master node so that the classifier can adapt itself and change the weights of the tasks to take appropriate assignment decision in the next phase.

During the execution of jobs in the default Hadoop system, some of the tasks might failed or straggle due to wrong assignment and it should be relaunched again at some other nodes. This method known as speculation technique used to minimize average completion time of the jobs. This failure occur because the scheduler is not aware a bout node capabilities and its current available resources.

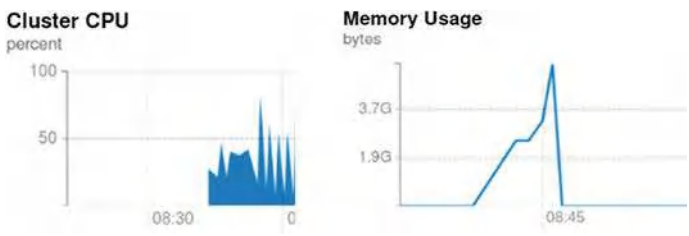

Fig. 4 Cluster CPU utilization and JobTracker memory utilization

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Fig. 5 Tasks execution and failure in the cluster

In our system, the scheduler assigns tasks according to node current available resources and task processing requirement. As a result all tasks will be executed successfully without any failure as shown in the Fig. 5. By following this scheduling technique, we will achieve a high level of resources utilization and improve the average completion time of jobs as shown in Fig. 5.

5 Conclusion and Future Work

In this paper, we introduce an adaptive scheduling technique for MapReduce scheduler to increase efficiency and performance when it is used in heterogeneous environment. In this model, we make the scheduler aware about cluster resources and job requirement by providing the scheduler with a classification algorithm. This algorithm classifies jobs into two categories executable and nonexecutable. Then the executable jobs are assigned to the proper nodes to be executed successfully without failures which increase execution time of the job. This scheduler overcomes the problems of previous schedulers such as small job starvation, sticky node in fair scheduler, and mismatch between resource and job. The adaptive scheduler increase performance of MapReduce model in heterogeneous environment while minimizing master node overhead and network traffic.

In the feature, we plan to improve performance by including multiple performance metrics such as average completion time, scheduling time, locality, and fairness. Also we plan to run different benchmarks such as sorting and searching on a bigger cluster and make a comparison with the default Hadoop system. The analysis of our system with default system will give us the pros and cons of our model. This will allow to do further improvement on our system.

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Enhancement in Connectivity by Distributed Beamforming in WSN

Vandana Raj and Kulvinder Singh

Abstract A pair of node is said to be connected if they lie in communication range of each other or more precisely in terms of graph theory, we can say that a pair of node is said to be connected if at least, there is a single path exist between them. This connectivity is affected by displacement, dying node, and communication blockage. Due to this reason, the network topology also changes dynamically. Disconnection results in nonfunctional WSN, although other nodes remain operational. Even owing to one node failure can results in end of whole network and we have to deploy the whole WSN again. We will show an improvement in connectivity and increase in lifetime of WSN and better quality signal by using master–slave architecture of distributive beamforming, if a node failure occurs. This approach requires no receiver feedback, other approaches such as one-bit feedback requires feedback from receiver for correctly superimposition of signals from two or more sources on receiver and therefore not an energy-efficient approach. The simulations of the proposed approach are performed and the acquired results highlight the benefits of this proposal.

Keywords Wireless sensor network · Distributed beamforming · Master–slave architecture · Directional antenna

1 Introduction

Connectivity is a major concern in many applications of WSNs such as monitoring, surveillance, battlefield, potentially terrorist attack detection, disaster management, target monitoring, border protection, and more. Connectivity is one of the crucial

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requirements of WSN, as information collected needs to be transmitted to the sink node or processing centers, if it fails to do so, then network life time ends no matter if other nodes are still operational. It is an open research problem. Connectivity depends on link existence. Connectivity can be modeled as graph, G(V, E), where vertices V are sensor nodes, and link between them is an edge. Graph is said to be connected, if there is at least one path between each pair of nodes. With the help of equation, connectivity can be defined as follows:

$$\mu(r) = N\pi r^2/A \tag{1.1}$$

where N is the number of sensors in area A, and r is the radius of transmission [1]. Due to a wide-range of potential applications, the concept of WSN has attracted a great deal of research attention. A wireless sensor network is composed of small sensing devices having processing and wireless communication capabilities, which are deployed in a region of interest. They gather information about the environment, generate and deliver messages to the remote base station. The issues related to WSN connectivity are: critical battery, environmental changes dying node leading to sparse amount of network or disconnected network, and security attacks on nodes such as denial of service [2]. Due to their limited range of communication, holes occur in the network. After operating for a long period, sensor nodes battery starts exhausting and thereby results in disconnection of other nodes from sink node. Figure 1a shows an example of a connected WSN. Communication here is multihop, therefore, if sensor 1 fails then it will result in no data transfer at sink node at all. We know that the purpose of WSN is to deliver data to sink node. But only due to sensor 1 failure can bring down whole WSN. Figure 1b shows an example of disconnected WSN containing isolated nodes. These sensor nodes are not able to send their data to the base station as sensor 1 has stopped functioning. Here one node failure resulted in nonfunctional WSN (Fig. 2).

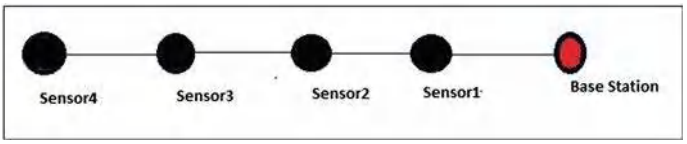

Fig. 1 This figure, shows linear topology WSN with four sensor nodes, and one base station or sink node, communication is multihop

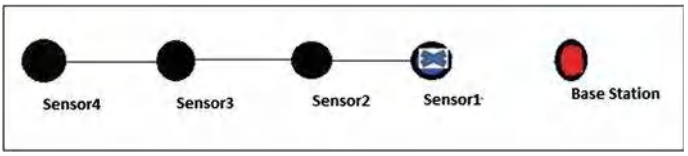

Fig. 2 This figure shows disconnected WSN, sensor 1 has stop functioning, there is no communication of data to base station which results in nonfunctional WSN

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To tackle the problem of disconnected WSN, we are using master–slave architecture of DBF, where master node calibrates and synchronizes the carrier signal of slave sensor to achieve beamforming. In paper [3], the author showed that this approach is feasible and is energy-efficient too. The remaining text is organized as follows: Sect. 2 presents related work in this field. Section 3 presents the proposed work. Simulation results are presented and discussed in Sect. 4. Section 5 concludes the paper.

2 Related Work

Advancement in directional antenna technologies had made it possible for sensor nodes to be equipped with directional antennas. Kranakis et al. [4] showed that using directional antenna, energy saving could be achieved as compared to omnidirectional antenna. The author here described that directional antenna provides same amount of connectivity as omnidirectional antenna by giving a condition on beam-width of unidirectional antenna. Saha and Johnson [5] bridged partition of network using unidirectional antenna, for maintaining connectivity. The conversion of sensor network of omnidirectional antenna to strongly connected sensor network of unidirectional antenna was first addressed by Caragiannis et al. [6]. The author here presented a polynomial time algorithms for linear case and two-dimensional case when the sector angle of the antennas was at least $8\pi/5$. When the sector angle is smaller than $2\pi/3$, it was shown that the problem of determining the minimum radius to achieve connectivity was NP-hard. To maintain connectivity, Pignaton de Freitas et al. [7] proposed mobile sinks (UAV). While moving, these mobile sinks cover up the entire region deployed of sensor nodes and thus connectivity and availability of information was achieved. Kranakis et al. [8] studied how to maintain network connectivity when antennae angles were being reduced, while at the same time the transmission range of the sensors was being kept as low as possible. It was showed in [9] that directional antenna could reduce security risk. It was shown that with narrower beamwidth of directional antenna, the signal was less likely to be intercepted by enemy. The connectivity recovery technique was proposed by Abbasi et al. [10]. The author proposed "Distributed Actor Recovery Algorithm" for maintenance of connectivity. Cheng et al. [11] proposed connectivity restoration by node rearrangement. Younis et al. [12] proposed an approach "Recovery by Inward Moving" to recover connectivity owing to one node failure. Ahmed et al. [13] proposed another approach of "Least Destructive Topology Repair" for connectivity recovery. To enhance connectivity, by increasing lifetime of the sensor nodes an algorithm was proposed by Guha and Khuller [14]. The Marinho and Marco [15] considered cooperative MIMO technique and UAV relay network together to support connectivity. It was shown here that by utilizing CMIMO and UAVs together increases the connectivity than using

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them alone. Heimfarth et al. [16] proposed another method utilizing UAV, for connecting disjoint segment in the WSN. In this method, UAV and message ferrying concept was utilized to join isolated network segment.

3 Proposed Work

To overcome this problem of disconnected WSN owing to node failure, and other issues like limited communication range of sensors, dying node problem and critical battery of sensor nodes, the master–slave architecture approach of distributed beam forming is proposed here. We will show that using this approach good connectivity, longer lifetime of WSN and quality of links could be achieved with inexpensive local coordination with a master transmitter. We will give a brief introduction of master slave architecture, after that simulation results achieved will be shown.

3.1 Master–Slave Architecture

Master sensor has a local oscillator that generates a sinusoid that serves as the reference signal for the network. The master sensor broadcasts reference signal to all the slaves. The slave sensor uses this signal as input to a second-order phase-locked loop, driven by a VCO with a quiescent frequency close to carrier frequency. From PLL theory, we know that the steady-state phase error between VCO output and signal received at slave sensor is zero, and therefore, the steady-state VCO output can be used as a carrier signal consistent across all sensors provided that the offset phase offset can be corrected for.

3.2 Implementation

The sensor data that is transmitted is a binary pulse train of random bits. Modulation of carrier wave is done by multiplying the carrier wave with the sensor data which is equivalent to BPSK modulation. Assumption here is that nodes has knowledge of their location and another standard assumption is that receiver has perfect knowledge of channel. This ensures phase synchronization, and therefore coherent demodulation of signal is achieved at the receiver.The base station or sink node first converts the signal to baseband using a mixer to multiply the incoming carrier signal with a local oscillator. The local oscillator is assumed to be frequency synchronized with the transmitting sensors. The implementation above satisfies the results, i.e., for integral wavelength $\lambda, 2\lambda, 3\lambda \ldots$ there is constructive interference and for fractional λ values we got destructive interference. Therefore, implementation satisfied the condition of constructive and destructive interference.

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4 Simulation Results

We performed simulation on SIMULINK. Simulation time was 0.3 s. Communication between nodes is multihop. We experimented with 4 sensor nodes and 1 sink node as shown in Fig. 3. By varying distances, between sensor nodes, we have shown that connectivity could be achieved by using master–slave architecture. We have defined distance using the time delay, i.e., we have frequency = 10 kHz, c = 3×10^8 m, by this we calculated the wavelength, λ which equals to 3×10^4 m. We calculated time period that amounts to 0.00001 s. Therefore, 1 m distance time delay amounts 0.3×10^{-8} s. In every sensor node, we created the delay of 0.3×10^{-8} s after that we started the simulation. The result of simulation after Distributed Beamforming on sink is shown in Fig. 4. It shows observed result with N = 4, where N is the number of nodes used in distributed Beamforming. These nodes cooperatively direct their data to sink node. Sink node has the same frequency of 10 KHz, i.e., it is frequency synchronized with transmitting nodes. The distance taken between each node is 1 m, i.e., a delay of 0.3×10^{-8} s and after performing simulation we gained signal-to-noise ratio = 3.85 dB. Here x-axis represents time and y-axis represents achieved signal-to-noise ratio. After that we experimented with N = 3, the SNR achieved here is 2.8 dB with 1 m distance between each node. Achieved result is shown in Fig. 5. We took N = 2 and performed simulation we got SNR = 1.9 dB. We have created

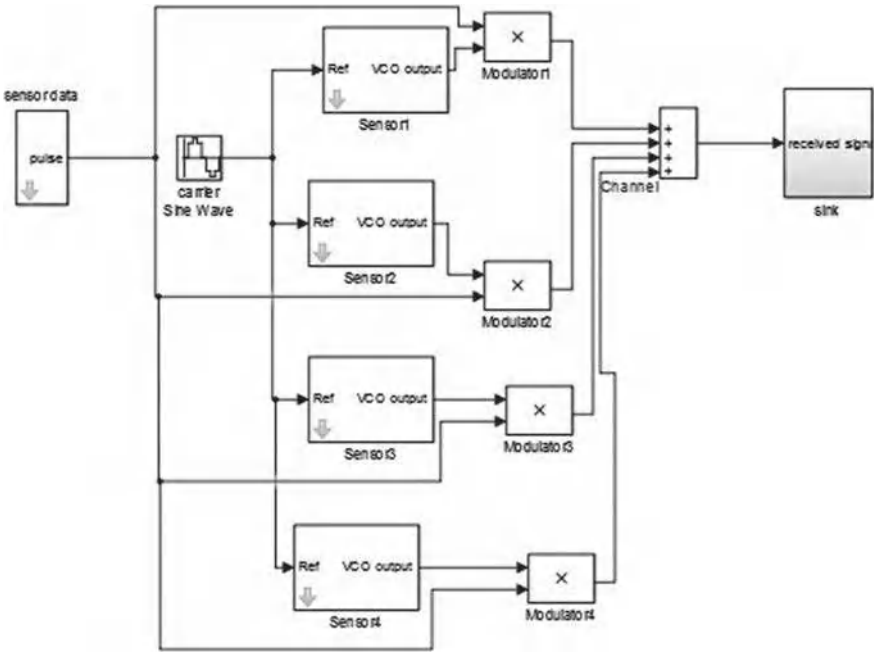

Fig. 3 Designed model of master slave architecture in SIMULINK

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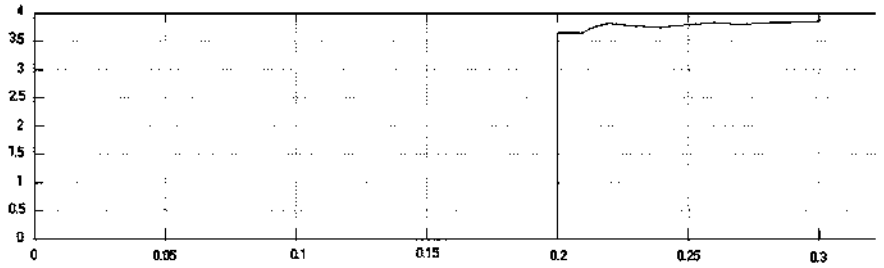

Fig. 4 Beamforming with 4 nodes on sink node with 1 m distance between each node. SNR = 3.85 dB

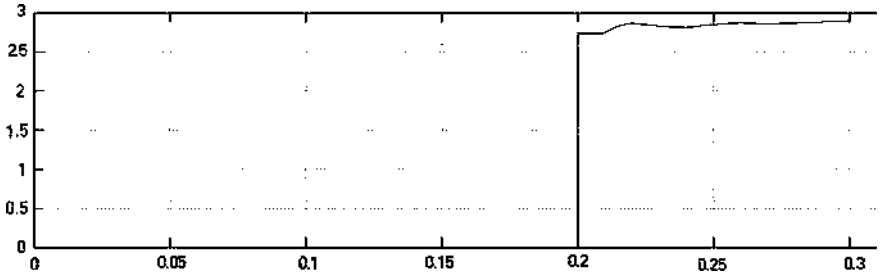

Fig. 5 Beamforming with 3 nodes on sink node with 1 m distance between each node. SNR = 2.8 dB

distances between nodes and after that tested the result, we conclude that these results satisfy the well-known formula written below:

$$\rho_N = N\rho_1 \tag{4.1}$$

where N = number of nodes chosen for Distributed beamforming, ρ_1 is SNR of one sensor. Also Fig. 6 shows that by considering distance of 2 or 4 m between sensor1 and sink node and N = 4, we got SNR = 3.8 dB which is same as the result obtained in Fig. 4. By only varying distance between sink and first sensor node, and keeping all other nodes distance uniform, i.e., 1 m each, we got same SNR value that depends on number of transmit antenna irrespective of distance between sensor1 and base station. We observed that by taking 2 or 4 m distance between second sensor and sink node, still signals were able to reach at the sink node by distributed beamforming which indirectly implies improvement in coverage too. Therefore, it will improve coverage as well. Figure 7 shows sensor 2 transmitting to sink node or base station. In this sensor 1 has stopped working, achieved SNR = 0.9 dB. In Fig. 8 it is shown that by cooperative distributed beamforming by sensor 2 and sensor 3 we achieved SNR = 1.9 dB on sink node, which are 1 and 2 m apart from sink node. Therefore, it is proved that it will achieve coverage, connectivity and good signal quality and also at the same time elongate the life of wireless sensor network (WSN). Using this

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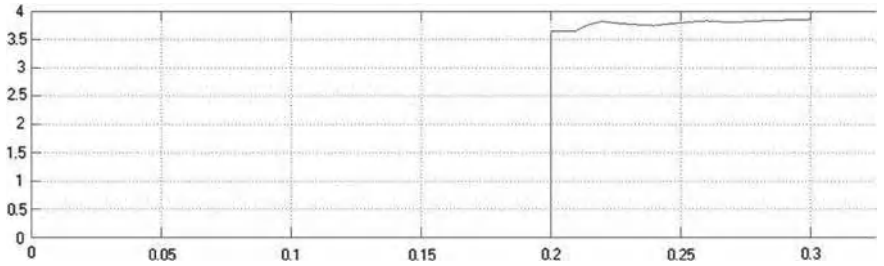

Fig. 6 Beamforming with 4 nodes on SINK by varying distance between sink and sensor. We have taken 2 and 4 m distance between SINK and sensor1 and in all 1 m distance SNR = 3.8 dB

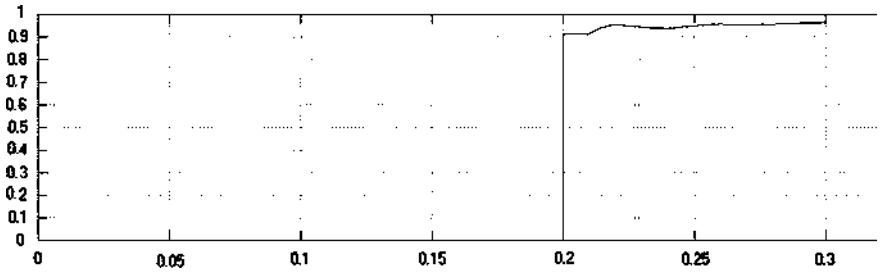

Fig. 7 Without beamforming, when sensor1 stop working, we got SNR = 0.9 dB by sensor 2

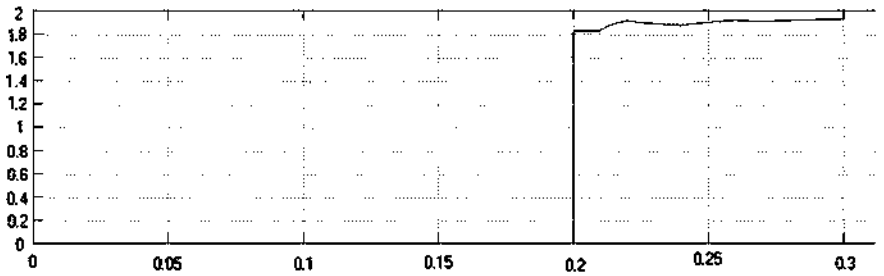

Fig. 8 Beamforming with sensor 2 and sensor 3 when sensor1 stop working. SNR = 1.9 dB

approach of connectivity, we will decrease the necessity of redeploying the nodes in the region of interest.

5 Conclusion and Future Directions

With the help of master–slave architecture of distributive Beamforming, we showed that by increasing distance between nodes and when a node fails still we are achieving good connectivity, and quality of signals. We have tested master–slave architecture

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many times, it is following the condition of constructive and destructive interference also satisfying the formula in Eq. 4.1. However, we have considered this approach in linear topology WSN but for random topology wireless sensor network, a proper algorithm should be developed that can utilize master–slave architecture effectively. Therefore, good algorithm for correctly utilizing this technology can be thought of as future work. Bandwidth consumption is a major concern in transferring information cooperatively, therefore it can also be thought of as future work.

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Sparse Representation Based Query Classification Using LDA Topic Modeling

Indrani Bhattacharya and Jaya Sil

Abstract In recent years, tremendous growth of documents provides scope and challenges to the interdisciplinary research community in text processing for retrieving information. Text analytics reveals high-quality information by identifying patterns and its trends using statistical methods. In this paper, we propose a novel approach to classify user query in a reduced search space by considering the query as a collection of words distributed over different topics. Latent Dirichlet allocation (LDA) has been used for topic modeling and a collection of topics containing words are obtained following Dirichlet distribution. We construct a sparse matrix called topic-vocabulary matrix (TVM) using probability distribution of words appearing in the topics. Finally, sparse representation based classifier (SRC) has been applied for classifying query using TVM consisting of training patterns. Here, we have analyzed the effect of number of patterns in classifying the queries and achieved 90.4 % accuracy.

Keywords Topic modeling · LDA · Sparse classifier · Statistical methods

1 Introduction

Huge collection of electronic documents posed new challenges to the researchers for developing automatic techniques to visualize, analyze and summarizing the documents in order to retrieve information accurately and computationally efficient manner. Topic models identify patterns which reflect underlying semantic embedded in the documents [1], needed to classify the documents based on the requirement of the users. Topic modeling is applied to index the documents using relevant terms whereas a topic is a probability distribution over words [2].

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In classical document clustering approaches [3] documents are represented by bag-of-word (BOW) model based on raw term frequency and therefore, poor in capturing the semantics. Topic models are able to combine similar semantics into the same group, called topic.

Term frequency inverse document frequency (tf-idf) method [4] can be able to identify discriminative words for a document, but pays little attention to inter- or intra-document statistical structure [5]. To address the problem, first latent semantic indexing (LSI) [6] and latter a generative probabilistic model [7] of text corpora were proposed. A significant step toward probabilistic modeling of text is probabilistic latent semantic analysis (PLSA) reported in [8]. LDA model has been developed to improve the process of forming the mixture models by capturing the exchangeability of both words and documents previously not explored in PLSA and LSA [9]. There are many LDA-based models including temporal text mining, author-topic analysis, supervised topic models, latent Dirichlet co-clustering, and LDA-based bioinformatics [10]. Several improvements have been proposed on LDA, such as the hierarchical topic models [11] and the correlated topic models [12].

A query consisting of several keywords can be viewed as distribution of words with probability over topics. Challenge is to develop more efficient retrieval mechanism for searching related topics from the corpus similar to the query submitted by the user. In this paper, we use LDA method to extract the topics from a large corpus of documents [2]. Then we propose a sparse representation-based classifier [13] for classifying the query, which is distribution of words with probability among the topics. A term vocabulary (TRV) has been constructed using unique terms in the topic corpus, representing the document repository. Since the number of terms present in the query is very specific, the query vector is highly sparse with respect to the TRV. In Sparse representation based classifier (SRC), query is represented in an overcomplete dictionary whose base elements are the training samples. In this paper, the topics are encoded using TRV and considered as training samples in topic-vocabulary matrix (TVM). Finally, we apply SRC to classify the query vector in a reduced search space.

This paper is divided into four sections. Section 2 describes detailed methodology using statistical topic modeling and sparse representation based classifier while results are summarized in Sect. 3 and conclusions are arrived in Sect. 4.

2 Methodology

In the proposed method, first we obtain the topics and the word distribution among the topics using traditional statistical topic models (LDA model). In the second part, we apply SRC to classify the users' query.

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2.1 Statistical Topic Modeling

LDA is a basic probabilistic model that describes a generative topic model for a large corpus of documents. In this model, each document is defined as a mixture of words with a given probability. The most dominant topics in the document are with highest probabilities.

Basic LDA model is built on certain assumptions. It assumes that (i) k number of topics is in the corpus, (ii) each document has topic proportions of θ, (iii) a word w is generated from a topic z, and (iv) each topic is defined as the word proportions β over the number of existing words.

The generative process is described below:

1. For each document d in the corpus
   (a) Generate $\theta_d \sim Dir\,(\alpha)$
   (b) For each word
      i. Draw a topic $z_{d,n} \sim Mult\,(\theta_d)$
      ii. Draw a word $w_{d,n} \sim Mult\,(\beta_{z_{d,n}})$

where n is the number of words and α is Dirichlet prior vector for θ and β is the topic probability. The joint distribution of topic mixture θ for given parameter α and β, a set of N topics zd and a set of n words wd is given by Eq. (1):

$$p(\theta, z_d, w_d \mid \alpha, \beta) = p(\theta \mid \alpha) \prod_{n=1}^{N} p(z_{d,n} \mid \theta).p(w_{d,n} \mid z_{d,n}, \beta) \tag{1}$$

where $p(z_{d,n} \mid \theta)$ is $\theta_{d,i}$ for the unique i such that $z_n^i = 1$.

Equation (2) shows the marginal distribution of a document:

$$p(w_{d,n} \mid \alpha, \beta) = \int p(\theta \mid \alpha).(\prod_{n=1}^{N} \sum p(z_{d,n} \mid \theta).p(w_{d,n} \mid z_{d,n}, \beta))\, d\theta \tag{2}$$

Finally, we obtain the probability of a corpus as given in Eq. (3):

$$p(D \mid \alpha, \beta) = \prod_{d=1}^{M} \int p(\theta_d \mid \alpha)\, (\prod_{n=1}^{N_d} \sum p(z_{dn} \mid \theta_d) p(w_{dn}, \beta))\, d\theta_d \tag{3}$$

In the learning method, latent variables z and θ are searched using LDA with an objective to maximize log-likelihood of the data and this problem is NP hard. Several approximate inference algorithms include Gibbs sampling [14] and variation inference [15] have been used for learning purpose. Figure 1 shows graphical representation of LDA model where each node is represented as a random variable and labeled according to the generative process.

In our experiment, we apply LDA considering variable number of topics. We set initial value of parameter α in the range [0, 1] and obtain its effect on distribution of number of topics. We choose 10^{-2} as threshold of difference in α varied over number of topics for the proposed retrieval method. We choose 25 topics as threshold because no significant change in α has been observed further.

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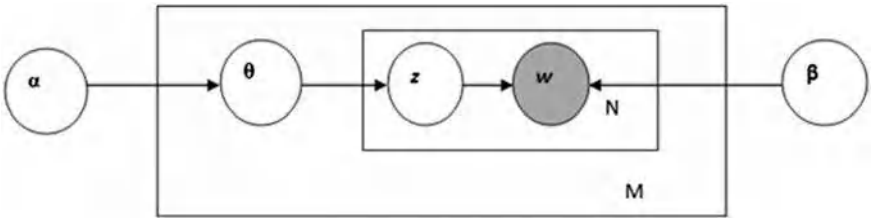

Fig. 1 Graphical representation of LDA model

2.2 *Sparse Classifier*

We obtain n topics containing words using LDA from the corpus of documents and a vocabulary TRV is prepared using unique terms present in different topics. Let us assume the number of unique words in n no. of topics is k, so the dimension of TRV is $1 \times k$. On the basis of TRV a feature vector (FV) of dimension $1 \times k$ for each topic is defined in Eq. (4):

$$\begin{aligned} \mathbf{FV}[i] &= P(w_i \mid T) \cdot P(w_i), \quad \text{if } w_i \text{ presents in the topic} \\ &= P(w_i), \quad \text{otherwise} \end{aligned} \tag{4}$$

where $P(w_i|T)$ denotes the probability of word w_i in topic T and $P(w_i)$ gives the probability distribution of the word in the corpus.

Let us assume that there are c known pattern classes. Let Ai be the matrix obtained using the training samples of class i, i.e., $\boldsymbol{A}_i = [\boldsymbol{y}_{i1}, \boldsymbol{y}_{i2}, \ldots, \boldsymbol{y}_{iRi}] \in \mathbb{R}^{d \times Si}$ where M_i is the number of training samples of class i.

Let us define a matrix $\boldsymbol{A} = [\boldsymbol{A}_1, \boldsymbol{A}_2, \ldots \boldsymbol{A}_c] \in \mathbb{R}^{d \times S}$, where $S = \sum_{i=1}^{c} S_i$. The matrix $\boldsymbol{A}$ is built for the entire training samples. Given a query test sample $\boldsymbol{y}$, we represent $\boldsymbol{y}$ in an overcomplete dictionary whose basis are training samples, so $\boldsymbol{y} = \boldsymbol{A}\boldsymbol{w}$ If the system of linear equation is underdetermined (P < S), this representation is naturally sparse.

The sparsest solution can be obtained by solving the following L_1 optimization problem given in Eq. (5),

$$(L_1)\ \widehat{\boldsymbol{w}_1} = \arg\ \min \|\boldsymbol{w}\|_1, \quad \text{subject to } \boldsymbol{A}\boldsymbol{w} = \boldsymbol{y} \tag{5}$$

This problem can be solved in polynomial time by standard linear programming algorithm [16]. After the sparsest solution $\widehat{\boldsymbol{w}_1}$ is obtained, the SRC can be done in the following way [17].

For each class i, let $\partial_i : \mathbb{R}^S \to \mathbb{R}^S$ be the characteristic function that selects the coefficient associated with the ith class.

For $\boldsymbol{w} \in \mathbb{R}^S$, $\partial_i(\boldsymbol{w})$ is a vector whose nonzero entries are in w associated with class i. Using only the coefficient associated with the ith class, reconstruction can be

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done on a given test sample y as $\boldsymbol{v}^i = \boldsymbol{A}\partial_i(\widehat{w_1})$; $\boldsymbol{v_i}$ is called the prototype of class i with respect to the sample $\boldsymbol{y}$. Equation (6) shows the residual distance between $\boldsymbol{y}$ and its prototype $\boldsymbol{v_i}$ of class i,

$$r_i(\boldsymbol{y}) = \|\boldsymbol{y} - \boldsymbol{v}^i\|_2 = \left\|\boldsymbol{y} - \boldsymbol{A}\partial_i(\widehat{\boldsymbol{w}_1}).\boldsymbol{v}^i\right\|_2 \tag{6}$$

The SRC decision rule is

if $r_l(\boldsymbol{y}) = \min_i r_i(\boldsymbol{y})$, $\boldsymbol{y}$ is assigned to class l.

In the experiment, we consider the **TVM** as the training set. **TVM** has been built by considering the feature vectors $\mathbf{FV_i}$ for each topic i as described below.

$$\mathbf{TVM} = [\mathbf{FV_1}, \mathbf{FV_2} \ldots \mathbf{FV}_n]^{\mathrm{T}}$$

The dimension of **TVM** is $n \times k$. Now, we consider a user query q as a test sample and convert it into feature vector $\mathbf{FV_q}$ of dimension $1 \times k$ as described in Sect. 2.2.

We apply SRC on **TVM** for reconstruction of $\mathbf{FV_q}$ and assigned nearest topic to $\mathbf{FV_q}$. The procedure is described in Algorithm 1.

Algorithm 1 Query classification using SRC

Input: Set of topics T , query Q, Set of unique keywords TRV, Number of topics n
Output: Topic related to the query,
Topic-SRC (T, Q, TRV, n)
1. TVM ← Φ; FV ← Φ // Topic-vocabulary matrix & Feature vector
3 For each $t \in$ T
4. FV = Feature-Vector (T, TRV)
5. $i \leftarrow 0$
6. For $i < n$
7. TVM[i] = FV [i] $^{\mathrm{T}}$
8. FV_q = Feature-Vector (Q, TRV)
9. t-Class = SRC (FV_q, TVM, n) // Topic of the query
10. Return t-Class
Procedure1: Feature-Vector (T, TRV)
1. For each $w \in$ T
2. Calculate P(w | T)
3. FV ← Φ; $i \leftarrow 0$
6. For $i <$ length (TRV)
7. If T[i] = = TRV[i]
8. FV[i] ← P(w | T) .P(w)
9. Else
10. FV[i] ← P(w)
11. Return FV
Procedure 2: SRC (FV_q, TVM, n)
1. W ← Φ; D ← Φ //Sparse co-efficient vector & Set of distance
3. W = pinv(TVM) * FV_q^{T} // Construction of W
4. Find sparsest solution W_s for W by equation (5)
5. $i \leftarrow 0$
6. For each $i < n$
7. $(FV_q)^{i}_{new}$ = TVM * W_s // Reconstruction of sample vector
8. D[i] ← Norm (FV_q , $(FV_q)^{i}_{new}$)
9. t-Class = min(D) //Finding minimum residue distance
10. Return t-Class //Returning nearest topic class of Query

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3 Results and Discussion

In the experiment, we used a subset of TREC AP (Academy Press) corpus containing 2246 news articles with 10473 unique terms. After preprocessing the document, we apply LDA and obtain 25 topics that are optimum for this experiment. Each topic is visualized as a set of words where each element of the set is assigned with the posterior topic measures. Table 1 shows five different topics with most frequent 10 keywords. Test samples as users' query are classified by executing algorithm1.

The performance of the classifier is evaluated using different statistical measures [18] considering 10 queries for each 25 topics, i.e., $10 \times 25 = 250$ queries. We considered varied length of query up to five keywords and no significant change is

Table 1 Topics with top 10 keywords

Economy	Administration	Judiciary	Healthcare	Aviation
Oil	Police	Court	Aids	Air
Cents	People	Trail	Health	Space
Price	Killed	Case	Hospital	Flight
Futures	Authorities	Charges	Medical	Plane
Cent	Army	Attorney	Disease	Two
Lower	City	Prison	Drug	Aircraft
Market	Man	Judge	Patients	Planes
Higher	Government	Two	Care	Accident
Million	Officials	Guilty	Federal	Navy
Farmers	Reported	Years	Doctors	Ship

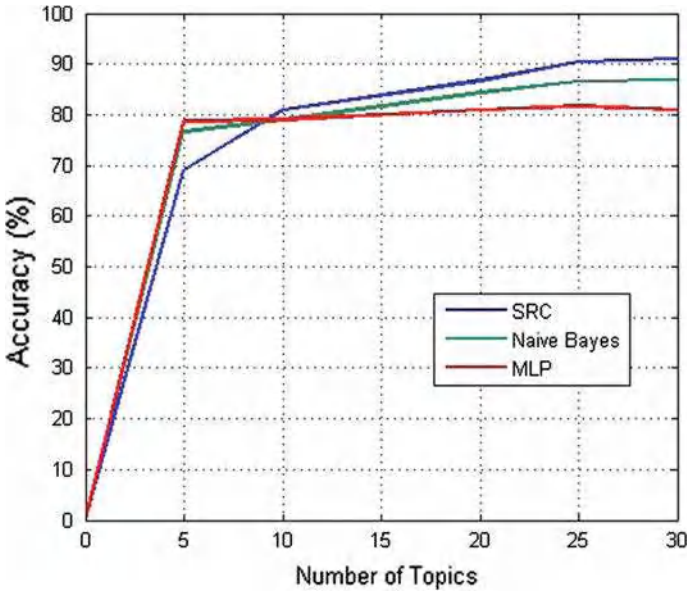

Fig. 2 Accuracy versus number of topics

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Table 2 Comparison with different classifiers

Classifiers	Statistical measures							
	Accuracy (%)	Misclassification (%)	TP rate	FP rate	Precision	Recall	F-measure	Specificity
Naive-Bayes	86.6	13.3	0.86	0.015	0.888	0.867	0.868	0.985
Multilayer perceptron	81.66	18.33	0.82	0.02	0.823	0.817	0.819	0.98
SRC	90.4	9.6	0.9	0.09	0.978	0.9	0.94	0.91

reported in the retrieved information. It has been observed statistically that maximum five keywords are provided by most of the users for their query [19]. For instance, the query vectors [judge trial charges guilty]^T, [oil higher market price]^T, [government authorities reported official]^T and [aids patients doctors care]^T of length 4 are classified as 'Judiciary', 'Economy', 'Administration', and 'Healthcare'.

Accuracy has been improved with the number of topics indicating appropriateness of applying sparse classifier in the proposed method. Figure 2 shows improvement in accuracy with increasing number of topics, not remarkable for other classifiers unlike SRC. High accuracy and high TP rate ensures good precision and recall for retrieval method that guarantees lower misclassification too. Detailed comparison of different classifiers using statistical measures summarized in Table 2 and ROC curve for SRC is shown in Fig. 3.

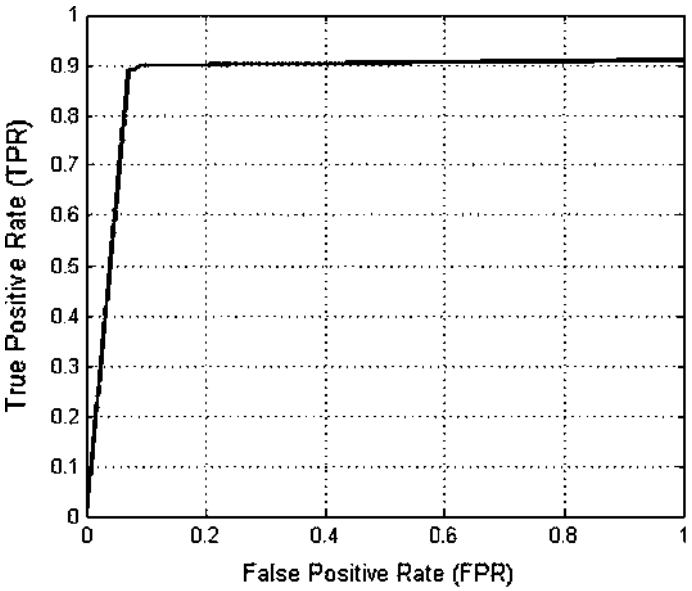

Fig. 3 ROC curve for SRC

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4 Conclusion

LDA is a basic and generative model for topic modeling used in the paper for initial latent topic identification. We consider any query as a distribution of words obtained from topics which is sparse with respect to high dimensional input space represented using vocabulary. Proposed approach gives satisfactory results in terms of statistical measures and improves with the size of the training set. For Naïve Bayes classifier performance is better for less number of topic, however, proposed approach using SRC outperforms when size of the training set increases, shown in Fig. 2.

Acknowledgments This research was partially supported by grants from Information Technology Research Academy (ITRA), under the Department of Electronics and Information Technology (DeitY), Government of India.

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Multiple Home Automation on Raspberry Pi

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Abstract A wireless home automation is an emerging trend in this era. Smart home automation finds itself a place that cannot be neglected, as more physical components can be connected through the internet, i.e., wirelessly. The basic elements in a wireless home automation network consist of an embedded sensors accompanied with actuators. This automation network can be used to control home appliances. WebIOPi is a web-based interface and browser-based software that is similar to an application in android phone. To automate multiple homes, the users need a common platform like Raspberry Pi, so that all homes can be managed through WebIOPi with minimal cost using Raspberry Pi. This paper mainly focused the emerging solutions that are suitable for Raspberry Pi and ZigBee.

Keywords ZigBee · WebIOPi · Raspberry Pi

1 Introduction

In traditional communication network all devices are connected through wires. This resulted in a major impediment in network advancements as more money has to be spent in installing wires and establishing connections between networks. Switch played a vital role in these wired connectives. As air space was used as a medium for communication, research and further development in technologies aiding this air

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medium began to slowly emerge. This led to the advent of wireless technology. Internet was used as a base platform for all wireless communications. All physical devices that are connected to the internet are assigned a separate internet protocol (IP) address. This IP address is the physical representation for the device. In recent years wireless sensor network (WSNs) receives significant attention from diversified spectrum of industries, from health care, video surveillance, military, etc, with the emphasis being placed in the field of home appliances, where there is a huge market for consumer electronic goods and a considerable population using these home appliances [1].

Wireless home automation is implemented through a network of interconnected devices which can monitor and control applications for home. A wireless home automation typically includes several embedded devices, which are battery powered and furnished with low-power radio frequency (RF) transceivers. One of the greatest advantages of using a radio frequency communication is its flexibility in allowing new devices to be added and removed as per the user's convenience. Moreover, it minimizes the installation costs since wired networks require ducts or cable trays [2]. Despite these advantages, the wireless home automation also poses some challenges like dynamics of radio propagation, resource limitations, and mobility of devices. A considerable advancement in architectural developments has been made by several organizations and companies across the length and breadth of the world. These architectural designs have been established as per the requirements of the companies personally. The main objective of home automation is to monitor and control devices in home with precision and with minimal direct human interference [3].

2 Main Features of Home Automation

2.1 Light Control

Light can be controlled from outside the place by passing commands. It will reduce the usage of wired connection. It does not automatically on and off. The human intervention is must. The sensor will decide whether the light will be on and off [4].

2.2 Remote Control

Infrared technologies are used for controlling television, heating, and ventilating equipment, but the infrared wavelength is only suitable for short distances. So the radio frequency waves are used to overcome the drawback of infrared solution [5].

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2.3 Smart Energy

The sensor only gives the information about temperature, humidity, and light, so smart technology is used to avoid the unnecessary waste of energy. The smart utility meters can be used to detect usage peaks and alert the household devices that may be causing them. Energy supply companies may also use wireless home automation mainly used to perform energy load management [2].

2.4 Remote and Care

Internet of things pills can be used to detect patient health condition and inform to the doctor. Wearable wireless sensors can continuously indicate the condition of several body parameters (e.g., temperature, blood pressure, and insulin) for a correct diagnosis. If acceleration sensors indicate that a person has health problem, alarms can be activated promptly [6].

3 Single Home Automation

Automation is reducing human intervention from the physical devices. Single home automation can be defined as an ideal environment where all appliances and devices inside the home can be controlled with a tap of a finger. Single home automation using the embedded browser of two-way communication is made possible. For all home automations, remote control is the main aim [7] (Figs. 1, 2, 3, 4, and 5).

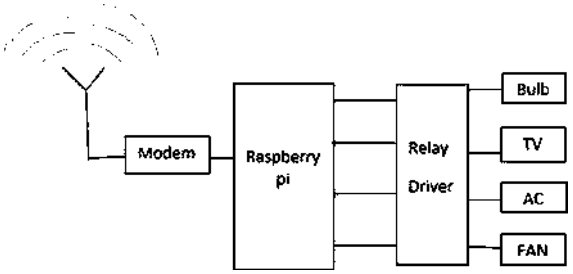

Fig. 1 Single home automation

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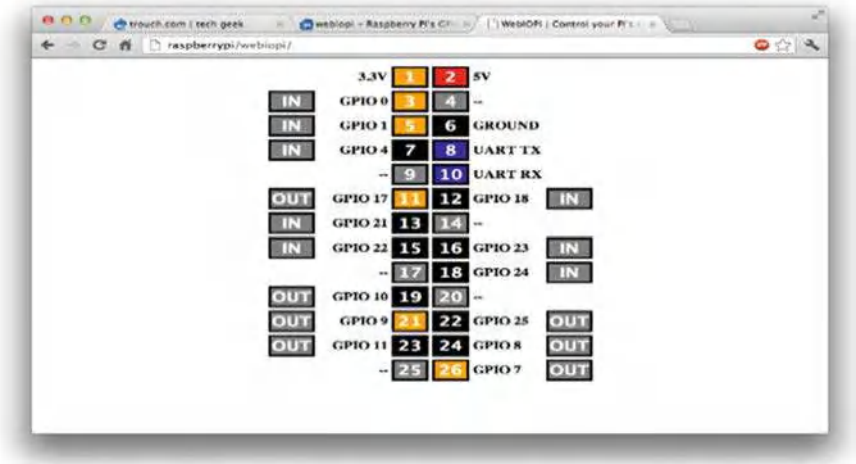

Fig. 2 WebIOPi

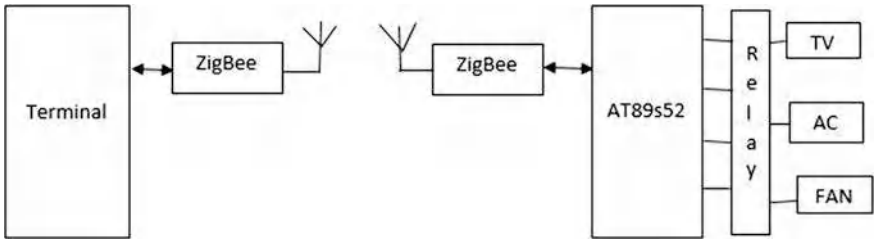

Fig. 3 Single home automation in ZigBee

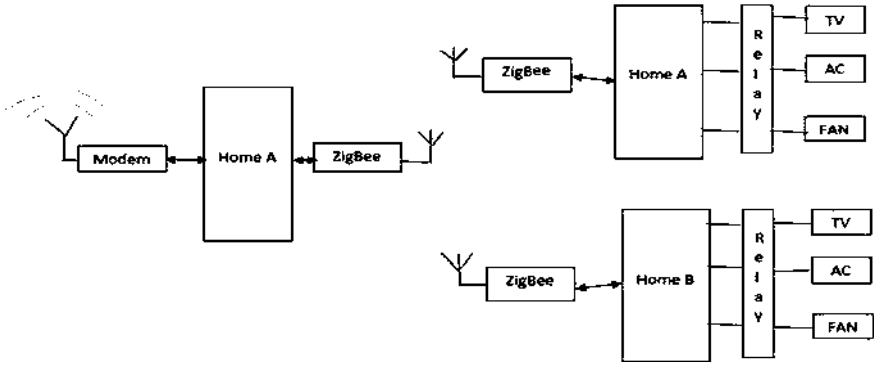

Fig. 4 Multiple home automation using Raspberry Pi and ZigBee

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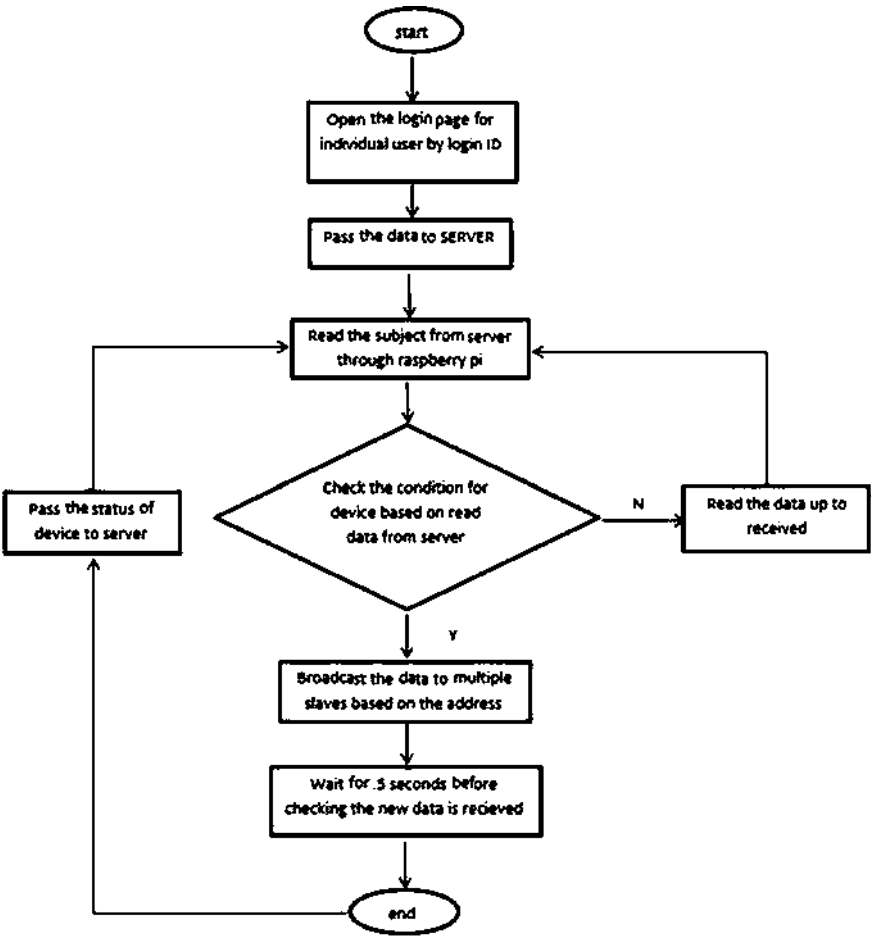

Fig. 5 Flow chart for the proposed method

4 Proposed Work

4.1 WebIOPi

WebIOPi can be defined as a REST framework that allows the user to control GPIO pins in Raspberry Pi from a browser. It is a client–server model of communication. The client is written in JavaScript and the server is coded in Python. The benefit of the WebIOPi is that it can perform the two-way communication [3]. In WebIOPi control, the air conditioner depends on the temperature value, because WebIOPi will give the options for digital monitor. For changing the Raspberry Pi as a server, Raspberry Pi will provide one hostname with port id, and will assign a new port.

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Otherwise, the user can change the port id as user's wish. Then running the host name with port id user will get the WebIOPi page [1].

5 ZigBee-Based Communication

ZigBee is a wireless protocol. It is mainly used to transmit the data to another device. The ZigBee is a transceiver module, which means transmitter and receiver. Till now there is no specific wireless network standard that makes the acquaintance of the needs of both sensors and control devices specifically. Sensors transmit data in small amounts while in need and thus do not require high consumption in bandwidth, but they do need very low energy consumption for a longer battery.

For this, ZigBee came to this world. The Bluetooth and NFC distance are very low. Using those technologies cannot send data over long distances. ZigBee is a low power consumption, and it has two states: one is active and another one is sleep state. In the first state, ZigBee sends data to another device. All slaves receive the data, but the device which is suitable will only be active. Another one also receives the data, but it will not give any response. The RX power will be varying depending on the standard. The advantages of ZigBee module are low cost, low maintenance, and low installment [6].

6 Multiple Home Automation

Multiple home automation can be defined as a cluster of single home automated environments, where a single user or multiple users can access their homes and control them through a single platform say internet of things, WebIOPi. The multiple home automation using single Raspberry Pi is a complex task. The Raspberry acts as a server and the microcontroller acts as a slave. The Raspberry Pi sends a data through ZigBee. One ZigBee is connected to Raspberry Pi and another ZigBee is connected to microcontroller. While pressing the button in Raspberry Pi, the string data will come out. The ZigBee receives the data and sends to microcontroller. The slave ZigBee receives the data and gives to that slave host. The slave host is a microcontroller. All microcontrollers will receive the data, but the microcontroller where the data is suitable will move to active state, while other microcontrollers will be in sleep state only.

7 Algorithm for Proposed Method

The above flowchart says the individual user gets a separate login id. When the user enters the login and presses the button, data is sent to the server. Then the server reads the data through Raspberry Pi, after that check the condition for device based

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on read data from server. If the condition false, then it will move to read data up to received. If the condition is true, it will broadcast the data to multiple slaves based on the address. The server will give the service which depends on the priority, wait for 5 s before checking the new data which is received. The 8051 microcontroller acts as a slave in this work, and has 40 pins and 4 ports. The user can access only two ports at a time. The microcontroller will be host for the ZigBee. User already dumbed the program in microcontroller. The serial communication program will work perfectly. There is no communication between the microcontrollers; the baud rate of this microcontroller is 9600. The parity bits also have to give [8].

8 Results and Discussions

Figure 6 shows the output of serial communication in AT89s52. Here, the Raspberry Pi is connected to microcontroller [3]. First, the Raspberry Pi is changed into local server. The frame name is WebIOPi. The Raspbian OS is running on the Raspberry Pi. The Raspberry Pi did not have an internal memory. The SD card is used for the memory of Raspberry Pi. For running the WebIOPi framework user has to run the following code:

Sudo webiopi -d -c/etc./webiopi/config

After running the above code, the WebIOPi framework page will be opened. Then the users have to type the username and password. The default username is WebIOPi and password is Raspberry, but the user can change the user name and password they like. After running the code the below page will be opened. The Linux kernel has to upload all the details into the configuration file. The user copies

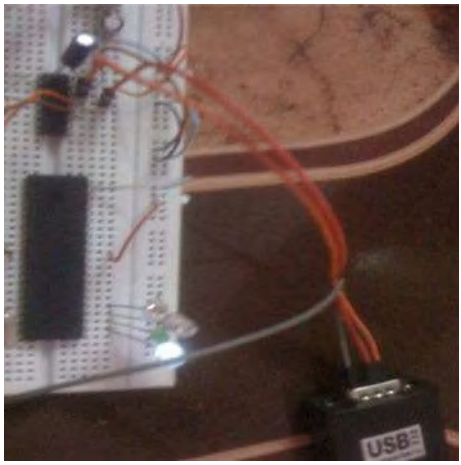

Fig. 6 Serial communication in AT89s52

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the internet protocol address with port id which is generated from the WebIOPi. The format is

http://ipaddress of Raspberry pi: Port id

By default, the Raspberry Pi will communicate on the port 8000, but the user wants to change the port id that is possible (Figs. 7, 8, 9 and 10).

When the user presses the above button, the character 'A01' will be sent to microcontroller through ZigBee. The ZigBee is a wireless protocol. The second part microcontroller will receive the string 'A01'. The character A means that it will select the first home. The character 'B' means it will select the home B.01 means the first light will glow and 02 means the second light will glow. The microcontroller will receive the code and will react depending on the code. The figure shows the output of serial communication in Raspberry Pi [5].

The above diagram shows how the relay circuit is connected with Raspberry Pi, because relay circuit is very important one. The need of relay converts the controller output into commercial output because all the home appliances needed 230 V power supply, but the Raspberry Pi cannot able to give that much of power. Our Raspberry Pi input voltage is 3–5 V. The relay circuit is used to connect with another end switch: the TTL output to commercial output (230 V, 50 Hz) [7].

Fig. 7 Output of Raspberry Pi server

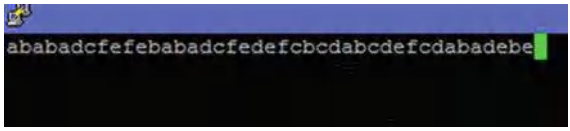

Fig. 8 Serial communication in Raspberry Pi server

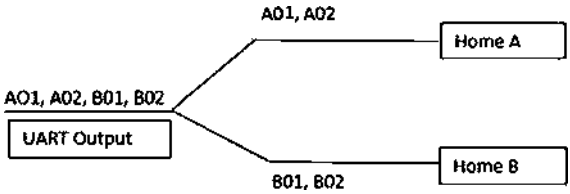

Fig. 9 Communication structure

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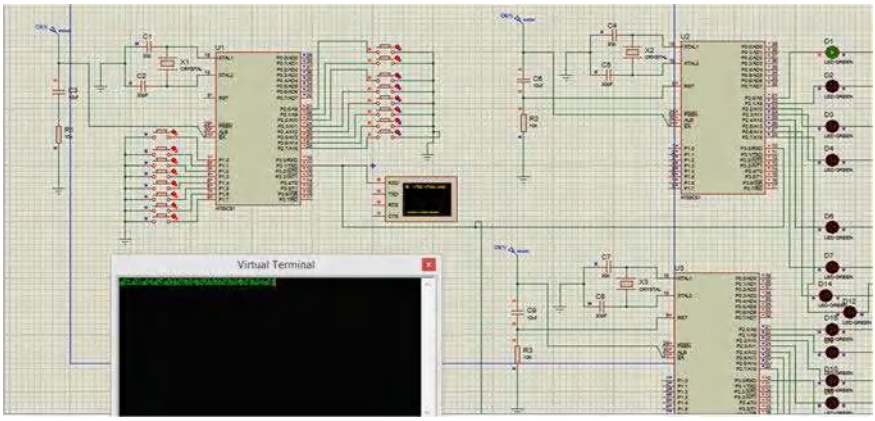

Fig. 10 Microcontroller simulation result

9 Conclusions

An approach for implementing multiple home automation is done using single Raspberry Pi. But the performance can be further enhanced using ZigBee module, as ZigBee reduces power consumption and its ability to establish communication even in the presence of barriers. Data is sent to the server; this minimizes the problem of transmission of data. Hence, using both internet of things (IOT) and ZigBee protocol, this approach could satisfy all hindrances in home automation like power consumption and cost issues. This approach ensures home automation with greater efficiency at lower cost.

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Sentiment Analysis Based on A.I. Over Big Data

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Abstract Area of interest over big data is a basic problem of data management system. In this paper we elaborate a methodology for sentiment analysis based on artificial intelligence. In any AI (Nicole, IEEE Trans Inf Theory, IT-9:248–253 (1963) [1]) systems think like human, think like rationally, act like human, and act like rationally. This type of AI system is imposed on big data to find the common sentiment as per user recommendation. In this paper we present a recommended technique for sentiment analysis. Recommended technique is based on AI approaches. In this paper we elaborate a matrix for user recommended data group for big data which is reduced by dimension reduction technique.

Keywords Cloud · Artificial intelligence · Recommended system · Collaborative filtering · Single value decomposition (SVD) · Big data

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1 Introduction

The user opinion about the EaaS (Everything as a Service) can be based upon the interest of the downloading or viewing the data over the Cloud. Cloud [2] is also known as a one-time big data. The relevant data, large data storage, high virtualization different networking equipments, and large platform are the area of interest for big enterprises as well as single user. Public cloud permits a large amount of availability of public data (texts, audio, video, images) which can be shared between large number of end consumers. These shared data help to find out the interest of the users. By the interest of cloud service consumers, cloud service providers can easily maintain a group of user recommended data group (Big data). This group contains a common data which is accessed by a number of service consumers.

Advantages of user recommended data group (Big data) [3] are as follows:

Each time when the service consumer logins in, he logins as a member of this group and finds out the people who have similar interest as him.
Cloud service provider can save himself from the overhead of data availability and data security.
Public Cloud becomes a platform where the service consumers with same interest can interact.

2 Problem Statement

Challenges for making a user recommended data group (Big Data) are as follows:

A large public Cloud can have huge amount of data, tens of millions of service consumers, and millions of different catalog groups.
New service consumer can have extremely limited information, based on very limited data which is accessed.
Old service consumers can have a glut of information, based on thousand of data which are accessed.
End-user consumers are volatile.

3 Proposed System

In this paper we are going to introduce the methodology for creating user recommended data group (Big data). In the present scenario for making data group, public Cloud is either done by the Cloud service provider or Cloud server. Manually, making these groups takes large amount of processing time, so it is important to make it using Cloud servers. Hence, using Cloud servers introduces artificial

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Table 1 Categories of AI [16]

Systems that assume like humans	Systems that assume rationally
"The exciting new effort to make computers think …. Machines with minds, within the full and literal sense"	"The study of mental faculties through the use of computational models"
Systems that act like humans	Systems that act rationally
"The art of creating machines that perform functions that require intelligence when performed by people"	"Computational Intelligence is the study of the design of intelligent agents"

intelligence in the cloud. For making these types of group we involve the search methods of artificial intelligence known as recommender system. In recommender system we use collaborative filtering to make user recommended data group (Big data) (Table 1).

Artificial Intelligence: Following table defines the artificial intelligence, organized in four categories:

Search Methods: The process of looking for sequence from problem formulation to solution is known as search methods. In artificial intelligence there are two methods:

Uninformed search: Sometimes we may not get much relevant information to solve a problem. This type of search is called uninformed search.

Informed search [4]: Informed search is also decision heuristic search. Rather than looking one path or several ways, similar to that informed, search uses the given heuristic info to make a decision whether or not to explore the present state further.

Recommender systems: Recommender systems were created to assist in sorting through the vast amount of information that the internet can provide. These systems function by taking in some types of user information, such as preferred music artists, etc., and provide recommendations for new data based on the user's previous choices.

4 Research Methodology

Detailed description of research methodology is as follows:

1. Cloud consumer or user logins access the data from the Cloud. Each time a log file is created corresponding to access data and forwarded to Cloud server.
2. Cloud server takes current log files and all the previous log files and applies traditional collaborative filtering [5] over them.
3. In this way a large cluster [6] is created over big data based on user interest or user recommendation.
4. This large cluster contains thousands of data interest over user interest so it is impossible or too difficult for a cloud server to match these files with other user interest files. So cloud server applies size reduction policy.

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5. In size reduction policy cloud server uses single value decomposition mechanism.
6. In this way size reduction policy is processed and user interest small cluster is created.
7. Cloud server matches small cluster of user interest of each user with other users and creates sentimental group.
8. In this way Cloud-based sentimental group is created.

5 Solution Approach

5.1 Traditional Collaborative Filtering [7, 8]

Collaborative filtering has two senses, a slim one and a lot of general one. In general, collaborative filtering is that the method of filtering for data or patterns and victimization techniques involving collaboration among multiple agents, viewpoints, information sources, etc. Applications of collaborative filtering usually involve terribly massive information sets. Collaborative filtering ways are applied to several totally different styles of information (Fig. 1).

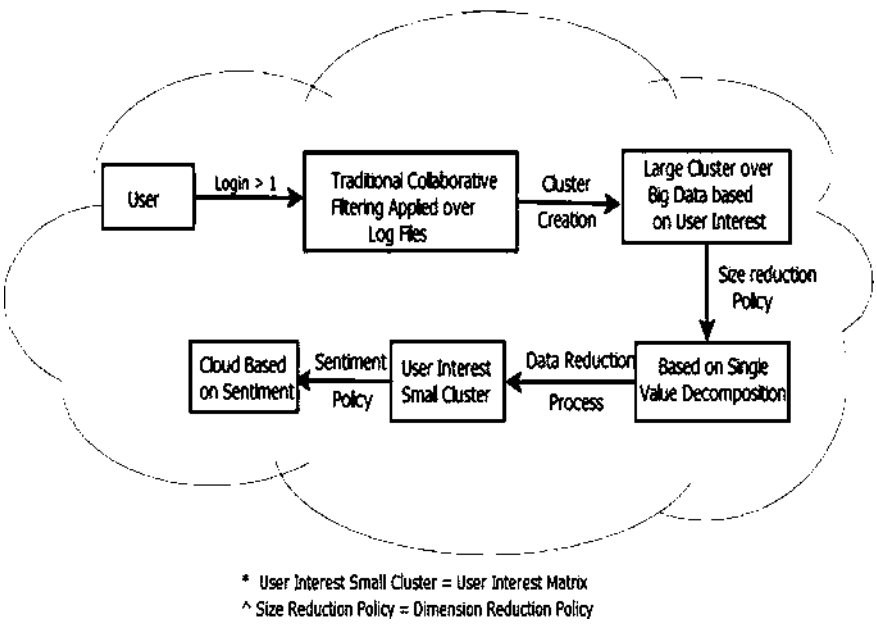

Fig. 1 Research methodology

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1. Prediction: Prediction is a mathematical value, and expresses the predict likeliness of the item for the active user.
2. Recommendation: It is a list of N items that the active user will like the most. The recommended list contains the items not already purchased by user.

Within the newer, narrower sense, collaborative filtering [9] may be a technique of constructing automatic predictions (filtering) regarding the interests of a user by aggregation preferences or style data from several users (collaborating). A collaborative filtering [10] formula represents a client as an N-dimensional vector of data, wherever N is that the variety of distinct catalog data. The elements of the vector are positive for accessed or absolutely rated information and negative for solely viewed information and negatively rated data. For almost all service customers, this vector is extraordinarily thin. The formula generates recommendations based on many service customers who are most similar to the finish user. It will live the similarity of two service customers, A and B, in numerous ways; a common method is to live the cos of the angle between the two vectors (Figs. 2, 3, 4, and 5).

Using collaborative filtering to get recommendations is computationally dearly won. It is O(MN) within the worst case, wherever M is the range of service customers and N is the number of product catalog data, since it examines M service customers and up to N knowledge for every client. However, because the average client vector is extraordinarily thin, the algorithm's performance tends to be nearer to O(M + N). Scanning each client is approximately O(M), not O(MN), as a result of the majority customer vectors contain a tiny low range of information, regardless of the dimensions of the catalog. However, there is a space for few service customers who have accessed a significant share of the catalog, requiring O(N) time interval. Thus, the ultimate performance of the algorithmic rule is roughly O

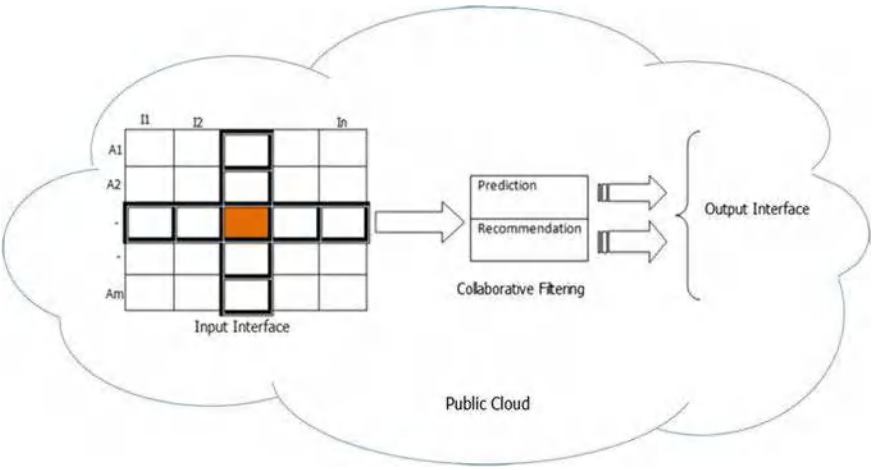

Fig. 2 The collaborative filtering process on public cloud

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$$\text{similarity} = \cos(\theta) = \frac{A \cdot B}{\|A\|\|B\|} = \frac{\sum_{i=1}^{n} A_i \times B_i}{\sqrt{\sum_{i=1}^{n} (A_i)^2} \times \sqrt{\sum_{i=1}^{n} (B_i)^2}}$$

Fig. 3 Cosine similarity rule [15]

$$\underset{m \times n}{X} = \underset{m \times r}{U} \; \underset{r \times r}{S} \; \underset{r \times n}{V^{\top}}$$

Fig. 4 Single value decomposition matrix

$$\underset{m \times n}{\hat{X}} \approx \underset{m \times r}{U} \; \underset{r \times r}{S} \; \underset{r \times n}{V^{\top}}$$

Fig. 5 Reduced matrix for user recommended data group

(M + N). Even so, for terribly massive knowledge sets—like ten million or more service customers and one million or additional catalog data—the algorithmic rule encounters severe performance and scaling problems. It is attainable to partly address these scaling issues by reducing the information size to 4; we are able to scale back M by sampling the service customers or discarding service customers with few access, and scale back N by discarding very common or less-traveled knowledge. It is also possible to cut back the amount of information examined by a tiny low and constant issue by partitioning the data space supported product class or subject classification. Dimensionality reduction techniques like cluster and principal element analysis can reduce M or N by an oversized issue. Unfortunately, of these strategies conjointly, it can reduce recommendation quality in many ways. First, if the algorithmic rule examines solely a tiny low customer sample, the chosen service customers are going to be less similar to the user. Second, data-space partitioning restricts recommendations to a particular product or subject space. Third, if the algorithmic rule discards the most common or less-traveled knowledge, they will never appear as recommendations, and repair customers who have accessed solely those knowledge will not get recommendations. Dimensionality reduction techniques applied to the area tend to possess the same result by eliminating low-frequency knowledge.

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5.2 Dimension Reduction [11] and Single Value Decomposition [12]

One common thanks to represent datasets is as vectors during a feature area. As an example, if we have a tendency to let every dimension be a film, then we are able to represent users as points. One natural question to request this setting is whether or not it is attainable to cut back the amount of dimensions we want to represent the information. As an example, if each user who likes the matrix conjointly likes Star Wars, then we are able to cluster them along to make an agglomerated film or feature. We are able to then compare two users by watching their ratings for various options instead for individual movies. There are unit many reasons we would need to try to this. The primary is quantifiability. If we have got a dataset with 20000 movies, then every user may be a vector of 20000 coordinates, and this makes storing and examination users comparatively slow and memory-intensive. It seems, however, that employing a smaller range of dimensions will really improve prediction accuracy. As an example, suppose we have got two users who like phantasy movies. If one user has rated Star Wars extremely and also the different has rated Empire Strikes Back extremely, then it is smart to mention the users' area unit similar. If we have a tendency to compare the users' supported individual movies, however, solely those movies that each user has rated can have an effect on their similarity. This can be an extreme example; however, one will actually imagine that there area unit numerous categories of films that ought to be compared. They were making an attempt to check document exploitation of the words they contained, and that they planned the thought of making options representing multiple words and so examination those. To accomplish this, they created use of a mathematical technique referred to as singular value decomposition. In addition, recently, Sarwar et al. created use of this method for recommender systems. The singular value decomposition (SVD) [13] may be a documented matrix resolution technique that factors an m by n matrix X into three matrices as follows.

The matrix S may be a square matrix containing the singular values of the matrix X, where square measures specifically r singular values, wherever r is that the rank of X. The rank of a matrix is that the range of linearly freelance rows or columns within the matrix. Recall that two-vector square measures linearly freelance if they will not be written because of the total or scalar multiple of the other vectors within the area. Observe that linear independence somehow captures the notion of a feature or clustered item that we tend to try to induce at. To come to our previous example, if each user who liked Star Wars additionally liked the Matrix, the two show vectors would be linearly dependent and would solely contribute one to the rank.

We can do a lot, however. We might love to check movies if most users who like one additionally just like the alternative. To accomplish, we will merely keep the primary k singular values in S, where k may provide US the simplest rank-k approximation to X, and so has effectively reduced the spatial property of our original area. So we have got: ratings Matrix[user][movie] = total (user Feature[f][user] * movie Feature[f][movie]).

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5.3 Recommendations with the SVD

Given that the SVD somehow reduces the spatial property of our dataset and captures the "features" that we will use to check users, however, can we truly predict ratings? The primary step is to represent the info set as a matrix wherever the users square measure rows, movies square measure columns, and therefore the individual entries square measure-specific ratings. So as to supply a baseline, we tend to fill all told of the empty cells with the common rating for that shown and so figure the SVD. Once we tend to scale back the SVD to induce X_hat, we will predict a rating by merely wanting up the entry for the acceptable user/movie try within the matrix X_hat.

6 Conclusion

Sentiment analysis is a future of big data as per this paper purposed. AI techniques are well-organized technique for creating any kind of result. Whatever AI technique is imposed in this paper or on big data [14] for sentiment analysis presents basic concept for futuristic technique. Reduced matrix system is generated for user recommended data which is based on AI techniques. So this paper presents base for big data to find common sentiment using AI techniques for user recommended data.

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Negotiation and Monitoring of Service Level Agreements in Cloud Computing Services

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Abstract SLAs are so significant in cloud computing because it establishes agreements between the cloud service providers and cloud consumers, about the quality of the providing service. SLA monitoring is the only available provision to check whether the agreed parties are following the agreement terms or not. A multistep SLA negotiation, which contains the selection of apt cloud service provider and the negotiation with the selected provider, is proposed here. An efficient SLA negotiation algorithm is also included in this negotiation method. Experimental evaluation shows that the proposed method is more efficient in resource allocation and it gives more revenue to the cloud providers.

Keywords Cloud computing · Service level agreement (SLA) · SLA negotiation · SLA monitoring · QoS

1 Introduction

Service Level Agreements (SLAs) plays a major role in maintaining the quality of service in cloud computing environment. An SLA contains a set of SLOs (Service Level Objectives) which define QoS properties for the agreed upon service. The usage of new improved mechanisms for negotiating and monitoring SLAs is highly essential because of the dynamic change in service requirements. Online monitoring of SLA is advantageous to both the involved parties because it detects possibility of violations in SLA and initiates some actions to correct or compensate it. SLA negotiation takes care of the conflicts in SLO values and tries to resolve them with some agreed upon values. The negotiation protocol controls the decision, desirability, and preferences of the parties to finalize an agreement.

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Dynamic SLA management includes a sequence of steps such as: (i) Negotiation and establishment of SLA with a suitable service provider, (ii) Monitoring the SLO parameters and assessing the performance of the delivered service and (iii) Renegotiation of SLO values on the detection of an SLA violation. In the literature, several techniques are discussed for SLA management, but none of these steps mentioned the multistep approach. In this paper, we introduce a multistep approach for dynamic SLA management where the selection of a suitable provider and negotiation of SLA are the different steps included. An efficient architecture and its working algorithm are included as part of this negotiation. The remaining part of the paper is organized as follows. Section 2 describes the related research work and Sect. 3 explains the significance of SLA negotiation and SLA monitoring. Section 4 gives a brief idea about dynamic SLA negotiation. Section 5 describes the proposed SLA negotiation architecture and the algorithm for implementing negotiation. Section 6 describes the experimental studies and finally Sect. 7 concludes the paper.

2 Related Work

Many research works are going on in the field of cloud computing regarding SLA negotiation and SLA management. In [1] the authors described a framework for defining and monitoring SLAs in interdomain fields. An approach for SLA-driven management suitable for distributed systems has introduced in [2] by A. Keller et. al. using CIM (Common Information Model). In [3], the authors tried to evaluate multiple architectures which perform SLA auditing by considering qualitative and quantitative aspects. An SLA management framework using agent systems has described in [4] in which the service provider (responder agent) markets its capabilities in service level and the service consumer (initiator agent) gets the marketed information to initiate the overall negotiation. The works explained in [5–8] describe runtime SLA renegotiation for managing violations in SLA. In [5], SLOs are modified and renegotiated at runtime and online services are adjusted to dynamically agreed SLOs. An almost similar approach is explained in [8], which allows the changes in SLO values by keeping the existing SLA. In [6], the authors explained a renegotiation protocol that permits the service provider or service consumer to begin with a renegotiation at the time of need.

3 SLA Negotiation and SLA Monitoring

SLAs are established among the involved parties through a set of iterative negotiations as shown in Fig. 1. With the agreement both the involved parties establish a consent on corresponding roles, rights, and obligations. The user specifies his requirements and the orchestrator of the resource starts the negotiation by using local

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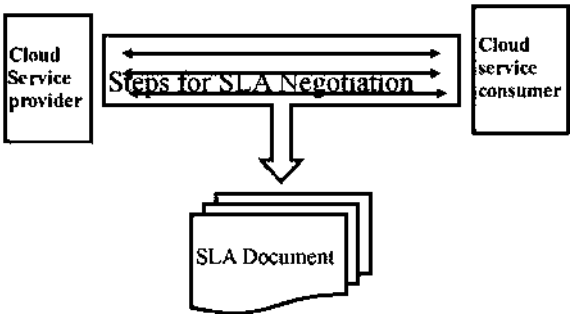

Fig. 1 Construction of SLA

resources and he tries to identify a common time slot where all the needed computing resources are available. This time slot identification means the orchestrator reserves the resources for assuring the agreement terms mentioned in the SLA.

The renegotiation of SLA is also possible in cases of lost, delayed, or reordered messages. The principle of renegotiation assumes an asymmetric nature of resource provisioning and consumption and gives more importance to the provider side. On initiation of renegotiation the agreement contract goes into a renegotiating state and after the completion of renegotiation, current state is viewed as superseded state as shown in Fig. 2.

SLA Monitoring is for determining whether the agreed parties are following the agreed terms and is done by checking the SLO values continuously. The different SLA monitoring schemes are online monitoring, proactive monitoring, and reactive monitoring. In online mode SLO values are monitored continuously and in proactive mode corrective actions are initiated before SLA violations. In proactive monitoring, the SLA negotiation is done immediately after service discovery for ensuring the availability of the cloud service. In reactive monitoring, the concept is different because on occurrence of SLA violation one of the involved parties complains to the monitor regarding violation. The reactive monitoring is better because the monitoring overhead is less and it gives an immediate response to SLA violations.

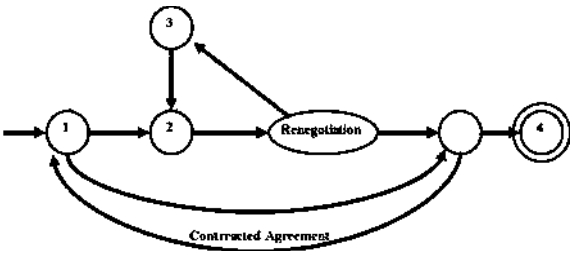

Fig. 2 Finite state machine for SLA negotiation

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4 Dynamic SLA Negotiation

The SLA negotiation is done according to certain policies framed by the negotiator which define the cost of the service, penalty for violation, etc. The dynamic variations in customer requirements signifies the importance of dynamic negotiation and renegotiation of SLA. The issues taken care in SLA renegotiation are: (i) removal of an existing SLA and negotiation of a new one, (ii) addition/deletion of an SLA objective and (iii) modification of the existing parameters in the SLA. A set of message interactions are required for the negotiation of SLA as shown in Fig. 3.

In the first phase, the negotiation unit initiates the process by taking all available SLA templates from all providers. The initiator selects the most suitable template from this set as an initial point, which describes the background for all subsequent iterations. In the second phase, the initiator generates a new SLA template as per the selected template. The agreement initiator is free to modify the contents of the generated template and the new modified template is forwarded to agreement responder through a message for checking its validity. The service provider (sometimes the agreement provider) then checks whether the defined service can be provided or not and if possible the provider sends back the template to the client, to convey that the particular offer will be admitted. The provider responds with some counter offers if the services are not possible. The negotiation initiator checks the received counter offers in the third phase and stops the negotiation process if the requirements are not satisfying and repeats the whole steps from phase 1.

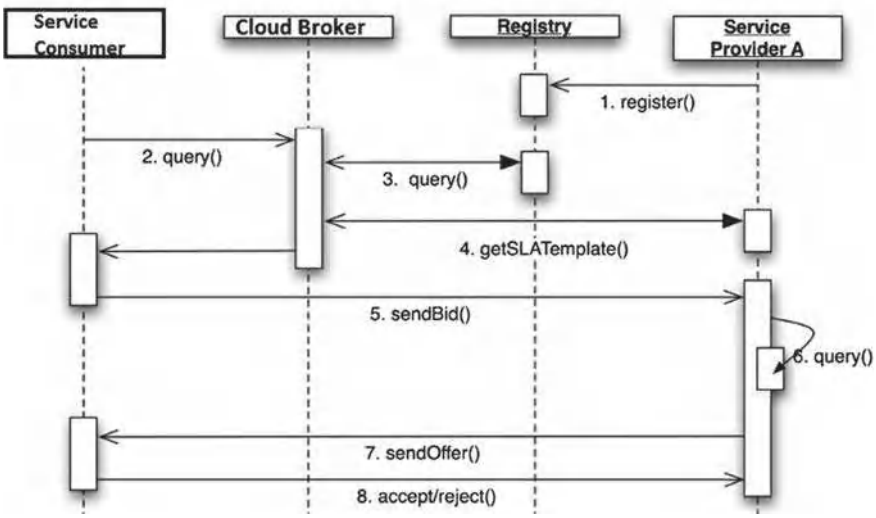

Fig. 3 Message interactions during SLA negotiation

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5 Negotiation Architecture and Implementation

The SLA negotiation architecture (Fig. 4) contains the following main units such as: (i) service requisition unit, (ii) service listening unit, (iii) SLA negotiation unit and (iv) agreed SLA document. Service requisition unit is to identify the apt cloud service and service provider where the selection is based on QoS values, nature, and behavior of the service and service provider, provisioning interface, etc. Service listening unit checks external service registry periodically for the changes and updates of the service. SLA negotiation unit is responsible for finalizing the suitable interface for interacting with the service. The last unit, agreed SLA document, contains all details about the agreed upon SLA.

The process of SLA negotiation is done according to a set of rules defined using XML schema in the form of conditional statements. The format of a negotiation rule is:

if (condition) *then* **perform action** *else* **perform action**

Here the 'condition' deals with QoS values and the '**perform action**' decides the actions to be done on QoS. The operation of negotiation unit is controlled by this action part. Different rule actions are: (i) accept, (ii) reject, and (iii) set actions. Accept action is for accepting different SLO values in the SLA. Reject action takes care of rejecting values and set action takes care of proposing new values for QoS.

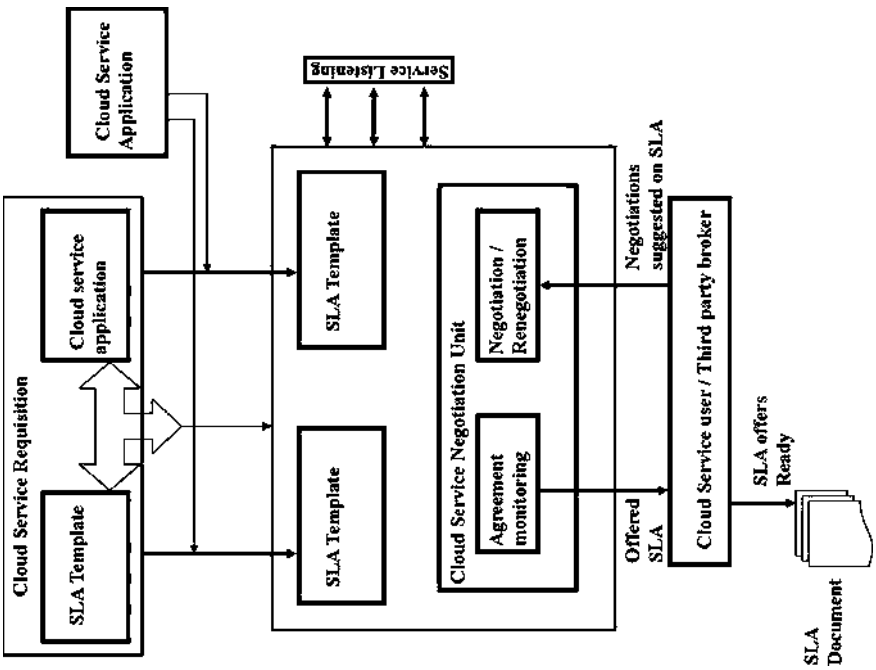

Fig. 4 Architecture of SLA negotiation

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To establish an SLA negotiation, the system has to go through a sequence of steps. The proposed algorithm for SLA negotiation contains the following steps. The detailed algorithm is omitted from this paper because of space restrictions. In the first

Algorithm 1 SLA Negotiation

1. SLA negotiation at the user requirement level.
2. SLA negotiation at the service provider level.
3. SLA negotiation at the job execution level.
4. Confirmation of negotiated SLA.

step the user requirements in terms of service descriptions, particularly meta data of the service, has communicated to the cloud broker in the system. The meta data include: information about the computing service, estimated time for completing the service, estimated service cost, etc. The broker then checks for a cloud service provider, who can provide the service as per the user requirements. This is done in Step 2 and on completion of Step 2 the service broker come up with a particular service provider and in the third level, the actual SLA negotiation is executed. As part of the execution, both the involved parties institute a consent on the QoS parameters of the provided service and the agreement terms has finalized. This finalized SLA document has then communicated to the involved parties as a confirmation.

The SLA negotiation proceeds through the following activities as shown in the activity diagram (Fig. 5). The process of negotiation starts with the *selection of service*. The initial selection is done from a comparative study among the service details collected from all sources and it depends on the service registry which contains the

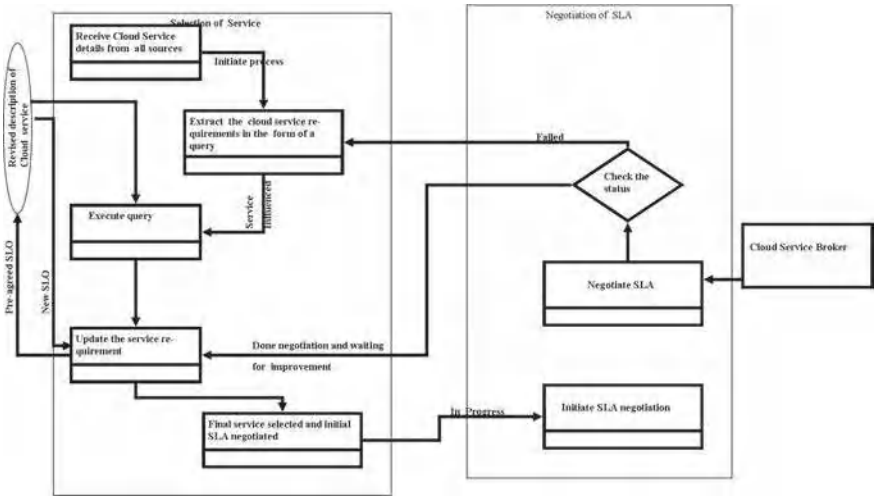

Fig. 5 Process of SLA negotiation

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details about all existing services together with the description of new modified service. The QoS parameters of the selected service and its SLO values are negotiated in this phase to generate the most suitable SLA for both the parties. If the negotiation with the selected service is not going smoothly, then a next service is selected and same sequence of steps continued.

6 Experimental Evaluation

The SLA negotiation architecture has been developed and implemented in Java and is deployed as an application. The details of service registry are accessed using RMI and the service deployment has done through service applications, programmed for notifying queries about service discovery and SLA negotiation rules. The service registry details are stored in a database and all the parties involved in the negotiation communicate their objectives, requirements, context, preferences for negotiation and business rules before establishing negotiation. To evaluate the efficiency of the proposed framework, we have performed a sequence of experimental studies and measured the overhead of SLA negotiation.

6.1 Results and Discussion

We have considered a set of computing resources like RAM, number of CPU cores, memory, network bandwidth, processor availability, etc. kept as a stored database within the system. A service requesting environment where every service has its own executable code and a set of limitations on QoS measures is also assumed. For each service request, 10 resources were selected in a random fashion from the stored database, by assuming these resources as available resources for the selected request. The random process model we have used here generates 50 requests and chooses the resources in a random fashion from the stored database. SLA negotiation is iterated several times and the average values are taken for plotting the results. Figures 6 and 7 show the rate of sanctioning of the service requests with and without the newly devised negotiation method. From Figs. 6 and 7, it is clear that out of 15 and 25 arbitrarily generated requests, 22 and 34 % of the requests are serviced by the proposed method of SLA negotiation and the rate of sanctioning the resources (Fig. 8) is more when comparing with the resource allocation without negotiation. These results prove the efficiency of our proposed method and it is confirmed that the throughput of the scheduler gets improved with the usage of our method. This performance improvement shows that, with the use of our proposed negotiation method the available resources/services in the cloud environment can be allocated to the needy service consumers in an efficient way and it enhances the

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Fig. 6 Rate of serviced requests

Fig. 7 Rate of serviced requests

Fig. 8 Percentage of negotiated SLAs

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utilization of resources which in turn increases the business volume of the cloud provider. Our newly proposed SLA negotiation method will increase the business revenue of the cloud provider and customer satisfaction of the cloud service user.

7 Conclusion

SLA negotiation has done over QoS values according to the alternative services determined by the service discovery mechanisms. The SLA negotiation ensures that a service could be utilized by an application and have a guaranteed set of provisions, according to the requirement, at the time of execution of the service. The negotiation approach introduced has analyzed with a valid set of experimental results which show that negotiation of SLA reduces the required time to do online service deployment. The performance of the designed framework might change dynamically according to the change in negotiation rules used by different designers. Our proposed SLA negotiation framework helps service providers and customers to finalize the agreements in a fast and efficient manner with decreased effort on both parties. The proposed method gives more efficiency to resource allocation and it improves the business revenue of cloud providers and satisfaction of cloud consumers.

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Impact of Performance Management Process on Print Organizational Performance—In Indian Context

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Abstract Performance management is an important concept in Human Resource Management. It places a very big role in today's business world. In measuring organizational performance, performance of an individual takes place a very dominant role. This article conceptualizes and investigates the four dimensions of performance processes like performance planning, performance development, performance appraisal, reward, and recognition. These processes are linked to print organizational performance parameters like effectiveness, quality of news production, target achievements, and innovation on the part of news presentation. This article is an endeavor to provide the benefits and the drawbacks of performance management process and its relationship with print organizational performance. The results may be used as the stepping stone for further empirical research and it will help to formulate the strong and healthy organizational performance in print organization.

Keywords Impact · Performance management · Process · Print organization · Relationship

1 Introduction

In today's competitive world, each and every activity of a human being expected to gain profit for an individual or the benefit to the society as a whole. But in corporate scenario, these terms are totally different in standardized terms like employer and employee. To achieve the organizational goals as well as to increase the organizational performance, employer should have the continuous watch on the employee

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and should maintain the positive relationship with the employee. Performance management is a device to improve the performance of employees in all organizational levels. By using performance management as a base, this article attempts to the next level called performance management process.

2 Aim of the Study

1. To find out the relationship between performance management and print organizational performance.
2. To examine the benefits and the drawbacks of performance management process on print organizational performance.
3. To identify, which one of the performance process significantly takes a dominant position in print organizational performance.

3 Research Gap

Large number of studies has been based on the area of organizational performance. But none of the comprehensive study has been focused on the performance management process and print organizational performance. To overcome the gap of previous research, this article is an effort to identify the impact of performance management process on print organizational performance, it will systematically fulfill the gap of previous research and it gives a base for future research.

4 Relationship Between Performance Management and Print Organizational Performance

4.1 Print Organizational Performance

Organizational performance means an action taken by the employer and the employee to achieve the primary goals and objectives of an organization. In the book of Kirkman et al. [2], defined that organizational performance is the achievement of organizational goals in pursuits of business strategies that leads to sustainable competitive advantages. Print media coming under the subcategory of media. It includes magazines, newspapers, journals, books, and dailies. Performance of the print organization includes the work of publisher, editor, writer, reporter, photo journalist, designer, and marketing executives. All the activities and the performance of these people related to news production, presentation, and distribution to the end users, called print organizational performance.

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4.2 Performance Management

Performance consists of both behavior and results. Behaviors are originated from the performer and it transforms the performance from the concepts to the action. Behavior is not an instrument for results but it is an instrument for physical and mental efforts applied to tasks and it can be judged apart from the results (In the book of Deb [3]). Performance management is a process of creating a knowledge about what is to be achieved and how is to be achieved. Deb [3] wrote that performance management embraces all the aspects of organization including organizational strategies, environmental responsiveness, business processes, innovation with employees and managers at the epicenter of the process.

4.3 Link between Performance Management and Print Organizational Performance

Print organization should have a relationship with performance management to achieve its organizational goals and objectives. Katou and Budhwar [5] Achieving the organizational goals depends only upon the extent to which the organizational performance is reached. Organization's sustainable competitive advantage is achieved with the source of highly committed workforce. A well designed and developed performance management system in organization can ensure the workers to do the actions related to organization's goals. Performance management helps the organization to achieve its organizational goals at the time of giving proper job analysis with effective recruitment policy, proper training and development programs, competitive pay structure, and maintaining good labor and employee relations. (In the book of Deb [3]).

5 Proposed Conceptual Framework

In the theoretical framework performance management processes (Independent variable) and print organizational performance parameters (Dependent variable) were analyzed by using the mediating variable called organizational performance. These two variables have been chosen to see the impact between these variables. The theoretical framework can also be seen from the Fig. 1.

6 Processes of Performance Management

The purpose of performance process is to transform the raw potential of human resource into performance by removing intermediate barriers as well as motivating and rejuvenating the human resource (Kandula [5]). Performance management is a

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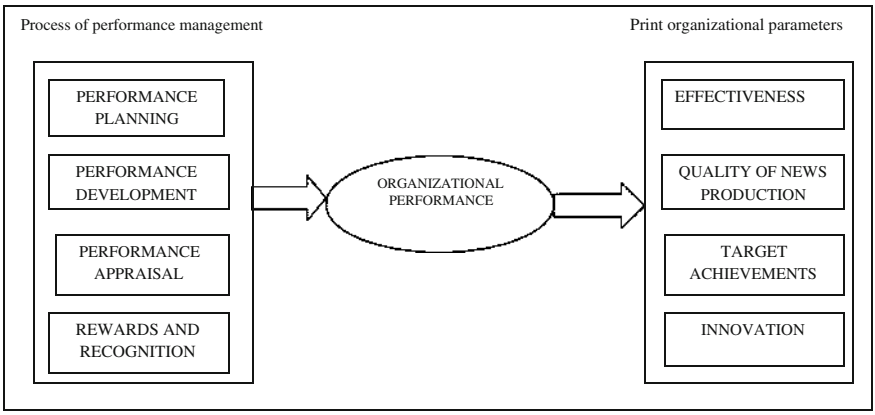

Fig. 1 Model to represent the impact of performance management process on print organizational performance

cyclical process in any organization. It is managed and maintained by the way of following performance processes.

6.1 Performance Planning

Performance planning is the first and foremost process in performance management. The aim of performance planning in print organization is to understand the meaning of organizational objectives, performance standards and competencies required to complete the task. In this stage, employer should describe about the job and expectations from the employee. In print organization, performance planning is very important for the workers to produce the news with quality and the news with expected standard. Armstrong [6] expressed that, performance planning is an agreement between manager and the individual to achieve organizational objectives, increasing production standards, improve performance, and develop the required competences for an organization. Performance planning in print organization is the basis for converting aims into actions.

6.2 Performance Development

Rao [7] explained that, development is a continuous process of developing, shaping, improving, as well as changing the skills, knowledge, creative ability, values, and commitment of employees based on the requirements of present and the future organizational commitments. In print organization employees should develop the

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skills, knowledge, qualifications and attitude. These kinds of developments are interconnected with the development of print organization and also the employee's development. Important thing to be considered in the performance development is, to increase the productivity of an employee by the prescribed standards and the norms of print organization. Productivity leads to the growth and expansion of an organization. Growth and expansion is the basic one for growing concern as well as going concern. By the growth of an employee, organizational growth is determined in print organization.

6.3 Performance Appraisal

Performance appraisal means, appraising the performance of an employee after the completion of prescribed job. In the book of Deb [3] defined that performance appraisal is the systematic evaluation of the individual with regard to his or her performance on the job and his potential for development. Performance appraisal in print organization based on the news presentation to the end users. While doing performance appraisal in print organization, organization should evaluate the work of editor, writer, reporter, photo journalists, designer, and efforts of marketing executives. Appraising the performance of an employee is based on the organizational process and procedures of performance appraisal. Performance appraisal is the formal measuring system of an employee. Employee's performance is measured after the completion of particular period especially 1 year. Employee's work completion is measured with the actual standard fixed by the print organization. Employees who complete the expected or fixed standard will be appreciated. But the employees those who are in below expected production will be under the review of appraising teams.

Rosemond and Asuinura [1] suggested the following steps for performance appraisal. Print organizations should follow these steps to validate the employee's performance. The first step in performance appraisal is scheduling: Scheduling means informing the employees regarding the review prior 10 days or 2 weeks. The instructions should be given to prepare for the annual performance appraisal. It includes the contents of job objectives and development goals of the employee for an individual and organization. The second step in performance appraisal is preparing for the review: In this step employees are asked to produce the documentation of work completed. It includes all the details of work patterns completed. The third step in performance appraisal is conducting the review: Employer reviews the performance of an employee. In this step, if employee's performance is below the expectations then employer gives the suggestion to improve the changes in performance.

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6.4 Reward and Recognition

In print organization, there is a possibility of increasing the performance by proper appreciation to the employee. Proper rewards and recognition makes the employee to be more loyal toward the job, toward the employer, and toward the organizational goals. In print organization recognition by the way of intrinsic happiness or extrinsic happiness is very important for the employee to be loyal. In the book of Deb [3], rewards can be either intrinsic or extrinsic. Intrinsic happiness means making the employee to feel,''this job is highly suited for me and for my career." Intrinsic happiness of employees automatically leads to job satisfaction. By achieving job satisfaction, employees surely moves to the next level, i.e., job involvement. If the work has been done with the involvement then organizational goals and the desired expectation from the employee's job will be attained. Extrinsic happiness is very important for the employees to sustain in the current organization. Extrinsic happiness means providing reward in the form of monetary benefit and career advancement. Career advancement means, promotions from one job to another job or one job designation to higher job designation. Getting proper recognition by the way of monetary benefit makes the employees to realize the job requirements and expected standard of production from the job. Extrinsic happiness may be in the form of career advancement.

7 Positive Impact of Performance Management Process on Print Organizational Performance

7.1 Goal Setting and Development Related Plans

In print organization, under the performance planning, employer and the employee are in a position to set their goals to achieve the organizational objectives. Performance management process gives an idea for goal setting and development-oriented plans, because it provides the measurement processes to the organization to identify the efficient employees. Based on the efficiency level, employer can set the organizational goals. Development is very important for the individual and the organization. In print organization, employees get a chance to develop their innovative skills, technical knowledge for the news production and the news presentation.

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7.2 Effective Decisions Related to the Organizational Growth

Employer of the print organization should take a valuable decision on the growth of an organization and benefit for the employee. Performance management process helps to identify the effective and the efficient employees. Based on the capacity of skilled employees, employer can determine objectives for an organization, production standard, and work quality. Performance management process gives an instruction as, production standards and objectives of an organization should be clear, concise, and achievable. It gives confidence among the employees to complete the job.

7.3 Meaningful Measurements

Under the criteria of measurements, all the efforts taken by the employees are considered. Right from the job roles to output given by the employee is considered in this criterion. Efforts taken by the employee is appreciated as well as absorbed. It gives a benefit as; employer can have the continuous watch on employee's activities. And the employees can correct their mistakes from the beginning itself. Performance management process makes the employees to be trained and well versed.

7.4 Feedback and Coaching

Managing committee of print organization may think that, all the initiatives and efforts taken by the management are correct. Performance management process helps to receive feedback from the employees regarding expectations from the management and gives feedback to the employees concerning the performance and suggestions to improve the performance to achieve the organizational targets. In print organization, receiving and giving feedback leads to smooth working conditions. Because in print organization, employees are running to capture the single second news as well as to achieve the work targets. By the review of performance management process, employer and employee can get a chance to interact with each other and low-performed employees can improve the performance by getting proper coaching and training from the management to do the work without errors and improve the performance.

7.5 Documented History of Employee's Performance

Performance management process provides the benefit as documented history of employee's performance. It gives the confidence among the employees who are in

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bottom level of operation. Documentation is very helpful at the time of promotion. From the management perspectives, employer can have a continuous watch on the employee's performance and the employer can understand the efforts of employees by documented evidence.

8 Negative Impact of Performance Management Process on Print Organizational and Employee's Performance

8.1 Discouragement and Lack of Credibility

Employees in print organization are under the control of continuous supervision. Performance and efforts of an employee are periodically reviewed and commenced by the immediate supervisors and the managers. But, employees in print organization expect freedom while news delivering and decision-making at the time of news production. Continuous performance management process gives a thought in the mind set of the employee as "whether I am producing the quality work to the society?" and "my performance acceptable and appreciable by the organization or not?" continuous performance management process gives discouragement and lack of credibility to an employee at the time of news production.

8.2 Implementation Failure

While using performance management process in print organization, all the activities of an employee are predefined and preplanned. Based on the performance planning, employees should work to achieve the desired organizational objectives. In print organization, the final outcome, i.e., newspaper includes the efforts given by publisher, editor, writer, reporter, photo journalists, designer, and efforts of marketing executives. If performance planning is not done in the proper manner then all the activities will get affected. Performance planning should be in the manner of acceptable as well as achievable. Otherwise implementation of performance management process leads to failure.

8.3 Bias

In print organization, all the production-related activities (i.e., from the news collection to news presentation) are carryover by the different designations of employees. Individual biases in print organization lead to the partial perspectives. By using performance management process, employees activities are assessed and

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reviewed by the management. At that time, bias places a dominant role. While assessing individual's performance, all the merits of an employee are only considered. Bias in print organization makes the employees to be discouraged and dissatisfied.

9 Discussions of the Research

From the study following statements have been identified

1. Performance management process has the direct and causal connection with print organizational performance. It has the impact on other core areas of HRM like talent management, employee services, organizational effectiveness, labor relations, and consulting.
2. At the same time, performance management process has an indirect influence on the operational performance of an organization.
3. Performance management process assists the gap between employee's performance and organizational expectations from the employees.
4. Rewards and recognition highly influence the print organizational performance. Based on the influence of rewards and recognition, all the processes of performance management moving in the correct direction.

10 Directions for the Future Study

This paper is a conceptual measure of evaluating the impact of performance management on print organizational performance. And this article depends only on the secondary data. Future studies may be conducted in the empirical view with larger sample size and particular sector wise longitudinal studies also be suggested.

11 Conclusion

To conclude that, this article shows the four processes of performance management and its impact on print organizational performance. It is mainly aimed to investigate the relationship between print organizational performance and performance management process. Findings of the article revealed that, performance management process has positive and meaningful impact on print organizational performance. And it highly influences the core areas of HRM like talent management, organizational effectiveness, employee services, and labor relations. This outlook suggests the employees to focus on organizational growth as well as individual growth. Three negative effects also highlighted by this article, i.e., discouragement, bias,

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and implementation failure. Employer and the employee should try to overcome the negatives proactively. As per the Indian print organizational culture all the activities of an organization are based on the human capital of that industry.

This article is a proof to reveal the power of human resources to the society. Overall there is a strong conclusion that, performance management process helps to increase the organizational performance. Considering the above-mentioned findings, to sustain in the current competitive world, employees of print organization should understand the values of performance management process.

12 Key Points

1. Organizational performance influences the employee to achieve organizational goals. So, the Print organization should focus on the organizational performance and performance of the employees.
2. Print organizational performance has positive relationship with performance management.
3. Performance management includes the processes of performance planning, performance development, performance appraisal finally rewards and recognition.
4. Performance management process gives the benefit as goal setting and development-related plans, effective decisions related to the organizational growth, meaningful measurements of employee's performance, individual's growth by following organizational growth, feedback and coaching, documented history of employee's performance.
5. Compared to other performance management process, rewards and recognition highly influence the employees to achieve job satisfaction and make the employees to be loyal to the organization.

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Mobility Aware Path Discovery for Efficient Routing in Wireless Multimedia Sensor Network

Rachana Borawake-Satao and Rajesh Prasad

Abstract This paper proposes effective solution for routing information in wireless multimedia sensor network using multipath and multi-objective routing scheme. The ubiquitous nature of the future Internet demands multi-objective routing for serving the dynamic applications and new technologies. Multimedia data and scalar data should be treated differently while routing through WMSN. This separation of data requires multiple paths for multiple objectives. Objectives can be the speed of communication, the energy efficiency of the network, the lifetime of the network, reliability of communication, or load balancing in the network. This paper discusses the advantages of multipath routing and proposed an effective solution for finding multiple paths depending upon the demand of quality of service from the network. The path discovery methodology is evaluated using a mathematical model and the results are compared for the mobility of the network which is a demand of ubiquitous future Internet.

Keywords WSN: Wireless Sensor Network · WMSN: Wireless Multimedia Sensor Network · Ubiquitous future Internet

1 Introduction

Dynamic applications of future Internet are promoting use of wireless multimedia sensor network due to availability of high-quality multimedia services. Since low-cost multimedia devices are easily available the use of these devices is in

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demand. Application-specific QoS requirement, high bandwidth demand, multimedia source coding technique, power consumption, and multimedia in network processing are the factors which influence the design of routing algorithm [1]. Various algorithms are proposed and implemented for multipath routing in multimedia sensor network [2].

Wireless multimedia sensor network enhancing the capability of the wireless sensor network for modern applications such as smart home, smart city, advanced healthcare systems, and multimedia surveillance sensor networks [1].

1.1 Multipath Routing

Multipath routing provides better solution in terms of reliability, load balancing, high aggregate bandwidth, end-to-end delay, minimum energy consumption, and high throughput [2]. Performance evaluation of the various routing algorithms can be analyzed using parameters like routing load, average end-to-end delay, jitter, energy balancing, and average energy consumption. In [3] author compared multipath routing techniques based on energy efficiency, delay, fault tolerance, and data accuracy.

In [4] author proposes context aware routing which combines cluster formation algorithm with routing. During cluster formation algorithm the information required for routing is also preserved and later used for routing purpose. This definitely improves the lifetime of the network as remaining energy is considered for routing. This also resolves the energy hole problem in the network.

MEVI [5] is a multi-hop hierarchical routing protocol for efficient video communication (MEVI). This algorithm proposes cross-layer solution for the selection of the routes. Algorithm implemented two modes for video retrieval and transmission where it is event-based video transmission. The main addition of the paper is the cluster formation by sending a single beacon message, multi-hop communication between CHs and base station, and cross-layer scheme to acquire the network conditions for selecting the routes.

Multipath routing reduces delay in the network by processing delay estimation and finding alternate path if some paths or nodes are exhausted in the network. In wireless sensor network effective performance improvement is achieved through multipath routing [6, 7]. Similar approach can be applied in WMSN for dynamic protocols. Multimedia traffic can be classified into set of classes, and priorities can be assigned to each one for packet classification. Non-preemptive packet scheduling scheme gives improved results for routing multimedia data [8]. The DCM (Dynamic capacity multipath routing) algorithm uses anchor nodes for deciding duty cycle scheduling of the node in vicinity of the target and improves lifetime of the network [9].

Quality of service (QoS) is a key issue in WMSN, if packet classification will be based on QoS issues like delay, residual energy, and loss rate, targeting a particular application which will be effective. Cluster-based architecture is more suitable for

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QoS-based routing [10]. Interference awareness, bandwidth awareness, congestion control schemes, and priority scheduling are some of the key aspects for design of routing protocols for application in future Internet [11–15].

The major communication challenges for QoS aware routing are energy consumption, application-specific requirements, resource constrains, variable link capacity and packet errors, dynamic network connectivity, and topologies [16]. Future Internet demands smart services in ubiquitous computing environment which introduces mobility awareness in basic architecture of wireless multimedia sensor network. In [17] author proposes mobile multimedia geographic routing (MGR) for QoS provisioning in MMSNs (Mobile multimedia sensor network). Mobility of nodes in the network and mobility of sink node in various applications are the challenges for researchers in MMSN.

2 Path Discovery Methodology

The important issue in communication is effective data dissemination and gathering. Various protocols are available for WSN and WMSN for routing the data efficiently. If we compare WSN with WMSN the multimedia data is a critical issue to address. The audio and video data transmissions require high data transmission rate and good quality of service. Hence, it is required that the design of routing protocol in WMSN must have effective methodology to handle multimedia data.

The path discovery process is achieved through multipath routing. There are many goals of multipath routing protocols to achieve such as reliability, load balancing, high aggregate bandwidth, minimum end-to-end delay, minimum energy consumption, and high throughput.

The proposed system uses multiple paths for routing. The captured data is divided into parts and forward through multiple paths. This will increase speed of data transmission as well as priorities can be assigned to the respective paths depending upon the parameter.

Following parameters are used for path discovery process:

(a) Link quality index (LQI)
(b) Remaining energy (Er)
(c) Hop count (HC)
(d) Speed of mobility (Mf)
(e) Location of node
(f) Movement direction of node

As shown in Fig. 1 the path discovery process starts after deployment of sensor network. After deployment the initiation process takes place which includes location awareness about the neighboring node, sink node, and the node itself. Once all locations are known the next hop is checked for whether it is a sink node or not. If next node is a sink node, the algorithm stops; otherwise path discovery takes place.

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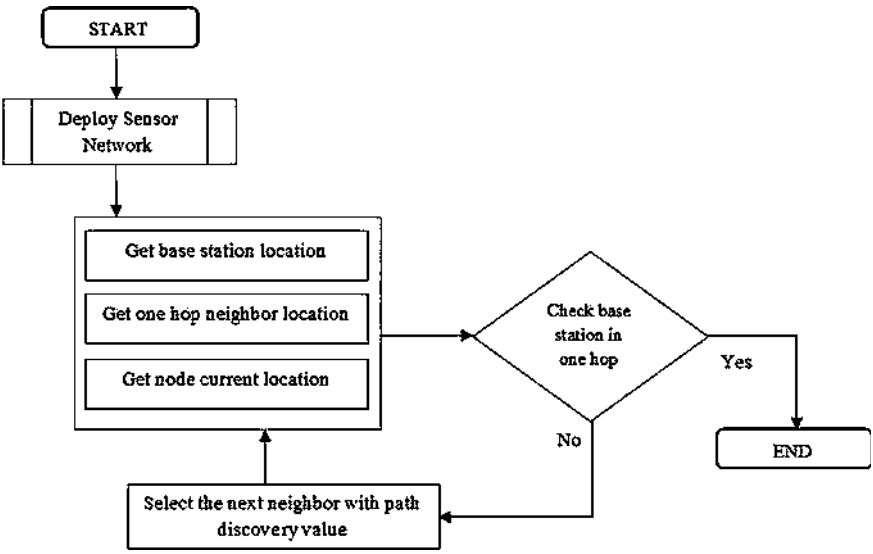

Fig. 1 Path discovery methodology

The path discovery process includes analysis of different parameters like remaining energy, hop count, LQI, and mobility value of neighboring node. Depending on these values the weight for multiple paths is calculated. One of the best solutions is used or multiple solutions are used for efficient routing.

The path discovery process makes use of formulae (I) in Sect. 3 for calculation of the Node_{val}. Various methods can be adapted to calculate the Node_{val}, but for this paper we are considering mobility as important factor as it is useful for ubiquitous computing in future network.

3 Mathematical Model for Performance Evaluation

As given in Eq. (1) the Node_{val} is calculated using three terms: remaining energy (*Er*), current link quality (*LQ*), and current hop count (*HC*). The Node_{val} ranges between 0 and 1. The multiplication factors α, β, and γ are used to assign priorities to the parameters respectively.

The equation *Er/Ei* gives value of remaining energy between 0 and 1 [5]. If application gives priority to energy saving, the value of the α will be more than β and γ. Possible values for α, β, and γ are {0.2, 0.3, 0.5}.

Similarly, the equation *curLQ/maxLQ* gives values for link quality ranges between 0 and 1 and equation *(totHC-curHC)/totHC* gives value for remaining traveling distance. As per the requirement of the application, three different paths

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Table 1 Parameter description

Ei	Initial energy of node
Er	Residual energy of node
curLQ	Current link quality of node
maxLQ	Maximum link quality of node
totHC	Total hope count
curHC	Current hope count of node
M_f	Mobility factor
PT_r	Remaining pause time duration in milliseconds
totPT	Total pause time duration in milliseconds
$\text{Node}e_{\text{val}}$	Node value for data transmission
PD_{val}	Path discovery value with mobility added to Node_{val}
Node with highest PD_{val} has better conditions to transmit packet	

are estimated and packet allocation is done according to the priorities assigned by the variables α, β, and γ:

$$\text{Node}_{\text{val}} = [(\alpha * Er/Ei) + (\beta * curLQ/maxLQ) + (\gamma * (totHC - curHC)/totHC))] \quad (1)$$

where α + β + γ = 1.

As mentioned in Sect. 1 the mobility is a critical issue in design of routing path in case majority nodes in the network are mobile node. Here we introduce mobility factor (M_f) as ratio of remaining pause time (*PTr*) and total pause time of the node (*totPT*). This ratio gives prediction regarding mobility of the node. If the node is having possibility of changing its position from the current place within very short time, then possibility of the selection of that node is reduced using mobility factor (M_f) (Table 1).

$$\text{Mobility factor}\left(M_f\right) = (PTr/totPT) \quad (2)$$

$$\text{Path Discovery value}\left(PD_{val}\right) = \text{Node}_{\text{val}} * M_f \quad (3)$$

3.1 Experimental Setup

Multiply mobility factor (M_f) with Node_{val} to get an exact value of every node with respect to the mobility prediction of the current node.

Figure 2 shows the experimental setup with total four nodes where node 1 is willing to transmit data, and various values related to all nodes in the scenario are describe in Table 2. Table 2 also describes the scenario if priority is assigned to a certain parameter which node is selected for transmission.

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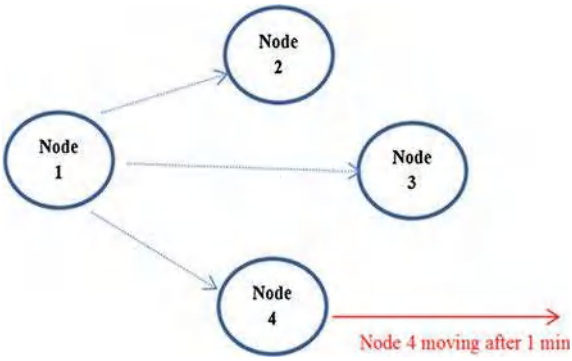

Fig. 2 Experimental setup for node mobility

3.1.1 Case 1: No Mobility Considered

As shown in Fig. 2 consider case 1 where the node 1 trying to select one node for transmission of data (either node 2 or node 3 or node 4). The decision depends on the values of remaining energy (*Er*), link quality (*LQ*), and hope count (*HC*) as shown in Table 2.

If energy saving is a priority, then value for α in Eq. 1 is selected as highest value and the node 4 is selected for transmission. Naturally, the node with highest remaining energy is selected which in this case is node 4.

If priority is high data accuracy (less packet loss) then Link Quality is important then value for β in Eq. 1 is selected as highest value and the result will be selection of node 3 for next data forward.

Similarly, if minimum delay is the requirement then value for γ in Eq. 1 is selected as highest value and result will be the selection of node 2 for next data forward.

Table 2 Values for no mobility in the network

Node Id	Remaining energy (*Er/Ei*)	Link quality (*LQ/maxLQ*)	(*maxHC* – *HC*)/*totHC* (distance to travel)
2	0.5	0.59	0.9
3	0.75	0.63	0.7
4	0.9	0.55	0.6
After applying Eq. 1			
If α is greater (priority = energy)		Node 4 is selected	
If β is greater (priority = LQI)		Node 3 is selected	
If γ is greater (priority = HC)		Node 2 is selected	

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Table 3 Values for mobility in the network

Node Id	Remaining energy (Er/Ei)	Link quality (LQ/Mac LQ)	(Max_HC – HC)/tot_HC (distance to travel)	Mobility factor (PTr/tot_PT)
2	0.5	0.59	0.9	0.50 (moving after 5 min)
3	0.75	0.63	0.7	0.50 (moving after 5 min)
4	0.85	0.55	0.6	0.10 (moving after 1 min)
After applying Eq. 3				
If α is greater (priority = energy)			Node 3 is selected	
If β is greater (priority = LQI)			Node 3 is selected	
If γ is greater (priority = HC)			Node 2 is selected	

3.1.2 Case 2: Mobility Considered

As shown in Fig. 2, consider case 2 where the node 1 trying to select one node for transmission of data (either node 2 or node 3 or node 4). The decision depends on the values of remaining energy (*Er*), link quality (*LQ*), hope count (*HC*), and mobility factor (M_f) as shown in Table 3.

If energy saving is a priority then value for α in Eq. 1 is selected as highest value and the node 4 is selected for transmission. But if we are using Eq. 3 then as per the mobility factor of node 4, it will not be selected; instead node 3 will be selected as node 4 is moving early as compared to node 4. Hence, connection loss and data reliability will be increased.

Similarly, while giving priority to link quality (LQ) and hop count (HC) the mobility factor is considered and accordingly decision takes place and increases reliability of data transmission.

4 Conclusion

This paper has addressed issue of multipath and multi-objective routing in wireless multimedia sensor network (WMSN). In Sect. 1 we discussed various multipath routing schemes. Section 2 describes our proposal for path discovery mechanism which not only takes care of multiple objectives like remaining energy, link quality, and hop count for routing but also considers mobility factor of the node. Path discovery value makes this algorithm compatible for future Internet applications. Section 3 supports the algorithm by implementation of mathematical model. This section also describes in detail about the functionality of model in two different cases. We proposed effective mechanism for routing using path discovery algorithm.

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Future studies in this research can be enhancement of the path discovery algorithm using packet classification and dynamic hole healing mechanism for expanding the application areas for the algorithm. Various duties scheduling mechanism can be applied to path discovery to improve the lifetime of the network.

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Emerging Internet of Things in Revolutionizing Healthcare

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Abstract In the era of science, technology plays the crucial role in healthcare for sensing devices, moreover in communication, storing, processing, and display devices. The advances in various streams such as sensing techniques, nanotechnologies, embedded systems, wireless communication networks, and miniaturization resulting to evolve intelligent systems to monitor and control various medical parameters in post-operational days. Hence, the IoT (Internet of Things) is emerged as a recent trend in healthcare communication systems. IoT serves as a catalyst for the healthcare and plays a major role in numerous healthcare applications. Wearable sensors recognize anomalous and unforeseen conditions by examining physiological parameters along with the symptoms and transfers the vital signs for medical evaluation. Hence, prompt provisional medication can be done immediately to avoid severe conditions. In the proposed system, a microcontroller is used as a gateway to communicate to the several sensors depending on parameters to be monitored such as pulse rate counter, temperature sensor, accelerometer, etc. The microcontroller acquires the sensor data, processes it, and transmits to the network through appropriate data transmission protocol, successively providing a real-time monitoring of the healthcare parameters for healthcare professionals. The doctor can access the data anytime by simply logging to the HTML (HyperText Markup Language) webpage or typing the corresponding unique IP (Internet protocol) address in Internet browser.

Keywords Internet of things · Microcontroller · Gateway · Wi-Fi module · Temperature sensor · Pulse rate counter · Accelerometer

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1 Introduction

The Internet is the combinational result of a transformation of telecommunications and information made available by sustained, augmented development in the performance, moreover in cost of electronics devices. Considering, the Internet becomes very essential to each aspect of life like education, business, industries, finance, entertainment, social networking, e-commerce, shopping, etc. Thus, the recent new mega trend in an era of Internet is IoT [1]. Visualize a world where several objects or things can sense, analyze, communicate, and exchange data over a private Internet protocol (IP) or public networks. The interconnected objects acquire the information or data at specified intervals, analyze, and respond necessarily, providing a smart network for the purpose of analysis, planning, decision making, and responding. This summarizes the world of **Internet of Things (IoT)** [2]. The whole concept of IoT is based on sensors, gateway, and wireless networks, which permits user to communicate and access the information or application. Being that IoT offers more prominent assurance in the field of health awareness [3, 4].

Researches are still in progress to focus at upgrading quality of human life concerning to health by designing, developing, and fabricating invasive and non-invasive sensors [5]. Global population and noteworthy rise in aging population are the reasons behind the rapid progress in this field. As per the statistic given by the U.S. Department of Health, more than 20 % of world's population will go above 65 years of age by 2050 [6]. This results in an increasing demand for medical care. But this medical care is very expensive for durable surveillance furthermore time consuming for consultations with health professionals or doctors [7]. The cost of hospitalization is high and it increases in case of recovery after a serious illness or surgery. Nowadays, hospitals are looking for moving patients back to home imminently as possible after surgery to recoup. During this recovery time, numerous physiological parameters are needed to be continuously analyzed. Due to this, telemedicine and distant monitoring of patients from home are acquired added significance and necessity.

This paper is structured as follows. Section 2 defines problem statement. Section 3 offers a brief review of previous work done related to healthcare systems and sensor networks. In Sect. 4 visualize the complete system overview. It also gives an idea about the sensors that are used in this system. The conclusion is stated in Sect. 5 and paper ends with a brief discussion on future developments.

2 Problem Statement

Nowadays, the patient who stays in home during post-operational period, get checked by overseer or medical caretaker. But it failed to accomplish ceaseless analysis, on the grounds that anything can be changed in health parameter within seconds and during that period if guardian or caretaker is not in the premises cause

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harm or sometimes become a serious issue with patient's life and death. So, in this developing era, web administers of the entire world give a thought to provide keen health awareness framework in which time-to-time ceaseless checking of the patient is accomplished.

3 Related Work

3.1 Health Monitoring System

ZigBee-based transmission is a reliable IEEE protocol for wireless patient monitoring. It uses a ZigBee module for fall monitoring, which combines indoor positioning, fall recognition, ECG observation, etc. The time when the fall is recognized by a triaxial accelerometer of a device, the contemporary location of patient is transferred into the emergency center using a ZigBee network [6, 8].

In microcontroller-based health monitoring system which uses sensor network, when blood pressure reading, heart rate, or skin temperature goes out of the standard limit for a patient, a system is designed to indicate with the help of an alarming circuit.

In development of noninvasive continual blood pressure computing and monitoring system, it computes blood pressure using a volume oscillometric methodology and photoplethysmography (PPG) technique continuously. There is linear relationship between rate of change of blood volume in a body organ, e.g., finger, and blood pressure. The optical sensor network is not only utilized to examine the rate of change of blood volume but also for estimating the blood pressure.

In PPG-based methodologies for noninvasive and unceasing blood pressure measurement, the design and implementation issues in the body sensor networks, the PPG signal could be obtained easily from an optical sensor attached on epidermis [8]. It is used alone or combined along with the ECG signal to compute the blood pressure. Depending on this, sensor-based systems and new instruments could be developed as well as integrated along with computer-based health monitoring systems which aims to support continuous and distant surveillance of assisted livings.

3.2 Sensor Networks

Web services are broadly and victoriously used mechanisms in the field of Information technology (IT). They can be stated as process to establish practical and distributed applications imposing on web standards such as HTTP (Hypertext Transfer Protocol). Sensor networks can extremely benefit from their utilization, since web services permit an emergence of WSNs into any of the systems which is

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escalated on standard IT components like industry or home automation as well as in healthcare monitoring systems.

In the IoT-enabled distant healthcare monitoring systems, the data acquired from the several sensors should be accessible anytime and anywhere without any restrictions, which needs constant network connectivity. If the distant healthcare monitoring application transfers the data continuously, then the amount of data generated at database or central station will be huge. This contributes to a hyper-connectivity framework in which network will get connected. In remote healthcare monitoring application we are not able to make the use of total available bandwidth effectively; in case we use the traditional mode for transmission of data. This mode leads to loss of sufficient amount of data due to delay as well as buffer overloading, but it is not acceptable specifically in the healthcare applications [9].

The platform and architecture of sensor networks in healthcare system perform a prominent role for unceasing monitoring of physiological parameters primarily for chronic patients. The appropriate network has to be selected relying on the performance, cost, ease of access, ease of configuration, requirement of additional sensor nodes, energy consumption and range, etc. A comparison of IEEE protocols that are presently available is shown in Table 1 [10].

ZigBee is used to create PAN (Personal area networks) from tiny, low-power digital radios. It follows IEEE 802.15 standard. It allows short-range wireless data transfer at comparatively low rates. It allows data to reach over a longer distance by passing it through intermittent devices or nodes to go more distant ones. Due to lower data rate, i.e., 250 Kbps, it reduces power consumption. As a result, it provides longer battery life and secured networking applications. There are few constraints on ZigBee as it may be unable to carry vital signs especially emergency messages which may be critical and important for diagnosing the disease or clue to directing the required therapy [5, 8].

Bluetooth has packet-based protocol containing master–slave structure. The bluetooth devices communicate with one another on a securely using an unlicensed short-scale radio frequency. Similar to ZigBee, bluetooth also may not be suitable

Table 1 Comparison of different protocols

Standard	IEEE protocols			
	ZIGBEE (IEEE 802.15.4)	BLUETOOTH (IEEE 802.15.1)	WI-FI (IEEE 802.11)	WIMAX (IEEE 802.11)
Range	100 m	10 m	5 km	15 km
Data rate	250–500 kbps	1–3 Mbps	1–450 Mbps	75 Mbps
Bandwidth	2.4 GHZ	2.4 GHZ	2.4, 3.7, 5 GHz	2.3, 2.5, 3.5 GHz
Network topology	Star, Mesh, Cluster tress	Star	Star, Tree, P2P	Star, Tree, P2P
Application	Wireless Sensors (monitoring and control)	Wireless Sensors (monitoring and control)	PC-based data acquisition, mobile internet	Mobile internet

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for sending vital signs, primarily for critical situations and emergency messages, as these messages are exceptionally important for diagnosing [5, 8].

Wi-Fi stands for wireless fidelity which is standardized by IEEE. It is used to transmit the data wirelessly. Wi-Fi has advantage of increased communication range so it can be used to transmit data up to the 5 km distance.

While WIMAX stands for worldwide interoperability for microwave access. It is a wireless MAN technology offering interoperable broadband connectivity to users. It is used to extend the transmission up to 15 km.

4 Proposed System

The basic architecture of human health monitoring system is as shown in Fig. 1 [10].

Sensors are selected based on the parameter to be monitored. Many sensors can be used to measure the physiological parameters such as heart rate, body temperature, accelerometer, etc. The processor collects the raw data from sensors, processes the data, and then displays on a display. A trans-receiver can be used to send the data to a central station, if the device having feature of wireless data transmission is used. The data may be completely processed or not at the sensing stage but it is stored in the memory and display either in numerical or graphical format.

The proposed system is shown in Fig. 2.

The proposed system comprises a temperature sensor to compute the body temperature, pulse rate counter to count the pulses, and accelerometers which recognize any fall that may occur. The microcontroller will gather the data from sensors to process and analyze. The processed data is then transmitted over internet through Wi-Fi protocol. Wi-Fi is used as a medium to connect with internet. The server is developed to store this data and update the data with respect to time. The website is developed to display the current data. Thus the doctor can access the data anytime and anywhere simply by accessing the corresponding website or typing the corresponding unique IP address in Internet browser.

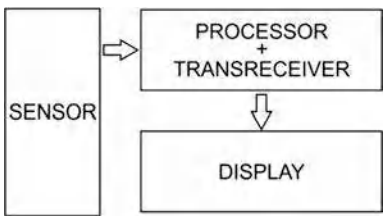

Fig. 1 The basic architecture of simple health monitoring system

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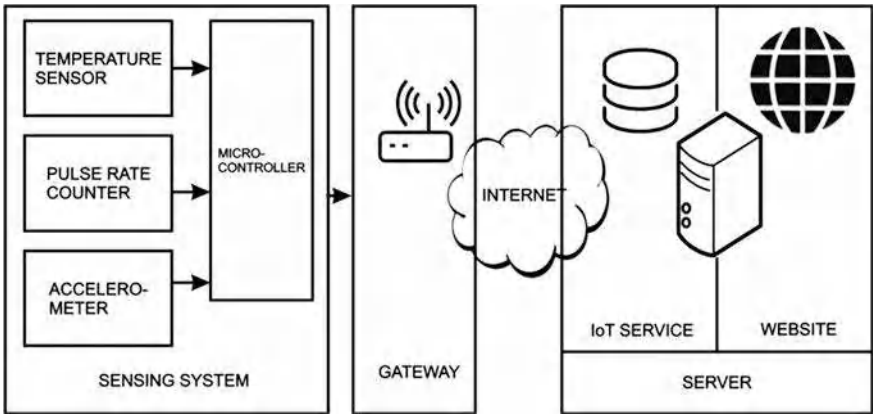

Fig. 2 The proposed system

4.1 Sensing System

Depending on the parameters to be measured, different sensors are used.

4.1.1 Body Temperature Sensor

It is most common physiological parameter measured by wearable sensors in health monitoring system. The variation in skin temperature can help to understand what is happening with patient's body and detect the various medical symptoms which may lead to heart attacks, shock, stroke, etc. Hence, it is exceptionally important and useful for estimating the physiological condition. The body temperature is commonly measured using different temperature sensors like DS600, DS18S20, and DS1621, which gives 9-bit temperature reading or simply LM35 sensor [6].

4.1.2 Pulse Rate Counter

Pulse rate is counted by a change in rate of blood flow in the blood vessels. Pulse rate counter simply uses IR LED and IR detector which are positioned to facing toward each other maintaining a certain distance in between them. By putting a finger in between that gap will cause a change in amount of IR light to be collected at IR receiver. The light emitted from IR LED must pass throughout a finger and recognized at receiver. The finger turns slightly opaque as the heart pumps the pulse of blood from the blood vessel. Due to this, the amount of light reaching to the detector is reduced. The detector signal varies with every heart pulse which is then converted into electrical pulse and amplified. Thus pulses are measured in healthcare systems. The signal of pulse rate counter is so weak or poor and noisy, and contains DC and

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AC components, additionally systolic peak which measures the contraction of arteries, whereas diastolic peak for pressure is exerted on the wall of arteries [8].

4.1.3 Accelerometer

An accelerometer is a device that measures the vibration or acceleration of motion of a structure. These are generally used in healthcare systems to measure acceleration along with a sensitive axis. It is useful for body motion evaluation, detection of fall, and postural orientation. Various types of accelerometer are available depending on piezoresistive, piezoelectric, and variable capacitance methodology of transduction. Generally, all of them follow the same key idea of operation of a mass that reacts to acceleration by creating a spring or any identical component to compress or stretch corresponding to the measured acceleration. Accelerometers are attached to various parts of body to determine the energy expenditure during physical movement [11–14].

5 Conclusion and Future Work

The emergence of the IoT in healthcare is important for two reasons:

- Advancement of sensing and communication technology allows various devices to collect, maintain, and analyze data which was not accessible earlier. In healthcare, the patient's data is collected over the time which helps to provide preventive care and quick diagnosis of acute complications and promote understanding of patient's progress and estimating the success of treatment.
- The ability of devices to collect the data by their own removes the constraints of human-entered data—automatically gathering the data which doctors need at anytime and in the way they require it. This automation reduces the probability of error. This reduction results in increased efficiency, lower the cost, and better quality in any field.
- The future work of the project plays a crucial role in making the system more advanced and accurate. This system can be enhanced by embedding many more sensors such as sensors for breathing rate estimation, swallowing monitoring, hand gesture detection, and analysis as well as gait analysis to the internet which measures the corresponding medical parameters to make the system more beneficial and user friendly for human health monitoring. The restrictions over communication can be removed by establishing a Wi-Fi mesh network which in turn increases the communication range. The most important parameter in any transmission system is security, so further work can be done to allow the data to be transmitted securely over a long distance to the destination and provision for authorized accessing only which enables this system to be acceptable worldwide without any fear or anxiety.

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Swarm Intelligent WSN for Smart City

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Abstract The smart city uses digital, computer, and communication technologies to enhance quality and performance of urban services by reducing costs and resource consumption. The smart city aims to drive economic growth and improve the living standards using state-of-the-art technology. Evolution of wireless sensor networks has been started from the idea that small wireless sensors can be used to gather information from the physical environment, in many situations ranging from monitoring the environmental, surveillance for security, health care, automated building control, traffic control, and object tracking. Sensors help each other to relay the information to the base station. The existing work includes simulation of routing protocols for WSNs in smart city and some hardware implementation. This paper presents a swarm intelligent routing algorithm for wireless sensor network to implement smart city. The particle swarm optimization (PSO) algorithm being most efficient is chosen for implementation (Yamille dl valle et al. in IEEE Trans Power Syst 12 (2):171−195, 2008 [1]). This paper has presented the implementation of prototype for smart homes and solid waste management system, and has also proposed the solution for street light intensity control and traffic congestion detection. For smart homes, fire detection, gas leakage detection, temperature control, and light intensity control are considered, while the designed solid waste control system is capable of detecting garbage level in dustbin and conveys it to the central monitoring system. The implemented prototypes for smart homes and waste management show that it will lead toward improvement of the living standard of the people living in smart city by way of energy conservation, health, and hygiene.

Keywords WSN · Swarm intelligence · PSO · Smart city

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1 Introduction

The foundation elements in a smart city includes sufficient water supply, liquid and solid waste management, assured electricity supply, public transportation, economical housing, smart homes, powerful IT connectivity, digitalization, good governance, especially e-Governance and citizen assistance, security, particularly children and women and health and education.

A wireless sensor network (WSNs) is an upcoming technology, which has potential applications in surveillance (military/civil), disaster management, environment, structural monitoring, healthcare, and many more. In WSNs sensors are spatially distributed autonomous sensors. The sensors sense and acquire physical parameters, and transmit acquired information over wireless medium to monitor the environment. The data transmitted by the wireless sensors can be received by one or more base stations. The various challenges which need to be addressed in WSN are ad hoc deployment, dynamic topology, spatial distribution and constrains in computational resources, bandwidth, memory, and energy. In WSN the nodes are generally static and deployed over vast areas or they can also be mobile and capable of interacting with the other nodes in its vicinity. In the WSN when the nodes are mobile such networks are generally called as a robotic network or as a sensor actor network [2]. To obtain optimum results in WSN an individual sensor node must have moderate memory and computational resources.

It is observed that as compared to analytical methods, bio-inspired optimization methods are computationally efficient. Swarm intelligence is an approach to collective behavior of sensor nodes inspired from the self-organized behaviors of social animals like ants and birds [3]. The advantages of using swarm algorithms are that they are robust, scalable and flexible to model the collective behaviors for coordination of large number of sensor nodes. This paper presents an application of swarm intelligent sensor networks for smart cities.

This paper is presented in six sections. Section 2 gives a brief introduction to swarm routing algorithms. The computationally efficient PSO algorithm is described in Sect. 3. Section 4 provides smart city architecture. Section 5 gives prototype design of smart homes and solid waste management system using WSN. The conclusion of the implanted work is given in Sect. 6.

2 Nature-Inspired Routing Algorithms

1. **Ant Colony Optimization (ACO)**:

The ant colony optimization (ACO) methods are inspired by operating principles of ants, which are used to perform complex tasks like nest building and foraging [4].

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2. **Ant Net Algorithm**:

The algorithm is applicable to asymmetric packet switched networks, and the primary objective of the algorithm is to maximize the performance of a network. The algorithm achieves load balancing by probabilistically distributing packets on multiple paths [4].

3. **Ant-Based Control (ABC)**:

ABC approach is used in circuit-switched telecommunication networks for routing and load balancing problems. As a symmetric network, a circuit-switched network forms a virtual circuit between a sender and a receiver by explicitly connecting them through crossbar switches [4].

4. **Particle Swarm Optimization (PSO)**:

Particle swarm optimization (PSO) is a simple and computationally efficient optimization algorithm. It has been applied to address WSN issues like optimal deployment, node localization, clustering, and data aggregation [3–5].

After comparing the various swarm routing algorithms, it is observed that PSO is uncomplicated and computationally capable algorithm for optimization. Hence, PSO is preferred for routing in WSN designed for smart city.

3 Particle Swarm Optimization

The mathematical model for the velocity of the particle in the particle swarm optimization algorithm is given by Eq. 3.1. In the number space, the vector $X_i \in R_n$ determines the position of every sensor particle and the vector $V_i \in R_n$ determines the movement of the particle by its velocity:

$$\overrightarrow{v_i}(t) = \overrightarrow{v_i}(t-1) + A_1.\text{rand}_1.(\overrightarrow{p_i} - \overrightarrow{x_i}(t-1) + A_2.\text{rand}_2.(\overrightarrow{p_g} - \overrightarrow{x_i}(t-1)) \quad (3.1)$$

where A_1 and A_2 represent positive numbers, and rand_1 and rand_2 are random numbers.

The equation is divided into three elements.

$\overrightarrow{v_i}(t-1)$: The first element shows the trend of the particle to stay in the same direction.

$A_1.\text{rand}_1.(\overrightarrow{p_i} - \overrightarrow{x_i}(t-1)$: The second element is a linear inclination headed for the best position denoted as BEST pat any time found by the given particle.

$A_2.\text{rand}_2.(\overrightarrow{p_g} - \overrightarrow{x_i}(t-1)$: The third element is a linear inclination toward the best position found by any particle considered to be its global best position denoted as BESTg.

Particle Swarm Topologies:
The different swarm topologies are shown in Fig. 1. The particles are in connection with two neighborhoods, i.e., local best (BESTp) and global best (BESTg).

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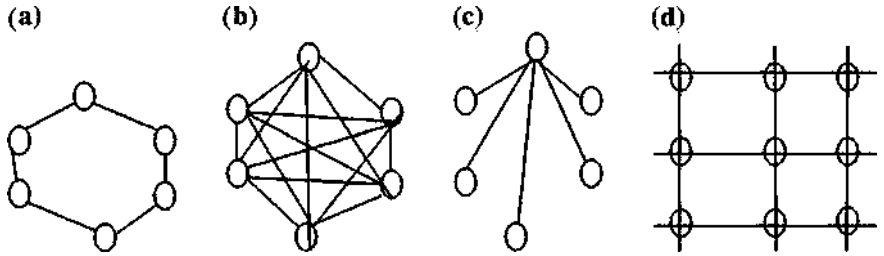

Fig. 1 Swarm topologies **a** Ring topology. **b** Global best. **c** Wheel topology. **d** Von Neumann topology

In the local best approach, each particle has access to the information of its immediate neighbors. The two most widely used local best topologies are ring topology and wheel topology. In the ring topology, each particle is connected with its immediate neighbors as shown in Fig. 1a. In the wheel topology the individual particles are connected to central particle and all the information is transferred to a focal/central individual [6] as shown in Fig. 1c.

The global best topology is a fully connected network. In this topology the particles are inclined toward the best position found by any particle of the swarm, where every particle is able to access the information of all other particles in the cluster as shown in Fig. 1b. The von Neumann topology shown in Fig. 1d can perform better than the other topologies for global best [1, 6]. The selection of topology depends on the application.

The prototype systems developed for smart home and solid waste management have taken into consideration the wheel topology.

4 Smart City Architecture

The clustered architecture of sensor network for the smart city is shown in Fig. 2. The city area can be divided into N trajectories depending on the need of monitoring data at the specific area, e.g., high traffic density of the roads, population of the area (smart homes and waste management). Clusters can be formed by grouping the sensor nodes. Every cluster consists of cluster head and sensor node, and each sensor network node has a microcontroller and a radio transceiver. Communication between cluster head and sensor node will be implemented using ZigBee module. Communication between clusters and base station can be implemented using GSM module.

The PSO algorithm for the clustered sensor network-based smart city can be implanted using the following logical steps:

i. Start the swarm by choosing a random position to clusters formed.
ii. For individual cluster, examine the fitness function.

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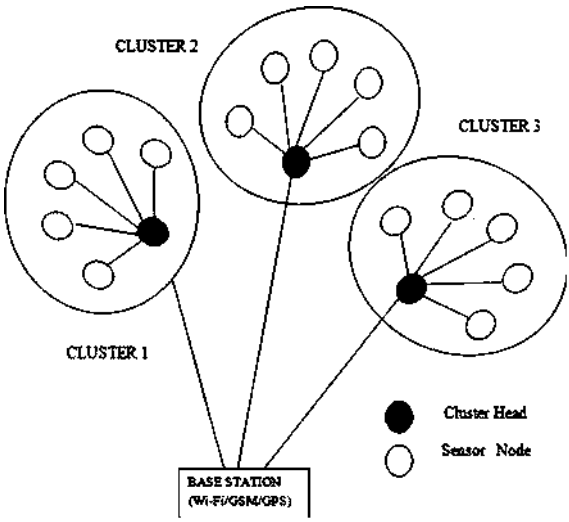

Fig. 2 Clustered architecture of sensor network

iii. Compare the fitness value of particle with its best position (BESTp) for every cluster. Whenever current value is better than the BESTp value, then fix the current value as a BESTp, and the particle's current position as, X_i, P_i.
iv. Find the cluster which has highest fitness value. This value is determined as BESTg and its position as P_g.
v. Revise the positions and velocities of all the cluster particles using i and ii.
vi. Iterate the steps from ii to v for getting the required result.

Sample smart city application areas are considered which includes street light intensity control, city traffic congestion, smart homes, and solid waste management.

Street Light Intensity Control:
The system enables the remote control of street lighting lamps, savings of maintenance costs, and electric power. The architecture uses integrated doppler sensors for vehicle detection and to complete the power efficiency objective. The system will have a gateway module installed at control center, and the control modules installed in the street lighting lamp system. For local communication through the WSN network, ZigBee is used and for communication between gateway module and control modules GSM will be used. The adjustment of the light intensity can be done by altering the PWM signal's duty cycle. This change will be induced remotely, from the control center. Thus, the command sent from the control center is transmitted through the GSM network to the WSN coordinating node. The coordinator sends the light intensity adjustment command to the first module and it will subsequently be sent throughout the network until the destination node is reached. When a vehicle is detected, the light intensity of the lamps is increased to a predefined level, not to affect road traffic safety, and reduces in the opposite case [7].

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Traffic Congestion Detection:
Road traffic congestion is a challenge to the entire large and growing urban areas. To resolve traffic congestion problem, we need to consider the following factors like traffic speed, road occupancy, traffic density, etc. [8]. This system can be designed to detect traffic speed; it can use RFID devices like tags, routers, and gateway/coordinators. RFID tags will emit radio frequency signals that can be received by routers or coordinators. The tag data captured by routers relay to coordinator in the range or another router. To make it a dual-radio device external GSM or GPRS can be interfaced with coordinators via serial interface. Assuming unique RFID tag is attached to all the vehicles. When a vehicle crosses the router, the nearest router receives a signal sent by active RFID tag of that vehicle. The coordinator then receives forwarded signal from router. The coordinator can save the message received from router and wait for another message to come from same RFID tag when it passes by coordinator. After getting the signal, from its timestamp, the coordinator can compare the time difference and calculate the speed of that vehicle. Using GSM network data can be sent to the control room/station.

5 Prototype Design

In this paper an attempt has been made to design and implement smart homes and the waste management system which are important elements in a smart city.

5.1 Smart Home

In smart cities the smart homes will be a key element as it will lead to the quality enhancement of human life and will also be of importance with respect to the conservation of energy resources. In smart homes energy conservation and efficient utilization is very important. The system is designed for fire detection and energy saving by controlling temperature and light intensity.

The designed and implemented system works on master and slave principle as shown in Fig. 3. The master asks for information from the slaves by sending frames using PC; smart phones can also be used. The communication between the master and the slave devices will be formed through ZigBee device. This system is designed for one master and multiple slaves. Master sends the request to all the slaves. If the slave ID in request matches with device's own slave ID, then slave device accepts the frame and sends requested parameter to the master device. If ID does not match then the slave device discards the frame sent by master device. In slave 1 passive infrared (PIR) sensor, gas sensor (MQ6), and fire sensors (bimetallic strip) are used. In slave 2 IR sensor is used to detect human presence in the home. If count is zero then the relay1 is turned off which results in energy saving. For temperature sensing LM35 and for light detection LDR is used. Using the smart

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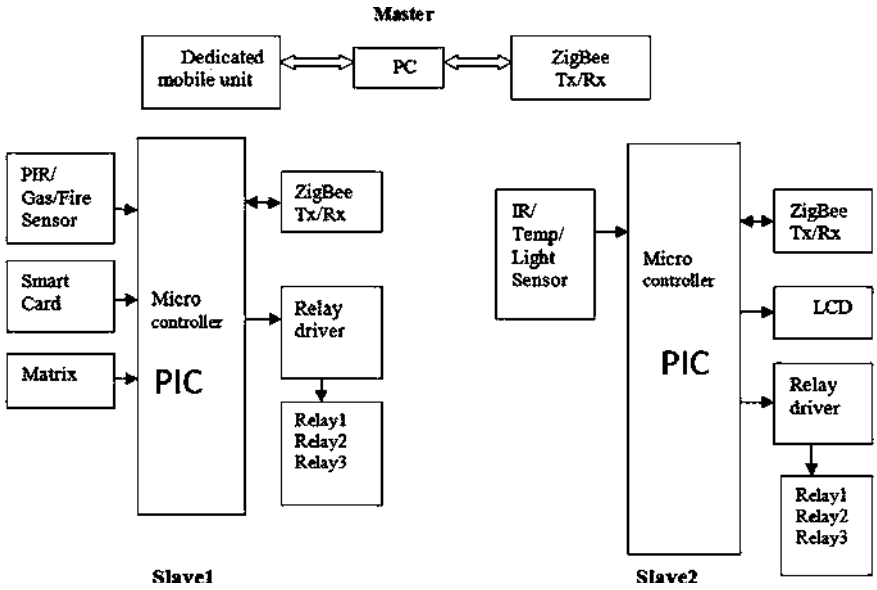

Fig. 3 Master–slave arrangement in smart home

card the threat of misusing the system can be minimized and only authorized person will have complete access to the system. Using the GSM module, measured parameters can be sent to the central database or authorized person via SMS.

5.2 Solid Waste Management

In smart cities waste management is of critical importance as it is directly related to the health and hygiene of the people staying in the city. Both a threat to environmental security, public health, and a strategic renewable resource, municipal solid waste is an inevitable byproduct of civilization and a target for clean technology innovation. The designed and implemented system shown in Fig. 4 consists of four pairs of infrared sensor to detect the level of garbage in the dustbin. As garbage level increases, the first infrared pair which is mounted at the bottom of dustbin at 10 % level will not receive a signal for 1 min and the system will sense the "bin is empty" and will start filling up. When garbage level is filled up to second infrared pair, it will not receive signal for 1 min indicating that garbage is "filled up to 80 %." Similarly, when it reaches up to third infrared pair, it detects that bin is "filled up to 90 %." It will display or inform the control room that "dustbin will fill soon."

For fourth infrared pair for garbage level detection, it will display "overflow of dustbin." The system cross checks filled dustbin using ultrasonic sensor and gives

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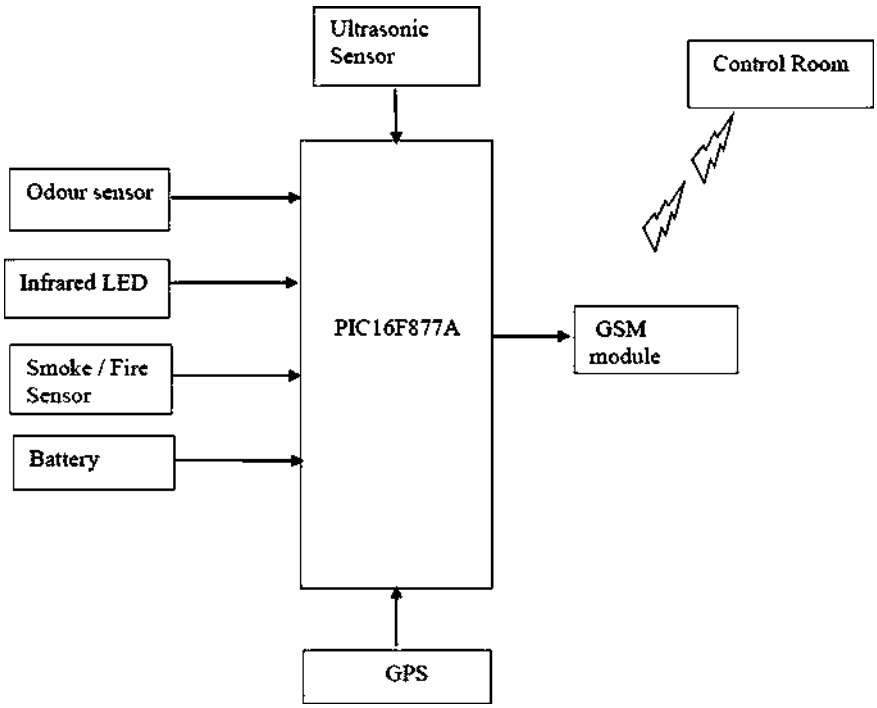

Fig. 4 Block diagram of solid waste management system

protocol "bin is full or overflow" through the GSM technology. With the help of GPS technology the garbage system is able to detect the location and send the protocol to the control room. If dustbin will not be clear by municipal sweepers within 1 h then another message will be sent to the controller that "unload dustbin within 1 h, garbage is already overflow." When first infrared pair receives signal, it indicates that bin is unloaded. It means "bin is unloaded." The designed system consists of two sensors namely smoke sensor (MQ2) and methane gas sensor (MQ6) continuously checking the level of gas in dustbin. When dustbin is not filled up for 2−3 days, decomposition of waste produces odor which contain methane which is detected using (MQ6) methane sensor. Similarly, in summer days garbage gradually burns to produce smoke/co2, which is detected by smoke sensor (MQ2). In such case designed system gives the alert by sending message to control room or fire-bridged. The supportive GPS technology is used to indicate location of dustbin, each and every message or protocol sent by the system through GSM which carries the GPS coordinates which will detect the location of dustbin. The designed system is working on battery source, so there is limited power consumption. The implemented sensor and technology make safe and real-time waste collection system (Fig. 5).

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Fig. 5 Solid waste management system results

6 Conclusion

In this paper an attempt has been made to design prototypes for smart city which includes smart homes and solid waste management. Nature-inspired routing protocols can remove WSN design issues such as scalability, maintainability, battery life, adaptability, survivability, etc. Swarm intelligent routing protocols are compared and effective PSO algorithm is chosen and designed for smart city. The work has been done to design real-time automated homes and smart waste collection and management system which is cost effective, consumes low power, and improves human life.

Smart city should meet the demands of performance of urban services by reducing costs, resource consumption, and energy saving. From the results of the implemented work it is observed that the smart homes will lead to automation of the homes, hence leading toward energy conservation and the waste management system will lead toward improving public health and environmental security.

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Representing Natural Language Sentences in RDF Graphs to Derive Knowledge Patterns

S. Murugesh and A. Jaya

Abstract English language has its own word order, which determines the way of ordering words in a sentence. This paper presents the manner by which sentences in English language can be represented as knowledge patterns by means of RDF graphs. Knowledge patterns are general patterns of knowledge that can be used in any knowledge base or ontology. Knowledge pattern is a logical design pattern which defines a formal expression that can be exemplified and morphed in order to solve a domain modeling problem. Knowledge patterns are proposed by ontology engineers. When using them, the general symbols in the pattern are renamed to special symbols from the modeled domain. The RDF graph language is used to represent knowledge pattern contained English sentences. The basic RDF model can be processed even in the absence of detailed information (schema) on the semantics. RDF model has the important property of being modular, i.e., the union of knowledge represented as directed graphs. The paper also provides examples of usage of knowledge patterns.

Keywords RDF graph · Ontology · Knowledge pattern

1 Introduction

Sentences are formed by sequence of words. Each word in a sentence belongs to a particular class of words, i.e., noun, pronoun, verb, adverb, adjective, preposition, etc. The ways in which sentences are to be constructed are laid down by the grammar of the particular language. Basically, there are two basic components of

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any sentence, i.e., subject and predicate. Apart from these there are extensions to the sentences like object, attribute, and sometimes adverb complements.

It is to be borne in mind that when a sentence is constructed, the order in which the words appear in a sentence is more important than the class to which the word belongs to. Word order indicates the order of members in a sentence. There are two kinds of word order, fixed word order where the order in which the members of a sentence appear are important, whereas in free word order, the order is not given importance. The members of a sentence are given a notational convention, i.e., subject is represented as S and predicate is marked by the letter V and O stands for object. The ways in which these three basic members of a sentence appear decide on the word order. There are six basic types of word order: they are subject verb object, subject object verb, verb subject object, verb object subject, object subject verb, and object verb subject. English, Roman, Bulgarian, and Chinese languages use the SVO word order. Even though there are many types of sentences, the basic focus of this paper is on declarative sentence since the subject of interest is ontology or knowledge base which contains positive or negative facts about a particular topic of interest. It is to be noted that questions or imperative sentences do not form a part of either ontology or knowledge base always. Negative sentences are identified by the presence of the word "Not" in the sentence.

Statements in RDF language contain facts and they are represented by RDF triples. A single RDF triple represents one statement and it consists of a subject, predicate, and an object. A directed graph is used to represent ontology or knowledge base in RDF graph language. Nodes in the directed graph represent subjects and objects of the statements and arcs or edges represent relations or predicate. Resource description framework (RDF) describes any concept, relation, or thing that exists in the universe. There are three things in RDF, subject (S), predicate (P), and object (O); subject is the thing you are describing, predicate is the attribute of the thing you are describing, and object is the thing we are referring to with a predicate. Consider the sentence, "ATM machine reads ATM cards"; ATM machine is the subject, predicate is reads, and object is ATM cards. There can be more triples associated with the subject, the more the triple, the more we know about the subject. Predicates point to the vocabulary. Vocabulary defines what the triples actually mean.

The English language makes use of fixed word order known as subject verb object. Here object refers to direct object. The basic word order may be little different since an auxiliary verb (do, have, be, will, can, etc.) or an indirect object may appear in the sentence. Sentences in each language may express a variety of things. It can state facts—declarative sentences (positive or negative). It can be asking about things' questions. It can be command or imperative sentences. The basic focus of this article is on knowledge patterns, which are closely related to knowledge bases or ontologies. We mainly look in for declarative sentence. Questions or imperative sentences do not form a part of any knowledge base or ontology. Declarative sentences usually states positive or negative facts. The structures of both positive and negative sentence are similar in English. A negative sentence consists of the word "not". The positive declarative sentence contains only

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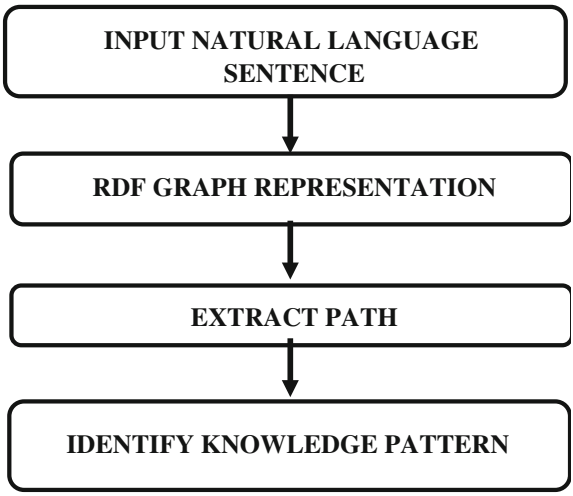

Fig. 1 Knowledge pattern discovery process

a subject and predicate. Another complex type of sentence that contains an object is of the form subject verb object, for instance "I see an ATM Machine," "ATM machine prints receipts," etc. A sentence may also contain an adverbial complement of place, manner, or time. A sentence may also have complements or combination of them. A sentence containing all three types of adverbial complements is labeled as subject verb object manner place time. "I withdraw money everyday." is an example of an adverbial complement sentence. Subjects and objects in sentences are extended by word features like "small" and "big." Negative declarative sentences are the same as a positive declarative sentence. When a verb in a sentence is changed to its opposite meaning, then it is a negative declarative statement [1]. Figure 1 depicts the knowledge pattern extraction/discovery process. The rest of the paper is organized as follows: Sect. 2 deals with literature survey, Sect. 3 about the knowledge patterns in general, and Sect. 4 is regarding the procedure to derive knowledge patterns for English sentences and Sect. 5 concludes the paper.

2 State of Art

In research conducted by Rostislav Miarka et al., they suggested use of RDF graph for representing knowledge patterns. Clark, Thompson et al. recommended that knowledge patterns can be used in any knowledge base or ontology. Antonin Delpeuch proposed that RDF is widely accepted as a standard for linked representation of information, i.e., words in a sentence can be represented using RDF graph. Peter Exner proposed an end-to-end system that extracts RDF triples for describing entity relations and properties from unstructured text. Wikipedia and DBpedia had created voluminous amounts of linked data which can be used as model training sets for information extraction tasks.

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3 Knowledge Patterns

Knowledge pattern is very much related to the process of creating ontologies or knowledge bases [2]. When ontology is being built, the concepts and the relations among the concepts pertaining to a particular domain are modeled. The term concept is identical to knowledge. The ontology building is based on concept-oriented approach. When ontology is being built, some structures of the modeled knowledge are same; the same structures of concepts can be identified as knowledge patterns where general terms are labels. The advantage of using knowledge pattern is the general terms are mapped to concrete terms from the domain model and also facilitates reuse of knowledge. *The process of renaming general terms to concrete terms is called morphism*. Thus we need not create relations among concepts every time, but can use knowledge pattern and make only the morphism. ISA relation or the unit–part relation which is found in almost every ontology is an example of a simple knowledge pattern. A directed graph in RDF graph terminology represents an ontology or knowledge base. Nodes correspond to subject and an object of statements, and arc denotes relations or predicates. RDF contains only binary relations; complex relations should be broken down to a set of binary relations. An URI, Uniform resource identifier, identifies nodes and edges in an RDF graph. A standard RDF graph uses only solid lines. To differentiate between knowledge patterns from the conventional RDF statements, dashed lines are used. The resource description framework (RDF) is an artificial language that takes the form of knowledge graphs. A triple links two objects, which consists of one entity, i.e., the subject of the predicate, the type of the link represented by a string refers to the property and a second entity is the object of the predicate. In a graph a triple is represented as a directed property from subject to object labeled by the predicate. Example of a typical RDF triple and a triple which represents knowledge pattern is shown in Fig. 2.

Figure 2 shows the classical RDF triple (above) and RDF triple representing knowledge pattern (below).

Morphism is a technique using which the general terms from the pattern are mapped to the special terms from the problem domain. Knowledge patterns can be represented using an RDF Graph [3, 4]. Mapping of one term will be denoted by one RDF triple identified with solid/thick line. The subject of the triple is the special

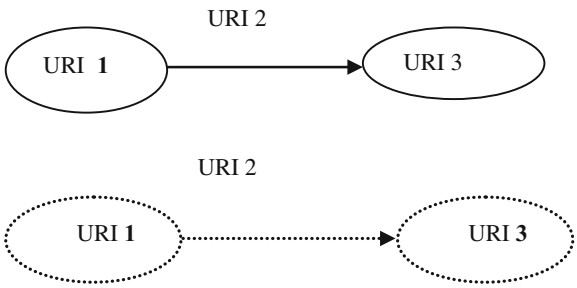

Fig. 2 Classical RDF triple

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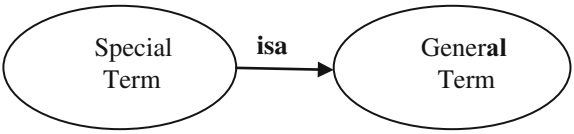

Fig. 3 Morphism

term from the domain, predicate will be "isa" relation, and object is the general term from the pattern. An example of morphism of one term is shown in Fig. 3.

4 Knowledge Patterns for English Sentences

Since our focus is on building an ontology which contains statements of fact, the main concern is on positive declarative sentence. A sentence contains three members, subject, predicate, and object, which facilitate us to represent the sentence as RDF graph as shown in Fig. 4.

The subject from sentence is denoted by the node "subject," the object is symbolized by the "object" node, and the predicate by the arc "predicate."

An example of the sentence "ATM machine reads ATM card" is represented in RDF graph in Fig. 5 and as RDF/OWL representation in Fig. 6.

In some cases a negative declarative sentence also states some negative fact—the fact that some statement does not hold good, i.e., not true [5]. RDF graph notation provides a symbol known as falsum. The standard form of representing a negative declarative sentence in RDF graph is shown in Fig. 7

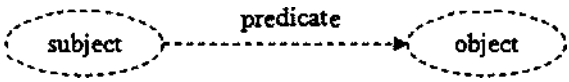

Fig. 4 Knowledge pattern for a sentence in basic form

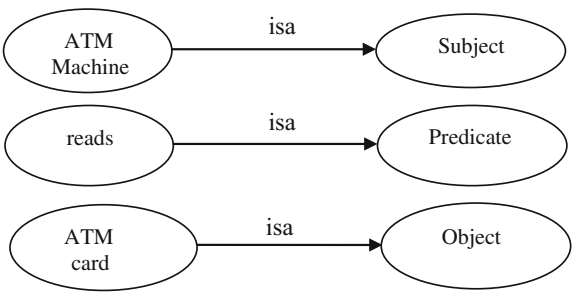

Fig. 5 RDF graph for the sentence "ATM machine reads ATM card"

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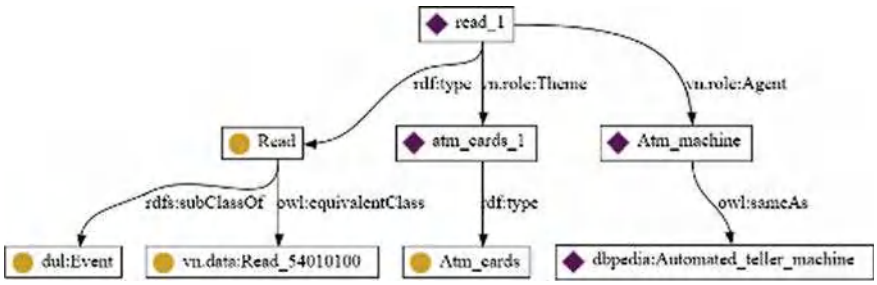

Fig. 6 RDF/OWL ontology and linked data from natural language sentences

Fig. 7 Basic form of a negative sentence

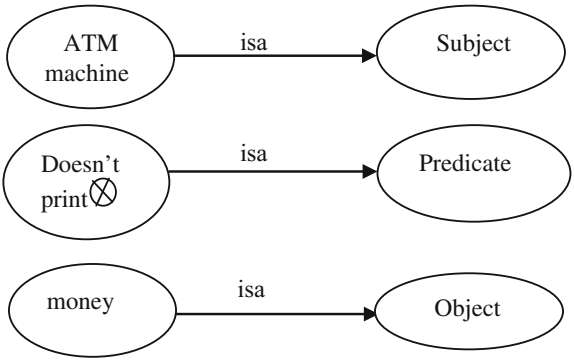

Fig. 8 Morphism

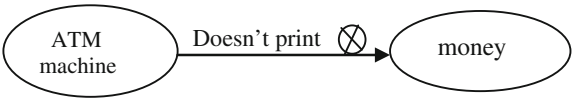

Fig. 9 RDF graph representation of the english sentence "ATM machine doesn't print money"

An example of a negative sentence is "ATM machine doesn't print money," morphism is given in Fig. 8 and RDF graph representation of the same is given in Fig. 9.

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5 Conclusion

English has its own vocabulary and grammar. Grammar plays a key role in a language, and it determines the particular order of a word in a sentence. This paper has introduced the concept of representing natural language sentences with the help of RDF graph. Thus knowledge patterns can be extracted from plain text and can be represented in RDF/OWL.

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A Framework to Enhance Security for OTP SMS in E-Banking Environment Using Cryptography and Text Steganography

Ananthi Sheshasaayee and D. Sumathy

Abstract Authentication of user in online banking is a major issue in recent days where transactions are carried out using insecure Internet channel. The modern communication medium is very much exposed to various threats. One time password (OTP) is used to prove one's identity over the wireless channel. The OTP sent to user's registered mobile number as SMS is most commonly used technique for user authentication. OTP SMS sent normally as plain text is vulnerable to various attacks along the communication channel. To solve this problem, this research aims to provide a technique to transform the OTP using a lightweight cryptography and hide the cipher text using text steganography and send the stego text as SMS to user mobile. Personal Identification Number (PIN) supplied by the bank during registration is used for ciphering. The user needs to know the PIN to read the OTP. The user can proceed with the business transaction, only after this authentication. This process provides end-to-end-encryption of the OTP SMS.

Keywords OTP SMS · Cryptography · Text steganography · User-authentication · Security principles

1 Introduction

Internet is a boon to the modern society. It provides a platform to obtain variety of services including information gathering, online chats, emails and financial services like online shopping, bill payments, e-banking and many more. It is widely used as it provides all services at ease and comfort. The people using internet for their financial transactions and to manage their accounts online is growing rapidly

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because of the numerous advantages it provides. The security concerns of Internet, poses serious threats to the financial transactions carried out. Online banking system provides with various mechanisms for authentication in an anonymous network [1]. The user needs to prove his identity before gaining access to his confidential data. The basic level of authentication is static password that needs to be changed only when needed. Static passwords are easy to remember and used every time for login. These passwords are prone to various attacks like shoulder surfing, brute force attack, birthday attack and are easy to guess by the intruder. To reduce the risks with static passwords, One-Time passwords (OTP) were introduced [2].

OTPs provide another level of authentication that is to be provided in order to proceed with the online business transaction. When the user requests for online banking facility, it required to register his personal information along with his personal IMSI (International Mobile Subscriber Identity) number with the bank. Transactions carried out to the bank account are intimated through SMS to the IMSI. When online business transaction need to performed, it is required to login with the static password. An OTP SMS is sent to the registered mobile number which is valid only for a specific time units and session. OTP is used to provide second level of authentication and transaction proceeds if only validated [3].

2 Cryptography and Text Steganography

Cryptography and Steganography are the two widely used techniques for information security. Cryptography is secret writing that scrambles the secret text into meaningless cipher text. Steganography is covered writing where the secret text is hidden under a cover which hides the very existence of the secret message. The cover media used to hide decides the type of steganography namely image, audio, video or text [3]. Text Steganography is the simplest form of steganography as it involves less overhead but difficult to hide, due to lack of redundant bits unlike image, audio or video. Text Steganography uses text to hide the secret text. The cover text can be an email, spam text or an innocent looking SMS. The meaningless information of the cipher text leads to suspicion and hence prone to attacks for deciphering. The advantage of steganography is that the attacker may overlook the existence of the secret text itself.

The idea of combining both techniques for the advantages each possess would be a highly secured system for securing OTP SMS which is vulnerable to various threats over the insecure communication medium.

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3 State of Art

In this section, this paper presents a brief overview of the related works in the area of OTP SMS security. A multichannel system for proving one's authenticity using RC4 encryption of OTP and QR code to hide the cipher text is proposed in [1]. To counter the attacks on SMS, an innovative scheme in [2] of encrypting the OTP using AES and hiding it under LSB steganography that is sent to user email is suggested. A visual cryptography combined with biometrics with PIN and for hiding OTP with image for better security is presented in [3]. A system for authenticating clients using digital watermarking is presented in [4]. A trust worthy m-banking system to verify using OTP with biometrics is proposed in [5]. It checks OTP with webpage id code along with biometrics for proving user identity. To safeguard SMS OTP from attacks two methods were proposed in [6]. End-to-end-encryption and an exclusive channel on the handset are proposed for transferring confidential data. Combining of text steganography with cryptography in visual form for the online shopping payments is proposed that provides secrecy of one's data is suggested in [7]. In [8] a technique to encrypt OTP using symmetric cipher with time synch module that provides efficient end-to-end-encryption is suggested. A simple method to secure OTP with secret key and trans-code to counter MITM attacks was suggested in [9]. It also provides efficient user authentication.

4 Motivation

During online banking transactions, the OTP sent from banking server to customer registered mobile number for user authentication. The secret OTP travels as plain text along the communication channel has to pass through many intermediate points like SMSC (Short Message Service Centre), SMS GMSC (SMS gateway MSC), MSC (Mobile Switching Centre), BSS (Base Station System) (Fig. 1 illustrates the diagrammatic representation) [10]. There are many different threats to OTP at these points namely wireless interception-eavesdropping of communication between mobile phones and base stations due to protocol inefficiencies, mobile malwares-intercept SMS messages containing OTP, 'mSpy'—a mobileapp that can be installed on the device to be hacked [6] and many more. As a part of MITM attack, a mobile malware is installed in the user's mobile which allows the attacker to capture the user's mobile and traces, call logs, inbox, contacts, and all the event happenings. The user is forced to reveal his credentials either using social engineering or by shoulder surfing. With the credentials known and mobile activities captured, OTP SMS is not spared.

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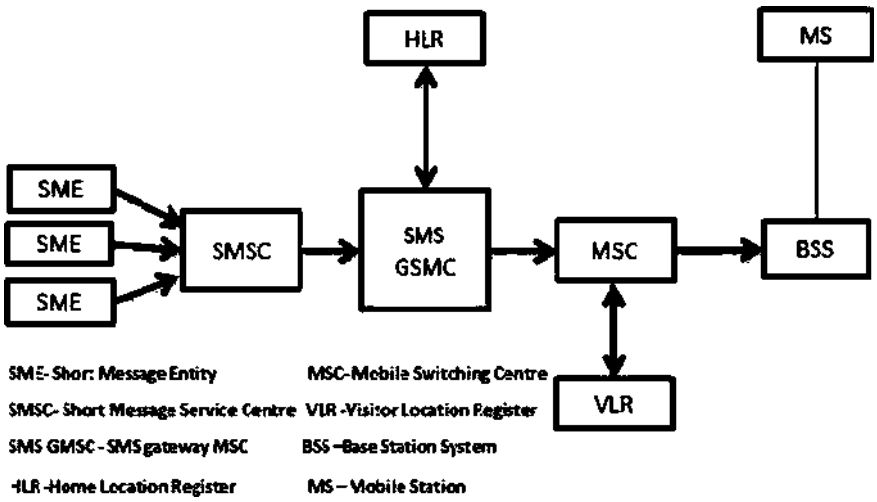

Fig. 1 Network nodes in GSM network for SMS

5 Methodology for Secure Internet Banking

Cryptography and Steganography can be combined to secure OTP SMS for the advantages each technique has. Ciphering scrambles the secret text into meaningless code and text steganography hides the very presence of secret text under an innocuous text carrier.

The step-by-step transaction procedure (Fig. 2 depicts the flow) of using mobile phones for internet banking is given as below:

Step 1: The registered customer uses the bank portal to enter into his personal homepage by using his login and password.

Step 2: The bank server verifies the user credentials and validates the user if found correct and allows the user to access the web page or generate queries. If not access is denied.

Step 3: When a customer initiates an online bank transaction, the request reaches the bank server, and OTP is generated.

Step 4: The key for encryption is generated by combining Personal Identification Number (PIN) and date-of-birth (DOB) in the specified format.

Step 5: The bank server then encrypts the OTP using light weight cipher using the keys generated in step 4.

Step 6: The cipher text generated in step 5 is further hided using text steganography using stego-key under an innocent looking SMS.

Step 7: This stego text with OTP hidden is sent as SMS to the user's registered mobile through Wireless Application Protocol (WAP).

Step 8: The user receives the SMS and the cipher text is extracted using the same stego-key.

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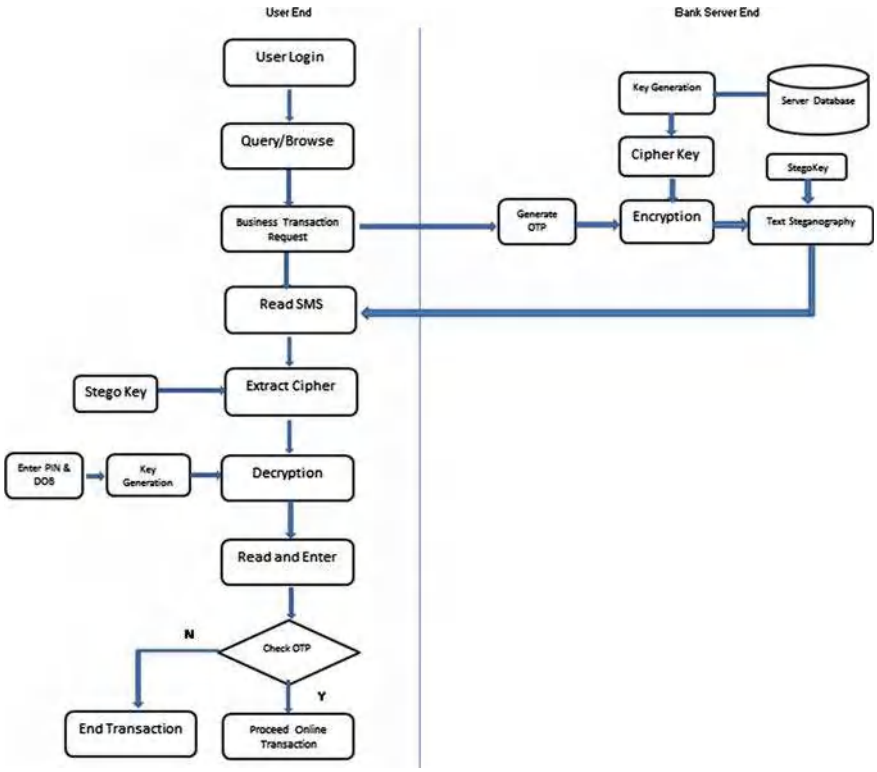

Fig. 2 Proposed Method for securing OTP

Step 9: The user is asked to enter the PIN and DOB. This is used for deciphering the cipher text.

Step 10: If PIN and DOB is correct, then OTP is deciphered and visible to the user. He proceeds with the online business transaction.

Step 11: If the PIN typed is wrong, cipher text C cannot be deciphered. Error is prompted and the transaction process comes to a halt.

These steps are carried out at the bank server and at user mobile, every time the particular customer initiates an online transaction.

6 Advantages of Proposed Work

- The 4-digit PIN and ciphering with steganography provides three levels of security. PIN—assumed to be kept as secret, assures flawless user identity and ciphering with stego under a simple text maintains invisibility.

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- It provides end-to-end-encryption and avoids any possible threats along the SMS path.
- Even if user's login name and password for e-banking are eavesdropped through shoulder-surfing attack, PIN, known only to the user, provides additional security even in the case of mobile theft.
- Text steganography technique used in this method provides invisibility and high payload within restricted 70 Unicode characters per SMS.
- It requires less processing power, time and memory. Ideal for mobiles and PDAs used for internet banking, as it involves less overhead.

7 Security Analysis of Proposed Method

The proposed method uses PIN for key generation phase for the lightweight cryptographic algorithm to secure OTP and hide it under an innocuous text cover for better invisibility. Traditional SMS Banking system sends OTP as plain text to carry e-transactions using time and login session to decide the validity of the OTP. In the proposed method, the OTP is ciphered and embedded at the bank server end before it is sent via the insecure channel. Extracting and deciphering are carried out at the user mobile. The secret text is encapsulated and sent as single entity that prevents any possible attacks. This method also adheres to the five security principles as suggested in [11].

7.1 Integrity

The OTP travels as stego text under an innocent SMS from the bank server to the user mobile. If the content is altered midway the extraction of the OTP will not be possible even for the genuine user and hence attack is understood. Request for new OTP or terminating the session can proceed.

7.2 Confidentiality

In the proposed method, the OTP is encrypted with the secret parameters that are assumed to be a secret between the user and the server. The level of confidence depends on how secret these parameters are kept. The storing of PINs at the bank server should be fully protected and the user should not reveal the PIN to anyone. If any one of these happens then confidentiality is compromised.

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7.3 Authentication

For authentication, the proposed method uses PIN supplied by the bank at the time of registering his personal identity, As PIN is not stored in mobile application the attacker cannot use this to decrypt OTP even if he steals the user's mobile.

7.4 Availability

The availability of OTP SMS depends on the factors listed below.

Mobile device: A smart phone with a mobileapp installed for extracting and decrypting is required. The algorithms are lightweight, thus not much processing power is required.

Network Service Provider: The signal strength, proper network elements and traffic handling power of the service provider decides the time within which the SMS delivered.

Capacity of the bank server: If the OTP validation fails, the proposed method discards the process and thereby reduces the load on the server. The bank server must be equipped with high speed processing elements to handle multiple requests generated at any point of time.

7.5 Nonr-Repudiation

The user need to register in person for the e-banking services by giving his mobile number, IMSI (International Mobile Subscriber Identity). The bank also provides the secret PIN during registration. Since the OTP SMS is sent to this unique number and the secret PIN must be used for reading the OTP, the user cannot deny the business activity.

8 Discussion

Table 1 clearly explains that the proposed algorithm has comparatively better secrecy, security, and authentication, invisibility for the minimal overhead in terms of time, processing power, and no extra hardware and software costs.

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Table 1 Comparison of existing algorithms with the proposed method

Item	Traditional OTP	Technique 1 [2]	Technique 2 [3]	Technique 3 [9]	Proposed method
End-to-End encryption	No	Yes	Yes	Yes	Yes
OTP transfer via Internet	Plain text	Plain text	OTP under image	cipher text	cipher-stego text
Cryptography	No	Yes. Visual cryptography	Yes. AES encryption	Yes. RSA algorithm	Yes. Light weight feistal cipher
Steganography	No	Yes. Image steganography. Finger prints as cover image	Yes. Image steganography using LSB technique.	No	Yes. Text Steganography
H/W circuitry	Basic h/w	h/w to capture biometrics	No extra h/w	No extra h/w	No extra h/w
S/W requirements	Basic s/w	s/w for preprocessing of image	s/w for OTP retrieval from image	mobileapp to generate passcode	mobileapp to extract and decipher OTP
Sending media	SMS	SMS	Email	SMS	SMS
Levels of authentication	Two	Three	Two	Three	Three

9 Conclusion

Even though Internet is used extensively for banking and shopping transactions, research proves it to be very insecure. It is exposed to various threats like phishing, spoofing, hacking, and many more. As the enhanced technology improves the way banking and financial transactions are carried out, the attackers also use sophisticated techniques to access confidential data. SMS-based OTP was introduced to mitigate the attacks. Recently, research proves that OTP SMS is also under threat. An approach is proposed to secure OTP SMS through cryptography and text steganography with an additional authentication using a PIN. The method is very simple to use and can be used in all mobile phones with less time complexity and does not require extra overhead for its implementation but counters many of the attacks. It also addresses the five principles of secure services, and hence proves to be reliable over other protocols.

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Study on the Use of Geographic Information Systems (GIS) for Effective Transport Planning for Transport for London (TfL)

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Abstract This paper is intended to illustrate the impacts of geographic information systems in the planning of transport services, having the Transport for London as the precise case study. The study entailed an identification of GIS features, which support the planning of transport services. These features were studied in line with the current challenges faced by TfL, and were practically recommended as a means of tackling the problems. As a means of recognising bottlenecks, likely to be encountered in the future, an integration of GIS into travel demand analysis should be done (Alterkawi in GBER J 1(2):38–46 [2]). Both qualitative and quantitative methodologies are used as a means of collecting data useful to the research area. It was found that TfL is already in use of GIS, but to a minimal extent, the organisation is open to recommendations in this regard.

Keywords Geographic information systems · Transport networks in Europe · Transportation services · Web mapping · Data capture · Transport for London (TfL)

Track: *GIS for effective transport planning.*

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1 Introduction

Over the years, there has been an extensive development in the planning of transportation services in London. This change is reflected in the regularity of transport services, the ability of individuals to track public transport (buses and trains), and also get live updates on departure times, arrival times, routes, diversions, and changes to services.

This paper analyses means through which the use of geographic information systems could aid the Transport for London, in planning transport services more effectively.

1.1 Introduction to the Research Field

The transport network in London is extensively developed, and it includes private and public services. 41 % of London journeys are made using private transport systems, while 25 % are made using public services [23].

In London public transport network is the principal pivot for the UK in land and air transports. These services are rendered by TfL. Most transport networks, such as buses, trains and river services, are controlled by Transport for London [4].

Other rail services are either wholly operated by National Rail or contracted to external transport firms by the Department for Transport. Furthermore, there are numerous self-regulating airports functioning in London, for instance Heathrow, which happens to be the busiest in UK [8].

As a result of the 1986 privatisation, bus services were twirled off to a discrete operation grounded on viable proffering. Included in the establishment of the Greater London Authority, in 2000, TfL took over the management of London transport. It remains the publicly owned transport corporation for the city of London till date [21].

1.2 Introduction to the Research Focus

Through the use of Information Technologies, it has become possible to track most public transport (e.g., buses and coaches), get live departure times online, and live feeds. The transport service in London, alongside that of Paris, is one of the greatest in Europe [4].

At peak time, rush hours, and weekdays, certain stations tend to be busier and overcrowded; Geographic information systems could help TfL to decide the busiest areas, and provide better services in such areas [14].

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Also, in cases of emergency, or scenarios where people will need to be in a certain place in the earliest time possible, better services could be provided. For example, better 'city to airport' shuttle services.

TFL already provides an express service to Heathrow Airport, which guarantees a 15-min journey to Heathrow [23]. However, this service is only guaranteed from Paddington. Through the use of geographic information system, the express service could be better planned to serve more areas across London.

Research Aim

This research aims to investigate means through which the efficient use of geographic information systems (GIS) could yield better planning of transport system, and resolve the current problems with the transport system in London.

2 Literature Review

2.1 Geographic Information Systems

Geographic information systems (GIS) are systems modelled to capture, operate, store and scrutinise various categories of topographical and spatial data [17]. GIS is a science of basic perceptions, application and structures.

GIS applications are tools, which enable organisations to initialise collaborative query, edit maps, scrutinise spatial data and render more competitive services [1, 9, 25, 26].

Maliene et al. [15] describe geographic information systems (GIS) as the basis of several services, reliant on location, which depend on visualisation and analysis, stating that such applications are often related to transport planning, management, telecommunication and other businesses.

2.1.1 Uses and Examples

According to Alsaheel [1], the execution of GIS is regularly prompted by application-specific requirements. Thus, most GIS applications are custom designed to meet the specific needs of an organisation. In essence, GIS developed for a transport organisation might not really be comparable with that, which has been developed for a telecommunications company. However, Wolfgang [28] suggested that GIS is always suitable and compatible with all sectors of an organisation. Nonetheless, GIS could help in the creation of explicit decision support systems (DSS) at an enterprise level.

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2.2 Transport for London (TfL)

Transport for London (TfL) is the organisation responsible for managing the transport system in London. Basically, the organisation is constantly developing new strategies to manage transport services in London, and the headquarter is located in Windsor House, in the city of Westminster [23].

In 2000, Transport for London was created by the Greater London Authority Act 1999. London Regional Transport was the predecessor, and from it, TfL gained most of the foundational structures and functions. Bob Kiley, Ken Livingstone and Dave Wetzel were the first commissioner, chairperson and vice-chairperson of Transport for London. Until 2008, when Boris Johnson was elected as the Mayor of London, Wetzel and Livingstone remained in office [10].

Although TfL was in charge of transport networks since 2000, it was not responsible for the London Underground until after the agreement of the public–-private partnership (PPP) contract for maintenance, which was very confidential, in 2003. Previously, the Metropolitan Police was responsible for managing the public carriage office [22].

2.3 GIS as an Information System for Transport for London (TfL)

Alterkawi [2], in agreement with Alsaheel [1] stated that the purpose of integrating GIS to travel demand analysis process is for the forecasting of future congestion areas, shortest path and travel time allocation for popular centres.

Not only does GIS include features, which improve access to services, they present information accurately, according to positioning and location, which can be used to enhance planning [27].

2.3.1 Key Features of GIS Used in Transportation

GIS is capable of portraying graphics, while connecting features with attribute table. This specific feature is valuable for the maintenance and update of roadway network. GIS further recognises errors in associations and trips loading from traffic analysis zone [2]. Antenucci et al. [3] highlighted road design, traffic volumes, highway mapping and analysis of accident data as some transportation applications of GIS.

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3 Research Methodology and Data Collection

Deductive or Inductive Approach?
While deductive approach involves the analysis of already existing hypothesis, inductive approach starts with specific research questions, upon which data is collected and researcher either analyses data from a new perspective or builds on (enhances) an already existing foundation [5].

A deductive approach therefore begins with a general level of focus, while an inductive approach kicks off with a specific focus level.

Deductive Approach
This research was not based on existing hypothesis, neither is it concerned with testing such hypothesis for a point to be proved. Deductive approach is therefore not the suitable design model for this research.

Theory (*General Focus Level*) ⟶ Analyse Data (*Analysis*) ⟶ Support Hypothesis or not (*Specific focus level*)

Inductive Approach
This research commenced with a main research question, from which sub-questions were formed, and data collected for the purpose of creating or developing a theory. The inductive approach is being used for this research.

Data Collection (*SpecificFocus Level*) ⟶ Pattern Discovery (*Analysis*) ⟶ Develop Theory (*General focus level*)

3.1 Data Collection Method

3.1.1 Survey

Both Gerring [11] and Remenyi et al. [19] agree that surveys are a set of predetermined questions. As a quantitative means of obtaining data, a **survey** was created to analyse the experience of customers as they used public transport services within London.

3.1.2 Interviews

Boyce and Neale [6] and Kahn and Cannell [12] agree that an interview is a focused dialogue involving multiple parties. Saunders et al. [20] categorise interviews as structured, unstructured and semi-structured. The latter is used for this research.

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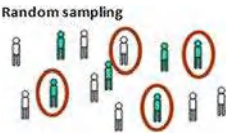
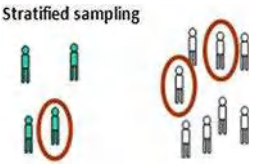
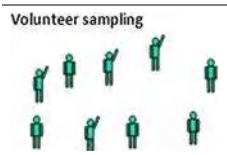
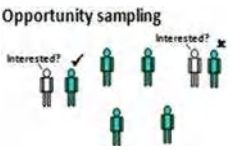
3.1.3 Choice of Sampling

Sampling types	Explanation	Advantages	Disadvantages
	The chances of each member of the population to be chosen is equal E.g. Pulling names out of a cap	For larger samples, it renders the best chance of unbiased representative sample	It could be difficult to achieve being that it is time consuming
	Splitting the population into subcategories, such that members are selected in the proportion that they occur in the population E.g. 2.5 % of population are blacks, so 2.5 % of chosen sample should be blacks	An intent effort is made to make the sample a fair representation of the population	It takes time to identify subcategories and calculate proportions
	This comprises individuals who have volunteered to be involved in a study. E.g. Responses from volunteering advert	It is convenient	This could lead to a participant being biased, and is therefore considered to be unrepresentative
	A selection of people who are available at a given time E.g. Walking into an organisation and interviewing available individuals	This is economical, convenient and quick	This could lead to biasness, as the researcher might partially select only those that are helpful

Opportunity sampling was used for this research because it is a very quick method of sampling, which does not require ambiguous procedures, and will not put an economical constraint on the researchers.

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3.1.4 Sampling Size

According to Proctor [18], there is no ideal sample size, as it depends on the nature of problem investigated. Thus, having considered the research objectives of this study, 100 survey responses and 10 interviews are regarded as ideal, within the given time.

A total of 784 survey invitation emails have been sent out, and a survey web link is made available online.

3.2 Data Analysis Tools

Survey monkey is embedded with great analytical tools, with which the data received from the survey filled in by respondents were analysed, classified and simplified. Through the use of ***excel spread sheet***, a summary of the survey was portrayed in bar charts, showing the number of collections received on each day covered by the survey period.

In line with the inductive approach, using these tools, a pattern is discovered after the collection of data, and a theory established.

3.3 Ethical Aspect

Collecting data regarding TfL, being a well-known established organisation, had to be done with extra care and precaution, to ensure that their terms and conditions are not breached. Confidentiality was a major area of concern, specifically considering the fact that as part of the research, a survey was sent to emails of various individuals, and it was necessary to ensure that their emails are not used for any other purposes beyond this research, and are not transferred to third parties, in line with the Data Protection Act.

4 Discussion of Main Findings

4.1 Discussion of the Main Findings in the Context of the Literature Reviewed

Bulc [7], Turro [24] and several other authors of publications gave their views on Transportation Networks in Europe; their views did not particularly contrast, but were complementary.

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Alterkawi [2] particularly discussed the suitability of GIS for transport planning and elaborated on the specific features of GIS, which support the planning of transport services. This tallied with some of the findings of the research, as indeed, GIS contains web mapping, travel demand forecasting, shortest route algorithm, spatial data analysis, data capture, amongst other features, which are useful for the planning of transport services.

In agreement, Alsaheel [1], Maliene et al. [15], Volk [25] and Warite [26] further discussed the benefits of GIS and their suitability for planning transport services. Indeed, through the efficient use of GIS, forecasting future travel activities will be made possible, thus making the planning of transport services more effective.

However, Wolfgang [28] insinuated that GIS was fit for the purpose of every challenge an organisation may have. This was found to be a limited statement as TfL had some challenges, which GIS was not the solution to. For example, increasing the capacity of tube and buses is not so much a GIS-solvable challenge as managing underground traffic.

Although Koontz [13] and O'Shaughnessy [16] did not entirely agree with Wolfgang [28], they admitted that GIS is suitable for various other purposes aside transportation. However, they mentioned that the implementation of GIS is very challenging.

Nevertheless, during the course of the research, it was found that there is no specific application, for which GIS is more suitable than others. In essence, GIS is suitable for various sectors, and is designed according to the requirements of the sector. Therefore, a geographic information system designed for an engineering firm might not perfectly be suitable for use in a transport network. This finding was very much in alignment with the argument of Alsaheel [1].

Alterkawi [2], Volk [25] and several other authors perceived GIS to be a technology, without which transport services cannot be operated. This was right, but limited, as TfL is actually making use of GIS (to a minimal extent), but does not rely on it. Therefore, the use of GIS is not the foundation of transport planning, but enhances and improves it.

4.2 Conclusion

This project entailed investigating means through which an efficient use of geographic information system could help the Transport for London to plan transport services more efficiently and effectively.

It was discovered that TfL is already making use of GIS, but to a limited extent; thus recommendations were made for the organisation to optimise its use of GIS for more effective results. Recommendations were also made on how GIS could be used to tackle some of the specific challenges faced by the organisation.

There is scope for further research in this area.

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An Integration of Big Data and Cloud Computing

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Abstract In this era, Big data and Cloud computing are the most important topics for organizations across the globe amongst the plethora of software's. Big data is the most rapidly expanding research tool in understanding and solving complex problems in different interdisciplinary fields such as engineering, management health care, e-commerce, social network marketing finance and others. Cloud computing is a virtual service which is used for computation, data storage, data mining by creating flexibility and at minimum cost. It is pay & use model which is the next generation platform to analyse the various data which comes along with different services and applications without physically acquiring them. In this paper, we try to understand and work on the integration model of both Cloud Computing and Big Data to achieve efficiency and faster outcome. It is a qualitative paper to determine the synergy.

Keywords Big data · Cloud computing · Software · Research · Integration

1 Introduction

Many organizations have grown and made the data associated with them also grew exponentially. Almost all the MNC's have data for multiple applications and in variety of formats. Sometimes, the corporates face many hurdles to keep all data securely. In 2011, research work by Mr. Gartner showed how there is a steep rise in data generation which implies that more and more data is emerging from all the spheres and it goes unchecked without analysis. This induced a need to develop a new technique to handle the enormous data available so that maximum utilization

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can be made as such it yielded to new development named Big Data. It is the most advanced data mining technique to analyse to the best as compared to all other research methods [1]. Enormous data available to the corporates which need to be used for the development is about to turn imperfect, complex, often unstructured. For this, they used advanced computational tools which have developed to reveal and identify trends and pattern within and across large database that would often otherwise remain undiscovered. It is difficult to execute the work by using the existing database management systems and other applications and desktop statistics and visualization packages, which takes lots of simultaneously run software in different servers and consumes a very large storage size. "Cloud computing is a model for on demand network which provide access to a plethora of different configuration computing resources which can be provided with least management effort" [2]. Before cloud computing, orthodox business applications have always been not so user friendly and complicated. The huge amount of hardware and software required to run them and it is difficult to manage all the components to gather together. The system requires a large team of experts to configure or install and then to process it. With cloud computing, the user can ease the process as the requirement or the component needed to run the system will be provided by the experienced vendor. In this digital age, the aspect of work activities and personal life are heading towards the availability of everything in the virtual online world. Many organizations and web based companies like Google, Yahoo, and other IT firms comes with the most powerful computing system "Cloud Computing" which means that there can be sharing of web infrastructure like IaaS, Paas and SaaS for data storage, computations and its scalability. The shared infrastructure means it works like a utility. In cloud computing, the model works on pay-per-use. Also it has automatic upgrades and scaling up or down is easy. Cloud-based apps can be made and execute in very less time with minimal cost [3]. All the process like anything from the basics to integration into the multimedia processing can be accomplished more effectively using cloud computing than using one's personal computer.

As the cloud computing is an internet-based services, it offers various companies an effective method of conducting their business by promoting their product or peoples without having a physical building or infrastructure of their own and it builds the economies of scale while enabling to achieve greater efficiency and by reducing costs. Now-a-days most of the world's largest companies are simply moving their non-cloud products and services to cloud computing and running all kinds of apps in the cloud, like Human Resource planning, Accounting, Material distribution and much more.

2 Big Data Technologies

Big data is a vital system which requires advanced technologies to efficiently process the enormous quantities of data.

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2.1 Column-Oriented Databases

Traditional, row-oriented databases are excellent for OLTP (Online Transaction Processing) with high update speeds, but less on query performance as when the volume of data to be analyse grows, the data leads to an unstructured system and gives slower execution. In this method of Column oriented databases, it will store the data on the columns, instead of rows, allowing for huge data compression and the outcomes come out very fast. The disadvantage of these databases is that they will generally takes the updates on batch wise which gives slow update time than traditional models.

Map Reduce

This is a programming model that allows for massive data processing, scalability against thousands of servers or clusters of servers. Map Reduce implementation consists of two tasks:

- "Map" task: The input dataset will be converted into a different set of key/value pairs, or tuples;
- "Reduce" task: The results of the "Map" task will be combined to form a reduced set of tuples (hence the name).

2.2 Hadoop

Hadoop is by far the most popular implementation of MapReduce. This is developed by Google but Apache in developed a generalized software framework today called as Hadoop, being an entirely open source platform for handling Big Data. It has several different uses but it is the most efficient applications for large volumes of dynamic data which changes in real time basis, such as location-based data, weather related data or the real data of web-based or social media data, or machine-to-machine transactional data.

2.3 Hive

Hive is a data warehouse infrastructure system to provide data summarization and supports analysis of large datasets stored in the systems. It consist of Hive QL which is provided by Hive system and it also integrate map/reduce factor. To accelerate queries, it provides index. It is initially developed by Facebook.

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2.4 Pig

SQL is one of the data flow language which is not suitable for big data so PIG was developed. It consists of a "Perl-like" language that allows faster activity execution over the data analysis on a Hadoop cluster which also can be written in Java and other languages also. PIG was developed by Yahoo!

3 Cloud Computing Providers Offer Their Services According to Several Fundamental Model

3.1 Software as a Service (SaaS)

It provides user with facility to run software on a cloud infrastructure without physically acquiring it. The applications are accessible anytime anywhere. It just need to have internet connectivity. Clients need not required to install any software on their device. They just need a web browser and network connection [4]. SaaS applications are designed and delivered to the user over the internet. The client has to pay only for services which he used as it is pay-per-use model. For example, with Microsoft Office 365 you can use services of Microsoft word, power point or excel without actually installing it on your computer. You just need to pay the fee which will be charged only for the services you had used. It might be a monthly fee. You can use this software anytime from anywhere.

3.2 Platform as a Service (PaaS)

PaaS is one of the best service which is provided through cloud where the set of tools and services designed to make coding and deploying those applications quickly and efficiently. Paas through cloud provides a platform for researcher or a developers to execute or create their applications on provider's platform over the internet [5]. PaaS provides physical server for software over the web. The user can control the deployed application but does not have control over cloud infrastructure. PaaS is mostly used by software development teams. Ex. Google Apps.

3.3 Infrastructure as a Service (Iaas)

Customer can rent a data center environment without worrying about maintenance i.e. it provides users with virtual servers. IaaS generally can help to achieve higher

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efficiency as it can includes multiple users on a single hardware [2]. IaaS can be implemented on the individual servers, computing resources, networks or messaging systems. All application are provided to the clients after charging a minimal fee. User has to pay only for services that he/she uses. i.e. pay for what you use model is applied. An organization can build a complete infrastructure using IaaS.

The early driver of widespread adoption of cloud computing was the SaaS delivery model. It offered the user scalability and customization based on their needs and goals. Since then, a combination of technologies has emerged which have further increase the demand for cloud computing.

- Server virtualization: Through this, multiple users can access a single server with their various hardware and software as they are pooled together. It gives the same feel and the nature of the server is maintained like an individual dedicated server, but without incurring any additional cost.
- Service-oriented architecture (SOA): Organizes software code so that one set of data, and the code written to process it, can be reused by other applications in the organization [6].
- Open source software: The software is made available to all the cloud users with no restriction or limitation of copyright duplication.
- Web development: The platform for web development is provided through the cloud have reduced the organization cost and made available to use it with more efficient manner.

4 Big Data Characteristics

Big Data has the following characteristics i.e. Variety, Velocity and Volume

4.1 Variety

Big Data can analyse any form of Data. It can be stored in multiple formats in databases, or excel access or in a simple text file. Sometimes, the data is not stored in the traditional format as we assume, it can be in any other form also. It can be a short video clips, a text message or in pdf or jpeg format. The organization need to gather these data and form a structured or meaningful data for the effective processing. It will be easy if we have data in the same format, but it may not be in all the time. This kind of challenges we can overcome with the Big Data. These varieties of the data represent Big Data.

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4.2 Velocity

In simple words, velocity means "The speed of data when it comes in and out". The enormous growth of data in social media explosion have changed how we look at the data. We feel that the yesterday data is recent. The matter of the fact newspapers is still following that logic [7]. On social media sometimes a few seconds old messages is not something interests users of social media. The users ignores old messages and pay attention to recent updates. The movement of data is now dynamic and almost real time. This high velocity data represent Big Data.

4.3 Volume

We are currently seeing that there is very fast growth in data storage not only text data but data in different formats like videos, images and music formats. It is very common to have Terabytes and Petabytes of the storage system for enterprises. The applications and architecture built to support the data needs to be revaluated quite often as the data volume increases. The big volume indeed represents Big Data.

5 Cloud Computing Characteristics

5.1 On Demand Self-services

We would like to mention that the computing environment such as email services, applications development platform, network or server service can be provided to the user even without requiring user interaction with the service provider. On demand self-services include Amazon Web Services (AWS), Google. Cloud services are available and shared over the internet or virtual network and can be accessed through any standard equipment such as mobile phones, laptops and PDAs. The resource provider's computing devices are gathered together and then extend its services to multiple consumers from different physical locations and the services are provided through the virtual resources dynamically after assigning according to consumer demand [8]. The resources shared over the internet includes storage, processing, memory, network bandwidth, virtual machines and email services. The pooling together of the resource and sharing the services with different user on pay-per-use model builds the efficiency and increases economies of scale (Gartner).

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5.2 Rapid Elasticity

Cloud services can be rapidly and elastically unrestricted, in some cases automatically, to suit the economies of scale. The scalability of the cloud computing services can be made to the capacity required by the users. As the cloud services requirement comes to the user, its services can be extended to any number of user. The Cloud capabilities which are available in the virtual platform can be bought anytime anywhere by anyone.

5.3 Measured Service

Cloud computing resource is a pay-per-use model and it thus provides an effective and transparency for the service provider and also the consumer of the utilized service. The cloud usage can be measured, controlled, and reported to meet the user's requirement and in its comfort level. Cloud computing services use a metering device which enables to control and optimize resource use. This implies that just like electricity or municipality water services are charged per usage metrics-pay per use. The more you utilize the higher the bill [9].

5.4 Multi Tenacity

It is a new addition in the features of cloud computing. It governs the use and security of data shared over the internet in a cloud system. It refers to the policy and the process for the enforcement, segmentation, isolation, billing models for all the different users.

6 Combined Working of Big Data and Cloud Computing—Benefits

Integration of Big Data and Cloud Computing is the two most vital technique in the world of Information Technology. These two IT initiatives can change the entire business world and also influence the way we can analyse a data. Most cloud vendors are already offering hosted Hadoop clusters that can be scaled on demand according to their user's needs [10]. As cloud computing continuous to mature, a growing number of enterprises are building efficient and agile cloud environments i.e. cloud computing has a structure to support their big data projects. Large to

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Medium sized companies are getting more value from their data than ever before with the Cloud computing, by enabling intense fast analytics at a fraction of previous costs [11]. Thus, Big Data & Cloud technologies using as a pair organizations can make big data analytics in clouds a reasonable option, since, data is becoming more valuable. This, in turn drives companies to acquire and store even more data, creating more need for processing and retrieving [12]. Thus, Big Data and cloud computing go hand-in-hand.

7 Conclusion

In my view this paper presents an outlines of cloud computing and big data. Cloud computing has become major discussion thread in the IT world. It is reduces the cost of purchasing physical infrastructures like email servers and software. Big data is best for fast query performance, massive data processing and scalability. Hence, it is not suitable for small business i.e. where fewer amounts of data are capture, manage and process.

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A New Approach for Rapid Dispatch to Remote Cooperative Groups with a Novel Key Archetype Using Voice Authentication

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Abstract Any newly emerging network must deal with problems of effectively and securely broadcasting data to remote cooperative groups. Limited or no network connectivity, absence of valid encryption/decryption protocols, and the individual metrics concerning the sender are some of the problems that plague newly established networks [1]. Existing techniques to overcome these problems do not address future concerns such as scalability, security, etc. The generation of a valid key that does not need to be changed or managed regularly is essential to a newly established network as it offloads the computational overhead and reduces the connection cost to a fraction of what it was before. This paper explores the possibility of generating such a key making use of acoustic model training and voice-tag creation. It also provides an overview for simple, efficient, and easy addition or deletion of members to cooperative groups, while keeping the rekeying mechanism as flexible as possible so as to increase the network's robustness. The implementation is designed in such a way that the group size does not factor into the computational overhead or the communication cost. The strong encryption protocol detailed in this paper, along with a simple and easy way to manage the implementation, makes this a viable solution to the problems that are associated with new networks.

Keywords Ad hoc networks · Broadcast · Cooperative computing · Access control · Information security · Key management

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1 Introduction

The current uptick in the adoption of wireless mesh networks (WMN's) has exposed how deeply the problem of security and privacy is rooted in any newly established network. A WMN is by its very nature an open and distributed system. A WMN is multihop layered network which provides high-speed Internet access points with dedicated stationary mesh routers [2]. The final band consists of a significant quantity of portable device users. As such, it is vital to administer network access control to deal with the problem of malicious attackers and/or freeloaders who inadvertently introduce congestion into WMN's. A WMN also contains enormous amounts of information that is user-specific and user-sensitive. Thus, it is imperative that one enforces adequate security protocols to protect against attacks on the network and privacy control mechanisms that ensure that the user-specific data is not revealed to others [3]. The attacks that can be carried out on a WMN vary from run of the mill passive eavesdropping techniques to highly specialized and targeted phishing to message interception and alteration. The success in the adoption rate of WMN's depends on successfully rooting out these problems along with mounting a solid line of defense against all attacks. The most popular way of distributing keys is the Diffie–Hellman protocol [4]. The algorithm enables two users to compute a common key using both secret and publicly exchanged information. However, this method does not scale well. When the number of users is extended even by as less as two additional members, the Diffie–Hellman protocol fails as there is no provision for selecting groups or subgroups of members to assign the keys to. Our project aims to extend the Diffie–-Hellman algorithm in a simple yet flexible way by making use of an acoustical model to train an heuristic algorithm.

The new hybrid archetype that is prospective in this paper is a combination of the established broadcast encryption and GKA (Group Key Agreement). In the prospective system each end user in the group maintains a key pair composed of a secret key and a public key. The remote sender chooses his group in an ad hoc way and then determines the public key of each of his recipients. This is a substantiated way to secure transmissions. The transmitted messages cannot have any useful information extracted from them even if some or all of the end users other than the intended recipients are in collusion to intercept messages. This paper presents a comprehensive implementation of the above prospective of hybrid archetype. The structure of the paper is as follows: Sect. 2 gives details about the shortcomings that persist in the various existing systems and Sect. 3 deals with the prospective system. Sections 4, 5, and 6 elaborate on the implementation of the prospective system. Finally, we conclude the paper in Sect. 7.

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2 Existing Systems

The existing systems currently use a group key agreement technique that provides an adequate solution that secures communication amongst members of the same group. However, for a remote sender, it is required him or her to stay online for multiple rounds along with the rest of the users who are members of the group to negotiate the key and all members of the group are required for decryption, and thus the messages which have undergone encryption. This removes the reliance on a server-generated key system and ensures that proper coping mechanisms are implemented for the interactions between the recipients and the sender.

The new key management system is of a hybrid form that has been derived as a result of extensive experiments that have been performed in context to mobile ad hoc networks [5–7].

The prospective protocol has been enumerated in Sect. 3 (Fig. 1).

3 Prospective System

During the first trial, the public group encryption key is extracted, and a constant complexity is enforced between the sender and the receiver. This applies even if the members of the group/subgroup are changing constantly or the system updates for rekeying. The prospective system scores highly on that security front as, even with collusion from non-intended recipients, an attacker performing an active attack will be unable to extract any valid information from the messages transmitted with the aid of the public/private keys. A variation of the Diffie–Hillman algorithm serves as

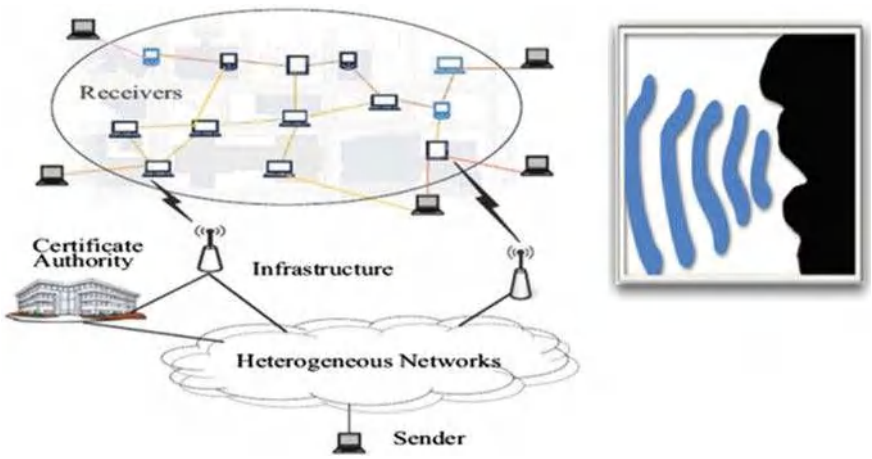

Fig. 1 Prospective system architecture

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the proof in this instance. This paper proposes two different conversion algorithms that make use of voice-to-phoneme conversion.

Abstractions from voice tags which are independent of the speaker applications in embedded platforms are extracted. This in turn lessens CPU loads and ensures faster memory retrievals. A phonetic decoder which is independent of its speaker undergoes a batch conversion of multiple phonetic hypotheses. Repeated utterances of the same voice tag will result in a general hierarchy of the phonetic consensus that is preserved by the conversion algorithm. The hypotheses which are phonetically admissible are then automatically chosen to represent the voice tag. As a control to the above-described procedures, an expert phonetician was employed to produce similar transcriptions of the voice-tag references. A detailed comparison was then performed for the voice-tag representations obtained using the above-mentioned algorithms against the manual transcription obtained from the expert. With only a marginal degree of error, both the algorithms performed exceptionally well against the manual transcription method. This leads to the favourable conclusion that both algorithms are effective in their targeted ranges and for their specific purposes. Our contribution includes three aspects. A formalization statement for secure dispatch to secluded cooperative groups, given certain constraints, and the implementation of a one-to-many efficient and secure channel is established. This is done so that we can implement a voice-based security system which consumes less computer resources. Second, a new key management archetype is prospective that allows transmissions to be delivered without compromising either security or efficiency [8]. This is done by effectively circumventing constraints and taking advantage of some of the mitigating features. A hybrid approach that is characterized by a GKA system and a public key broadcast encryption technique lies at the crux of both the algorithms [9]. This is highly effective, if in case either member changes or system updates need to be performed. This new approach yields the following advantages:

- The sender can be both remote and dynamic.
- The transmission can now cross-multiple networks, even if they are insecure before reaching the intended recipients.
- The interactions between the group of recipients and the sender are limited.
- The sender can create subgroups within the group, i.e., the sender can make sure that it only select few members within the group who can receive the transmitted message.

Finally, it is assumed that the group of recipients is cooperative in their communication and any interactions that occur between them are local and efficient.

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4 Implementation

Implementation can be defined as the actualization of a theoretical concept. It is the execution of a plan, idea, or model in such a way that the results obtained can be considered successful. Many implementations may exist for a given standard or a specification. Implementation is one of the most important steps in the software development life cycle (SDLC). This phase of the system is conducted with the idea that whatever is conceived, designed, and developed must be implemented, keeping in mind that it fulfills scope, objective, and user requirements of the initial problem. The implementation phase produces a complete solution to the initially defined problem.

The implementation in this paper is carried out along the following lines. In the first step, multiple nodes are created which act as access points to the multiple portable devices such as PDA's, smart phones, tablets, wearables, etc. Then, a connection is established amongst these devices. Once the connection is established, a private/public key pair is generated. This is further clarified through key management to make sure that every recipient of the intended group is assigned a key. Then the group is divided into various subgroups in an ad hoc way. A rekeying process takes place to make sure none of the non-intended members are assigned keys. A message authenticator is used to verify the validity of each user to give accurate results.

5 Key Management

The most important aspect of group-Oriented communications when it comes to providing or restricting access is concerned with key management. An ideal key management archetype allows no compromise on security or efficiency during transmissions to groups even when they are remote. This is done through various methods, by either effectively exploiting mitigating factors or circumventing constraints [10]. This system securely distributes session keys to the intended recipients, the system in of itself acts as the session key and simultaneously encrypts any messages under the session key, which can be decrypted only by the intended recipients. In the prospective scheme, an authentication key is a pair of public/private keys and a certificate signed by the base station which is distributed before hand in each cluster head. Member sensor node identities are verified using the authentication key. The base station and all the cluster heads are made aware of the authentication key beforehand. Pair-wise keys are established amongst the cluster heads using the public/private key. Each sensor node is also made aware of an authentication key and the public key of the base station. Public key is used to verify the certificates of the cluster heads (Fig. 2).

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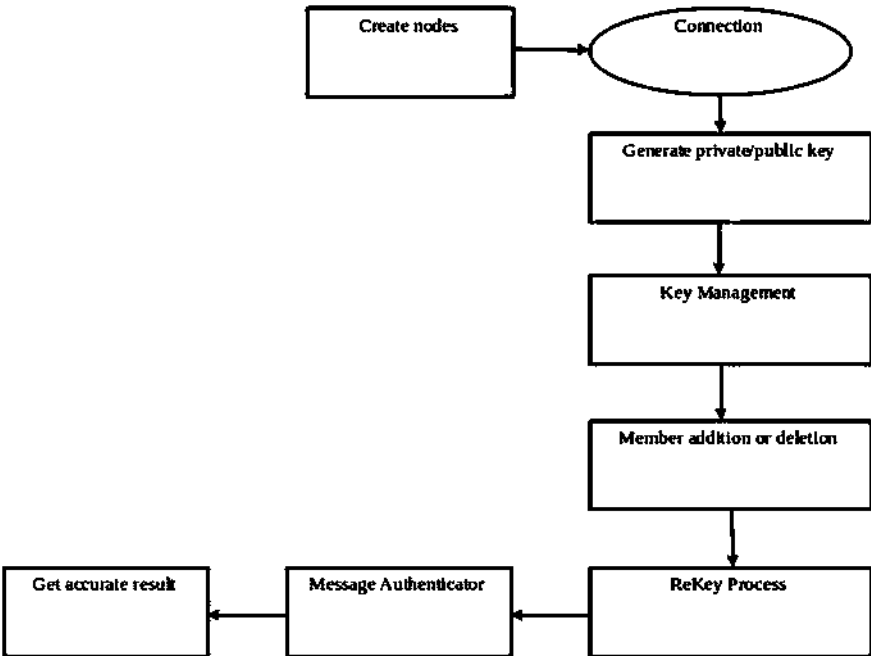

Fig. 2 Design flow of the graph

6 Algorithms Used

The following is an explanation of the batch mode conversion employed by the voice-to-phoneme algorithm: Let us consider that there are M example utterances, X(m[1, M])m ε available to a voice tag (batch mode). M X is a set of distinguishable vectors corresponding to an example utterance. From here on, for the purposes of this paper we consider a set of distinguishable vectors and an utterance to be one and the same. The objective here is to find N phonetic strings, P(n[1, N]) n, following an optimization criterion. In previous works enumerating a batch mode voice-to-phoneme conversion method, the authors modify a tree-trellis search algorithm for a single utterance which is used to modify multiple phonetic strings [11]. The newly generated tree-trellis search algorithm results in a tree containing partial hypotheses that are phonetic in nature. Each of the hypotheses is directly related to the example utterances and makes use of the time-synchronized Viterbi decoding with a phoneme loop grammar in the forward direction. The M trees of phonetic hypotheses of the example utterances are used jointly to estimate the admissible partial likelihoods from each node in the grammar to the start node of the grammar. Then, utilizing the admissible likelihood of partial hypotheses, an A* search in the backward direction is used to retrieve the N-best phonetic hypotheses, which maximize the likelihood. This modified tree-trellis algorithm falls firmly into

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the category of probability combination algorithms. Because this algorithm requires storing M trees of partial hypotheses simultaneously, with each tree being rather large in storage, it is very expensive in terms of memory consumption. Furthermore, the complexity of the A* search increases significantly as the number of example utterances increases. The above-proposed algorithm is disregarded because of its many downsides namely the space and time complexity of the DTW implementation. Almost every embedded platform has its own dedicated library to manage its specified hardware. Given two utterances, iX and j are upper-right corners of the trellis. A new utterance ijX can be formed along the best path of the trellis, *ijij* $X = X \oplus X$, where $\oplus$ is denoted as the DTW operator. The length of the new utterance is the length of the best path choices of both the principal ideas of a sequential voice-tag creation strategy via voice-to-phoneme conversion which is described seed phonetic of a voice-tag abstraction. The high-frequency phoneme n-grams correspond to voice tag via a phonetic decoder; the best phonetic string is used to create the current (or seed) phoneme n-gram histogram for the voice tag.

1. An example by the end user gives us positive confirmation of the speech recognition result and a new voice-tag utterance. This new voice tag for example in turn gives rise to N new phonetic strings which get created via the phonetic decoder; and the best amongst those N is used to update the current histogram of the utterances. In reality though, many utterances are of a low frequency and require a garbage collection process to be disposed of.
2. Every phonetic string for N current and N new voice-tag phonetic strings gets a histogram estimated.
3. Each phonetic string histogram is compared with the current histogram by making use of a distance metric, usually the divergence measure. Multiple metrics such as distance metric and divergence measures are utilized to compare the current histogram of every phonetic string with the current histogram of the voice tag. N phonetic strings whose histograms are the closest match to the voice-tag histogram are selected.
4. The steps from 1 up to 3 are iterated whenever a new utterance is made available.

The RSA algorithm has long been in use to both encrypt and decrypt messages.

It is a very popular asymmetric cryptographic algorithm. An asymmetric algorithm contains two different keys, namely a public key and a private key. The public key is made available to everyone, while the private key as the name suggests is kept private. The strength of the RSA algorithm lies in the fact that anyone with a public key can encrypt a message; only someone with the knowledge of the previously selected prime factors can decode the message, provided that the initially selected prime factors are large enough. The RSA algorithm can roughly summarized in the following steps:

1. p and q are chosen randomly with the condition that both p and q are prime and are relatively large in value.
2. The product of p and q is assigned to the variable n. $n = pq$.

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- The variable n acts as the modulus for generating both the sets of private and public keys.

3. The totient is calculated such that $\varphi(n) = (p - 1)(q - 1)$
4. An integer e is chosen such that $1 < e < \varphi(n)$, e also has to be co-prime to $\varphi(n)$

- e is the public key component

5. The variable d is computed so as to satisfy the congruence relation which is $de \equiv 1(\text{mod}\varphi(n))$

- d is kept as private component.

Encrypting messages: Haley gives her public key n & e to Andy and does not share her private key with anyone. Andy wants to send message M to Haley. Andy makes use of a reversible protocol such as the padding scheme to turn the message M into a number smaller than n. Andy makes use of the following formula:

c = m e mod n to compute the cipher text c.

Exponentiation by squaring is the quickest method of solving the above formula.

Andy then sends c to Haley. Decrypting messages: Haley can recover M from c using her private key in the following procedure: m = c d mod n

By making use of m, she can recover the original message M.

7 Conclusion and Future Enhancements

The research in this paper has proposed a new type of key management archetype to enable dispatch broadcasts to secluded cooperative groups along with a sufficient security authority. Future enhancements that can be recommended to our project are as follows:

- The admin login can be provided with better security than the traditional password-based system.
- The system can be extended to send all kinds of files (E.g., GIF, JPEG's, EXE file, MpeG, and Mp4's.).
- The system can be implemented with more efficient routing algorithms.
- This will result in a higher standard of security being implemented in group transmission, allowing less chance for data to be altered or leaked by hackers.
- Making use of the above algorithms will significantly reduce the overhead required during communication and result in successful and secure transmissions even with lower bandwidths.

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ICT Enabled Proposed Solutions for Soil Fertility Management in Indian Agriculture

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Abstract An intensive implementation of Information and Communication Technologies is highly required for greater beneficiary in agriculture. To achieve this in a sustainable way, implementation of ICT-based technology in precision farming at the earliest is required. More specifically, Indian farming requires efficient usage of fertilizer recommendations for each crop type at time intervals during the harvesting period. India needs to go mature in taking agriculture technology a bit further by using technologies like Multi-model decision support system, GPS (Global Positioning System), GIS (Geographic Information System) Cloud, Spatial data analytics, and various other technological wonders. This paper proposes a best available edge cutting and benefiting ICT initiatives by using cloud-based web GIS, Mobile, and Kiosk in fertilizer recommendations for precision farming and primarily aiming at the soil health in Indian agriculture.

Keywords ICT · GPS · Web GIS · Cloud · DSS · Fertilizer recommendations

1 Introduction

Soil Fertility management plays an important role in precision farming. The soil testing is used for estimating the fertility status of the soil and soil health. Presently, the available Indian soil testing laboratories are facilitating the nutrient values based on the soil samples collected from the farmers cropped land. This soil testing report is used to recommend the fertilizers required for the harvesting. Improper usage of fertilizers in farming is leading to environmental pollution and large yield gap that

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still exists across India for major crops [1]. To overcome this, a complete and effective decision support system is highly required for a balanced fertilizer recommendation system. At present, Government of India has taken several measures to overcome consequences in agricultural industry such as setting up STL (Soil Test Laboratories), fertilizer recommendations, issue of Soil Health Card in many states.

Multiple measures and inventions are undergone in ICT (Information and Communication Technologies) in Indian agriculture as such introduction of NAT (New Agricultural Technology), largely recognized as HYV (High Yielding Varieties)—fertilizers [2].

A cloud-based web GIS (Geographical Information System) for fertilizer recommendations using DSS (Decision Support System) DSS for fertilizer recommendations are predominantly essential for India because an enormous amount of overseas trade is depleted each year on fertilizers [3]. DSS assists in providing information on fertility status, expected crop yield, soil health of a particular village, Taluk, District, State or country. Use of ICT helps to provide recommendations to farmers on soil fertilizers.

This paper showcases the need of ICT in soil fertilizer recommendations for precision farming with the literature survey in Sect. 2, Sect. 3 with ICT enabled proposed multi-model DSS and Sect. 4 with conclusion.

2 Literature Survey

India ranks third largest fertilizer user and average rate of nutrient application is only 85 kg/ha [4]. The major nutrients available in Indian soil are classified into two types of macro (nitrogen, phosphorous, potash) and micro nutrients (sulfur, zinc, boron, iron). Consumption of these nutrients is concentrated in certain areas and varies from state to state. To manage a balanced fertilizer usage in Indian agriculture, the Government of India has taken several measures to promote Integrated Nutrient Management (INM) involving soil test to improve soil fertility, National Project on Management of Soil Health & Fertility (NPMS&F) was launched during the year 2008–09 to develop soil test and soil fertility (State of Indian Agriculture, 2012–13, Government of India).

Several studies have shown methodical soil testing followed by proper utilization of nutrients (N, P, K, S, Zn, and B) can increase the efficiency level by 2–3 times in most of the states of India [5]. At present, many SHC (Soil health Centers) has been setup at state levels of India to the needs of state farmers in respect of soil testing. The fertilizer recommendations are generally made in conjunction with soil test reports provided by SHC without using ICTs.

The applicability of ICT in expansion services has been researched by a number of researchers [2]. However agricultural innovations and agricultural technologies are mainly produced from ARIs (Agricultural Research Institutes) but not much is documented on use of ICT tools related to crop variety, land use, soil health, soil nutrients requirement, and irrigation.

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Few initiatives are taken by Indian Government for providing online and mobile messaging services to farmers related to agricultural queries, agro vendor's information to farmers [4], it provides static data related to soil quality at each region.

At present, several fertilizer recommendation support systems are available across countries and each has several limitations. Many developed countries based on ESRI website are already using web-based online systems integrated with spatial database for mapping [3], GPS, GIS, etc. in the betterment of agriculture.

In [5, 6] authors have described the Fertilizer recommendations System development by Bhopal–India. This system is based on STCR (Soil Test Crop Response) for targeted yield approach of fertilizer recommendations for different crops. This software is limited only for few states of India. The system lacks to provide geospatial data and nutrients of soil shown based on region for each district are static which are based on the data collected by agricultural departments of the respective district.

In [6] authors have described sustaining soil fertility using ICT in Indian agricultural fields which proposes a tool for fertilizer recommendations which support multi-language but fails to provide spatial data. In [7], the paper describes about use of cloud computing for agriculture sector in developing Multidisciplinary Model for Smart agriculture using Internet-of-Things (IoT), sensors, cloud-computing, mobile-computing, and big-ata analysis for storing details of agriculture information.

Currently in India, different DSS Models are incorporated in various areas of agricultural management [3] such as land and water management, soil and water resource management, crop production, and management.

Although researchers have proposed many models in agriculture sector using one or more of ICT technologies mentioned; the dynamic multi-model is needed that provides an integrated approach to fertilizer recommendations which help to maintain soil fertility, increasing crop yield, and helps in distributing Soil Health Card.

2.1 Importance of DSS in Fertilizer Recommendations

- DSS intelligent system helps in optimizing and balancing soil nutrients.
- Automates the estimation of fertilizer requirement based on parameters (land, soil, crop, and season).
- It enables complete multi-model web GIS and smart database across cloud.
- Provides complete visualization and spatial decision support system which helps farmers and e-governance.
- Inscribing DSS into smart cloud-based web GIS application, smart phone application, and kiosk system.

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2.2 Challenges for ICT in Indian Farming

Though technology is part of the agriculture, the efficiency of the technology is not up to the mark it is expected since the systems that are in place are not such user effective, customizable, open to new trends, and customer friendly. The legacy solutions induce and empower the static means of help to agriculture that is insufficient for the current and future trends of farming methods.

- Lack of centralized technology system in agriculture.
- Limited accessibility to ICT tools to farmers.
- Lack of appropriate ICT-based service offers targeting rural sectors.
- Scarcity of sophisticated technical centers and poor economic condition of farmers.
- Low awareness and usage of technology among farmers.

3 Proposed Multi-model Decision Support System for Fertilizer Recommendations

With the basic background discussed earlier, it is observed that the increased ICT demands in agriculture will enable farmers to bring more sophistication in modern farming. Using recommendations from the proposed solution, farmers are handed with best recommendations, like fertility usage, soil test data, expected yield, insects, and weeds. Two types of fertilizer recommendations can be done, one by using generic recommendations using SHC reports which may not be accurate and the other one which is more efficient way using STCR targeted yield equations to provide precise amount of fertilizers required based on crop type, variety, soil type and season. Farmers get awareness in the proper usage of fertilizers required for each crop. Using this technology, farmers will have better control over yields sooner than they start farming.

3.1 Cloud-Based Web GIS Multi-model Decision Support System for Fertilizer Recommendations

Today, inscribing intelligent system using GIS cloud aided, large-scale database is an important characteristics of individual farms, e.g., soil, air, weather condition, and water quality. The cloud database should be spatially hierarchical (that should be able to provide data for geographical in zoom controls regions) and dynamic (data should be updated regularly). This database will serve as a repository and store spatial agricultural datasets.

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Geospatial computing is an effective approach to be implemented in agriculture sector. GIS applications are best integral on cloud due to the use of wide-ranging and chronological agricultural datasets, processing capabilities, and an intelligent optimized data storage [6] method that helps to get fertilizer recommendations based on available agricultural datasets. Many companies in IT, such as Amazon, HP, Google, Microsoft, IBM, etc., have realized potential need in the field of GIS-based cloud computing, and are being used in various areas [2].

A complete GIS cloud-based multi-model decision support system will help farmers in farming and sustaining agriculture as depicted in Fig. 1. This system allows farmers to access, update, retrieve information related to their farm, get fertilizer recommendations, and can visualize spatial data. The cloud database would be initialized with what is already available with the various organizations, such as Soil Testing Labs, State, and central agriculture departments, ICAR institutes, and agriculture universities (field trials, soil sample data). The contents of the database are continuously updated by the results generated by the Soil Testing Departments, individual farmers, NGOs across India.

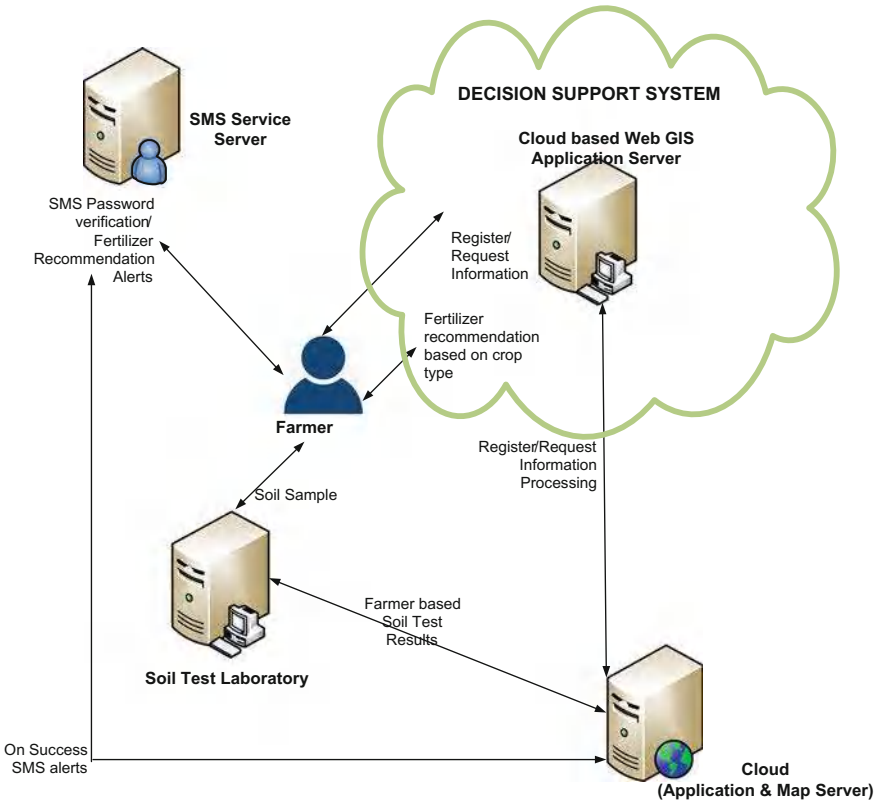

Fig. 1 Cloud based web GIS multi-model decision support system

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3.2 Cloud-Based Web GIS Enabled Mobile Decision Support System for Fertilizer Recommendations

As per current situation in India, there have been significant gains in usage of ICT; especially mobile users are increasing day by day. In India, the number of smart phone users is nearly 50 % in rural area and it may increase in near future. With this aspect, smart phone plays a vital role to farmers in providing better agricultural information to help economic growth as well to get better yield to farmers. This DSS enabled on mobile computing will help farmers to access the system, view their land using spatial maps, get details on fertility status of their land, update soil test data, and retrieve fertilizer recommendations.

Development of android application to get fertilizer recommendations based on Geospatial Cloud gives more flexibility and reliability to the proposed DSS. Integration of message convey systems (SMS) that assists farmers in time of alerts and useful short message in farmer understandable and communicable regional language helps in betterment of getting best fertilizer recommendations and expected yield.

The proposed DSS model is shown in Fig. 2 can operate on smart phones where famers can access the web GIS application and get details/information of their farming land area by latitude-longitude values, cropping pattern in that area, can input the Soil Test Sample results provided by STL and finally can get fertilizer recommendations for each crop type and expected yield based on the STCR (Soil Test Crop Response) targeted yield approach by using the already developed STCR targeted yield equations for different crops. By using this approach, usage of fertilizers are used efficiently to help in larger savings to the farmer as well as to the Indian economy.

3.3 Cloud-Based Web GISEnabled KIOSK Decision Support System for Fertilizer Recommendations

The enormous amount of information is available on internet. Urban people easily can get access to these information however rural people mainly farmers have less accessibility to internet. Farmer finds it difficult to access information of fertilizers, crops, soil health, land, etc. across the internet because of limitation to tech awareness.

The proposed DSS is integrated to a Kiosk machine that is devised in each village similar to ATM centers in reachable areas throughout India. The key idea of enabling these Kiosk machines is due to lack of facilities like economical conditions of farmers hold a gadget, poor internet access [8]. This Kiosk helps famers to accept

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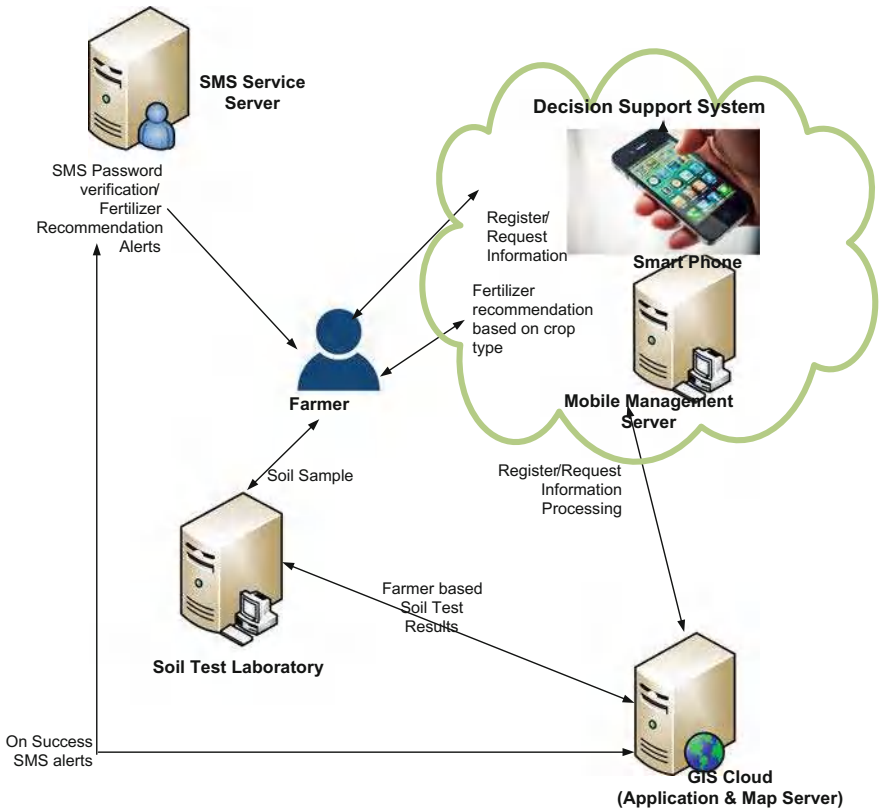

Fig. 2 Cloud based web GIS enabled mobile decision support system for fertilizer recommendations

and implement the DSS to get fertilizer recommendations in their local languages as Indian farmers are less communicable in English. Live demos can be viewed by the farmers on fertilizers utilization which helps farmers to get clear picture about their farming. Vending machine option can be induced to the Kiosk which helps farmers to get fertilizers through their Kiosk centers itself which also saves time in buying fertilizers outside.

The proposed Kiosk enabled DSS model shown in Fig. 3 is a touch screen, voice-based system supporting regional language which helps famers access the web GIS application and get details of their farming land area by latitude-longitude values and get balanced fertilizer recommendations. By placing this Kiosk in each village, farmers can use this like touch screen systems (kiosks) similar like existing touch screen systems in the railway stations, coffee vending machines, and ATM centers.

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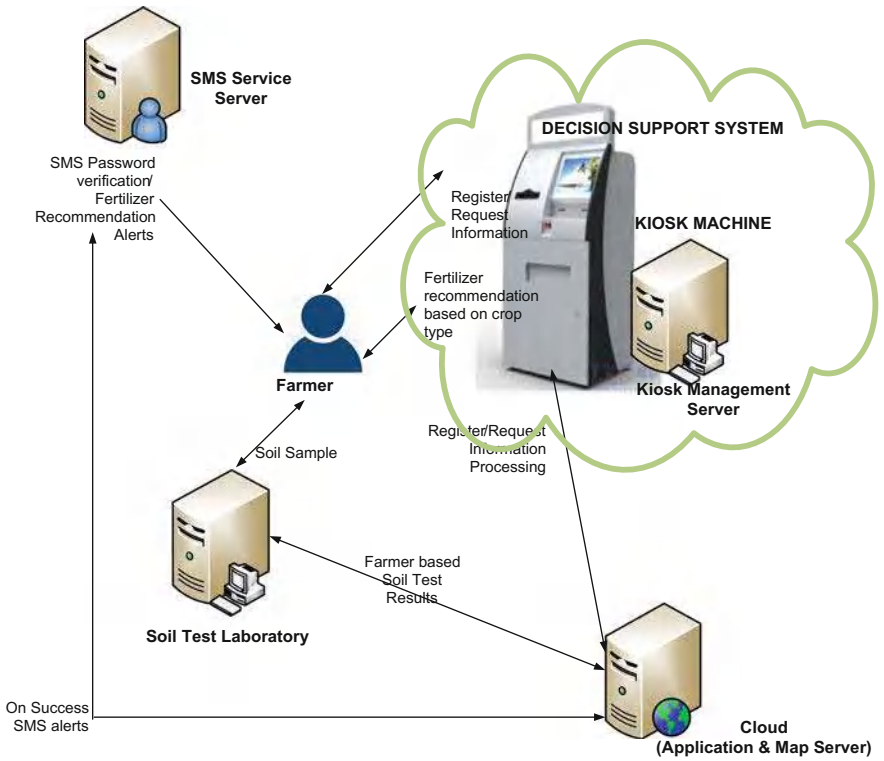

Fig. 3 Cloud based web GIS enabled KIOSK decision support system for fertilizer recommendations

4 Conclusion

This article aims toward the proposition of Decision Support System for optimizing usage of fertilizers in Indian agriculture using various ICTs: Cloud-based web GIS Server, Mobile application, and Kiosk System. Using this interactive system, farmers are facilitated with recommendations about the proper use of fertilizers for a particular crop using real-time soil sampling data and enabling to get maximum crop yield, cost efficient, and increase farmer economic growth.

All these proposed methods are highly depending on huge agricultural data sets and active technology will keep the services up and available online, further proposed methods must be engaged to global active to update farmer and agricultural database is highly required all time in Indian agriculture. This interactive system will be helpful to e-governance to make decisions in distributing required fertilizers for each state by using analysis report provided by the interactive system.

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Software Maintenance: From the Perspective of Effort and Cost Requirement

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Abstract Software and software deliverables have high impact on all fields. Once software is deployed, it has to be maintained continuously, till it becomes obsolete. Various activities that come under maintenance include adaptive, corrective, and predictive maintenance. Even though software maintenance is not tagged as a core field in software engineering compared to other software-related activities, almost 70 % of time and resources are allotted for maintenance activities. According to the related work, very little research is going on in the field of maintenance and this article highlights the scope of maintenance-related research. Identifying the factors that directly and indirectly affect the maintenance activity will in turn make the estimation activities easy. Implementation of an effective software maintenance model will have a very high impact in the quality of software and thereby with customer satisfaction. This article aims to project an effective maintenance model which reduces cost of rework and improves customer satisfaction index.

Keywords Software maintenance · Adaptive maintenance · Maintenance cost estimation · Effort estimation

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1 Introduction

Maintenance, as the word says, is the process of preserving a condition or situation or the state of being preserved. Maintenance has to be performed for the perfect working of any system. Like any material or object in use, software and software deliverables also require maintenance. From the time software is released to the time it is taken out of use the whole software system evolves, thus making it in shape for use. There are not many domains that still have to make use of the possibilities that software can provide. From robotic surgery to defense to embedded systems to astronomy, software systems are in use some or the other way.

Customer satisfaction is the main objective of any service provider and same is the case of a software developer and service provider. This has to be taken care even after the software is deployed. The features that add to customer satisfaction varies for type of software, domain, etc. Good process and products will always produce better and more reliable results that in turn make customers "happy". In order to keep the customers happy, one should be able to answer the following questions:

- What makes a customer happy?
- How a software product is able to bestow reliable results?
- What makes software sustain for the continuous changes?

The only answer to the above questions can be obtained by the activities carried out as post deployment activities in software and software deliverables. These activities may be treated as software evolution or software maintenance, which makes a system fit for use in any environment as well as any domain. It may be recalled here that evolution demands transformation of a software or process or product from one technology to another technology while maintenance may demand modifications to the existing systems or fixing of defects or even to adapt to a new environment [1]. Software needs to be enhanced for its functionality not just in preventing the errors that may occur in future but for making it compatible with different environment and also to fix the errors observed in software that is in use.

Even though maintenance of software enables software to sustain, it is not tagged as a core software engineering activity. Act of software maintenance is challenging due to lack of proper documentation, unstable team, unskilled staff, etc. Almost 70 % of time and resources are allotted for maintenance activities. After all these support, maintenance activities are facing real-time problems due to quality of original programming, programmer availability, hardware/software reliability, documentation quality, etc.

Efficacious software stands the test of time irrespective of the hardware or the environment it was designed for. In 1969, Lehman addressed the issues related to software maintenance and till date the core issues in maintenance remain the same. As the software ages with a complex structure, it becomes difficult to understand the

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system and thereby maintain the system. The characteristics of high-quality software are not just the development of the software product but also to maintain it with changing requirements which the customer dictates from time to time.

2 Why Software Maintenance?

Software maintenance is a postdelivery activity and its main purpose is to preserve the value of software over time [2]. All the issues related to software, from character enhancement to defect fixing are handled as a maintenance activity once the software is delivered to the customer. It is a fact that world is never static and perfect. Hence, requirements and enhancements always keep evolving during post-release period or the product is prone to failure due to creep of latent bugs. Requirements on which product was initially defined, built and released, hence will undergo modifications.

An efficient maintenance team should perform the functional and performance enhancements raised by the customer. They should make changes according to the environment and should be able to fix the postproduction defects. If maintenance is not performed reliably in the specified time, it will result in business down time and it directly or indirectly result in customer dissatisfaction. It further raises questions on product quality that directly affects the organization.

Taking the example of scenario that happened in UK on 12 December 2014, when they had to shut down five International Airports because of a software glitch. The air traffic control system of UK dated back to 1960s with its source code written in redundant JOVIAL language. The supercomputer that runs the software crashed from 15:30 until 16:30 just for an hour. The incident happened due to one line error in the software source code. This 1 hr window of software failure resulted in loss of business and almost 10,000 customers were directly affected.

The above-stated example solely reveals the importance of effective and efficient software maintenance.

3 Related Works

In general, more than half of the development time of a software engineer is spent for understanding, modifying, and retesting existing code, which is maintenance activity. Therefore, it is very important to identify the factors influencing maintenance process and also appropriately calculating the effort, time, and cost associated with it [3]. Analysis of maintenance work performed on several products helped the authors of [3] to put forth the lacuna in the maintenance phase. Software maintenance activities can be viewed in different perspectives. Authors of [4] has very clearly stated the problems in external and internal perspectives of software maintenance includes high maintenance cost, delayed maintenance service,

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prioritizing the change request and poorly designed and coded software. Further, there is lack of proper documentation.

Authors in [5] have classified various problems encountered by software maintainers which include perceived organization alignment problems, process problems as well as technical problems. The authors of [6] have pointed out that very less research work is carried out in software maintenance compared to software development. Even the academic works does not highlight the maintenance process in depth.

Software maintainers provide services on daily basis based on various contexts and interfaces. Even though International standards body has well-defined specifications for maintenance-related activities, the SEEBOK initiative identified a large number of software maintenance specific activities not covered under it [4].

Authors in [7] clearly state that it is an unmanageable task to estimate the size and thereby the effort related to it with a degree of accuracy. Along with that, accuracy of estimation in maintenance increases by various other factors such as complexity and functionality of the system. The authors of [7] also stated that maintenance is an evolutionary activity that is entirely different from development process and also has different inherent characteristics and requires more attention in context of estimation models.

Authors in [8] have stated the lacuna in software cost estimation model and its importance. They have put forth the categories that come under cost estimation, which includes size, effort, and project duration. Authors have also mentioned the factors which rise as issues to maintenance team. Some such issues include selection of software cost estimation model, software size measurement, accurate estimation, and so on.

Authors of [8] have also mentioned that real-time data from software maintenance projects are not available because of organizational constraints. They also state that very less research work is happening in the field of maintenance compared to estimations carried out in software development.

Gerardo Canfora and Aniello [9], in their article “Software Maintenance” have mentioned maintenance task as an iceberg to specify and highlight the herculean problems and costs that relates to it.

Thomas M. Pigoski [10] has pointed out very clearly the breakdown of the maintenance phase. The key issues, according to him include measurement, cost, estimation, technical, and management. The author mentioned the various process models as well as activities related to it. The author mentioned the lacuna in the existing activities related to maintenance. The author mentioned the unique activities as well as the supporting activities related to maintenance. He has mentioned the lack planning in the maintenance phase and has related it to the missing attributes associated with maintenance. He further mentions in detail the key issues related to technical level, managerial level as well as organizational level.

Author of [10] has cited the key issues that come under technical level in the maintenance phase as limited understanding, maintainability, testing, and impact analysis. The author states that the technical staff will have very less or zero knowledge about the software under maintenance which will intensify the problem.

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From the organizational aspect, cost, and cost estimation are major factors. Since major share of life cycle cost is consumed by maintenance phase, and all organizations completely depend on the project turn over, accuracy of proper cost estimation is a major factor that concerns them.

Depending on the above-stated aspect of the software, post deployment is outsourced or a maintenance team is assigned. In the managerial perspective, there are more complex challenges that include process, staffing, training, experience of staff, etc.

Measurement and monitoring of maintenance process is the one area where there is a major deficit in research. According to the authors in [11], the current maintenance practitioners are not able to keep up with the requirements in the maintenance field. Because of the lack of documents as well as design details, it will become further complex.

Even though software engineering is a well-defined area, evaluation of software maintenance activity is not well defined. Authors of [11] have proposed a quantitative-based approach. But it lacks in analyzing the status of maintenance activities. Outlier behavior again is not considered in this study.

Thus, above works indicate the scope for research in software maintenance and the drastic need for accurate estimation of maintenance in order to reduce the rework cost, time, and effort.

4 Maintenance Process

In the current scenario, maintenance activity is either performed by software developing organization or can be outsourced to a third party. Whoever does the maintenance, the whole set of activities is same. The whole set of maintenance activity aims at maintaining the reliability and quality with minimum effort, cost, and time. In real world, even organizing the maintenance activity and finding the right person is a difficult task [3]. In case of a third party doing software maintenance, all the resources related to the software to be maintained is handed over to them.

Once customer raises any issues, it is registered formally as a modification request and is first analyzed and cross verified to check if the issue is relevant. A change request form is generated based on that. It is passed on to the maintenance team after verifying its relevance, where it is classified into major enhancement, minor enhancement, or defect fixes. Defect fixes are further classified depending on their severity or priority. These fixes will be carried out as per the Service Level Agreement defined by the customer. As for minor enhancement, the effort will be estimated and the customer will be informed about its development and deployment in the required state or version of the software. Major enhancement will be estimated and taken to the change control board for approval and actions by the development team. The resources required for the corresponding request as well as

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its impact on the system are analyzed. Required resources are allocated. For each defect identified a report is generated.

Software maintenance is a continuous effort, and the whole set of maintenance activities costs five times more than the cost of whole development process [4]. Hence, it is important that maintenance has to be performed with care, which demands a clear, consistent, and complete knowledge of the requirements. The main necessity for an efficient maintenance work is proper communication of the requirement from customer to the maintenance team. The complete set of documents related to the product development must be available to the maintenance team. The team members should have appropriate skill set to handle the product under maintenance. In most of the cases, people who do maintenance may not be a part of the product development, thereby demanding enough awareness to be given to the team about the tools and techniques used [12]. In case of a feature enhancement, the maintenance team should be well aware of the modules that directly or indirectly get affected by it. Failure of which may lead to the condition called software regression.

However, software maintenance was never considered a rewarding job for the reasons like less creativity involved and also the work load. This results in the likelihood of staff leaving the job or changing the domain, thus directly affects the maintenance activity. For the realization of high-quality software that is dependable, understandable, and efficient and satisfying to the customer, it is required to have accurate estimation of effort, time, and cost involved in the maintenance activity, as well as the quality of people involved in the maintenance. This directly results in good quality of software maintenance.

5 Types of Maintenance Activities

Based on the survey by Lientz and Swanson in the late 1970s the whole set of maintenance activities are classified into four broad categories [2]. Corrective maintenance is actually defect fixing postdelivery. The whole process involves reproducing the failure reported and finds out the cause of the failure. If the defect is in code, verify and validate its corresponding documentation. Fix the defect without altering anything, since defects are injected causing regression failure. Update the documentation accordingly. Once the maintenance is done, it is tested again to make sure the fix works and no regression faults have been introduced.

Adaptive maintenance is performed to make a computer program usable in a changed environment which includes hardware upgrade, software platform changes, or policy changes. The changes should preserve existing functionality and performance, otherwise it is required to perform adaptive maintenance. Perfective software maintenance is performed to improve the performance, maintainability, or other attributes of a computer program that includes functional or nonfunctional

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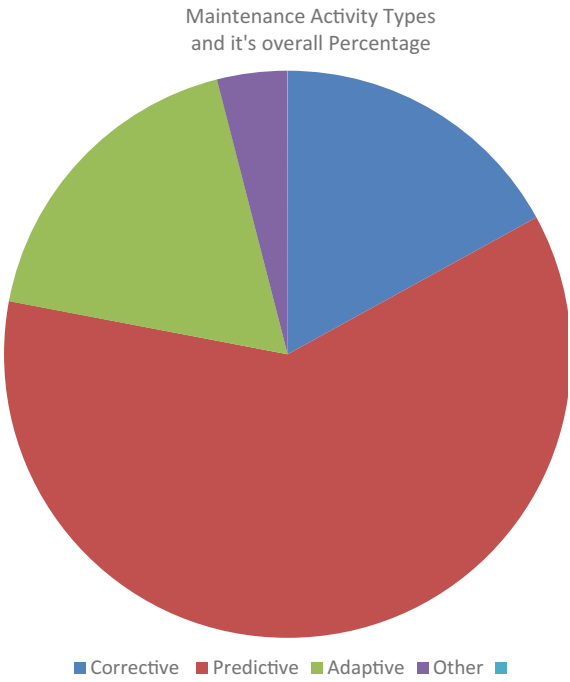

Fig. 1 Types of maintenance activity

requirements. Preventative maintenance is performed for the purpose of preventing any maintenance issues before they occur. It involves changing a software system in such a way that it does not alter the external behavior of the code yet it improves its internal structure [2]. Figure 1 depicts the maintenance effort required for various types of maintenance activities as explained above.

Figure 1 infers that 75 % of the maintenance effort is spent on adaptive and perfective maintenance whereas 17 % of effort is spent on error correction. It is an indisputable fact that estimating software metrics within software development and maintenance project is important. Since, software effort has a direct relation to the overall cost of the project, it is important to predict apt and effective software effort metrics. Effective prediction of effort can help allocate proper resources required and also helps in realistic cost estimates. Since, effort estimation is not exactly based on the actual statistics, but is computed based on domain knowledge, the estimated effort will not reflect the complexity or skill set required to perform a particular maintenance task. However, the estimation model that exists in the industry has lacuna since they use multivariate linear regression techniques, and this technique itself has drawbacks demanding the need for an accurate software estimate [13].

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6 Case Study

A sample case study of one of the leading software industry is considered in this section in order to comprehend the significance of software effort estimation. It comprises of the type of maintenance activities that occur in network security-based software project, which is a noncritical application. The range of maintenance activity varies from changing the outdated copyright date to fixing the alarm for software crash to retaining the list of crash in a repository. Corrective maintenance and perfective maintenance is what is considered in this case study. The effort and cost related to these activities are estimated and is compared with the actual cost and effort associated with the development of the software and related software deliverables. From the case study, it is implicit that the maintenance cost and effort is more than the development cost of the same.

In order to maintain network security, period audits are conducted to ascertain the level of security amongst users, system, servers, and across different systems. The setup is audited to find out the levels of password encryption, unique password and to find out if there is a complete ban on using generic password. The audit also ensures security in maintaining across firewalls and adequate protection is given in opening of ports in routers and switches. This effort also investigates to make sure that most recent antivirus patches are in place in individual systems and at the gateway level.

Table 1 Maintenance activities that arises in the network security application along with it's severity

Domain	Issue	Severity
Network security	Enhance the application to retain alarms once the application is restarted	Major
Network security	Copyright dates in login web page are outdated	Minor
Network security	Password complexity modification enhancement	Medium
Network security	Update install/uninstall mechanism to be able to stop and restart application during migration	Major
Network security	Software monitarization mechanism	Medium
Network security	Remove unwanted messages during installation and uninstallation	Medium
Network security	Upgradation of the supporting Apache software to support latest version of the application	Major
Network security	Upgradation of the supporting SANE software to support latest version of the application of the application	Major
Network security	Upgradation of the supporting openssl software to support of the application latest version	Major
Network security	Adapt application to work in a client without Java	Major

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This case study classifies network security issue into major, minor, and medium severity and thereby analysis its effect. The results of this analysis as depicted in Table 1 thus indicates the amount of maintenance effort that one would have to put in as per the issues raised and also indicates the degree of accuracy that one should have while estimating such efforts.

This paper limits to bring in awareness of the maintenance effort and further papers will bring out predictive model for better estimation of maintenance effort. It may be noted that the impact of maintenance effort varies from application to application and hence it further leads towards scope for research pertaining to various domains of applications.

7 Conclusion

Software is one of the highly beneficial introductions of human thoughts to the society. In fact generation of software and application of software in all the domains of livelihood has turned out to be a panacea. Hence, it is the rudimentary responsibility of every software developer to develop software projects which is going to be the best fit for purpose. Hence, every software industry strives towards all those strategies which lead toward the development of good acceptable software. These strategies include both preproduction and postproduction actions one has to follow for every software development.

Nevertheless, such quality gates are emphasized, yet there is always a proneness to overlook postproduction action points. This is because of the investment on time and effort involved in enhancing productivity in the company rather than looking at rework under maintenance activity. However, it is proven that the cost, time, and effort required for maintenance is very high and endorses the reputation of the company too.

This paper therefore brings in awareness toward formulating those strategies which aims at reducing the rework expense due to maintenance and uphold the flag of the company in the industrial quality market.

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FPGA Implementation of Low Power Pipelined 32-Bit RISC Processor Using Clock Gating

R. Shashidar, R. Santhosh Kumar, A.M. MahalingaSwamy and M. Roopa

Abstract Here we developed the RISC 32-bit processor architecture using Clock gating technique to perform logical memory and branching instruction. The different blocks are using to fetch, decode, execute, and memory read/write to execute four stage pipelining. The Harvard architecture used which contains memory space for data and program. To reduce the power of RISC core, clock gating technique is used in the architectural level as an effective low power method. The further enhancement of pipeline architecture can be done using Verilog and simulation is carried out using Model sim tool and implemented on FPGA board.

Keywords Architectural power reduction · Clock gating

1 Introduction

The Reduced Instruction Set Computer (RISC) is a microprocessor CPU design philosophy that favors a smaller and simpler set of instructions that take the exactly similar amount of time to achieve. ARM, DEC Alpha, SPARC, MIPS, and IBM's PowerPC the most common RISC microprocessors.

Nowaday's electronics industry appears with low power. Necessity for low power has activated a major typical example where power dissipation has become as important consideration, such as area and performance. As RISC architecture

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supports predefined set of instruction it follows processor. Also the lengths of the instructions are same. The features considered in traditional CPU architecture were inspired by researchers. These features were used to build the coding were being ignored by the programs. Several processor cycles were performed for the more complex features. As a result gap between the main memory and processor was increased. This lead to streamline processing within the CPU, in parallel time taken to minimize the total number of memory accesses [1].

People started searching other alternative methods because of completed design of controller in CISC and reduced performance. By keeping the very simple instruction set on CPI, we can overcome the speed reduction when a processor talks to the memory. This is the reason why very few instructions are typically RISC architecture, here processor gets data from memory not from store and load [2]. Hence such addressing modes are kept limited. By using operands and opcode, complexity of controller design is reduced with bits determined in instruction register, Pipelining with additional register added a new dimension in the speed. The concept called super scaling is used to enhance the pipeline architecture, by allotting more than one execution unit [3].

The word Computer Architecture was first defined by Amdahl, Blaauw and on April7, 1964 Brooks of International Business Machines (IBM) Corporation introduced IBM System-360 computer family. The Computer Architecture which includes Operation codes, Instruction format, Instruction set, Addressing modes with register memory and memory locations.

The RISC architecture has been developed as a result of many projects started in 1975 at the IBM T.J. Watson Research Center and was completed by early 1980s. The term RISC (Reduced Instruction Set Architecture) architecture was widely known after the use of RISC the Berkeley research project and well recognized today.

The reduced instruction set computer (RISC) is a microprocessor CPU design that takes identical amount of time for execution with simpler and smaller set of instructions. PA-RISC, ARM, MIPS, DEC Alpha, SPARC, and IBM's PowerPC are the most common RISC microprocessors. The classic RISC pipeline consists of Instruction decode, Instruction fetch, and register fetch, Execute, Memory access, and Register write back [4].

2 Methodology

Simultaneous execution of instructions of parts or stages more effectively and efficiently is carried with the help of technique called pipelining that uses RISC processor. During the first instruction exaction the next instruction will be decoded

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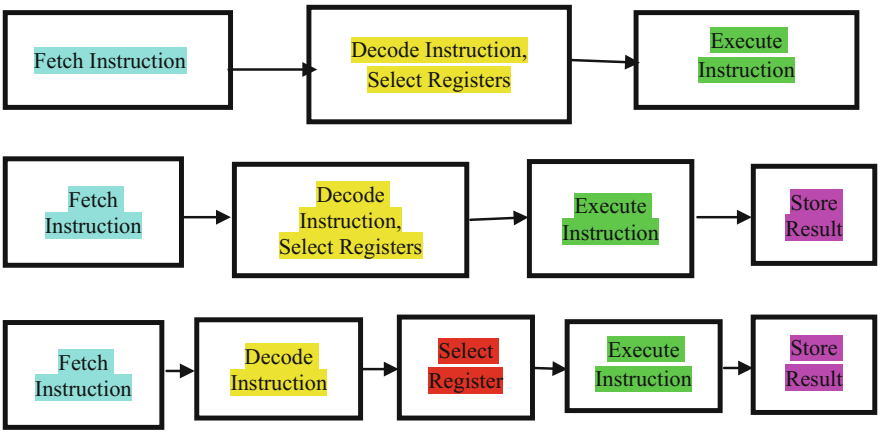

Fig. 1 Block diagram of pipelined architecture

and in parallel operands are loaded and following instruction is being fetched [4]. Figure 1 shows the three, four, and five stage RISC Pipeline, respectively.

Branch Prediction

a. This is a digital circuit which tries to guess in which way the branch as to go.
b. Increase flow in instruction pipeline.
c. High performance is achieved effectively.
d. Two-way branch predictions are implemented with conditional jump.
e. Without branch prediction, after the conditional jump the processor has to execute cycle, making sure that the next instructions have not entered the fetch stage in instruction Pipeline.
f. Branch predictor identifies that conditional jump is most likely to be taken to avoid the waste of time and identified branch to be fetched and speculatively executed.
g. Pipeline start over the correct branch by increasing the delay, this happens when the detected guess is wrong. In this case partially executed instructions are desirable [5].
h. Miss prediction of branch causes waste of time which is equal to the number of stages in the pipeline from the fetch stage to the execution stage.
i. More the pipeline greater the need for good branch predictor.
j. Conditional jump is identified by the Branch predictor.
k. Target of conditional or unconditional jump prediction is attempted by branch target predictor prior to the decoding and execution of the instruction itself.
l. Often in same circuit Branch prediction and branch target prediction are combined.

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3 Architecure

3.1 Instruction Fetch

From memory, send the program counter to memory and fetch the current instruction. Program counter is updated to the next sequential PC by adding four bytes to the PC. The purpose of instruction fetch unit is to supply valid "Program Counter" Value to code Memory [6]. Fetching instruction means that the instruction present in the memory is fetched from the PC and stored it in the instruction register (IR) [5] (Fig. 2).

3.2 Instruction Decode/Register Fetch Cycle

Read the registers and decode the instruction comparable with register source specified from the register file. The purpose of instruction Decode and register fetch unit is to get operand value from CPU registers. The ID cycle decodes the instruction. During this cycle the instruction stored inside the Instruction register (IR) gets decoded [7].

3.3 Execution/Effective Addresses Cycle

Prior cycle contains operands which are operated by ALU for performing one of three functions depending on the instruction type. The purpose of instruction Execute is to perform required operation based on the opcode and store the result in immediate register.

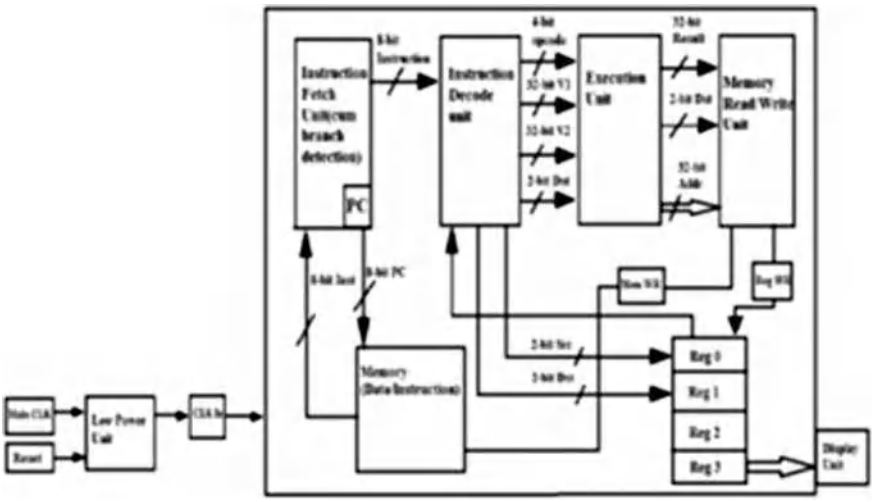

Fig. 2 Architecture of pipelined RISC processor

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4 Clock Gating Methodology

4.1 Clock Gating

The clock gating applies to synchronous load enable registers; the HDL variable decides synchronous clock and control signals are used in a flip flop. Synchronous load enable, synchronous reset, synchronous set, and synchronous toggle come under the synchronous control signals. Register banks disabled during some clock cycles. Typical implementation uses multiplexers. Clock gating cell replaces multiplexers [8].

Design compiler by use of feedback loops to implement the register. Unnecessary power can avoid by maintaining the same register logic level through multiple cycles. Clock gating eliminates the unnecessary activity associated with reloading register banks to save power (Fig. 3).

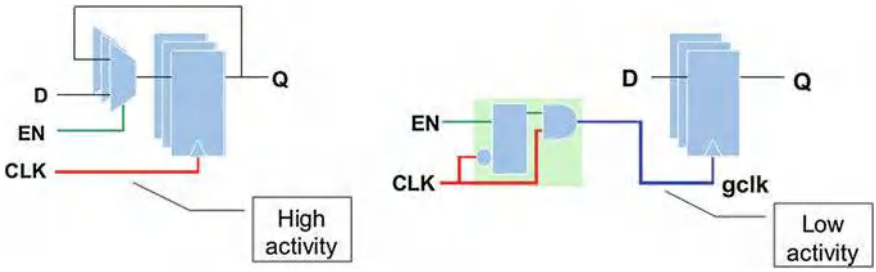

Fig. 3 Clock gating

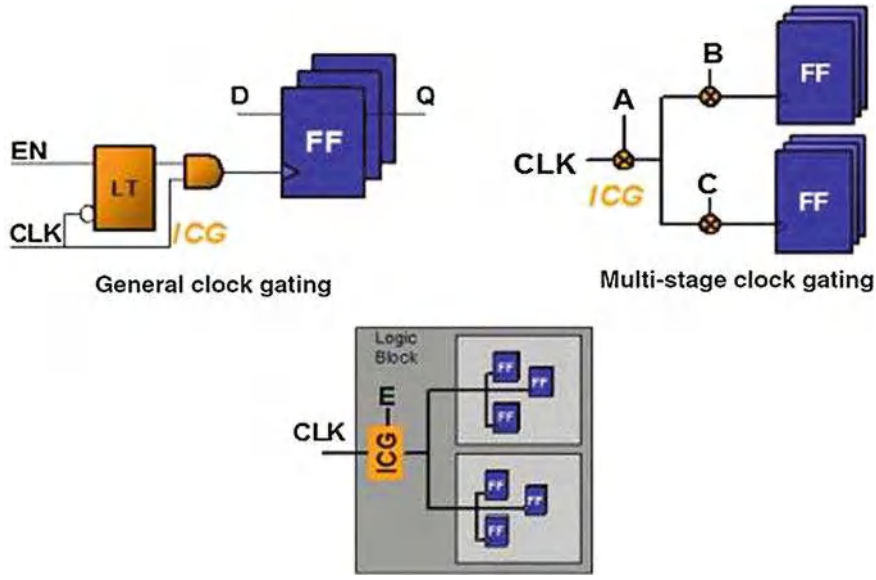

Fig. 4 Clock gating styles

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4.2 Clock Gating Styles

From the standard style, one clock gating cell is applied per register bank, More dynamic power saving can be gained by implementing clock gating in different modes. Figure 4 shows three different clock gating styles such as general, multi-stage, and hierarchical.

In multistage clock gating, further gating is done for the clock gating cells which have common enable signals. As a result, more dynamic power can be saved.

In the hierarchical clock gating style, clock gating is done at the logic hierarchy level by gating hierarchical logic modules that share a common enable and the same clock group. This reduces the number of clock gating cells in the design [8].

5 Simulation Results of RISC Processor

See Figs. 5, 6, 7, 8, 9, and 10.

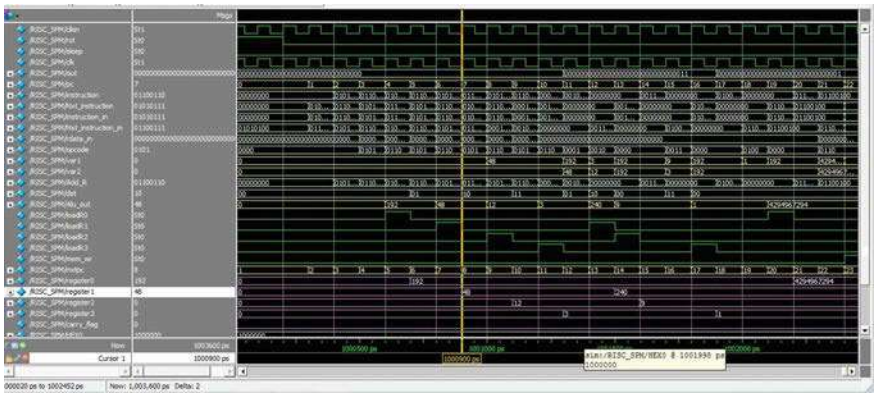

Fig. 5 Simulation result of the memory RD/WR and arithmetic operation

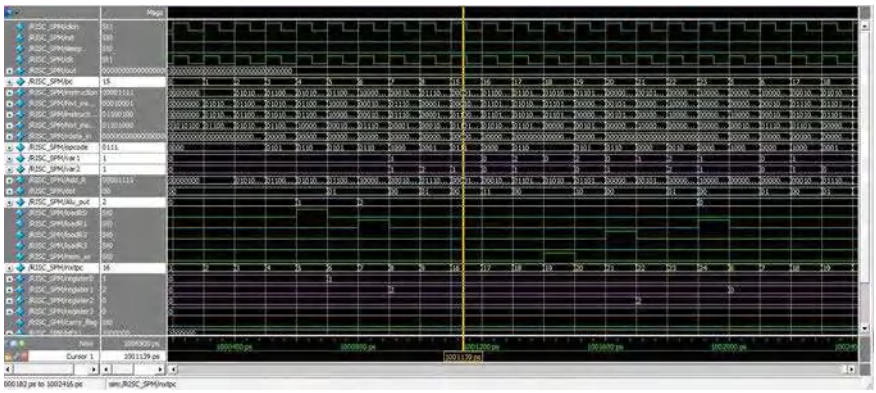

Fig. 6 Simulation result of the memory RD/WR and operation condition

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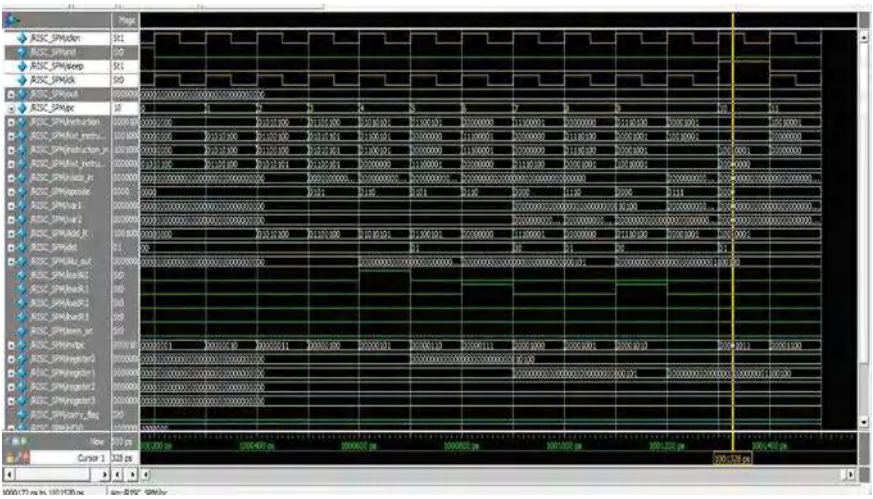

Fig. 7 Simulation result of the how power unit using clock gating

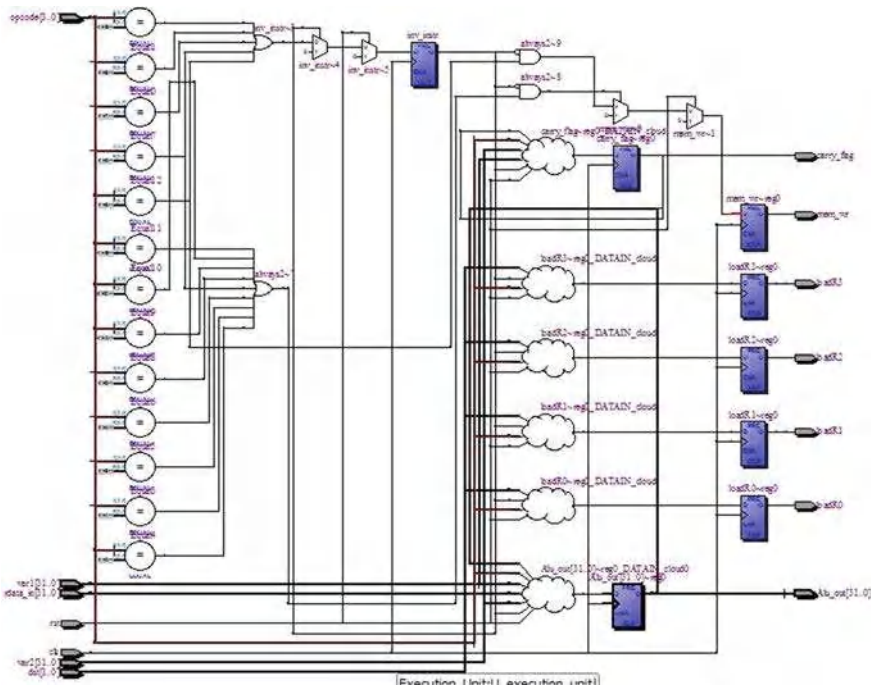

Fig. 8 RTL unit of execution unit

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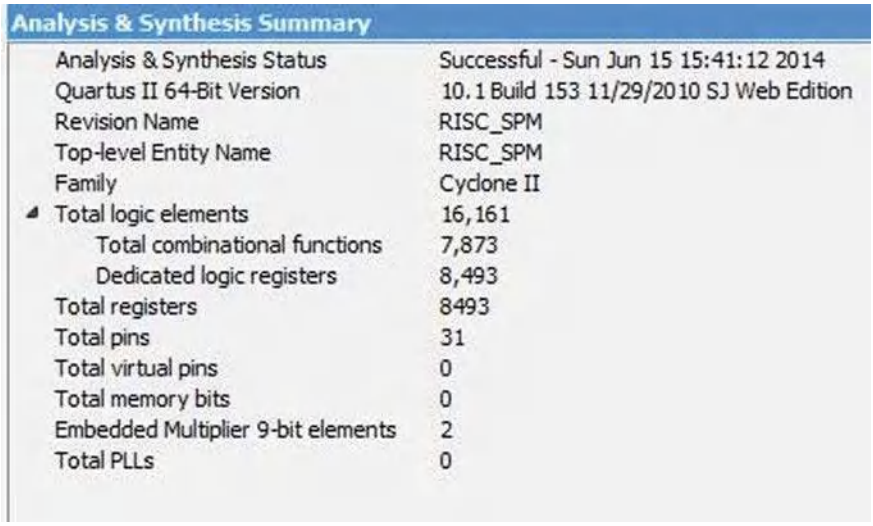
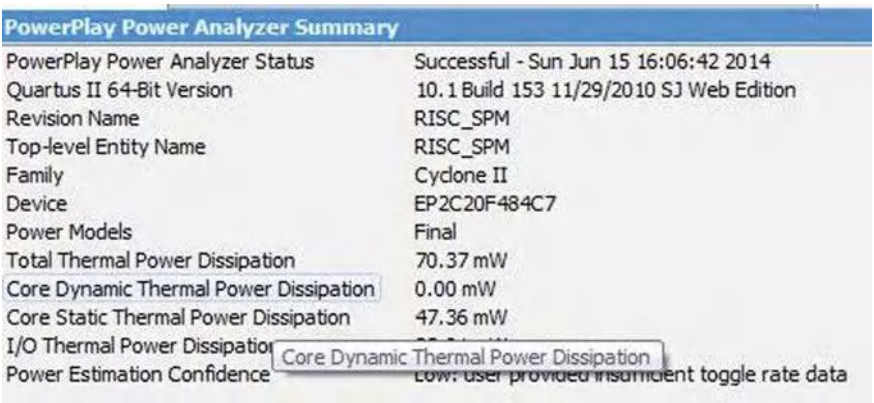


Analysis & Synthesis Summary	
Analysis & Synthesis Status	Successful - Sun Jun 15 15:41:12 2014
Quartus II 64-Bit Version	10.1 Build 153 11/29/2010 SJ Web Edition
Revision Name	RISC_SPM
Top-level Entity Name	RISC_SPM
Family	Cyclone II
Total logic elements	16,161
Total combinational functions	7,873
Dedicated logic registers	8,493
Total registers	8493
Total pins	31
Total virtual pins	0
Total memory bits	0
Embedded Multiplier 9-bit elements	2
Total PLLs	0

Fig. 9 Shows the device utility summary



PowerPlay Power Analyzer Summary	
PowerPlay Power Analyzer Status	Successful - Sun Jun 15 16:06:42 2014
Quartus II 64-Bit Version	10.1 Build 153 11/29/2010 SJ Web Edition
Revision Name	RISC_SPM
Top-level Entity Name	RISC_SPM
Family	Cyclone II
Device	EP2C20F484C7
Power Models	Final
Total Thermal Power Dissipation	70.37 mW
Core Dynamic Thermal Power Dissipation	0.00 mW
Core Static Thermal Power Dissipation	47.36 mW
I/O Thermal Power Dissipation	
Power Estimation Confidence	

Core Dynamic Thermal Power Dissipation

Fig. 10 Shows the power analysis summary

6 Conclusion

Here we developed the RISC 32-bit processor architecture using clock gating pipelined method to reduce the power. It performs logical, memory, and branching instructions, the coding is done using Verilog and simulation is carried out using Model SIM Se6.4e tool and implemented on ALTERA FPGA board. The results can be obtained from the synthesis report for the proposed architecture speed which is approximately 111.286 MHz.

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In future, one can extend this project to 64-bit RISC processor with high performance and lower power consumption using clock gating techniques or other lower power techniques which can be implemented in both back end and front end with 45 nm technology.

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Dynamic Software Aging Detection-Based Fault Tolerant Software Rejuvenation Model for Virtualized Environment

I.M. Umesh and G.N. Srinivasan

Abstract Cloud computing has emerged as one of the most inevitable technologies that encompasses huge software components and functional entities, which during operation accumulates errors or garbage, thus causing software aging. Software aging can cause system failure and hazardous consequences, and therefore to deal with it, a technique called software rejuvenation is proposed that reboots or re-initiates the software to avoid fault or failure. Conventional approaches still suffer from higher downtime resulting in decreased performance and unavailability. In this paper, a controller based dynamic software aging detection and fault tolerant rejuvenation model has been proposed. This model has been implemented in a live virtual migration environment to ensure resource security during virtualization. In addition, the proposed checkpoint and log detail based migration has eliminated the probability of downtime which is highly significant for realistic applications.

Keywords Software aging · Rejuvenation · Virtualization · Fault tolerant · Live migration

1 Introduction

Cloud computing has emerged as an efficient and large scale computing system that provides multi-level services through virtualization while ensuring fair resource (software applications, data, bandwidth and storage) allocation to the users. A cloud-based software application, in general is developed as a distributed system that encompasses multiple cloud service segments where it communicates with each other through certain interfaces or connections. On the other hand, the comprising

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software components (SCs) in their long-run operation accumulate numerous internal errors and garbage, thus resulting into software aging and probable failure or performance degradation [1]. Numerous large scale software applications and associated systems do suffer from performance degradation or even failure because of premature resource exhaustion. The huge resource consumption, fragmentation and error accumulation causes software aging.

The above issues demand certain optimal and effective fault tolerant technique to avoid software failure [2] at runtime. To deal with the situations of aging, a number of fault tolerant approaches have been proposed such as redundancy oriented software failure and its recovery, rollback scheme based on check points. Recently, a novel preventive and proactive approach called 'software rejuvenation' has been proposed to deal with these aging issues. Software rejuvenation enables freeing up the resources, storage and deletion of garbage, system reconfiguration, etc., that significantly reduces the probability of premature system failure and performance degradation caused due to software aging.

In this paper, three predominant issues have been considered.

1. Prediction of probable aging in online software components on cloud platform.
2. Performing software rejuvenation using certain efficient virtualization paradigm.
3. Optimal resource utilization and its security during live migration.

The proposed rejuvenation model examines dynamic behaviour and recent resource utilization of a host VM and predicts aging. On the other hand, the rejuvenation controller schedules migration of the services on aged VMs to newly created virtual machines using a live migration paradigm. The novelty of the proposed system is its dynamic fault prediction, secure migration and zero downtime.

Section 2 presents related work, Sect. 3 represents the contribution and proposed system, which is followed by Sect. 4 that discusses results and the conclusions are given in Sect. 5. The relevant references used in this manuscript are given at the end.

2 Related Work

To deal with software aging, software rejuvenation has emerged as a key technique that significantly reduces performance degradation, resource depletion and premature system failure [1]. A number of approaches have been developed for enhancing software rejuvenation by means of appropriate scheduling to reduce downtime and availability maximization. These approaches are classified into two major classes. The first is periodical rejuvenation method that considers time and workload to perform scheduling and the second one incorporates adaptive and proactive rejuvenation where the rate of resource depletion and performance degradation is examined dynamically. Some researchers have suggested

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rejuvenation based on the time estimation [3–8], and the predictive measurement approach [9, 10]. The time-based scheme intends to estimate various dynamic parameters such as workload, mean time to repair (MTTR), and failure distribution over certain defined period. A number of tools have been developed for scheduling, such as continuous-time Markov chain (CTMC) [3], a Markov regenerative process (MRGP) [5], stochastic reward nets (SRNs) [4, 6, 7] and others [8, 11, 12]. On the other hand, predictive paradigm continuously monitors the operational behaviour and performs triggering for rejuvenation in case of any fault occurrence resulting in degradation or downtime.

The virtualization-based rejuvenation has emerged as a significant approach to achieve higher resource availability and minimal downtime [12–15]. The earlier studies [14] proposed a CTMC model to monitor behaviour of the virtualized system, which was later implemented for rejuvenation scheduling. The system availability on the basis of time-based rejuvenation was employed and consolidation of virtual machines (VMs) was performed. An approach, VMSR was developed for software rejuvenation for application server systems [16]. CTMC approach to consolidate multiple VMs on a single host server was employed in some studies. The work done in [13, 14] employed only the time-based rejuvenation policy without taking into consideration of the VMM failure and its rejuvenation problem and since VMM being a very critical point of faults often plays significant role has not been addressed.

3 The Proposed Model

This section discusses the proposed rejuvenation model.

3.1 System Model

In this paper, a software rejuvenation model has been developed for applications running on virtualized environment. The proposed model encompasses multiple interconnected components or services with numerous functional software components. A software module was developed to monitor virtual machine (VM) functions for predictive fault analysis and for rejuvenation scheduling. Figure 1 represents the overall architecture of the proposed software rejuvenation model. As a significant contribution of this research a fault tolerance technique was developed that continuously operates for aging detection to avoid premature failure, fault or any probable hazardous consequences. Here, fault and aging has been estimated using aging detector that periodically estimates CPU and memory utilization along with a message signal arrival time. The aging detector retrieves key performance indices about VMs, namely, CPU utilization, other resource consumption, and associated context of probable failure, and uses these metrics for

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labelling the VMs for its fault status. The proposed dynamic fault estimation unit examines the degree of fault at a certain defined interval, iteratively in the course of operation and the respective degree of fault is automatically updated in a queue in the decreasing order of criticality. Thus, the fault label reflecting highest probability of failure and service disruption has been scheduled for prioritized rejuvenation at the first instance. The overall proposed scheme of the software rejuvenation is given in Fig. 1.

The overall rejuvenation monitoring-based execution and scheduling is controlled and performed by Rejuvenation Controller. Once any software component is detected with highest fault probability or failure prone, its fault status label is updated to the controller which then initiates rejuvenation process. The proposed mechanism has the ability to send the tasks and service requests of aged VM to the new VM in the same host and even to the other host VMs as per resource availability and scheduling. It significantly reduces the computational cost and probability of downtime. The services of aged VM are migrated to the newly created VM so as to continue normal software running operation. To ensure resource security and availability, a live migration technique is developed to avoid copying of resources or significant information. Once the VM migration has been done, controller schedules for rejuvenation where, the cache, garbage data and fault causing errors are deleted by means of rebooting the VM that finally destroys the aging

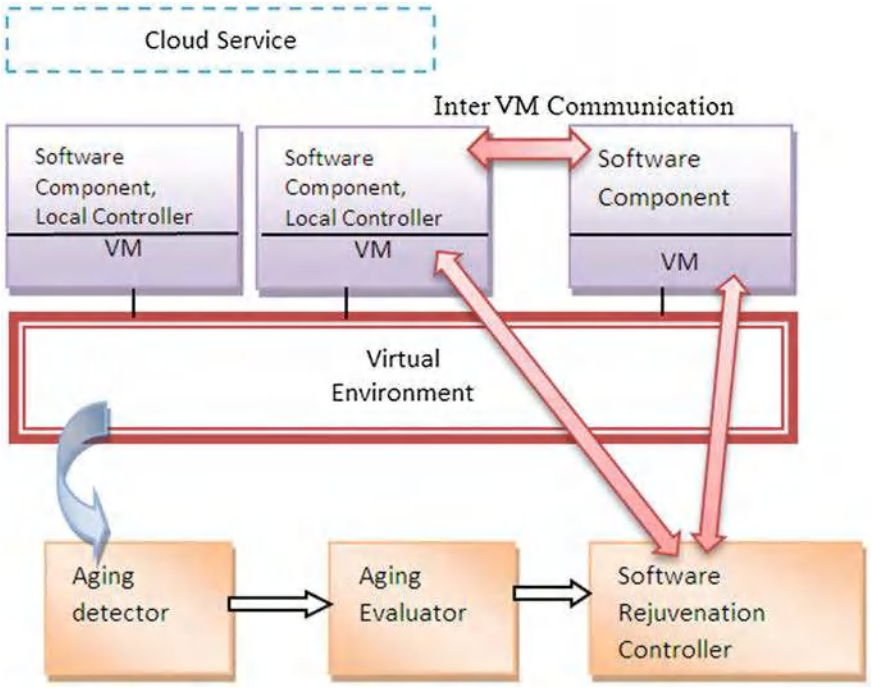

Fig. 1 Proposed rejuvenation model

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effects. In our proposed scheme, it has been ensured that during rebooting of the aged VM, the software components keep running on the newly created virtual machine and thus a replica is formed on the new VM. To ensure non-disrupted migration, a replica of the communication trace back and logs have been generated that helps VMs to operate at the newly created virtual machine. Once, the rebooting of the initial VM is done, the replica of the running software components are migrated to the original host and newly created trace backs, log files, check points, etc., are deleted to make it available for next rejuvenation. The detailed discussion of the proposed research methodology and implementation strategies is given below.

3.2 Dynamic Aging and Fault Prediction

As illustrated in Fig. 1, the functional software components execute on individual VMs. Considering realistic scenarios; it is probable that some of the VMs might be active, some may be underutilized and some VMs are overloaded. It is noted that overloaded nodes tend towards higher probability of aging. The dynamic functional behaviour of cloud systems and large scale online software demand certain predictive model for aging detection. To achieve this, a dual threshold scheme was developed for static aging threshold and dynamic aging threshold estimation. For dynamic aging detection, the CPU utilization is considered as the indicator for aging. Rising CPU utilization infers higher aging. A robust local regression (LRR) algorithm is used for CPU utilization threshold-based aging detection. Robust local regression provides a simple but powerful approach for estimating the aging prediction.

The static threshold scheme estimates a message receiving time called transmission delay at rejuvenation controller. It was also taken into consideration the transmission delay using a message packet between host VM on which the software is running and the fault aging detector. Local controller on host VM collects runtime metrics such as CPU utilization and memory occupancy of the software components. In case any VM is suffering from aging, it is reflected in higher CPU and memory consumption. Furthermore, the inability of a host VM to send message to the aging detector might state aging condition and thus demanding rejuvenation.

Expected message arrival time (EMAT) represents the expected time for reaching the next packet at the aging detector. Here, it is assumed that in case aging detector doesn't get message at certain predefined time interval from a host VM, it represents the probability of aging or failure. The actual message arrival time of the recent packets was considered as the historical statistics in a sliding window. In other words, the recent n messages $m_1, m_2, \ldots, m_n$ and $T_1, T_2, \ldots, T_n$ are their respective actual arrival time at the aging detector. Here the value of $\mathrm{EMAT}_{k+1}(k > n)$ is the expected arrival time of the next message. Mathematically, it can be expressed as

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$$\mathrm{EMAT}_{k+1} = \frac{1}{n}\left(\sum_{i=k-m+1}^{k}(T_i - \Delta t_{k+1} \times i)) + (k+1)\Delta t_{k+1}\right) \quad (1)$$

3.3 Evaluation of Software Aging

Retrieving the significant metrics such as CPU Utilization, memory availability, expected message arrival time (EMAT), etc., the software aging evaluation has been done and the respective aging label is assigned based on metrics and behaviour. The proposed model defines three aging levels for scheduling rejuvenation. Level 1 refers to the critical aging scenario reflecting maximum failure probability and thus demanding instant rejuvenation. Level 2 refers to the serious situation that may lead to serious outcome, such as higher performance degradation and higher transmission delay or high performance loss. Level 2 states the requirement of rejuvenation as early as possible. Level 3 represents the normal functional environment and thus rejuvenation is not needed in this case. In addition to it, rejuvenation is also scheduled based on dynamic thresholding done on the basis of predictive analysis. At certain defined time interval, the proposed aging detector estimates the aging level for each VM and updates the event queue, where it is ordered automatically in ascending order of the aging level.

3.4 Live Migration Based Software Rejuvenation

A robust live migration scheme has been developed to reduce the problem of re-execution and shutting down of the running application or VMs thus reducing the downtime significantly. To achieve this, a checkpoint-based mapping scheme has been implemented that stores the functional records and supports live migration during rejuvenation. The functional rejuvenation events for the proposed system are given in the Fig. 2.

Time	Original VM Status	Transitory VM
T1	Normal functioning	
T2	Aging	Created
T3	Generate checkpoint	Trace-log mapping between 2 VMs
T4		Live Migration from Original VM
T5	Rejuvenation done	
T6		Transmit trace-log to Original VM
T7		Shutdown
T8	Normal functioning	

Fig. 2 Rejuvenation events

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The proposed system incorporates mapping of the functional metrics (EMAT, CPU utilization, resource availability, etc.), which is used by the rejuvenation controller to schedule live migration followed by rejuvenation. Once any fault probability (Level 1 and Level 2) is detected with software components on VM, the rejuvenation controller triggers the rejuvenation scheduler to start migrating on-going software components to the newly created virtual machine (Figs. 1 and 2). The newly created virtual machine establishes a connection with the software components of the original VM to generate the mapping of the on-going process, and ultimately the image of the mapped checkpoint is transmitted to the newly created VM. Once these activities are over, rejuvenation of original VM is done. Finally, once the original VM having software components continues functioning, the newly created virtual machine is refreshed by deleting log files, check points and other images before shutdown. In case of multiple hosts and aged software components, the use of genetic algorithm (GA) is being proposed to implement an evolutionary computing based migration scheduling scheme for VM allocation during migration. Due to the space constraints, the discussion of GA based resource allocation in multiple host scenarios will be discussed in separate paper.

4 Discussion

The proposed fault tolerant paradigm successfully incorporates multi parameter (CPU Utilization, memory and expected message arrival time (EMAT)-based aging detection, which has been followed by a live migration scheme. Thus, the proposed system can accomplish realistic and better aging prediction, dynamic scheduling and secure live migration. The controller based rejuvenation scheme proposed in this paper, where the local controller which is connected to each functional software components, collects dynamic behavioural statistics and transmits it to the aging detector which is a part of rejuvenation controller. The local controller has been deployed not only to retrieve the real time functional behaviour of software components but it also maintains log files and checklist details which is further used for continuing communication while performing live migration.

Unlike traditional replication oriented approaches which require huge replication host node for the individual software component, this scheme does not require any such nodes and hence, it is highly cost effective. Now, focusing on the downtime during rejuvenation, the proposed system employs log files and checkpoint based synchronization that enables undisrupted function of software components. Interestingly, the proposed system performs better than generic rebooting based rejuvenation as rebooting based scheme introduces higher downtime and re-initialization of software can be time consuming and costly. On the contrary, the approach can significantly deal with multiple rejuvenations of independent software components or VMs. In addition, the implementation of multiple parameters for aging detection enables the proposed system to be more realistic and

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responsive. Hence this model can be a novel alternative for large scale software applications or cloud application utilities.

5 Conclusion

The overall proposed system can be a potential candidate for fault tolerant software aging detection and software rejuvenation for cloud infrastructures as well as online/offline software applications. A future proposal has been planned to enhance the fault detection accuracy, dynamic scheduling and resource allocation for live migration. Furthermore, it is intended to employ certain evolutionary computing scheme for live migration and task placement to enhance rejuvenation and down-time reduction.

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Analysis of Group Performance by Swarm Agents in SACA Architecture

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Abstract This paper focuses on to develop a cognitive architecture which demonstrates a broad range of cognitive issues such as decision-making, learning, problem solving, planning, using the concepts of swarm intelligence. To investigate the behavior of swarm intelligent agents in ambient environment with respect to motivation, coordination and performance. To check how performance of agents in a group varies with proper motivation and coordination. Since group of agents are performing together the intelligence performance exhibiting from the group is always greater than individual intelligence performance. The question is, what exactly is happening in these groups that their performance is superior to the individuals? With better group members, performance of the group will be better. What makes the individual member better? This research work provides the solution to the stated problem by developing the cognitive architecture and found that the actual dependents are type of individuals in a group and type of the task performed by the agents.

Keywords Cognitive architecture · Motivation · Agent · BDI · Swarm intelligence · Perception

1 Introduction

According to the research of social psychology of groups, social loafing is the concept where people exert less effort when they work in a group than when they work individually. But we know that group performance is always greater than the

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individual performance. In 1913, Ringelmann says people put less efforts when they work in group than they work individually by considering the rope pulling experiment [1]. But he did not say the reason why people put less effort. In 1974, Alan Ingham proved that performance decrease depends not only on the communication but also on the motivational losses by considering the same rope pulling experiment [2]. Hence motivation is a force acting on or within a person that causes the voluntary efforts toward the direction of the goal. Karau and William found motivation was highest when individual believed that the goal was easily attainable and very valuable [3]. According to Richard M Ryan and Edward L Deci, motivations are of two types—Intrinsic and Extrinsic [4]. Intrinsic motivation is an internal force acting within a person to perform the task without expecting the reward. The person performs the task due to his or her own interest. Extrinsic motivation is an external force acting on the person to perform the task so that reward is achieved or to avoid punishment. A motivational theory explains why and how human behavior is activated. There is no single theory that is universally accepted. Motivational theories are categorized into two-content and Process theories. Content theories say what motivates the people to perform the task. Some of the examples are Maslow, Alderfer, Herzberg, and Mclelland. Process theories deals with how motivation occurs. Examples are Expectancy Theory, Goal Setting Theory, and Equity Theory. This research has concentrated on the goal setting theory which is proposed by Edwin Locker in 1960. According to Fred C. Lunenburg, the goal setting plays a significant role in the performance. He says performance is always higher for specific and challenging task with the appropriate feedback [5]. According to Mark R. Lepper, David Greene, and Richard Nisbet when an expected external reward decreases, a person's intrinsic motivation to perform a task decreases. Reward has the impact on the performance [6]. According to C. Bram Cadsby, Fei Song, Francis Tapan individuals were more motivated to perform at the high level when they were paid more based on their performance by experimenting the Pay-For-Performance verses fixed pay, and showed that Pay-For-Performance achieved higher productivity significantly through sorting and incentive effects. Productive employees selected PFP [7]. According to Barrie L Cooper, Pamela Clasen, Dora. E Silva-Jalonen, Mark Butler, when an individual were told that the feedback will be given, then they were more motivated and performed the task in a better way. Performance is high [8]. According to Jurgen Wegge, Alexander Haslam, all groups with the specific and difficult group goals performed better than a group asked to do the best. Group goal setting counteracts motivational losses like social loafing, group goal setting increased team identification, compensate for other weak team members, value of group success and failure. Group goal setting is a robust strategy for motivation and performance [9].

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2 Proposed System

The design of Swarm Ambient Cognitive Architecture (SACA) draws heavily on natural swarms and our immediate surroundings which are termed as ambient environment. Hence the name SACA. The SACA is developed from the Society of Mind Cognitive Architecture developed by Vijayakumar [10]. The proposed cognitive architecture has collections of motivated and non-motivated intelligent agents working together for the predefined goal. The implemented SACA is a four-layered architecture with reflexive, reactive, deliberative, swarm, and meta-learning agents. The reflexive, reactive, and deliberative agents based on given situation in the environment exhibit cognitive skills like planning, decision-making, reasoning, problem solving. At the higher level in the proposed cognitive model, the swarm and meta-learning agents exhibit skills like learning, communication, and capability to move. The behavior of the agents in the environment is analyzed based on how well the agents are self or externally motivated to perform a given task which is defined as competition, survival of the agents in the environment. In the cognitive architecture, the test beds are used for simulating, comparing the outcomes of the architecture.

In the developed simulated test bed using prolog graphics the agents are created. The swarm agents are represented in circle shapes. Different parameters considered for agents are food defined as energy resource and are represented in the small green square shape and diamonds defined as the goal parameter and are represented by small while circle shape as shown in the Fig. 1.

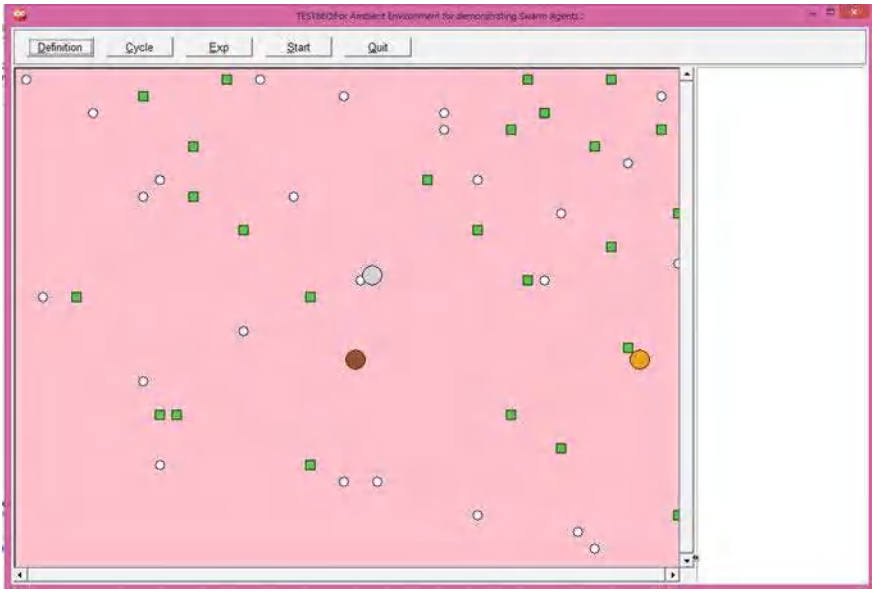

Fig. 1 Ambient test bed

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In the test bed, the agents have to collect as many diamonds as possible. Since group of agents are performing together, the performance of the group will be high. Different metrics are used to analyze the behavior of the swarm agents. The major metrics are performance with respect to competition, level of motivation, and social interaction with each other and with the environment. Performance of the swarm agents depends on the number of cycle the agents has survived in the environment. The performance of the agents is evaluated based on the diamond collection. The performance of the group depends on the level of motivation of individuals and type of motivation of the individuals. Resource collection and life expectancy are two metrics used in the SACA test bed experimental results. The life expectancy is defined as agents' survival in a test bed for fixed energy. Resource collection is defined as the number of resources collected in a given time cycle.

SACA architecture consists of reflexive, reactive, deliberative, swarm, and meta-learning agents.

Reflexive layer: These agents are in lower level and exhibit simple reflexive behavior. These agents exhibit low level of motivation or same times zero level of motivation toward the collection of goal parameters. The reflexive agents can sense the edges of the environment and center of the environment. These agents can move in all the four directions. If the next space is free, it moves to that position without any deliberative intensions. The agents exhibit simple reflex behaviors, the actions which happen before thinking. These behaviors are implemented using Finite State Machine. Based on the input, the output of FSM is directly mapped on to the agents' actions.

This agent does not understand the energy bound parameters such as food and the goal-oriented parameter such as diamond. The degrees of motivation in these agents are zero. Zero because it is moving toward edges where it is idle and move toward the free space when next space is free. The algorithm used to implement the reflexive agent is

step 1: Agent in the initial position
step 2: Sense the space ahead and move to the next position if the space is free and its energy is above the threshold.

If other agent is in the random moving direction, then change the direction in which there is a possible move.
If the agent reaches the border of the test bed, then change the direction to either up, down, right, or left.

step 3: Continue step 2 until energy reaches to zero.
step 4: When energy is zero, the agent dies.

Reactive layer: These agents exhibit well-planned and coordinated actions to satisfy the goal defined for that agent. The reactive agent is highly goal-oriented and hence exhibits extrinsic motivation. There is one reactive agent created in the environment which is reactive diamond whose aim is always to move toward the nearest diamond and collect it.

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These agents understand the affecting parameters of their behaviors. Through the perceptual range, the agents calculate the shortest distance toward the diamond and it always moves in the direction in which the nearest diamond is available. Within the perceptual range, if there are no resources available, then the agent move toward the edges of the environment like reflexive agent.

These agents lack in intrinsic motivation such as understanding that its energy level has gone down below the threshold and it requires food to survive longer in the environment. The agent at this level shows the extrinsic motivation. The algorithm used to implement the reactive agent is

step 1: Agent in the initial position.
step 2: Sense the goal parameter in the environment and move in the direction.

If there are many goal parameters in the perceptual range, calculate the shortest distance and move toward the nearest goal.
If wall is found in its move, then change the direction and move toward the free space.
If agent 2 is found in the direction, then move with the agent.

step 3: When energy is zero the agent dies.

Deliberative layer: The second layer of architecture is the deliberative layer which has a BDI agent who is capable of reasoning about their own internal task and plan. There is one BDI agent, BDI-diamond. BDI-diamond selects and controls reactive diamond.

The BDI agent first maps its internal state on to the belief set. Based on what is its internal stale, it creates an appropriate desire set from the belief set. From the desire set it sets an intension to the BDI agent.

For example, If an agent is intended to collect the diamond and if its energy is less than the threshold value, it changes its desire to collect the nearest food. The agent at this layer is highly (Intrinsic) motivated comparing to the other two layers below.

Due to highly intrinsic motivation, the agents collect the parameters available in the environment to achieve their goals according to their intensions. Agents are highly motivated as they understand their energy levels. They intelligently change their desire to collect food where they are hungry. The algorithm used to implement the deliberative agent is

step 1: Agent in the initial position.
step 2: Sense the goal parameter in the environment and move in the direction.

If there are many goal parameters in the perceptual range, calculate the shortest distance and move toward the nearest goal. (Planning)

step 3: If energy is less than the threshold (less than 40) then agent moves toward the shortest food. On consumption of food the agent energy increases. (decision-making)

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step 4: If energy is greater than the threshold (more than 40) then agent moves toward the shortest goal.
step 5: Continue until all foods are collected or till the agent dies.

Swarm layer: This is the layer where agents will coordinate and perform the assigned task. Suppose if the task assigned to the agents is to find and consume the treasure food, then the working of the agents is as follows:

step 1: Agents at random initial position.
step 2: The agent which can sense the treasure food first will update its current position to the memory and all agents will follow the position of the agent which has been sensed. As first sensed agent moves near its position, it will be keep updating and all other agents will follow it.
step 3: Continue till all agents reach the treasure. Energy level can be considered as described in the deliberative layer.

Meta-learning layer: This is the fourth layer of architecture. Consider the scenario where in the test bed there is a decayed food. On consuming the decayed food the agent loses its current energy by 10 units. So, immediately the agent has to move toward the food. Consume the food and increase the energy by 45 units. Next time if an agent comes across same decayed food it avoids consuming it as it learnt from its previous experience. This is reinforcement learning. Reinforcement learning algorithm can be used in this layer. It is a learning through interacting with the environment and selects it actions based on the past experiences and new exploitation. The agent receives the reward which helps in learning for future. The algorithm of each layer is implemented using prolog programming language.

Bar graphs are used to design the graphs because bar graph displays the data in separate columns and are used to compare two data sets.

3 Results

The results will demonstrate that group performance depends not only on the communication among the agents but even the individual's level of motivation adds to the performance. SACA architecture is designed to check how individual agents will behave in a group, how agents behavior will have an impact on the group performance. The graphs are generated by experimenting with the following data: Initial energy 100 units, Cycle 500 units, Food 25 units, Diamonds 25 units. 3 agents are considered: Reflexive, Reactive, and Deliberative. The experiment is conducted and the output text file is generated with the data. This data is plotted to the excel sheet and the graphs are generated. Figure 2a gives the comparative study to find out the highly motivated agent among the group of agents. Figure 2b shows the group performance by considering the motivated agents. Figure 2c shows the group performance by considering the non-motivated agents.

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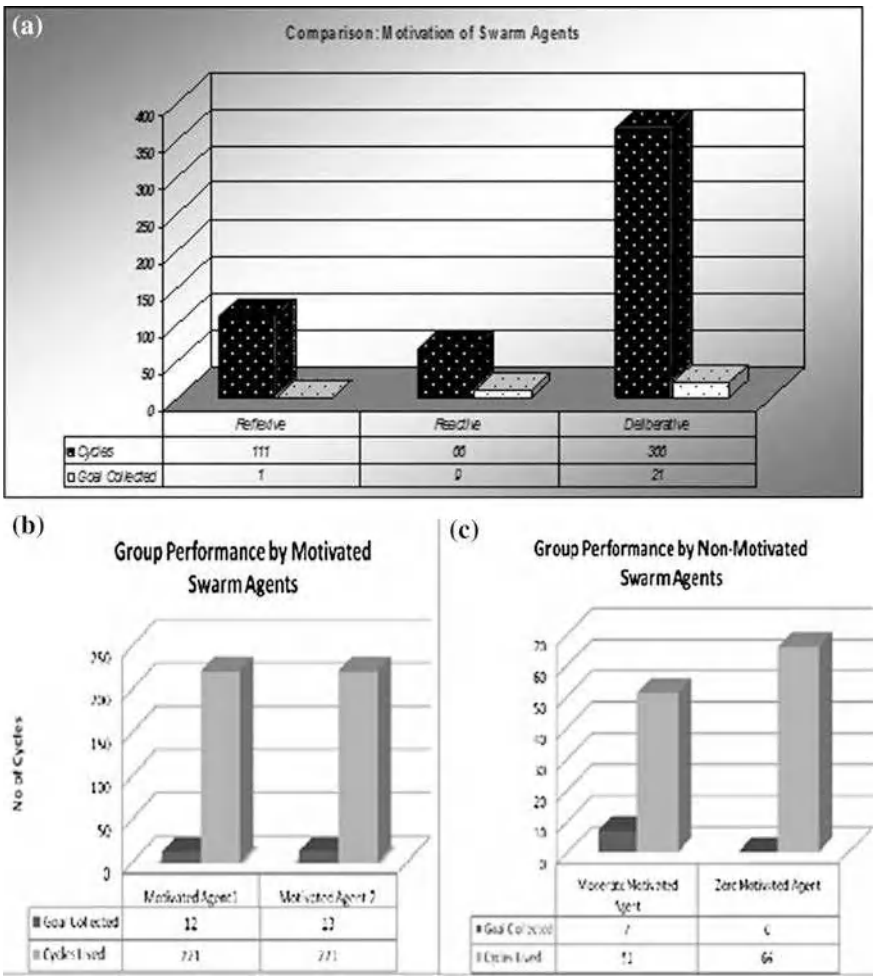

Fig. 2 **a** Comparison of swarm agents. **b** Group performance by motivated swarm agents. **c** Group performance by non-motivated swarm agents

When the experiment is conducted with the same input, the Fig. 2a shows that deliberative agent is highly motivated agent than reactive and reflexive agents. This graphs shows that intrinsic motivation is better than extrinsic motivation. After running the experiment, the deliberative agent has survived for 366 cycles out of 500 cycles and has collected 21 diamonds out of 25 diamonds. The reactive agent has survived for 66 cycles and collected nine diamonds. The reflexive agent has performed for 111 cycles and collected one diamond. Since the deliberative agent is intrinsically motivated, the agent has collected more number of diamonds and survived for longer cycle than reactive and reflexive; hence the deliberative agent is highly motivated agent than reactive and reflexive. This graph also shows

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deliberative agent can reason about their change of aims, sense their state, and achieve their goals, thus, exhibiting decision-making and intelligent behaviors. Deliberative agents are more efficient in managing their energy level collecting more goals. Deliberative agents having complete control in managing food and goal, try to balance motivations. Deliberative agents collect more goals and manage higher life expediency than other agents. In this, results process that deliberative agent has more control and self-reflection catalyst. Thus stating that deliberative agent is highly motivated than other agents and improve the performance [11].

From the Fig. 2a, it is clear that deliberative agent is highly motivated than reactive and reflexive. Figure 2b shows when two deliberative agents are considered in the test bed, both agents have survived for the same time 221 cycles and collected almost the same goals 12 to 13 diamonds.

Figure 2c shows when reactive and reflexive agents are considered who are moderated and zero motivated agents, reactive agent has survived for 51 cycles and collected seven diamonds and reflexive agent has survived for 66 cycles but did not collect even one diamond. Figures 2b and 2a demonstrates that motivation of an individual is essential for successful motivation of the group which means when all agents in a group are highly motivated for a specific goal or a challenging goal, then competition for a goal to complete the task among the motivated agents increases and thus the performance of the group will be effective. If the agents are less motivated to the specific goal in a group, then the performance of the group declines and leads to the motivational losses like social loafing. Thus performance of the group depends not only on the communication among the agents but also on the specific goal, the motivational levels of individual agents in a group, composition of the group.

4 Conclusion

In SACA architecture, group of agents works for the same tasks. It was been demonstrated in SACA that the group performance was high when they had a specific goal and their performance was high. The group's goal setting also increases the individual performance in SACA. It motivates agents to achieve the goal. Performance of swarm agents in SACA is high, because individuals are more responsible of their task when they work in a group. Therefore, the performance is more when they have a well-desired goal setting with highly motivated agents. SACA model clearly demonstrates that communication alone among the agents is not sufficient for the performance to increase but even on the type of the task (specific goal), the motivational levels of individual agents in a group and composition of the group(type of individuals in the group). The main contribution of the work has made several contributions to the field of motivational theories and cognitive architectures. It is found that the performance of the group will be high when the individuals are highly motivated to the goal and the goal defined should be specific.

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Background Modeling and Foreground Object Detection for Indoor Video Sequence

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Abstract This paper proposed efficient and reliable algorithm for background subtraction for indoor video sequences. The paper mainly focused on compensating the illumination variation in the frame and then applying improved Gaussian mixture model to build the background model and then detect the moving foreign objects in indoor video sequences by using the Euclidian distance as metric. To compensate the illumination variation, homomorphic filtering algorithm for color image in HSV color space was proposed in the paper. The paper also reported the performance evaluation of the proposed method and existing and found that the proposed algorithm achieved 80 % of improvement in detecting actual foreground objects in indoor video sequences having illumination variations.

Keywords Background subtraction · Homomorphic filter · Euclidian distance

1 Introduction

Background subtraction and foreground detecting are very preliminary and essential steps in many computer vision applications. The frames of the given video with and without the intruding objects show some different behaviors that can be well defined and described by a statistical model. The statistical model has been built for the first initial frame of the given video, and then new foreign foreground objects can be detected by comparing them pixel by pixel from the next frame of the same video which does not match with the model. This process of extracting foreground objects from the background is usually called as background subtraction. This process of segmenting foreground and background is often one of the first and foremost task in computer vision applications such as activity recognition, video

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summarization, key frame extraction, etc. [1] The background subtraction method's performance relies upon the type of the background model applied. The background model should be capable of handling video types with objects overlapping, cluttered areas in the visual field and shadows [2]. The extraction of moving foreign objects may result in extraction of relevant information and can be used for many computer vision applications such as recognition, classification, and activity analysis. There are many existing basic models which can be applied for initial frame of the video. The basic model is taking the average of the images over time [3, 4]. The initial frame to be selected for background model is the set of initial frames where there is no motion of objects. Even though there are many existing background subtraction algorithms which can handle all the issues and challenges, still many algorithms are more sensitivity to illumination changes for indoor video sequence [5, 6].

This paper proposed efficient and reliable method of background modeling and foreground object detection which can solve the problem of gradual illumination variation for indoor video sequence. This paper also reported performance evaluation of the proposed method in comparison with existing methods.

2 Related Work

Mixture of Gaussian (MoG), which is very popular model, is to build initial frame of a given video with an only one Gaussian [7], which is a basic technique that calculates mean and standard deviation of each pixel; this is called background model. Incoming frame is subtracted with the background model and gets the threshold of the result. Algorithm also updates the model parameters recursively that can be adapted to the scene change in the video; the model does yield accurate results when the video contains dynamic content. In order to avoid this situation multi-Gaussian distribution per pixel (MoG) was used to build the model, which can handle such situations [8]. MoG to build background model is proved successful for outdoor video sequence but not feasible for indoor video sequences because of more illumination variations. MoG method results in lot of noise or false alarms. To overcome many false alarms, texture features have been used to model background statistics [9].

Even if color is significant information to extract features from images, there are some constraints where color information is not enough. Combining with color information texture information and analysis plays a vital role for many computer vision applications. Texture measures can also be used to build background model which can compensate variation in illumination. Texture can become useful tools for interpretation of high-level context for natural image. The approach employed local binary pattern (LBP) operator, which has shown excellent performance when applied for background subtraction and has several properties that favor its usage in background modeling. But this method also fails to capture gradual illumination variation which is normal in indoor video sequences.

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Zhang et al. [10] proposed fuzzy logic approach which combines the gradient and color information for background subtraction. Raja et al. [10] make use of Hue Saturation Intensity (HSI) color space which results in limited level of intensity invariance and achieved moderate results for indoor video sequences. Ivanov presented a method where fast background subtraction is carried out by incorporating disparity. This method is invariant to changes in illumination, but cannot achieve accurate results for indoor environment. Lim and Mittal analyzed the method proposed by Ivanov [11] and suggested a better sensory placement strategy which can help in reducing errors and results are enhanced. Hanzi and Suter [12] evaluated the performance proposed by (GMM method) and suggested certain modifications in order to get better performance of the algorithm. [13] done extensive error analysis of statistical background modeling and pixel labeling and provides both theoretical analysis and experimental validation. All the above-said background methods can perform well for the outdoor video sequences but cannot be applied for indoor environment [14]. The next section describes about the proposed method which is the modification of existing improved Mog method with illumination compensation technique.

3 Proposed Method

All background subtraction algorithms track objects by applying statistical background model. There are many background subtraction methods but all background subtraction methods failed for indoor video sequences because of illumination variation. To overcome the illumination problem, homomorphic filter [14] on HSI color space has been proposed, which extracts the intensity, lightness, and brightness of each scene. Then, Adaptive Gaussian mixture model was applied on the enhanced illumination compensated frame. The proposed methodology is given in the Fig. 1.

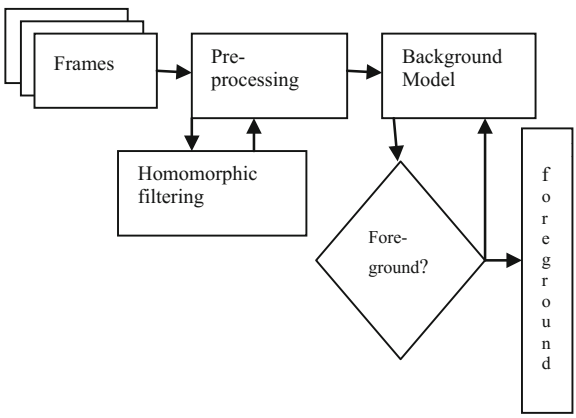

Fig. 1 Proposed methodology

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3.1 Preprocessing

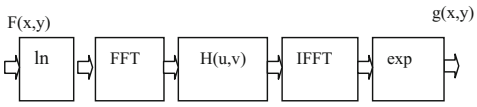
This is the preliminary step in the proposed method, all frames have been preprocessed to eliminate illumination component, which can be a factor under different illumination factors. The main aim of preprocessing step is improvement of the input data by suppressing undesired illumination variation.

3.2 Homomorphic Filter for Color Images

This paper considered and analyzed many preprocessing image enhancement algorithms and found that homomorphic algorithm is best to remove illumination variation component from an image. This filter normalized the brightness and increases the contrast of an input frame. Homomorphic filter has to be directly applied on color images without converting color image to gray scale and convert back to color image.

Following is the developed homomorphic algorithm for color images:

Step 1: Get background frame from video
Step 2: Separate color and intensity of image



Step 3: Apply homomorphic filter on intensity part of the image
Step 4: Integrate color and intensity component of image.

3.3 Gaussian Mixture Model

A Gaussian mixture model (GMM) is a probability density function that is represented as a weighted sum of Gaussian component densities. GMMs are usually used to model many image processing activities. This work employed GMM to model each and every pixel of the initial frame of the video [15]. GMMs are used in many computer vision applications such as speaker recognition system, behavior modeling, and many more.

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Principle:
This paper describes the principle to model each pixel of image using GMM. The probability of getting the current pixel whether background or foreground is given by Eq. (1):

$$P(X_t) = \sum_{i=1}^{K} \omega_{i,t} n\left(X_t, \mu_{i,t}, sd_{i,t}\right) \tag{1}$$

where K is number of Gaussians to be used to model, $\omega_{i,t}$ is weight associated with ith Gaussian with mean $\mu_{i,t}$ and standard deviation, n is a Gaussian pdf

$$n(X_t, \mu, sd) = \frac{1}{(2\pi)^{n/2}|sd|^{1/2}} e^{-1/2(X_t-\mu)sd^{-1}(X_t-\mu)} \tag{2}$$

The covariance matrix is given by Eq. (3)

$$\sum_{i,t} \sigma_{i,t}^2 I \tag{3}$$

The first B Gaussian distributions which go beyond certain threshold T are termed as background distribution

$$B = \text{argmin}_b \left(\sum_{i=1}^{b} \omega_{i,j} > T \right) \tag{4}$$

Where T is threshold value.

Case 1: If match is found with one of the K Gaussians of background model, then for the matched component updating has to be done.

$$\omega_{i,t+1} = (1-\alpha)\omega_{i,t} + \alpha \tag{5}$$

Learning rate is given by α.

$$\mu_{i,t+1} = (1-\rho)\mu_{i,t} + \rho X_{t+1} \tag{6}$$

$$\sigma_{i,t+1}^2 = (1-\rho)\sigma_{i,t}^2 + \rho\left(X_{t+1} - \mu_{i,t+1}\right).)(X_{t+1} - \mu_{i,t+1})^T \tag{7}$$

3.4 Foreground Detection

In this method, foreign moving objects are located by comparing the behavior of the next incoming pixel with the background model. If it behaves similarly, that means,

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if incoming pixel matches with the background model, then it classifies as background otherwise new foreign pixel has arrived into the scene. Euclidian distance metric is used to find out the match with the model and identifies the foreground moving objects from the frame. Euclidian distance is given by the following Eq. (8).

$$d = \sqrt{\sum_{i=1}^{n} (X_i - Y_j)^2} \tag{8}$$

4 Result and Performance Evaluation

A lot of experimentations have been carried out with the proposed method and performance was evaluated with improved GMM and GMM using different types of videos [16]. This paper also reported the experimental results and showed that, the proposed methods can outperform existing methods for videos which contain illumination variations. Figure 2 shows the comparison of the various BS algorithms.

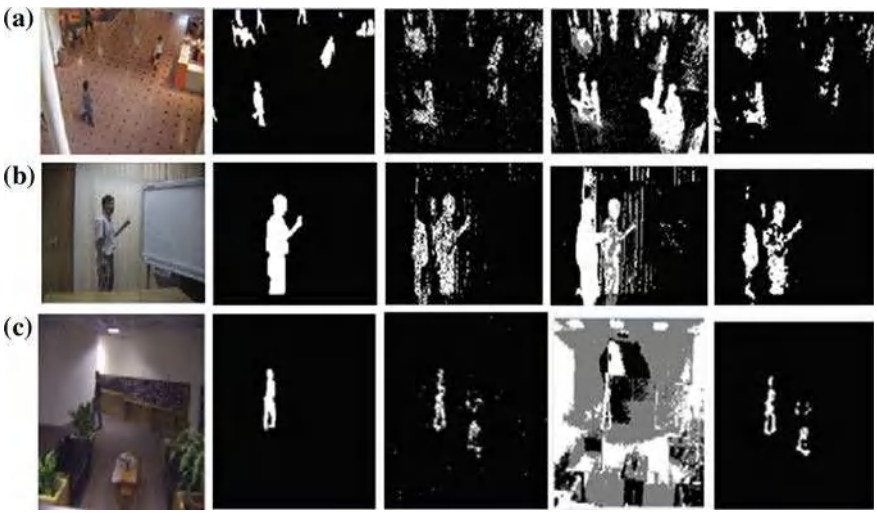

Fig. 2 Background subtraction results from *left* to *right*: **i** reference frame, **ii** ground truth, **iii** GMM, **iv** improved GMM, **v** proposed method

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Table 1 Values for different BS algorithms

FPR		
GMM	IGMM	Proposed
1913	1628	1496
580	755	468
117	127	100
611	233	202
1783	928	590

4.1 Performance Evaluation

Following are the standard metrics which can be used for performance evaluation of the background subtraction algorithms. The following table reported the false positive ratio values of three methods and found that proposed method outperforms all the existing methods.

- False Positive Ratio (FPR): which are not actually foreground pixels, is given by **FPR = FP/(FP + TP)**.
- False Negative Ratio (FNR): which are not actually background pixels.
- True Positive Ratio (TPR): which are actually foreground pixels. (Table 1)

$$\text{Recall} = \frac{tp}{tp + fn} \tag{9}$$

$$\text{Precision} = \frac{tp}{tp + fp} \tag{10}$$

where *tp* is true positives, *fp* is false positives, and *fn* is false negatives.

The following Fig. 2 shows the results of our proposed method and Table 2 gives the comparison with GMM and IGMM methods, and found that proposed method outperforms the other two methods in terms of precision and recall values, the same is reported in Table 2.

The Fig. 3 demonstrated recall and precision values for all the video sequences and found that for the proposed algorithm, recall and precision values are better than others. The above graph shows the values of recall and precision for Dataset#1, Dataset#2, and Dataset#3. The graph shows that for all the datasets both precision and recall values are better for the proposed method.

Table 2 Precision and recall values for different dataset and BS algorithms

	Dataset#1		Dataset#2		Dataset#3	
	Pre	Rec	Pre	Rec	Pre	Rec
Proposed	0.94	0.91	0.93	0.89	0.91	0.88
IGMM	0.85	0.86	0.83	0.88	0.89	0.89
GMM	0.76	0.80	0.78	0.80	0.75	0.79

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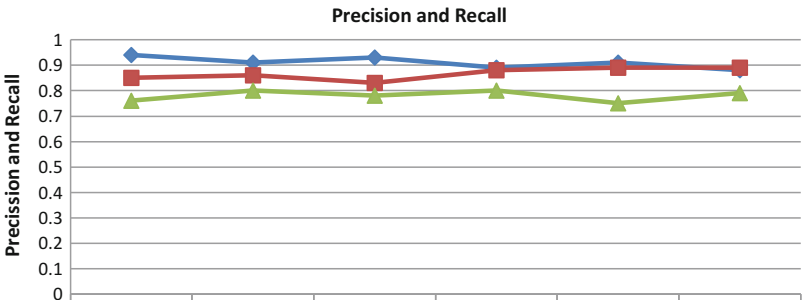

	Pre	Rec	Pre	Rec	Pre	Rec
	Dataset#1		Dataset#2		Dataset#3	
Proposed	0.94	0.91	0.93	0.89	0.91	0.88
IGMM	0.85	0.86	0.83	0.88	0.89	0.89
GMM	0.76	0.8	0.78	0.8	0.75	0.79

Fig. 3 Graph for precision and recall

5 Conclusion

This section concludes that very less research has been done specifically for indoor video sequence where there is lot of illumination variation. The proposed approach of detection moving objects using background subtraction is a contribution to the background subtraction for indoor environments. To compensate illumination variation, homomorphic filter has been applied directly on color frame. This paper also proposed homomorphic filter as a preprocessing step before background subtraction. The major strength of the proposed method is its invariant for illumination changes for indoor sequence.

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Agri-Guide: An Integrated Approach for Plant Disease Precaution, Detection, and Treatment

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Abstract Agriculture growth is the key component in socioeconomic growth of our country due to liberalization and globalization. Gradually with significant increase in technology, advanced telecommunication services assist plant disease treatment at remote locations. Earlier systems were designed for either monocot or dicot plant family disease detection. The paper proposes an integrated approach for monocot and dicot plant disease detection and treatment along with precautionary measurement through smartphone and image processing techniques. The paper mainly focuses on plant disease detection technique based on integrated approach of K-means segmentation algorithm and SVM Classifier. The proposed and developed approach gives 83 % accuracy for plant diseases recognition.

Keywords Classification · Dicot plant disease · Feature extraction · Monocot plant disease · Preprocessing · Segmentation

1 Introduction

In India, our farmers suffer due to lack of knowledge in context with crop diseases along with proper cultivation process, which in turn results in reduction in crops at higher investment [1].

Plant disease is one of the important factors which causes significant reduction in the quality and quantity of plant production. Classification and recognition of plant

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diseases are important tasks to increase plant productivity and economic growth. Detection and classification of plant diseases are one of the challenging topics and much more interesting topics in Engineering and IT fields.

Due to Digital India Initiative, each and every person irrespective of his age and literacy is using finger tip access through mobile or smartphones. Therefore the paper presents framework titled as 'Agri-Guide v1.0' for farmers based on smartphone with the help of image processing techniques. Agri-Guide v1.0 provides precautionary measures to avoid plant diseases for monocot and dicot family along with disease detection and the treatment.

The related work is briefed in Sect. 2. Section 3 presents a proposed and developed work for precaution, recognition of plant diseases and treatment. Section 4 discusses the result and analysis and Sect. 5 concludes the paper.

2 Related Work

Ferzli et al. [2], contributed in the development of agriculture with the integration of image processing, visualization, and mobile cloud computing.

Dubey and Jalal [3] investigated the approach of detection and classification of apple fruit diseases which cannot be extended to other fruit diseases. Revathi and Hemalatha [4] explored advance computing technology to assist the farmer in the plant development process which is suitable for dicot family plant. The approach based on enhanced particle swarm optimization (PSO) feature selection method with skew divergence method is applied to identify the visual symptoms of dicot family: cotton plant diseases [5] whereas the approach [6] based on hybrid algorithms of template matching and support vector machine is suitable for sugar beet. Yan et al. [7] proposed a method to select features of cotton disease leaf image by introducing a fuzzy selection, fuzzy surfaces, and fuzzy curves. The extracted features were used for diagnosing and identifying diseases. The features were extracted from the fuzzy selection approach. This approach removes the dependent features of an image for reducing the number of features in classification process.

In [8], they investigated an approach for automatic identification of chilies plant diseases. For that, color features were extracted with the help of CIELAB color transformation model and comparing the color features for identification of chili plant disease. The accuracy can be increased with the enhancement in extracted features.

Next paper [9] proposed an approach to diagnose the grape plant leaf disease using image processing and artificial intelligence techniques. Remote sensing technology is used to identify plant diseases at the local level [10]. In current scenario, the available systems for plants are Spray Guide and CropInfo. Spray Guide needs user intervention where as CropInfo provides information about production aspects, post-harvest technology, processing possibilities, and market information of plants.

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3 Proposed Work

The proposed approach named as 'Agri-Guide v1.0' shown in Fig. 1 has considered the plants such as onion, wheat, and potato under monocot and dicot family plants, respectively. The farmer sends image of affected plant leaf to the server through mobile camera. At server side the features from image are extracted and the disease is detected with the help of SVM Classifier. The server retrieves an appropriate treatment based on disease detection and sends to farmer. The processing at the server side is explained in later section.

3.1 Server Side Processing

The processing at server side has three phases Disease Precaution, Disease Detection, and Treatment as shown in Fig. 2.

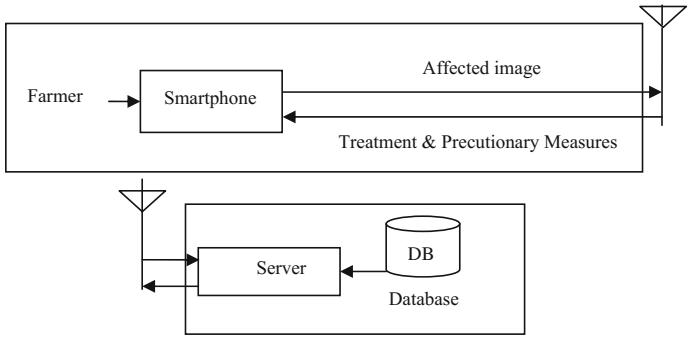

Fig. 1 Architecture

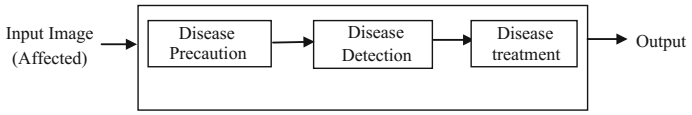

Fig. 2 Processing at server side

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3.1.1 Disease Precaution

The precautionary measures provide the usage and proportion of pesticides, insecticides, and water as per the monocot/dicot plants. The history of crops corresponding to usage and proportion of pesticides, insecticides, and water is stored. The storage of history is beneficial for disease detection in the future. For each farmer separate records are maintained.

3.1.2 Disease Detection

The automatic detection of plant disease is an integrated algorithm based on existing K-means segmentation algorithm and support vector machine (SVM) classifier as shown in Fig. 3. In the initial phase, the features such as color, texture, and shape feature values are extracted with the help of L^*a^*b color space and gray level co-occurrence matrix (GLCM). The extracted features are sent to SVM classifier to detect particular plant disease.

3.1.3 Feature Extractor

Image Preprocessing and Segmentation

The image preprocessing method involves shade correction, formatting, removing artifacts, and removing noise procedures to enhance the image. The captured image contains the noise which affects the image quality. The median filter is used to remove the noise. The RGB image is converted into $L^*a^*b^*$ color space for better color visibility. Initially image is converted from RGB color space to International Commission on Illumination (CIEXYZ) color space and then converted into to $L^*a^*b^*$ color space. $L^*a^*b^*$ color space consists of lightness (L) and a^* and b^* for the color opponent dimensions. After converting into $L^*a^*b^*$ color space, the image is segmented into sub-images of same color using K-means clustering algorithm. The odd cluster size $k = 3$ is used for clustering. The odd cluster size calculates the median value which helps to form cluster. If cluster size is even, then there is need to calculate mean of these set of values which corresponds to median

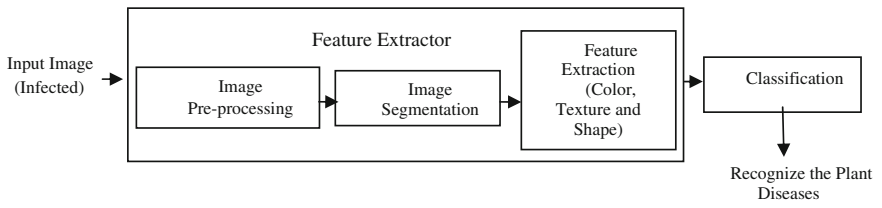

Fig. 3 Algorithm for disease detection

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value to form cluster. After segmentation, the infected regions of plant leaf are clearly visualized. Clustered regions are those areas in the image that represents visual symptoms of plant disease.

Feature Extraction

The plant leaf disease symptoms are classified based on variations in color, texture, and shape features. These are dominant in classifying plant leaf disease symptoms. Color features are extracted with help of $L^*a^*b^*$ color space. First convert the image into 8 bit gray scale image and then use the gray level co-occurrence matrices (GLCM) to extract texture features. To extract shape features, four feature vectors namely area, perimeter, skewness, and kurtosis [6] are considered. The following feature vectors are used to extract the texture feature from GLCM matrix,

1. Contrast: Contrast is the difference in luminance or color that makes an object distinguishable which is calculated using Eq. 1.

$$\text{Contrast} = \sum_{i,j} |i-j|^2 p(i,j) \tag{1}$$

2. Angular Second Moment (ASM): ASM is calculated using Eq. 2.

$$\text{ASM} = \sum_i \sum_j p(i,j)^2 \tag{2}$$

3. Energy: The square root of angular second moment is known as energy and calculated using Eq. 3.

$$\text{Energy} = \sqrt{\left[\sum_i \sum_j p(i,j)^2\right]} \tag{3}$$

   Where, μ_x, μ_y, σ_x, and σ_y are the means and standard deviations of p_x and p_y coordinates.
4. Homogeneity: Homogeneity measures the nearest distributed elements in the GLCM to the GLCM diagonal which is calculated using Eq. 4.

$$\text{Homogeneity} = \sum_{i,j} \frac{1}{1-(i-j)^2} p(i,j) \tag{4}$$

5. Entropy: Entropy measures the loss of information and also measures the image information and calculated using Eq. 5.

$$\text{Entropy} = -\sum_i \sum_j p(i,j) \log(\text{p}(i,j)) \tag{5}$$

   Where, element $[i, j]$ is generated by GLCM matrix. 'i' is x coordinate and 'j' is y coordinates. 'p' is the probability value of element $[i, j]$.

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6. Correlation: Correlation measures the linear dependency of gray levels of adjacent pixels and calculated using Eq. 6.

$$\text{Correlation} = \left[\sum_i \sum_j (ij) p(i-j) - \mu_x \mu_y\right] / \sigma_x \sigma_y \tag{6}$$

7. Inverse Difference Moment (IDM): IDM is also known as local homogeneity and calculated using Eq. 7.

$$\text{IDM} = \sum_i \sum_j \frac{1}{1+(i-j)^2} p(i,j) \tag{7}$$

IDM is high when inverse GLCM is high and local gray level is uniformed.

Classification

Support vector machine (SVM) is a set of related supervised learning method used for classification and regression. SVM is used to classify the infected plant leaf diseases. In this process, color, texture, and shape features extracted from segmented image are considered. The SVM classifier is trained for fifty patterns of each plant leaf disease. It compares the extracted features of an input image with the stored features in database. If the input image features are matched with stored features in database, then it gives the result of corresponding plant leaf disease.

3.1.4 Disease Treatment

Based on the detection of disease, the treatment is provided. The treatment corresponding to plant leaf diseases for each stage is stored based on the symptoms and features extracted. Once the disease is detected, the corresponding treatment is retrieved from database and sent to the farmer.

4 Result and Analysis

The experiments and their validations are carried out using Android Software Development Kit (SDK), Eclipse Integrated Development Environment (Helios IDE), Android Honeycomb (3.0) to Lollipop (5.0) Operating System (O.S.) Platform. The hardware computing platform used for experiments is Intel Core-i5, 2.5 GHz with 4 GB RAM. The variations in the plant leaf image diseases are taken into account from time to time along with guidance and consultation from more than 4 Agricultural Domain experts. The input image to proposed and developed system, 'Agri-Guide v1.0,' is of either of Joint Photographic Expert Group (JPEG), Graphic Interchange

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Format (GIF), and Portable Network Graphic (PNG) format. Thus the input database has more than 1000 leaf images of wheat, onion, and potato plants. The input image is an RGB image which varies from 60 × 20 pixels of size ~1.5 Kb up to 300 × 200 of size ~44 Kb. The output of proposed and developed system is precautionary measures for disease prevention and treatment in case of disease detection.

The wheat, onion, and potato plants leaf image dataset was collected from National Agricultural Research Center, Pune. The samples collected are of diseases namely purple blotch, Stemphylium Blight, Basal Rots, Black Mould disease of onion plant, stripe rust, powdery mildew, aphids, yellow rust disease of wheat plant and bacterial wilt (brown rots), black scurf, dry rot disease of potato plant.

The proposed and developed system is trained for 50 patterns of wheat, onion, and potato plants leaves diseases. The accuracy increases with training of more number of patterns. It is observed that accuracy of known patterns is 83 % whereas accuracy unknown patterns is 73 % as shown in Fig. 4. The response time of Agri-Guide v1.0 is less than 1 ms. Figure 5 shows graphical user interface

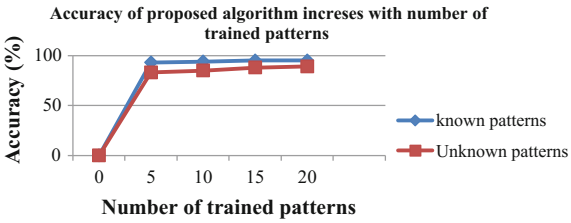

Fig. 4 Accuracy of proposed and developed approach

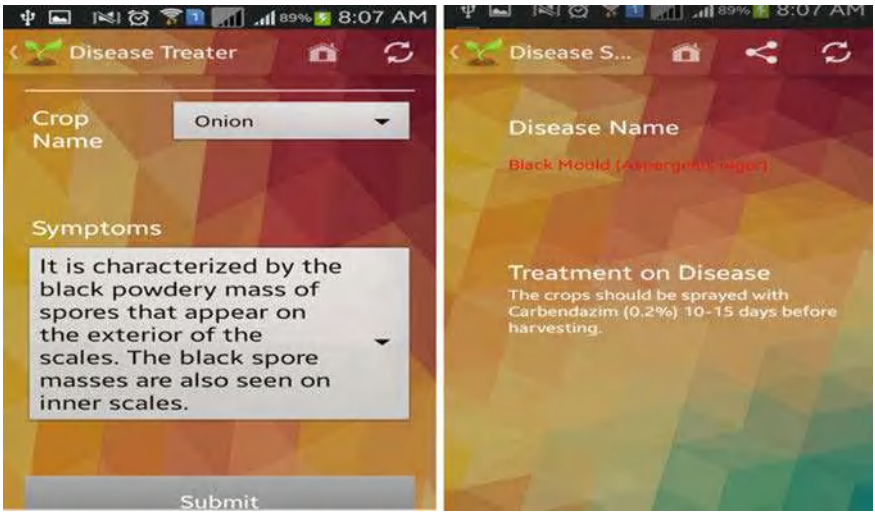

Fig. 5 Graphical User Interface (GUI) implementation of Agri-Guide

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Table 1 Comparative study of existing system and Agri-Guide

	Spray Guide	CropInfo	Agri-Guide
Purpose	Provides information about usage of pesticides and insecticides and water	Provides information about post harvesting technologies and production aspects	Provides precautionary measures and treatment for plant disease
Accuracy	_	_	83 % Known pattern 73 % Unknown patterns
Family	Monocot	Monocot and Dicot	Monocot and Dicot

(GUI) implementation of proposed and developed Agri-Guide. The comparative study of Agri-Guide v1.0 with existing systems is as shown in Table 1.

5 Conclusion

The proposed and developed 'Agri-Guide v1.0' provides precautionary measures along with treatment based on plant disease detection with response time less than 1 ms. The disease detection is based on the features such as color, texture, and shape. The other researchers are encouraged to detect the disease with enhancement in features. The 'Agri-guide v1.0' gives accuracy of 83 % for known patterns whereas 73 % for unknown patterns of monocot and dicot plant diseases.

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Determination of Area Change in Water Bodies and Vegetation for Geological Applications by Using Temporal Satellite Images of IRS 1C/1D

Mansi Ekbote, Ketan Raut and Yogesh Dandawate

Abstract Watershed management is a topic of great concern in the areas coming under shadow zone of rain. Watershed management needs the information about the area covered by water bodies and the relative change in the water body area over the years. This information can be obtained from field survey or by remote sensing. In remote sensing the satellite image is classified into a range of types of land covers by land use and land cover segmentation. The area of segmented water bodies is calculated and validated with the ground truth obtained by field survey. Pondhe village in Pune district is taken into consideration in this particular study. The temporal satellite images of this area are classified into various land covers, and area calculation is carried out. The reduction in water bodies and in the vegetation area is observed over the years by 2.94 % and 27.10 % respectively. The same technique can be used for various regions in future to provide change in areas and to establish a link between geology and image processing.

Keywords Land use land cover (LULC) classification · Image segmentation · Satellite images · Watershed management

1 Introduction

Every continent has been affected by water scarcity. About 1.2 billion people that are around one-fifth out of total world's population live in physically water scare areas. Around 500 million people are soon to face the same situation. About 1.6 billion persons that are nearly equal to a 25 % of world's overall population suffer

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from economic water shortage. Economic water storage occurs when countries fail to build the infrastructure which is necessary to take water from rivers and aquifers.

In urban India scarceness of water is becoming number one woe at a very fast rate. It has been revealed that out of 32 major cities, 22 have to face water shortage on daily basis. The condition is even worse in rural India. 73.2 % of rural population has undersupply of water. Therefore, watershed management becomes India's crying need. Planning and development of watersheds needs proper understanding of movement and occurrence of water in surface and subsurface systems and also earth and nutrient fatalities in watershed.

The proposed work aims to categorize the land use and land cover. Land cover indicates the physical land type, like open water, forest, or bare land. Land cover can be determined by studying the satellite and aerial imagery. Land cover maps present data to assist managers best comprehend the current landscape. To get an idea about change over time, land cover maps of several different years are required. With this data, managers can weigh up past management decisions as well as gain insight into probable effects of their present decisions before they are implemented. Land use shows how people use or utilize the landscape—whether for conservation or development or mixed uses. Land use cannot be determined from satellite imagery. Land use and land cover segmentation is done based on different intensities of various regions in satellite image. The images are taken from IRS 1C/1D satellite launched by ISRO (Indian Space Research Organization). The satellite images taken here for study are in GeoTIFF format. Each satellite image is divided into three areas, viz., land, vegetation, and water bodies and each area is represented by on separate plane. The rate of degradation of vegetation and water bodies is calculated over the period of 15 years. The study area for this project is Pondhe village in Purandar taluka, Pune district. This area has extremely fertile land but its utilization is limited due to scarcity of water. Thus this area seeks for some measures to conserve the water resources already available and also to find some ways to enhance the water resources.

This paper proposes an efficient way of classifying satellite image in different land use and land cover which is used to calculate the areas covered by various land covers. The calculated area in number of pixels is then linked to the actual area in square meters obtained by actual field survey. The change in area covered by water bodies and the area under vegetation is calculated and the rate of change is deliberated. This offers an important tool for planning and management of watershed. The flow of this method is divided into five main stages which are preprocessing, segmentation, classification, area computation, and accuracy validation. In the first stage, preprocessing, original satellite image is applied with wiener filter. This removes blur from input image if any. Then the image is resized to a lower size. Satellite images are low contrast images by default. So in order to make the image suitable for segmentation, satellite images are subjected to contrast stretching and histogram equalization. For segmentation, using intensity-based classification on these three planes the land use and land cover classification is performed. After segmentation the area of various land covers is computed in number of pixels. Finally, this area is linked to the physical area in square meters and a geological

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relation between land use and land cover is derived. To avail this study in geological point of view and to provide an aid to water conservation, rate of change of various land use is computed. The land use and land cover classification to be useful is associated with the geological observations. The relation between geographical and geological data is derived by this segmentation process. The changes in various areas over the years are observed and a relation is established to see how various geological aspects are changing over time.

The remaining paper is organized as follows: literature survey is presented in Sect. 2. The proposed scheme is described in Sect. 3. Section 4 illustrates the segmentation process. Area calculations are included in Sect. 5. Section 6 presents a conclusion of the method proposed and study carried out.

2 Literature Survey

Various techniques are evolving day by day to classify satellite images into various land use and land covers. The goal is to reduce computational complexity of the method while increasing the accuracy. Various traditional as well as new methods of classification and segmentation are studied and implemented to check their suitability and accuracy of segmentation for this work proposed. Few of the important literatures studied are included here.

Pradhan et al. [1] proposed a technique to categorize Google earth images to calculate roof area in aim of estimate rainfall and to help in rainwater harvesting. They made use of GLCM, k-means clustering algorithm for this work. In this method the parts of the satellite images are segmented and classified by the use of k-means algorithm. The residential areas and built up areas are then separated. Then the roof top area is calculated. Using this calculated area of this roof tops, the water runoff is computed based on the rainfall. Rainwater harvesting schemes can be designed by this estimation, for water conservation, recycle, and percolation.

Prasad et al. [2] proposed a method for classifying land use and land cover in multispectral satellite images using SVM classifiers. They used SVM, Hierarchical Clustering Algorithm, Fuzzy C-Means Clustering. The accuracy of this method was 83.2 % and this method was not suitable for low contrast images.

Shiraishi et al. [3] proposed a scheme for fully supervised SVM Classifiers, ensembles of S one-class SVDD Classifiers. The specially aimed area is classified into various land cover classes by supervised classifiers.

Longbotham et al. [4], proposed a dexterous system for land use image classification. They made use of image various methods for processing the images and Support Vector Machines (SVM). The way calls for Training of the SVM and Testing of SVM. The image data is subjected to nonlinear isotropic diffusion and unsharp filtering in the stage of training. For training the SVM input is the segmented image pixels which match the land use parts. To make the testing automated, the regions segmented were mined out by using the active contour model.

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The SVM which has been trained is then correctly classified into the regions of land cover on the basis of values of pixels of the area which is mined out.

Many researchers have presented various methods for land use and land cover classification [5–8]. Out of number of techniques studied, the methods useful for satellite images are shortlisted and tried on the set of satellite images of desired area. In our case, due to the eastward slope of land, active contouring method failed to present accurate results. Also due to very low change in intensities, k-means clustering gave misclassified clusters. The methods though suggested good means of classification, did not present any way of area computation and making it significant for geologists, water managers and various committees of water conservations. Thus there is a need of tool which can establish a link between image processing and geology. Once, this method works out well for area under study, the same method can be used for different areas and a geological survey can be made easier. The proposed work focuses on this application.

3 Proposed Scheme

A general flow of method to obtain the desirable results from the input is explained in this section. The complete method is organized in four main steps: preprocessing input satellite images, segmentation of preprocessed image into different land covers computation of area of each area and finally validates the accuracy of results obtained by comparing with ground truth data. The block diagram of technique being proposed is represented in Fig. 1.

In the presented approach, the input is satellite image of area under study. The satellite images are in GeoTIF format. The satellite image is of very high resolution. These images are of same area taken in different years. The time series of images covers a period of 15 years.

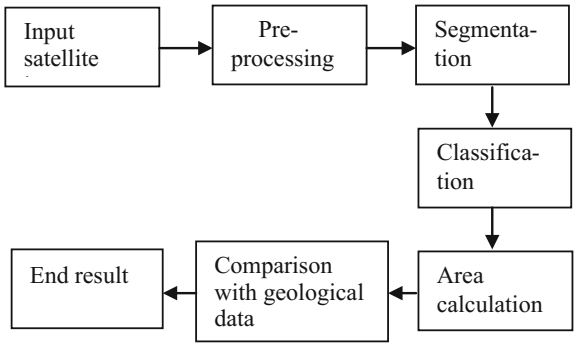

Fig. 1 General block diagram of system

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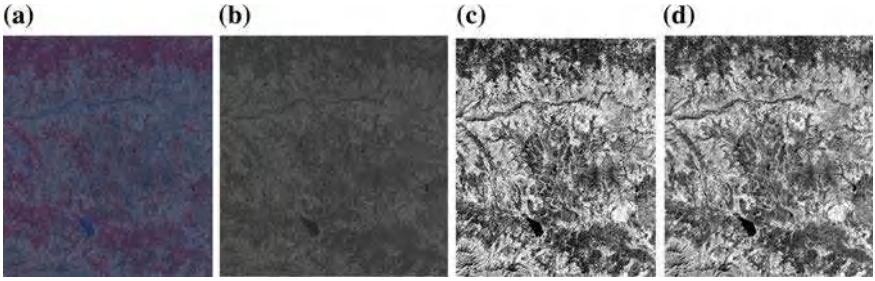

Fig. 2 Preprocessing results. **a** Original satellite image. **b** Grayscale image. **c** Contrast stretched image. **d** Histogram equalized image

The input image is then undergone to preprocessing. The input images readily are not well suited for further processes, thus there arises a need to preprocess the input satellite image and make it ready for next stage. The blur, low contrast, darker intensities, and high dimensionality of satellite images make the segmentation a great challenge. Thus following preprocessing steps are conducted. In preprocessing step, the image undergoes resizing, contrast stretching, and deblurring. In preprocessing a good care has been taken to maintain the quality of the image. The results are shown in Fig. 2.

The preprocessed image is then given to segmentation stage where it is segmented into various land use and land covers. The segmentation is done based on intensity value of each pixel. The satellite image is classified into three land covers, viz., bare land, water bodies, and vegetation. The area of interest, that is, vegetation and water bodies are observed over a period of time to determine what change has been taken place and at what rate and also to estimate the possible condition and suggest protective measures for avoiding problems.

Once the image is classified into desired classes, the next stage is area computation. The area of each land cover is calculated in terms of number of pixels. The already available area in square meters obtained via field survey is linked with this calculated area and a relation between image area and physical area is established.

The relation established between image area and physical area in the previous stage is checked in the last step of accuracy validation. In this stage the hypothesized relation is tested for rest of the images in the data set and the correctness is verified before presenting the end result of classified satellite image.

3.1 Study Area

In Pune district of state Maharashtra, a classic village, named Pondhe is situated in eastern parts. The watershed of Pondhe is positioned about 60.5 km starting Pune

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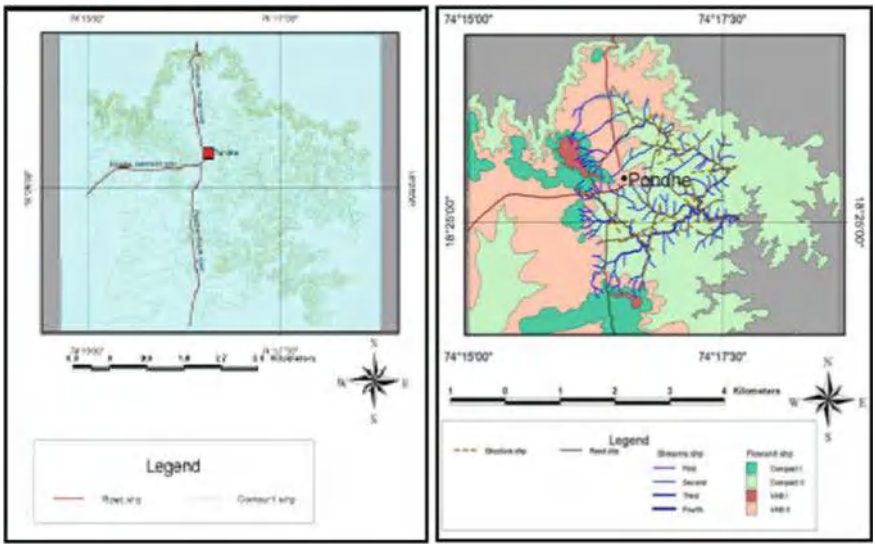

Fig. 3 Base map and geological map of Pondhe village (*Source* ACWADAM, p. 5, 10)

town. Figure 3 is a base map and geological map of the watershed which has been arranged with the reference of Survey of India Toposheet numbered 47/J/7/NW [9]. At the bottom of the wide crest which characters the western partition of the watershed, Pondhe village is situated. The area is encircled by the latitudes 18° 25′N and 18° 27′30″N and by the longitudes 74° 15′E and 74° 17′30″E [9].

4 Segmentation

Segmentation is the heart of the proposed work. The accuracy of the whole technique depends on the accuracy of segmentation. There are numerous segmentation techniques for land use and land cover. But our goal is to provide a technique which is computationally simple and accurate. Thus after a comparative evaluation of various methods following method is devised and proposed.

First, the input image is divided into three color planes red, green, and blue. Then on each plane, segmentation is carried out based on the value of intensity separately. An average intensity value of the entire plane is calculated first and then the threshold for segmentation is decided. Once the threshold has been set, the regions of the image plane having intensities above the selected threshold are set to 255, i.e., the maximum intensity and rest are set to zero, i.e., minimum intensity.

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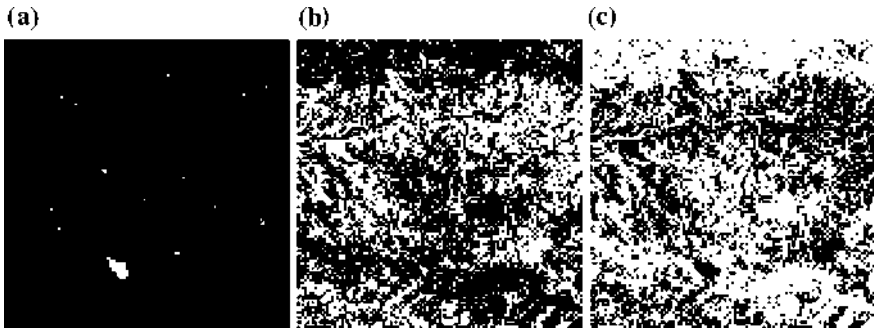

Fig. 4 Segmentation results. **a** Water bodies. **b** Vegetation. **c** Bare ground

Mathematically representing the above relation for segmenting water bodies from the satellite image,

$$i'^{(s,j)} = \begin{cases} 255, & r(s,j) < b(s,j) \text{ and } g(s,j) < r(s,j) \\ 0, & \text{otherwise} \end{cases} \quad (1)$$

where,
$i'(s, j)$ is the new intensity value for the pixel (s, j) and
$r(s, j)$, $g(s, j)$, $b(s, j)$ are the red, green, and blue components of the pixel (s, j).

Similar relations are derived for segmenting other areas too.

Thus as an output of segmentation we get, three planes each representing one area or one land cover. For segmenting water bodies, blue plane of image is used. For segmenting vegetation part, green plane is used. Whereas, these two areas when subtracted from original image we obtain the remaining area which is nothing but the bare land. The results of segmentation are shown in Fig. 4.

5 Area Computation

To make segmentation results beneficial for end user, we need to represent various areas statistically. Here, the area of each region is calculated in terms of pixels. The area in pixels is mapped with area in square meters. This mapping establishes a link between the area computed by the proposed method and the physical area of that particular region. Once the mapping is done, the relation is tested for several images for accuracy validation. The results are then compared with the ground truth, which is nothing but area calculated by actual field survey. The variation of various areas over the course of 7 years is represented in the graph below in Fig. 5.

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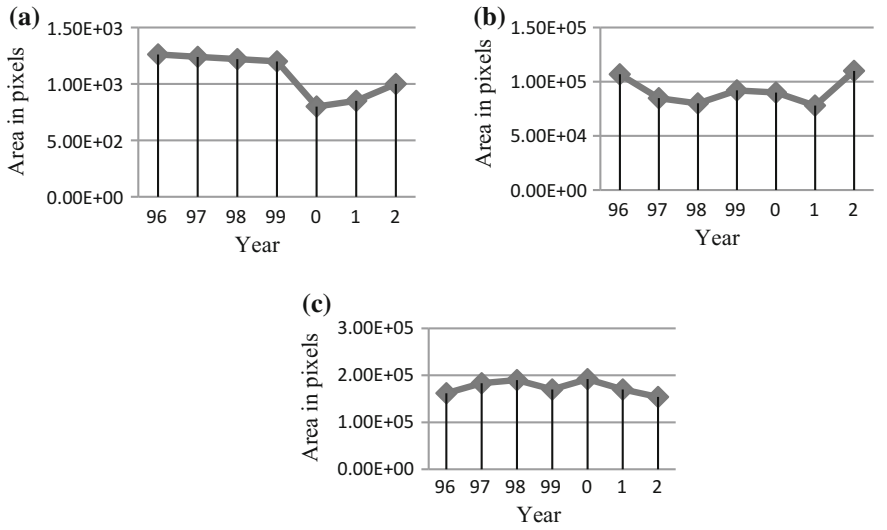

Fig. 5 Variation of land covers. **a** Water. **b** Vegetation. **c** Bare land, over 1996–2002

6 Conclusion

The approach described, a classification system, based on processing of the images, for land use and land cover and computing areas of land, water bodies, and vegetation in Pondhe village located in Purandar taluka in Pune district, is presented. The algorithm uses satellite images of Pondhe village obtained from NRSA database. The main aim of the presented work is to help geologists, water resource engineers, builders, and architects for taking crucial decision such as water content in particular area, for study of water flow, soil quality, and texture analysis respectively. The degradation of water bodies and vegetation is observed over the period of 7 years by 2.94 % and 27.10 % respectively. Thus, a tool is presented to aid water management and with the verified accuracy the technique can be used for different areas too.

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Significance of Independent Component Analysis (ICA) for Epileptic Seizure Detection Using EEG Signals

Varsha K. Harpale and Vinayak K. Bairagi

Abstract Electroencephalography (EEG) is a measurement tool to measure electrical activity generated by translating chemical variation in brain into voltage. EEG signals are measured with multielectrode placed at properly localized part of the brain with either intracranial or extracranial (Scalp EEG) method. EEG analysis has become very important to detect various human diseases. Usually, EEG signals are recorded with the multichannel acquisition module. It is very data intense, time and resource consuming because it should handle a heavy workload of computations. As EEG signal composed of various random signals, independent component analysis (ICA) is considered to be very important method. This paper specifically studies significance of ICA in Epileptic seizure detection using EEG signals. Mostly ICA is used for EEG artifact removal from raw EEG signals. Thus ICA is useful in removing artifacts and improving epileptic seizure detection accuracy.

Keywords Electroencephalogram (EEG) · Seizures · Independent component analysis (ICA)

1 Introduction

Various real-time biomedical devices use the EEG information for diagnosis of brain disorders, thus demands real-time digital signal processing of EEG signals. Intracranial EEG is preferable during surgeries and scalp EEG signals are most commonly used for diagnosis and monitoring central nervous system activities [1]. The electroencephalogram (EEG) is a well-proven measurement tool to measure

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electrical activities in brain. These measured signals containing various artifacts such as muscle movements, eye blinking, and instrumental electrical noise [2]. ICA is a mathematical tool for extracting individual and independent components from mixed EEG signal. Most of the random signal analysis uses ICA for extraction of independent sources from high-dimensional recorded data as offline signal analysis [3]. Most of the research carried in this area uses only two channels, whereas for better spatial resolution and improved accuracy of detection or prediction of diseases more numbers of channels are preferable [4].

Development of epileptic seizure initiates ictal activity, this is analyzed to detect epileptic zone of each channel [5]. There are various high performance tools such as Electroencephalography (EEG), functional Magnetic Resonance Imaging (fMRI), Near Infrared Spectroscopy (NIRS), and Magnetoencephalography (MEG) for brain signal analysis. Recent brain research demands the design and implementation of real-time system. While implementing such real-time system computational complexity, hardware optimization, and power dissipation are the challenges. Designing real-time system with asynchronous circuit's benefits in power optimization as clock is measure component of power consumption.

Epilepsy is considered to be major neurological disorders among all brain diseases [6]. Currently, numerous antiepileptic drugs are available for seizure control, but 30 % of epileptic patients remain either drug-resistant or develop limiting adverse effects [7]. The occurrence of epileptic seizure is detected and suppressed using an electrical stimulator [8]. High performance and accuracy algorithms or devices are required in order to use electrical stimulator. Earlier research demonstrates various real-time seizure detector methods [9] but still further improvement is expected.

Since artifacts because of eye blinking and muscle movements affect the accuracy of epileptic seizure detection, it is required to separate from EEG signals of interest. Principle of artifact removal using independent component analysis (ICA) [10] is based on decomposition of mixed signals recorded from different sources. ICA processor implementation with closed-loop system can be designed to enhance the performance of epileptic seizure detection [11].

This paper includes Sect. 2 which gives idea about selection of features for EEG signals, Sect. 3 explains about concept of independent component analysis; Sect. 4 covers significance of ICA, Sect. 5 gives recent trends in EEG analysis architectures on the basis of various performance parameters and Sect. 6 concludes this work.

2 Selection of Features for EEG Analysis

Electroencephalogram (EEG) is a tool which records a multifrequency nonstationary brain signal from various localized channels. Feature extraction is very important aspect of the analysis and classification of EEG signals. Repeatability and regularity (periodicity) of the signal are well analyzed by autocorrelation function

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for differentiating brain signal into seizure, non-seizure, and pre-seizure EEG. The autocorrelation for nonstationary signal is not robust because of highest changes during seizure, thus during seizure regularity of the signal increases and EEG signal behave more oscillatory in nature [12].

EEG is a nonstationary signal, comprises of events at different frequencies. Most commonly used frequency domain feature is Power Spectral Density (PSD). PSD has the limitation that it cannot isolate the time at which frequency of interest occurs. Spectrogram, sequential computation of PSD over small window is calculated to extract frequency and temporal information for detection of seizures in EEG signal.

EEG related time frequency features such as event-related shifts in the power spectrum or event-related spectral perturbation (ERSP) and inter-trial coherence (ITC) (event-related phase-locking) can be used as shown in Fig. 1.

Various methods are adopted to extract time–frequency information such as Gabor Transform, Hilbert Houng Transform, Wigner Ville Distribution, and wavelet Transform.

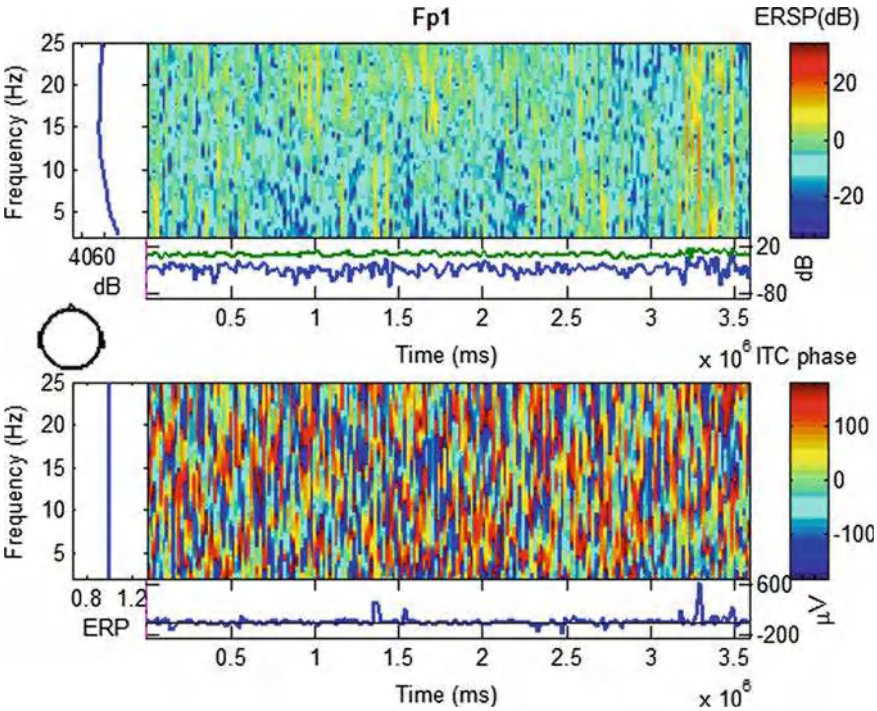

Fig. 1 Time frequency analysis of ERSP and ITC

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3 Independent Component Analysis (ICA)

Independent component analysis (ICA) is a statistical tool, normally used for blind source separation [13]. ICA also has significant application in EEG artifact removal and feature extraction.

3.1 Concept of ICA

ICA model assumed that source signals are statistically independent and has non-Gaussian distribution. It is composed of independent source signals s_i, unknown mixing matrix A_i and mixed signal x, where $i = 1, 2, 3 \ldots n$. This mix signal component can be represented as per Eq. (1).

$$x = \sum_{i=1}^{n} A_i s_i \tag{1}$$

Here A is assumed to be square matrix, x and s are considered to be vectors. While obtaining independent signal, inverse of unknown matrix 'W' need to be calculated and used to find value of 's' as shown in Eq. (2).

$$s = A_i^{-1} x \; or \; s = Wx. \tag{2}$$

This ICA has some limitations like determining variance and order of independent component is difficult, but still this is preferable for signal separation. Thus basic objective of ICA model is to estimate unknown mixing matrix. Source independence can be verified with probability density function (PDF). If joint probability of source $s1$ and $s2$ is $P(s1, s2)$ and individual probability function for $s1$ and $s2$ are $P(s1)$ and $P(s2)$ then two sources are considered to be independent only when it satisfies Eq. (3)

$$P(s1, s2) = P(s1)P(s3) \tag{3}$$

Independence also can be checked with covariance of $s1$ and $s2$. Signals are said to be independent if its covariance is zero. Non-Gaussian property of signals can be verified by kurtosis function.

3.2 Processing Steps in ICA for EEG Signal

3.2.1 EEG Data

Standard database [14] of epileptic seizure collected at the Children's Hospital Boston is used to understand ICA concept applied to EEG signal. EEG recording of 22 patients with sampling rate of 256 samples per second and 23 channels is used

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for testing. The International 10–20 system for EEG electrode location was adopted to record the data. Here experimentation is performed with a single subject and data of 1 h recording.

3.2.2 Kurtosis for Non-Gaussianity

An arbitrary distribution of integrated independent signals tends to Gaussian distribution. If Independent signals are mixed then they can be separated by linearly transforming signals as non-Gaussian. Thus non-Gaussianity is very important in calculation of ICA components. Normalized signals thus tested for non-Gaussianity using kurtosis. If signal 'x' has unit variance its kurtosis is the fourth moment of that signal as defined by formula given in Eq. (4)

$$\text{kurt}(x) = E\left(x^4\right) - 3\left(E\{x^4\}\right)^2 \tag{4}$$

Figure 2 shows statistic of one patient recorded with 23 channels and thus clears non-Gaussianity of individual signals. This statistics is calculated by EEGLAB Toolbox, which shows kurtosis is nonzero and thus non-Gaussian behavior of signals.

3.2.3 Independent Components

Independent Component Analysis (ICA) is a signal processing tool that separates statistically N independent inputs which have been mixed linearly in N output channels, without knowing their dynamics. The EEG signal frequency range is the mixing of brain fields at the scalp electrodes and their distribution is linear. ICA gives the scalp topographies of the independent components thus support source localization. If we apply ICA to the single continuous recording of patients, it defines power distribution, frequency distribution, and topographic presentation of independent components. Figure 3 shows spectrograph for power density function for 6, 10, and 22 Hz frequency. Similarly, all independent components and their spatial characteristics can be observed with Fig. 4.

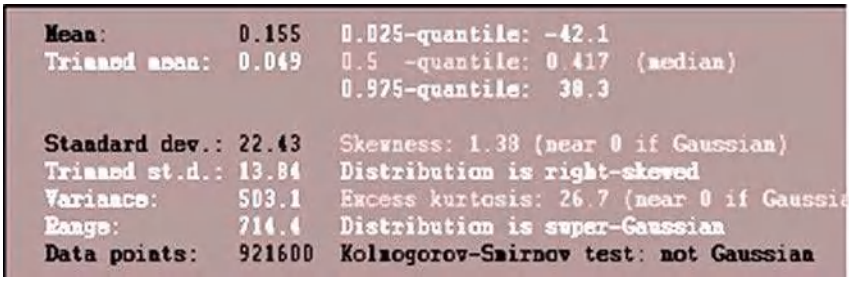

Fig. 2 Parameters for testing non-Gaussian distribution

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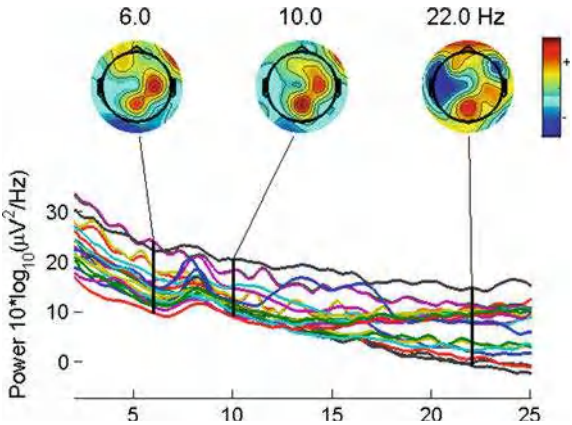

Fig. 3 Specto map of EEG signal

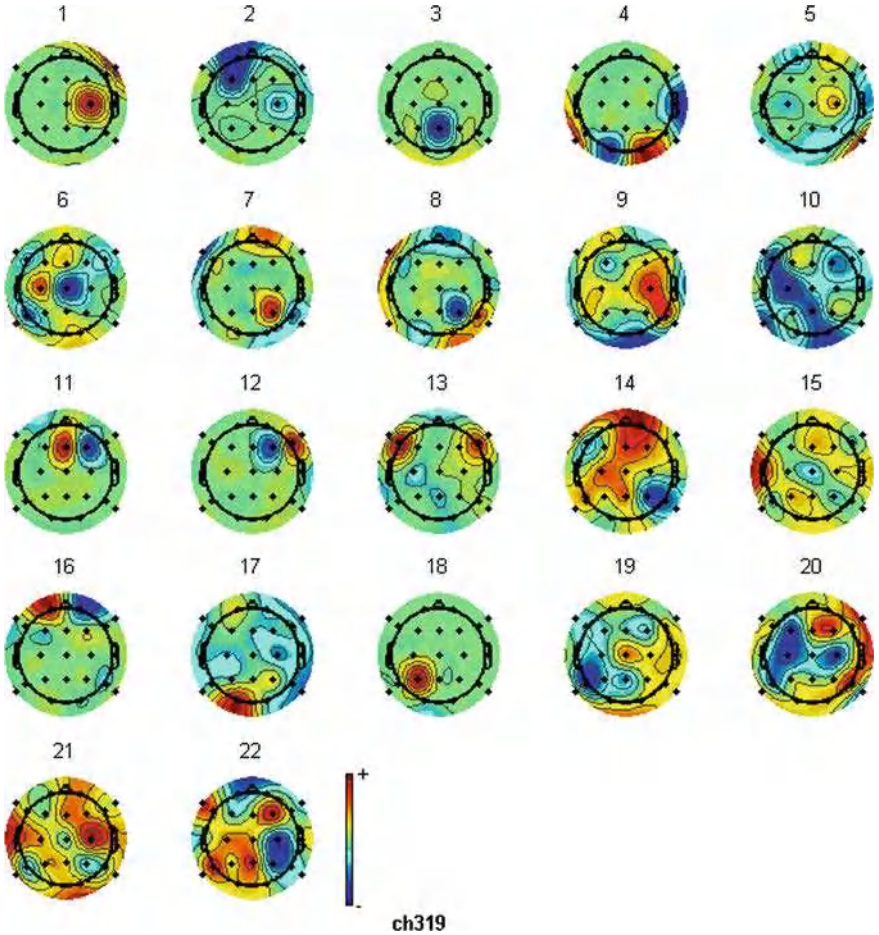

Fig. 4 Independent components and their spatial mapping

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4 Significance of ICA in EEG Analysis

Thus ICA plays very important role in various mixed signal analysis. In EEG analysis ICA model is mostly being used for feature extraction, seizure detection, and artifacts removal. Mammone and Foresta et al. [15], proposes hybridization of wavelet and ICA for significant artifacts rejection from EEG signals recorded by multichannel scalp EEG electrode. This automatic wavelet independent component analysis (AWICA) provides full automated solution for artifact removal from scalp EEG with improved performance.

Arunkumar and Balaji et al. [16] uses principle component analysis (PCA), independent component analysis (ICA), hurst exponent (H) for epileptic seizure detection. The system could achieve 73.8 % seizure detection rate by ICA, hurst component with thresholding method and 87.9 % with wavelet transform.

Soomro and Badruddin et al. [17] proposes eye blink artifact removal method using Empirical Mode Decomposition (EMD) and ICA. The system could achieve signal to artifact ratio (SAR) as −19.1673 dB for noncorrected EEG and 2.71 dB for corrected EEG. Thus most of the research in the field of ICA, FastICA and EEG carries artifact removal with good rejection capability as shown in Table 1.

Table 1 Application of ICA for artifact removal from EEG signal

Authors	Methodology	Application and performance parameters
Liao and Shih et al. [18]	System on chip architectural design with 90 nm CMOS tech. for online recursive ICA(ORICA)	Power consumption 8.56mW and latency 0.2532 s
Soomro and Badruddin et al. [19]	Hybrid model of empirical mode decomposition (EMD) and advanced canonical correlation analysis (CCA)	2.2–6.0 dB improvement in signal to artifact ratio (SAR)
Jirayucharoensak and Israsena et al. [20]	Neurofeedback system is designed for artifact removal using ICA and wavelet transform	Attention analysis with good artifact removal
Liao and Fang [21]	Online recursive ICA(ORICA) for artifact removal	BCI application
Bedoya and Estrada et al. [22]	Fuzzy classification based on (Learning Algorithm for Multivariate Data Analysis) along with ICA	BCI application
Zachariah, and Jai et al. [23]	Artifact removal with hybrid model of wavelet transform and ICA	Increase in accuracy and reduction in processing time achieved.
Mammone and Foresta et al. [15]	Hybrid model of ICA and Hurst Exponent	Epileptic Seizure Detection with 87.9 % detection rate
Heute and Guzmán et al. [24]	Combination of ICA and Adaptive Weiner Filter is used	Improved artifact rejection ratio
Mahajan and Morshed [25]	Combination of ICA, modified Multi-scale entropy (mMSE) and wavelet denoising	average sensitivity: 90 %, average specificity: 98 %, average execution time: 0.06 s

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Table 2 Comparison of various EEG analyzer architectures

Parameters	Huang 2008 [2]	Van 2011 [26]	Yang 2015 [11]
Implementation approach	FPGA	ASIC	ASIC
No. of channels	4	8	8
Operating freq (MHz)	68	100	11
Power dissipation (mW)	–	16.35 W	0.0816
Gate count	315 K	272 K	69.2 K
Core area (m^2)	–	1.4872	0.3869
Max. latency(ms)	–	290	84.2
Algorithm	Info Max	Fast ICA	Fast ICA
Application	EEG	EEG	ECoG

5 ICA Architectures of EEG Analyzers

The EEG signal analysis provides a proper detection of the mental disorders of human being. Recent studies include combination of analysis of EEG and heart rate variability to improve diagnosis and treatment methods.

Chen et al. [3] presents SoC architecture designed using with ICA and loseless data compression. This architecture is complexity-efficient with an average correlation of 0.9044 and power consumption optimized by 41.6 %. Jenihhin et al. [4] was based on an original patented algorithm for SASI calculation. For the proof of concept it was, first, implemented as a MATLAB program running on a computer connected to a commercial EEG signal capturing equipment.

Chen et al. [9] presented a solution for epilepsy seizure detection. The proposed SoC is a combination of signal processing closed loop system with an 8-channel Intracranial EEG (iEEG) and 10-bit ADC. It also includes an electronic stimulator based on adaptive high voltage and a wireless transmission link. To improve the performance of epileptic seizure detection, independent component analysis (ICA) is applied by Yang et al. [11] to multichannel signals.

Table 2 shows the comparison of different SoC architecture designed for EEG signal analysis by various authors and concludes Yang et al. [11] shows better performance, with limitation of low operating frequency.

6 Conclusion

The electroencephalographic signals are random signals collected from different locations of electrodes placed on the scalp. Various time and frequency domain features can be calculated and selected as per requirements. These also comprise of various artifacts such as eye blinking and muscle movements. Independent Component Analysis (ICA) is one of the well-proven artifact removal methods. Combination of ICA and other methods such as ESD, entropy, and kurtosis improves

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signal to artifact ratio and assure corrected signal without artifacts. ICA can be also used for epileptic seizure detection, but the accuracy improvement still is a challenge in this method. There is one more scope of system on chip (SoC) and FPGA implementation of ICA method for seizure detection with greatest accuracy.

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ESMD: Enhanced Suspicious Message Detection Framework in Instant Messaging Applications

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Abstract— **The excessive use of Instant Messaging Applications (IMA) and Social Networking Sites (SNS) has tremendously increased the suspicious information sharing activity which in turn is effectively used for evil purposes too. Many of terrorist and extremist organizations use these as a means of latent untraced communication for criminal activities. Surveillance of instant messages which usually include abbreviated or short-form words with malicious intent are difficult to detect. These words cannot be detected by an earlier OSMD surveillance tool, resulting in the concealment of suspicious messages. For detecting suspicious messages, the SFC program is proposed for OSMD which is renamed as Enhanced Suspicious Message Detection (ESMD) Framework that converts short form into full-form words and then categorizes the type of crime. Further, ontology-based information extraction technique (OBIE) and logical predefined rules are used for the detection of suspicious words from domain experts blended with the information taken from historical knowledge of suspicious dataset i.e., GTD (Global Terrorism Database).**

Keywords- Instant Messaging Applications (IMA); Social Networking Sites (SNS); Short-Form Correction (SFC); Enhanced Suspicious Message Detection (ESMD) Ontology-based Information Extraction technique (OBIE); pre-defined rules.

I. INTRODUCTION

Social networking service is an online platform that people utilize to make good social relationships with other people by sharing their personal traits, interests, behavior, historical events of their life to establish strong affection. Users are forced to expose their personal profiles on these websites or apps of SNS as requested by them. Thus, the SNS is designed so intelligently that it groups like-minded people based on their profile details such as characters, interests, education, hobbies, likes, and dislikes which assist in establishing strong connectedness among these online users of other social networks. Many SNS are web-based that provides the platform for online users to share their views over the Internet via audio and video conferencing, online chatting and also through forums.

The criminal minds had indulged in the usage of SNS for sending suspicious messages, criminal activities, and plans. The tracing of such e-criminals becomes extremely difficult for the e-crime department to identify them from SNS, due to the bulk of messages communicated through social networks from one group of users to another group of users. Monitoring such e-criminals from innumerable messages that to from SNS is an extremely impossible task for the cybersecurity department.

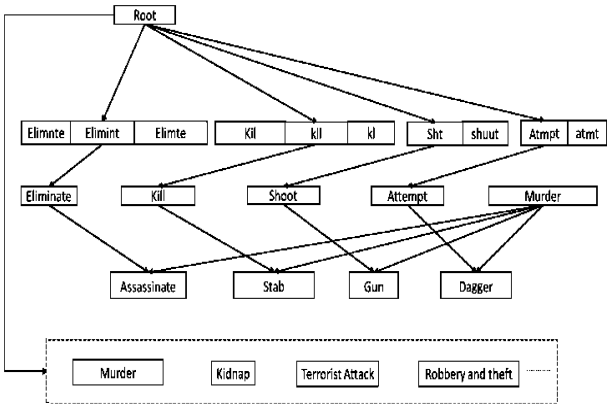

Fig 1: Taxonomic structure for Conversion of short-form words to Full form words

Because of many issues and restrictions of cyber laws that need special permission and access to online messaging servers of various SNS, which may also require special international permission as per the cybercrime act [12]. Nowadays the e-criminals adopted new techniques of sending suspicious messages in SNS through short-forms and code-words.

Even though many methodologies to detect cyberbullying among which deceptive Phishing in IMs for text-related messages being developed [1] [2], there remains some inefficiencies in the detection process of suspicious words in the IM & SNS. As it may also contain shorthand or short-form words in those microblogs which are being communicated. These words cannot be detected by the help of regular surveillance tools leading to concealment of suspicious messages. To overcome this, a solution is proposed to detect these messages by using an SFC algorithm for efficiently detecting of short-form words and categorize the type of crime. The taxonomic structure that converts the short form words into full form words which are suspicious is shown in Figure 1. For testing, very rare datasets exist for cybercrime detection due to security reasons. We had taken the user-generated content (UGC) consisting of suspicious words to test our ESMD framework. The UGC test-bed is checked using pre-defined rules that are taken from past learning experiences through brainstorming sessions of cybercrime domain experts for which suspicious datasets GTD (Global Terrorism Database) is taken as a benchmark [3].

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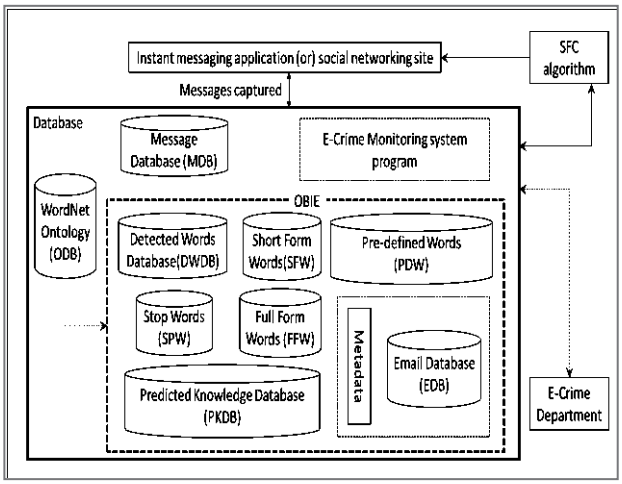
The section I, gives a brief overview of deficiencies that exists in IM services and problems faced in IMA and SNS for detecting of cybercrimes. The remainder of the paper is organized as follows: Section II, reviews the current research advancements in pinpointing crooks from messages sent via IMA or SNS. Section III illustrates the detailed components of the proposed Enhanced Suspicious Message Detection (ESMD) Framework to confirm the messages or posts that are sent are suspicious or not even when short forms being used in microblogs and show methodology adopted in tracing out the offender. The results of our practical implementation are discussed in Section IV, which is tested on the UGC test-bed. Finally, Section V concludes the paper that identifies the future research scope to improve the ESMD Framework further.

II. RELATED WORK

Many of surveillance projects exist that catch malware and fraud detection, few of them are CANTINA, Net craft, and Spoof Guard; none of them used to expose the information which is found in SNS that has suspicious words. There are very few approaches to detect cybercrime messages from Twitter, Facebook and other social media is limited to cyberbullying [4]. DARPA is actively involved in the surveillance of ubiquitous words used in various types of criminal activities and provides early detection methodologies to identify the possibilities to prevent from being executed [5]. Yang exposed, the usage of weblogs that illustrated how these extremists execute their criminal activities under the weblog social network project that had provided the criminals an unidentified platform to propaganda their activities [6].

In recent times the Facebook chat communications and photos are monitored to identify criminal behavior [7]. Detection of suspicious emails from static messages using decision tree induction proposed, which is purely dependent on the highest information entropy, that identifies the e-mail is deceptive or non-deceptive [2]. Surveillance tools fail to detect the type of threat activity (Murder, terrorist attack, Match Fixation, Drug smuggling, Kidnap, Robbery and theft, Corruption charges and Sexual harassment) and also the spying for suspicious messages is difficult which, when contains short-form words. These words cannot be detected by the help of regular surveillance tools that lead to concealment of suspicious messages. We propose a solution to detect these messages by using an SFC algorithm which efficiently detects these short-form words and categorize the type of crime. The proposed ESMDs Framework can be deployed on various IMA & SNS to overcome the above problems for reducing the cybercrimes by tracing the cyber-attackers and helps in mentoring the national as well as international security.

The next section, illustrates the improvised ESMD framework which is proposed to detect short-form suspicious messages.



III. ENHANCED SUSPICIOUS MESSAGE DETECTION FRAMEWORK

Fig 2: Architecture of the ESMD Framework.

In this section, we present the working components that are used in the ESMD framework. We used different databases (to store user microblogs), ontology-based information extraction (to identify synonyms of suspicious words in messages) and pre-defined rules. This proposed ESMD framework has the tendency to predict suspicious words from microblogs that contain short-forms which can be effectively integrated in existing IMA and SNS (Google Talk, IMO, Whatsapp, Skype, Facebook, Twitter, and others) respectively. The components of the ESMD framework is depicted in Figure 2 are as follows:

A. Word extraction from unstructured text using ontology.
B. ESMD Framework *(A Generic Approach).*
C. Short-form to Full-form Conversion (SFC) Algorithm.

Messages sent among the client modules are identified and stored in the various databases. The reason of using different databases is to better understand the working of ESMD, these databases are named as ODB, MDB, FFW, SFW, DWDB, SPW, PKDB, PDW, EDB, and metadata. In ESMDs, to store chat sessions between the user's Message database (MDB database) is used. Short-form words (SFW) consist of words that are neglected and to be converted into full form words are stored which are ignored temporarily.

Ontology database (ODB) is a lexical database that logically groups words, synonyms, concepts, taxonomy (concept hierarchy), axioms and pre-defined rules. FFW captures the converted SFW words after filtering out unnecessary words (SPW) from instant messages (MDB), which is checked by ODB as and when it requires. The suspicious Pre-defined words (PDW) chosen by the e-crime department is shown in Table 1. The PDW suspicious words are compared at run-time with FFW and SFW words.

Table 1. Shows Three (3) rules which is to be met by OBIE Model for extracting of the stem words

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RULE 1 (PDW)	
Root of threat activity (Domain)	**Stem words that are to be predicted**
Murder →	Kill, assault, assassinate, eliminate, gun, dagger, knife, stab, location, money.
Kidnap →	Hijack, capture, seize, abduct, usurp, grab, gun, take hostage, location, amount, kill, property.
Terrorist attack →	Bomb, vehicle, location, suicide attack, bag, holy_place, laptop, demolish, payment, cash.
Drug supply & Smuggling →	Packet, brown sugar, cash, cocaine, hashish, M.tabs, Methaqualone, opium, charas, location, injection, Morphine, LSD STR/ECA, dibucaine.
Match Fixation→	Location, luxurious flat, cash, hotel, bet, gifts (car), virgin girl, bank, payment, loose game.
Corruption charges →	Luxurious flat, money, bank, cheque, deposit, diamond, avoid tax, laptop, offshore account.
Robbery & theft→	Jewelry shop, place, bank, night, gun, knife, location, vehicle, break, night, keys, locker.
sexual harassment→	Phone messages, beautiful, come, payment, spend night, location, jewelry items, park Hotel, car gift, body parts, property, help, Job.
RULE 2 (threshold value)	
Check user specified threshold value for stem word which belongs to other domains, using GSHL Algorithm as shown in Figure 3	
RULE 3 (undetected words)	
Un-clear and un-identified words required to be checked and corrected by mapping with nearness of the stem words using SFC algorithm and ontology taxonomy constructed on each of the stem words of rule *1*.	

When the detected words are found to be suspicious, the e-crime spying program is initiated by Tree Alignment program (Figure 5), during this process of finding suspicious words if the short form is detected they are converted into full form words with the help of SFC algorithm (Figure 8). PKDB stores the actual set of predicted words under each domain. EDB (email database), saves the e-mail information of each of these users such as user-names, education & achievements, place details, cell number, and other relevant information. Interestingly, sufficient biography information is captured by these users. Metadata maintains the information related to databases and users' information to whom this message belongs and other confidential information pertaining to ESMDs (timestamp, receivers and sender's location details, etc.). Just like a log history of IM and SNS.

A. Word Extraction From Unstructured Text Using Ontology

i. Information Theory principle using probability

Ontology uses the probabilistic models which construct the Taxonomy of words under a particular domain hierarchy. The GSHL algorithm [8], is one that represents the concept hierarchy based on the information theory principle [9]. Kullback-Leibler, divergence **($D_{KL}(P||Q)$)**(which is well-known as relative Entropy) is used for building the relationships between the topics [9]. Following the Gibbs inequality [9], KL divergence value is to be: $D_{KL} > 0$.

ii. Topic (Domain) Hierarchy Construction Algorithm

After defining of the information principle, above for

Algorithm 1. *GSHL (root)*
Require: Initialize *V, Ms, I,* TH_s, TH_d, TH_n, and M_c.
Ensure: A terminological ontology with "broader" and "related" relations.

```
1  Initialize V, Ms, I, THs, THd, THn, and Mc;
2  while (i < I and V is not empty) do
3    Add current root into V;
4    Select most similar Mc nodes (words) of
5       root word (topic)
6    from Ms;
7    Add similar nodes into Vtemp;
8    Remove nodes in Vtemp against//similarity and divergence
9                                  //difference condition
10   for (all nodes n ,in Vtemp) do
11     if (Sim(ni, root) > Sim(ni, Sibling(root))) then
12       Assert broader relations between root and
13          topie ni; //relationship between topics is broader
14     else default
15      Assert related relation between root and
16          topie ni; //relationship between topics is nearer
17     end if
18    Move topic ni from Vtemp to V;
19    Increment i by 1;
20   end for
21  Remove current root from V;
22 end while
```

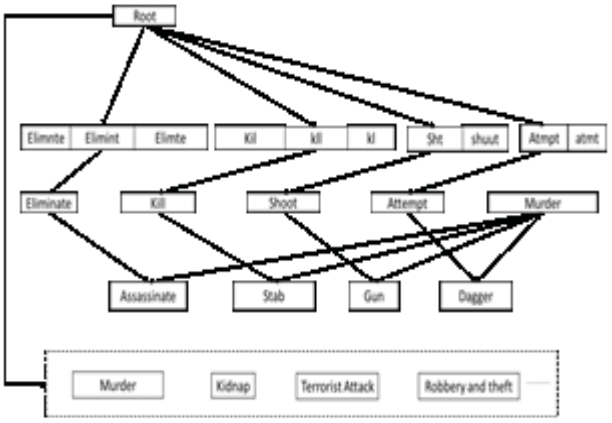

Fig 3: GSHL algorithm to find the root word from the domain (topics) using a threshold value.

The algorithm continues until the constraint is specified in the while loop. The pseudo-code of the *GSHL* algorithm is depicted in Figure. 3.

iii. ODE Model for Root word (Domain) Extraction

It captures the synonyms of the stem words within that domain (root) and describes it. The undetected suspicious words are explored from these messages (MDB) and domain (Murder, Kidnap, Drug supply, and smuggling, Terrorist, Match-fixing, fraud charges, Robbery & Theft, and Sexual harassment) is predicted in ESMD Framework. If the words are in other languages, the Onto Learn system will learn, that interpret (Ariosto language processor) and find the precise meaning of that word (WordNet) [10].

Sometimes erroneous words in microblogs that are suspicious and found to have spelling errors in the words are automatically spell-checked by using the SFC algorithm shown in Figure 6. Once these words from the SFC database are corrected are pushed into the FFW database, they are then

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compared with the PDW database during this process the suspicious words are predicted. Suppose if erroneous suspicious messages are stored in FFW, then it directly picks and starts comparing with SFW then it is difficult to predict suspicious words correctly. SPW overrides (preposition, articles, such as 'the', 'of', 'is', etc.).

The crucial role of Ontology, i.e., ODE is it initially builds the ontology for a particular domain as per the matching of stem words are identified within the domain (FFW) and among the other domains (FFW and PDW).

iv. Tree Alignment algorithm to find the Core word

The TreeAlignment algorithm, explains the mapping process of suspicious words when suspicious words are detected by the ESMDs framework. The multiple mapping of suspicious words between FFW and PDW is shown in Figure 4 in which Ontology plays a vital role in the segregation of words among the domains.

When erroneous words which may be suspicious if not detected then those words are spell-checked with the aid of the SFC algorithm which is shown in Figure 6. Once the words from such erroneous words are corrected, then the algorithm starts pushing of converted short-form words (SFW) to full form words (FFW). If words like 'Eliminate', 'Eliminate', 'Elimte', are found, then they are converted to the word 'Eliminate'. If the 'eliminate' stem word is searched using WordNet ODB [11], the other similar words are 'excretion', 'killing', 'evacuation', 'Demolition', 'assassinate', 'murder'. From those words 'eliminate' is mapped with 'assassinate', which is shown in Figure 4. The ontology assists in the building of tree which is restricted to 2-levels, i.e., 'parent-child' using algorithm 2.

Fig 4: Taxonomic structure of suspicious words.

Algorithm 2. *TreeAlignment(RootNode,node)*
Require: Initialize *RootNode, Node(s), MinThreshold* value
Ensure: Domain (topic) extraction from stem words.

```
for (int i:1 to numDomainTopic {   //traverse tree for DomainTopic i
 NumLevels=2;    //size of tree is 2(parent & child)
  for (int j:1 to NumLevels){
   RootNode[ ]Nodes=Empty // top most level 1
   Node[ ]nodes=getNodesAtlevel(nodes);//All the stem words from the MDB at level 2
   RootNode[]Nodes=Node[]nodes          //stem words are assigned to RootNode
    checkForRepetitiveData(Nodes);    //check for the stem words(MDB) that matches
                                      //with other domain (topics) (PDW) using Ontology
    checkFordisjunctiveData (nodes);  //check for stem Words that belongs to more than
                                      //one domain (topic)
  }//end for
}//end for
checkForRepetitiveData(Node[ ]nodes){
 for(int i:1 to nodes.length){
  If(node[i]!=nodes[j]){
  //nodes of MDB does not match with PDW words
    checkForOntology(Node[]nodes)
     If(nodes[i] == nodes[j]){       //compare nodes[i] and nodes[j] if matched then
                                     //MDB words are compared with PDW words
      call GSHL(RootNode, node) //algorithm 2   //GSHL algorithm calculates threshold for
                                     //stem words with respect to Domain(topic) nodes
                                     // then assigns the Domain(topic) from PDW
        RootNode[]Nodes=DomainNode[]
     }//end if
   }//end if
  }//end for
}
checkFordisjunctiveData(node[ ]nodes){
for(int i:1 to nodes.length){
  If(node[i]!=nodes[j]){              //nodes of MDB does not match with SSWDB words
    checkForOntology(Node[]nodes)
     If(nodes[i] == nodes[j]){       //compare nodes[i] and nodes[j] if matched then
                                     //MDB words are compared with PDW words
      call GSHL((RootNode,node), MinThreshold)
                                     //GSHL algorithm 1 calculates the threshold for
                                     // stem words with respect to Domains(topics)
                                     // then assigns to multiple Domain(topic)
                                    //that satisfy minimum threshold (user-defined)
      RootNode[]Nodes=DomainNode[]
     }//end if
   }//end if
  }//end for
}
```

Fig 5: Predicts set of suspicious words under each of cybercrime domains in ESMD Framework

In algorithm 2, the 'checkForRepetitiveData' method does the task of finding repetitive stem words within the domains. It means that the stem words stored in FFW are to be matched with words stored in PDW, from pre-defined domain types (Table I). Similarly, the 'checkFordisjunctivedata' function does the task of finding the stem words that may exist in some other domains, for this it uses user-defined threshold value.

B. ESMD Framework (A Generic Approach)

When a user sends a message, it is captured and sent to the detection framework where it is taken and stored in the Message database (MDB). The detection of synonyms is carried out with the help of the Ontology-based Information Extraction (OBIE) technique [11]. The framework uses an E-crime monitoring system to extract the information of the wrongdoer and send it to the E-crime department.

Steps involved in the pseudo code of the ESMD framework are as follows:

1. The first step is for capturing the messages sent between the users of IMS (or) SNS. These messages are saved in a database called Message Database (MDB).
   a. In this step, a single message is taken from the (MDB), these messages are converted to plain text (raw individual words).
   b. Next, stop words are eliminated using a database called "Stop Words (SPW)" for the elimination of stop words from the message.
   c. Now, prefix and suffix from the text are eliminated. Porter Stemmer algorithm [9] is used to remove it from the unstructured data. After the above steps, we get root stem words that are searchable.

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2. This step separates the short form words and the full form words and stores them in different databases. Separation is done with the help of Wordnet by comparison of words in the message with the actual words in wordnet [11]. If the word matches it is flagged as full form word (FFW) else like a short-form word (SFW).
3. This is the main step in which unrecognized words are processed using SFC (Short Form to Full form conversion) algorithm shown in Figure 6. Suspicious words in short form (if any) is detected by this algorithm are converted to respected full form words.
4. This step compares the full form words with the Pre-Defined Words database (SWDB) Shown in Table 1, and predicts if the word is suspicious then it is stored in Detected Words Database (DWDB).
5. Once a word is detected as suspicious in a message, then consecutive messages will be checked to detect the presence of any suspicious word if the chat conversation exceeds the threshold value in *Rule 2* Table 1 then the whole message in chat conversation is flagged as suspicious. The type of threat is identified with the help of PDW which contains suspicious words along with their domains and stores the suspicious message in Predicted Knowledge Database (PKDB), it helps in relating the type of crime going to be planned, then profile details such as the E-mail address, phone number, ISP details, IP address, location, etc. are found out from the Email Database (EDB) and a report is generated.
6. The last step is to send the report to the E-crime department for further investigation.

C. Short-form to Full-form Conversion (SFC) Algorithm.

The SFC (Short-form to Full-form conversion) algorithm initiated when some short-form words are found in the message. This algorithm is in the 4th step of the main algorithm. If no short-form words are detected, then this algorithm is not initiated, and the program completes without initiation of this algorithm. This algorithm makes use of the short-form words that are stored in the database SFW (Short Form Words).

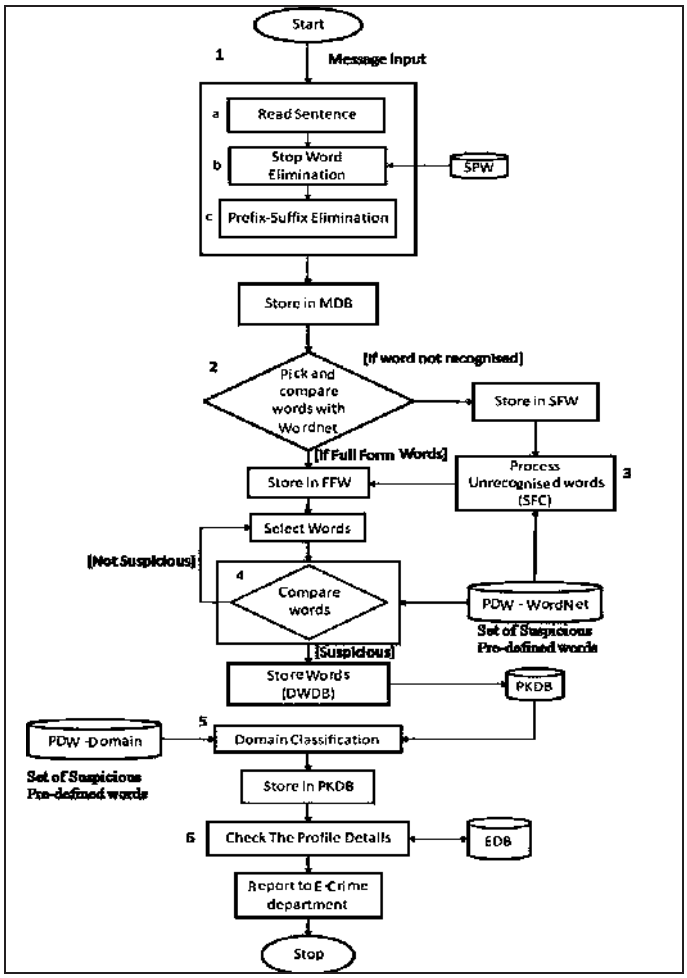

Fig 6: ESMD Framework (Generic Approach)

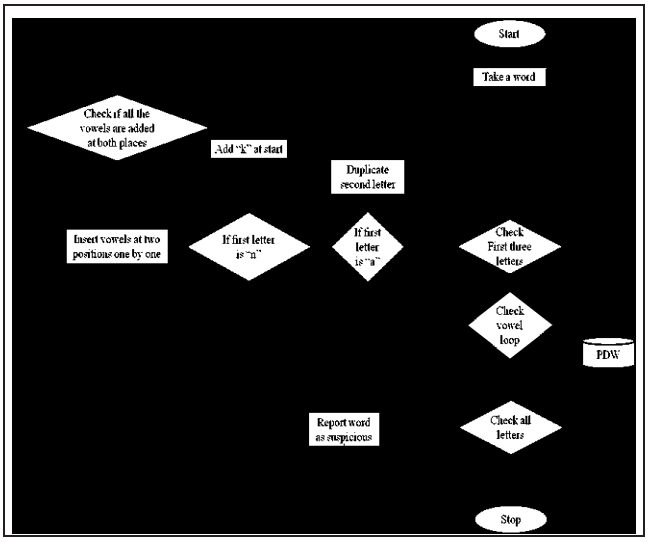

Fig. 7: Short form words to full form words conversion process

During the conversion of short-form words to full form words, algorithm 3 (figure 6) is illustrated using the flowchart which is shown in figure 7. In this algorithm 3, a

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Algorithm 3. *Short-form to Full-form conversion (SFC) Algorithm*
Require Unrecognized words.
Ensure: Converted Full form words from Short-form words.

```
1   Check_first_three_letters ();
2       { If(match_found()) then
3           {Check_all_letters();
4             { if(all_letters_matched) then
5               return true; //word is flagged as suspicious
6               Else
7               return false; }}
8       else if(first_letter== "a")
9           { Duplicate_second_letter();
10            Check_first_three_letters(); } //Goto step 1
11      else if(first_letter== "n")
12          { add_K_A_Start()
13            Check_first_three_letters();}//Goto step 1
14       else if(introduce_vowel(int pos));
15          { for(pos=0;pos<2;pos++) //checks if all void
            //spaces are filled with vowels or not.
16              { for(i=0;i<5;i++)
17                  { if(i==0) then insert "a" at "pos+1" ;
18                    else if(i==1) then insert "e" at "pos+1"
19                    else if(i==2) then insert "i" at  "pos+1"
20                    else if(i==3) then insert "o" at  "pos+1"
21                    else if(i==2) then insert "u" at  "pos+1"
22                    Check_first_three_letters();  }}}
23        else ignore(); }
```

Fig 8: Short form words to full form conversion Algorithm.

short form word is taken and then the first three letters of the short-form word are checked with the first three letters of all the suspicious words. This step makes use of the PDW (Pre-Defined Words) Database in which all the suspicious words are stored (Table 1). Here we are checking only the first 3(three) letters of the short-form word with the first three letters of suspicious words to lower the number of comparisons and lessen the execution time. If we check only the first 2(Two) letters of the short-form word with the first three letters of the suspicious words, then the information would not be sufficient, and we will not get accurate results. Conversely, if we check more than 3(Three) letters of the short-form words, then the execution time will increase and hence, the conversion will slow down because the algorithm 3 (Figure 8) will have to check more words and the number of comparisons increases. The checking system works with the first letter. If the first letter is "A", then all the first three letters of the short-form word are checked with the first three letters of the suspicious words which start with the letter "A".

Table 2: Chatting session Scenario of 'Murder' domain (UGC Test-bed-1)

Thread Domain	**User 1**	**User 2**
Murder	"There is one deal of mdr of a businessman livin in bandra mumbai, he is a software engineer"	"Ok do u hav any pln how to eliminate and how mny pple are there with him ?"
	"We will hire a vehicle and powerful men and pick him on road during journey, we stb him with nif and throw him nearby road"	"ok it is better once we meet and talk about this deal about physical atk"
	"What will be the amnt of this deal"	"5,000 rupees"
All short- form words detected = 10		Mdr, livin, pln, hav, mny, u, stb, nif, amnt, ppl.
Suspicious short-from words(SFW) detected after correction = 4		Attack, money, Stab, Nife.
Suspicious Full-form words(FFW) detected = 2		Eliminate, Vehicle
Total Number of Suspicious words detected (SFW+FFW) =6		Eliminate, Vehicle, money, attack, stab, knife.
Precision rate with FFW		20%
Precision rate with (SFW+FFW)		60%
Recall		90%
F-measure		72%
False positive detected =1		money
True negative = 1		murder

IV. EVALUATION AND EXPERIMENT ANALYSIS

The precision and recall measures [9], are usually used metrics in assessing the performance of text retrieval, that evaluate and access the efficiency of GSHL algorithm in

Table 3: Confusion Matrix for murder testbed

	Condition Positive	**Condition Negative**
Predicted condition positive	True Positive =6	False Positive =1
Predicted condition negative	False Negative = 4	True Negative =1

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Table 4: Depicts precision, recall and F-measure values

S.no	Domains	Precision	Recall	F-measure
1	murder	60	90	72
2	kidnap	30.76	61.53	41
3	terrorist attack	66.66	92.3	77.41
4	sexual harassment	26.31	36.84	30.69
5	corruption	41.66	66.66	51.27
6	robbery	38.46	55.84	44.86
7	drug smuggling	53.33	73.33	61.57
8	match fixing	42.85	78.57	55.45

ESMD framework illustrates the quality of stem words that are learned using ontologies. The efficiency metrics that are used are Precision and recall. Precision is the number of actual words found in the predefined database, i.e., PDW with respect to domain, to that of the number of words that are extracted from UGC testbed-1 (Table 2).

$$\text{precision}(p) = \frac{\text{Correctly extracted}}{\text{Total extracted available}} \times 100$$

$$\text{Recall}(R) = \frac{\text{Possible no. of words to be correctly extracted}}{\text{Total extracted available}} \times 100$$

Currently, many of the datasets related to cybercrimes are not authorized for use due to security reasons. For this reason, the dataset for the "murder" domain is taken from domain experts and brainstorming sessions, which is named as UGC Testbed-1, as shown in Table 2.

Table 2, describes the scenario of the "murder" cybercrime domain, which is tested using the ESMD framework. The values of the Confusion matrix obtained is depicted in Table 3, which shows the obtained precision rate is 60%. But, the expected F-measure value to be retained is 72%, whereas the recall value is 90%, for murder UGC Testbed-1. Similarly, we have calculated the efficiency for other cybercrime domains using various UGC Testbed(s) of Table 1. For which the precision rate, recall, and F-measure are shown in Table 4.

- *Comparison of ESMD framework with existing IM:*

Currently, none of Instant Messaging Applications, Social Networking Sites and Android-based Messaging Apps, have the feature of predicting the suspicious words from microblogs at run-time from chatting sessions. The Proposed Framework is an Enhancement of the OSMD framework. Table 5 shows a comparative assessment of the features of the ESMD framework with IMA and OSMD Framework. Figure 9, graphically depicts the results obtained when the UGC dataset test-bed (Table 2) is tested with OSMD and ESMD frameworks.

V. Conclusion And Future Work

In this paper, the improvised ESMD Framework predicts the suspicious words sent via IMA/SNS, either in Full-form or Short-form words. In this framework, the SFC algorithm is used for converting short-form to full form words, along with TreeAlignment (Figure 6) and GSHL algorithms (Figure 3) consecutively. The various cybercrime stem words of Table 1, are tested by creating the UGC test-beds starting from 1 to 8 respectively and the results are shown in Table 4. Apart from that, the ideal F-measure values for various cybercrime domains are also tabulated which are to be achieved by removing the False positive rate as discussed for the "Murder" cybercrime domain (Table 2).

Table 5: Comparative features of ESMD framework with IM and OSMD

Features	IM Applications (WhatsApp, & Others)	OSMD Framework	ESMD Framework
Cybercrime Prediction	No	Yes	Yes
WordNet Ontology Support	No	Yes	Yes
Pre-defined Rules with Ontology	Not Supported	Supported	Supported
Pre-defined Rules	Not Supported	Supported	Supported
System architecture	Secured, but restricted	Secured and Moderate	Secured and Complex
Assess-Time	Not Applicable	Less	Moderate
Short-Form to Full form Word Conversion	No	No	Yes
Accuracy	Not defined	Good	Very Good
Categorization of Crimes	No	Yes	Yes

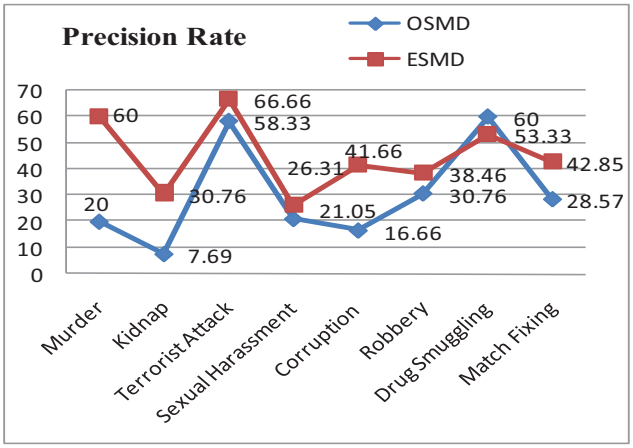

Fig 9: Comparison of Precision Rate of ESMD vs OSMD

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The Accuracy of the ESMD Framework is better than the OSMD framework by a margin of 40%. The ESMD can be further enhanced by appending few more features listed below:

- Predicting of suspicious activities from audio and video conferences performed through IMS/SNS.
- Prediction of Suspicious words from multilingual words used in IMS/SNS.
- Surveillance by Suspicious Images sent via SNS.

The proposed ESMD can be embedded into instant messaging Apps like SMS (Short Messaging Service), Yahoo Messenger, MSN Messenger, Google Talk, WhatsApp and other messaging applications for detecting e-criminals. The experimental results conducted on UGC test-beds proved to be very useful in predicting various types of cybercrimes along with domains. The ESMD surveillance system aids in the detection of latent suspicious activities from various messaging applications to identify the e-criminals and assist the e-crime department.

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Analysis of CFRP Flight Interface Brackets under Shock Loads

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Abstract:

Interface structures in spacecraft's and flight vehicles encounter mechanical shocks from a variety of sources such as stage separation, release operations and sudden external disturbances. The flight interface brackets must be designed, analysed and tested to withstand these shock loads acting for short durations. Due to high strength-to-weight ratio and resistance to corrosion carbon fiber reinforced polymer (CFRP) is popularly adopted as flight interface brackets and are replacing metals. The response of CFRP flight interface brackets under shock loading is not fully understood. This paper presents transient shock analyses performed on typical flight interface brackets such as flat rectangular and L-shape CFRP brackets with fiber orientations in 33 different stacking sequences for fixed-fixed and cantilever boundary conditions;and subjected to impulse loading. Results indicated that the stacking sequence [90/0/0/90]s proved best for rectangular fixed and cantilever conditions while stacking sequence [90/90/90/90]s yielded best results for L-shaped cantilever and fixed-fixed boundary conditions with minimum reaction load at fixed end.

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*Keywords:*Flight vehicles; shock load;CFRP; interface brackets; stacking sequence

1. Introduction

In day to day life in many engineering applications, systems are subjected to shocks and impact loads due to violent and sudden change in the state of motion of the components or parts resulting from sudden application of an external force.

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Spacecraft's and flight vehicles are subjected to shocks due to stage separation, release operations and momentary external disturbances in space

Flight vehicles in endo- and exo- atmospheres are often subjected to different electro-explosive devices that produce near-instantaneous release of explosive energy.

Flight vehicle interface brackets are resting platform or supporting member used to mount various sub systems (navigations, control, guidance, etc.) in a flight vehicle. In order to sustain these high shocks, interface brackets should be analysed and designed to function under these extreme loads. Weight saving of even a few grams can be crucial in flight structures. Currently theinterface brackets are made of aluminium. One can obtain high strength and stiffness at the expense of high thickness as in the current scenario with aluminium but it is against light weight design which is most important criteria in aerospace applications. Therefore,carbonfiber reinforced polymer (CRRP) is widely used as flight interface brackets in aerospace applications due to unique properties like high specific strength and specific stiffness, light weight, high fatigue life, tailorable design, corrosive resistance and low co-efficient of thermal expansion. Composite material mainly consists of two constituents such as fiberand matrix. Fiberprovideshigh strength and matrix material enhances bonding between fibres and transfers load to fibers. A typical flight interface bracket mounted with different subsystems in a flight vehicle is shown in Figure 1.

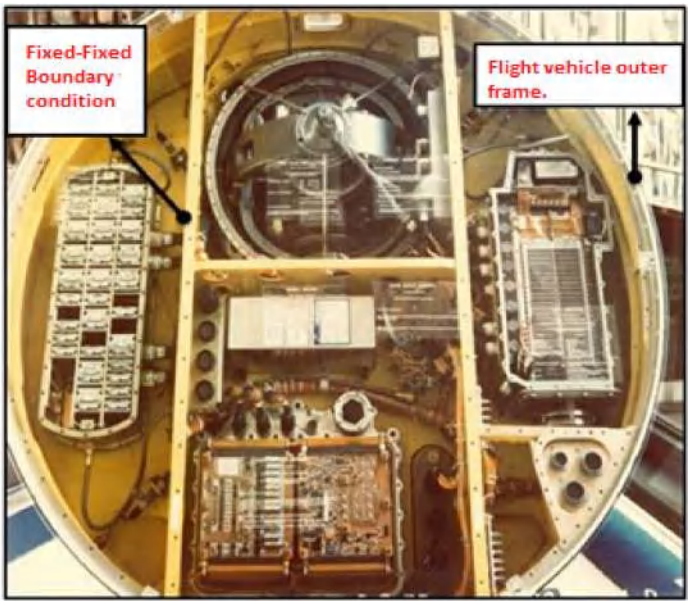

Fig.1. Typical interface bracket in a flight vehicle

Different studies on composite structures under dynamic loadings are reported in literature. Roy *et al*. [1] investigated the stresses and displacements in cantilever beam subjected to short and long duration impulse loads and concluded that the maximum stress and deflections are not influenced appreciably by the damping within the realistic limits. Further, Roy *et al*. [2] studied effects of different types of variations in profile and thickness of composite on the amplitude of deflection and the dynamics of a cantilever beam subjected to a harmonic end moment and concluded that use of a variable thickness beam can be used to lower the maximum value of the stress or the displacement. Joseph *et al*. [3] analyzed dynamic behavior of beams with discontinuity in the thickness and subjected to an impulse load at a point and studied the variation in maximum displacement in beams of simply supported and fixed-fixed boundary conditions. Wagg *et al*. [4] presented analysis of data from

an engineering system using statistical and probabilistic methods; studied dynamics of vibro-impacting cantilever beam experiment using an impact load cell, and analysedissues related to sampling rate and threshold values. Oguibe*et al*. [5] studied large deflection analysis of multilayer cantilever beams subjected to impulse loading and validated with experimental results. On comparison with experimental data they concluded that the numerical model based on the finite element method provides a good method of solving the elastic-plastic, large deflectionand dynamic problems of multilayer beams, which are difficult to analyze analytically. Yu *et al*. [6] studied the dynamic plastic behavior of a double cantilever beam system subjected to impact by a rigid mass at their tips using three approaches: a rigid-perfectly plastic solution, a mode solution and an elastic-perfectly plastic solution based on non-linear beam theory.

Barkonov*et al.* [7]analysed the transient response of sandwich and laminated composite structures with viscoelastic layers under impulse loading using finite element method and proposed technique that gives the possibility to preserve the exact mathematical formulation for the damping model.Botta*et al* [8] studied influence of impulse (rise function, rise time) and geometric parameters (thickness of the plate, distance of the measure point from the point load) on shock response spectrum (SRS) of plates under impulse loading.Brake *et al*. [9] presented method to calculate an inverse of an arbitrary SRS using three sets of well characterized basis functions: an impulse function, a - damped sine function and a modified Morlet wavelet.Verma*et al*.[10]investigated the experiment to identify a new flow condition in free shock separation that is found to contribute significantly towards the overall flow unsteadiness in a thrust optimized parabolic nozzle at certain operating conditions. Ingle *et al.* [11] studied the effect of different stacking sequence and fiber orientation on natural frequency of four different flight interface brackets and Tilakpure et al [12] analysed these interface brackets under randomly excited loads and proposed best staking sequence of composites under such loads. J. Kaufmann*et al*. [14] studiedPLA-viscose-composites with continuous fiber reinforcement for structural applications using unidirectional by processing unidirectional plates by film stacking.

Stiffness of composite structure can be varied by changing the layup sequence, direction of fibres i.e. fiber orientation of each layer and layer thickness. Direction of fibres in only one direction proves to be unsatisfactory as it gives maximum stiffness in that particular direction and comparatively less stiffness in other two directions. Considering this tailorable property of composite, 33 different stacking sequence of (0^0, 45^0,90^0) family with two different geometry and two different boundary conditions are analyzed in this paper for design of flight vehicle interface brackets under shock load with an attempt to find the best stacking sequence for a given geometry and boundary condition of brackets.

2. Geometry, Boundary Condition and Stacking Sequences

Geometry of brackets used in flight vehicles are mainly flat(rectangular) or L-shape with cantilever and fixed-fixed boundary conditions. Brackets are subjected to shock load at any point along the length of the brackets but in the present paper, brackets are analysed for the shock load acting at extreme end of cantilever boundary and mid length of fixed–fixed boundary of interface bracket which areworst case of loadingas maximum deflection at cantilever and fixed-fixed beam occurs when loading is at corresponding points. Hence total four different cases as shown in Table 1 with different combinations of shapes, end conditions and direction of shock loads arestudied for 33 different stacking sequences as shown in Table 2 for each case.

The interface brackets are modelled in a finite element analysis software ANSYS [13] which represents the actual structure of bracket.Lamina level approach was used to perform analyses on brackets; brackets had 8 layers of each 0.5mm uniform thickness as shown in Figure 2.

Table 1. Different geometry and boundary condition of brackets

Sr. No.	Shape of beam	End condition	Shock Load Direction
Case I	Rectangular	Cantilever	Z-axis
Case II	Rectangular	Fixed-fixed	Z-axis
Case V	L-shape	Cantilever	Z-axis
Case VI	L-shape	Fixed-fixed	Z-axis

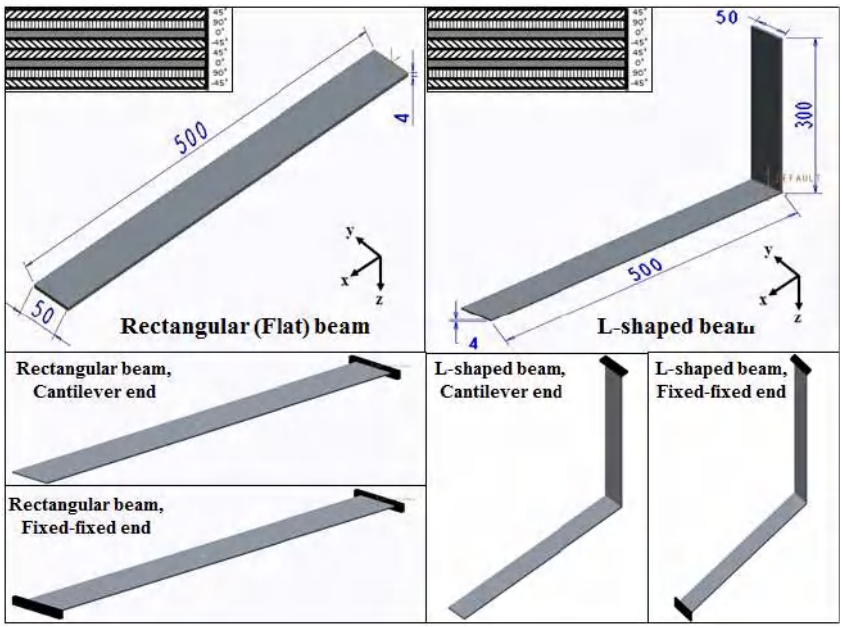

Fig. 2 Model of rectangular and L shape brackets with different end conditions

Load time is an important parameter in shock analysis; it is a time for which impulse load is acting. Load time is calculated from first frequency obtained from modal analysis here for purpose of studying the best fibre orientations and the load time can be the actual duration of shock if a shock measurement data is available. Modal analysis is a prerequisite for shock analysis and isperformed first to extract natural frequencies and mode shapes. During both analyses same end conditions were used for different cases, only difference being no external shock loads were applied during modal analysis as it gives frequencies due to inherent properties of material i.e. mass and stiffness. All 33 different stacking sequences used in analysis belonged to family of (0^0,45^0,90^0) because 00 takes care of longitudinal loads,45^0 takes care of shear loads, and 90^0 takes care of transverse loads and these orientations offer high fabrication efficiency. Using results of shock analysis stacking sequence which is subjected to minimum reaction at fixed end is considered as best sequence.

Table 2: Different stacking sequences considered in study of shock loads

S.No.	Stacking sequence	S.No.	Stacking sequence	S.No.	Stacking sequence
1	$[0/90/45/-45]_s$	12	[0/90/45/-45]s	23	[45/90/-45/0]s
2	[0/45/90/-45]s	13	[-45/0/90/45]s	24	[45/-45/90/0]s
3	[0/-45/90/45]s	14	[-45/90/0/45]s	25	[0/90/0/0]s
4	[0/90/-45/45]s	15	[-45/45/0/90]s	26	[0/0/90/0]s
5	[0/45/-45/90]s	16	[-45/0/45/90]s	27	[0/90/90/0]s
6	[0/-45/45/90]s	17	[-45/90/45/0]s	28	[90/0/0/90]s
7	[90/45/-45/0]s	18	[-45/45/90/0]s	29	[0/45/-45/0]s
8	[90/-45/45/0]s	19	[45/0/90/-45]s	30	[0/0/0/0]s
9	[90/0/45/-45]s	20	[45/90/0/-45]s	31	[90/90/90/90]s
10	[90/45/0/-45]s	21	[45/-45/0/90]s	32	[45/45/45/45]s
11	[90/-45/0/45]s	22	[45/0/-45/90]s	33	[-45/-45/-45/-45]s

3. Finite Element Modelling

Shock analyses were performed on both types of brackets with two different boundary conditions i.e. cantilever and fixed-fixed for all 33 stacking sequence.Modal analysis being prerequisite for shock analysis was performed first and first 3 modes were extracted. There were certain assumptionsmade during analysis:

- lamina level approach was adopted;
- lamina was considered as orthotropic material while in fact a unidirectional lamina is transversely isotropic; and
- constitutive equations used for each lamina are orthotropic and dependent on assumption of shell theory.

Simulations were performed using finite element analysis software ANSYS [13]. Composite material was defined by giving orthotropic properties of AS4D/931. The geometry was discretised with free mesh using layered SHELL181 element (four-node element with six degrees of freedom at each node) which is suitable for analysing thin to moderately thick structures. Layered shell elements have capability to compute laminate properties using laminate stacking sequence and lamina properties. Thickness, orientation of fiber and stacking sequence were input as sections for a SHELL181 element. Mesh sensitivity analyses were performed for all cases with different mesh sizes to finalize a minimum element size of 1.5mm. Total number of elements is 10989 for rectangular flat beam bracket and 16000 for L-shape bracket. The x, y and z coordinates represent respectively the longitudinal, lateral and vertical (transverse) directions.

4. Analyses under Shock Loading

Shock load is a high magnitude load acting on system for fraction of a second. Time for which shock load is acting is termed as load step. The load step is calculated from first modal frequency of natural vibrationas loadstep = (1/20f) where f = natural frequency. A typical acceleration of 1000g for very few (10-50) milli-seconds is common in a flight interface bracket. Thus a shock acceleration of 1000g was used for analysis, which isconverted into force and the duration of shock was considered as load step duration discussed above. The position of shock load application on four interface brackets considered in this paper is shown in Figure 3. In shock analyses three modes of natural frequencies were extracted, third one being the highest natural frequency of vibration it was considered for analyses.

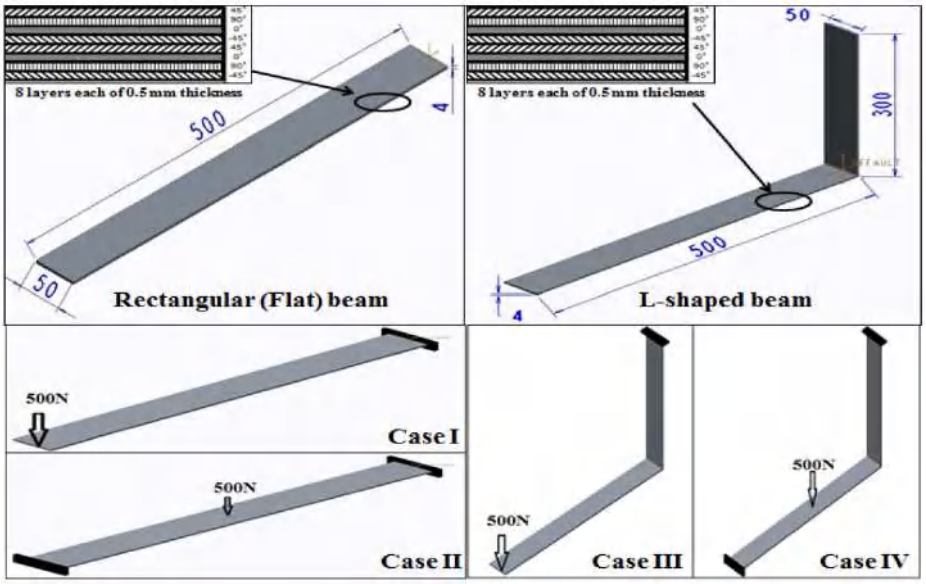

Fig. 3.Position of shock load on four different cases of brackets

Figure 4 shows a typical nature of shock response spectrum. Peak observed in the graph is maximum amplitude in bracket when shock load is applied upon the beam for the particular load step. When shock load is removed the value of amplitude decreases quickly within short time and afterwards effect of shock load becomes negligible. Although less magnitude is shown in Figure 4 for a demonstration of the nature of shock spectrum, the actual magnitude of shock load applied considered in analysis is 1000g.

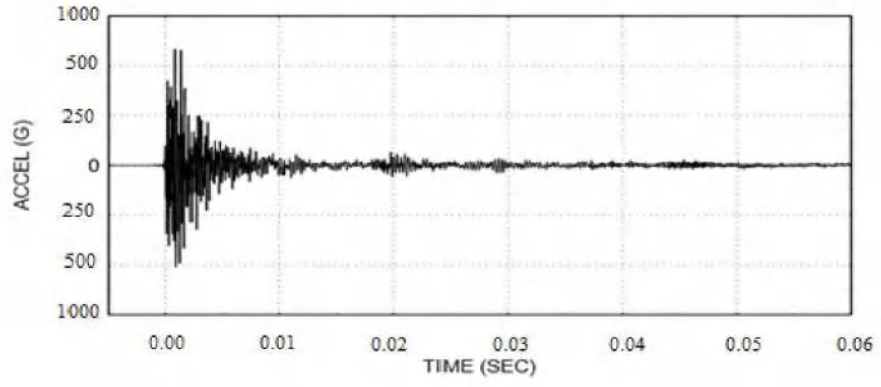

Fig. 4 . Nature of shock response spectrum

5. Results and Discussion

Shock analyses were performed on flat rectangular and L-shape brackets for both cantilever and fixed-fixed condition for 33 stacking sequences. The stacking sequence yielding minimum value of reaction at fixed end is considered best for shock loading. Deformations of brackets in four cases are shown in Figure 5. The results for shock analysis are given in Table 3 for flat bracket and in Table 4 for L-shape bracket.

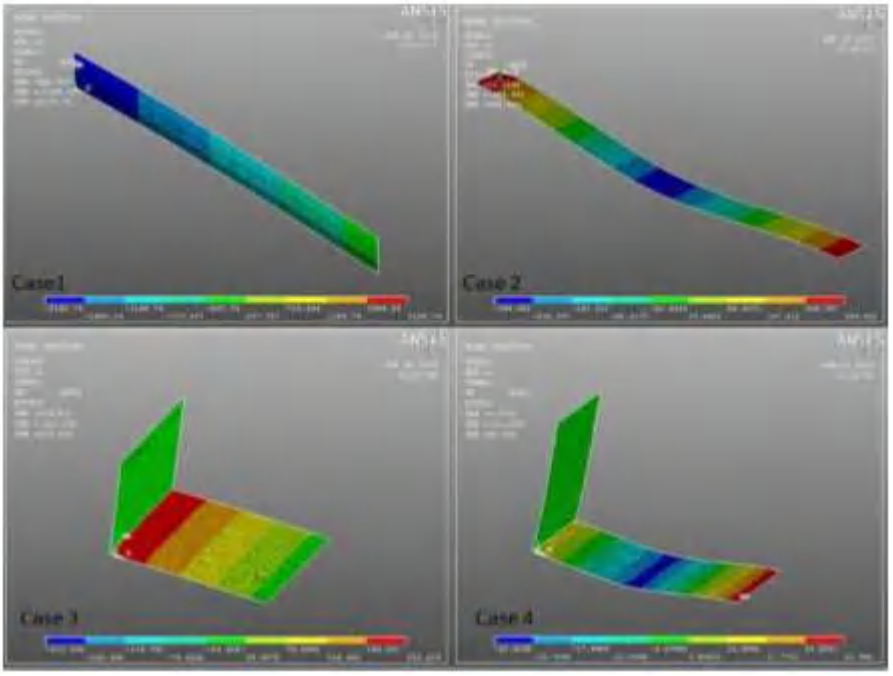

Fig. 5 Deformation of brackets under shock loading for [90/0/-45/45] stacking sequence

Table3. Results for rectangular brackets

		Cantilever Condition				Fixed-Fixed condition			
S. No.	Stacking sequence	N.F. Third (Hz)	Shock duration (s)	Maximum deflection. (mm)	Fixed end reaction(N)	N.F. Third (Hz)	Shock duration (S)	Deflection (mm)	Fixed end Reaction (N)
1	[0/90/45/-45]s	5.8133	0.0086	88.29	7.470	12.323	0.00405	4.57	5.07
2	[0/45/90/-45]s	5.8622	0.0085	86.17	13.063	14.313	0.00350	4.36	6.38
3	[0/-45/90/45]s	5.8622	0.0085	86.17	13.063	14.313	0.00350	4.36	6.38
4	[0/90/-45/45]s	5.8133	0.0086	88.29	7.470	12.323	0.00405	4.57	5.07
5	[0/45/-45/90]s	5.8622	0.0085	86.27	21.74	16.201	0.00308	3.56	17.58
6	[0/-45/45/90]s	5.8622	0.0085	86.27	21.74	16.201	0.00308	3.56	17.58
7	[90/45/-45/0]s	5.1529	0.0097	110.03	47.06	10.136	0.00493	3.76	19.46
8	[90/-45/45/0]s	5.1529	0.0097	110.03	47.06	10.136	0.00493	3.76	19.46
9	[90/0/45/-45]s	5.7369	0.0087	96.11	8.480	11.953	0.00418	4.00	4.66
10	[90/45/0/-45]s	5.8622	0.0086	98.66	9.030	11.676	0.00428	2.74	11.35
11	[90/-45/0/45]s	5.8622	0.0085	96.20	13.18	11.676	0.00350	4.36	6.38
12	[90/0/-45/45]s	5.7369	0.0087	96.17	8.480	11.953	0.00418	4.00	4.66
13	[-45/0/90/45]s	5.8622	0.0085	91.94	15.73	15.562	0.00321	***0.46***	14.76
14	[-45/90/0/45]s	5.346	0.0093	101.98	9.110	11.688	0.00427	2.77	15.67
15	[-45/45/0/90]s	5.8622	0.0085	95.89	36.86	13.287	0.00376	1.05	35.14
16	[-45/0/45/90]s	5.8622	0.0085	93.68	30.28	16.606	0.00301	1.07	23.52
17	[-45/90/45/0]s	5.3415	0.0093	100.72	67.03	10.630	0.00470	3.67	28.37
18	[-45/45/90/0]s	5.6971	0.0087	102.53	54.66	11.514	0.00434	3.07	41.57
19	[45/0/90/-45]s	5.8622	0.0085	91.94	15.73	15.562	0.00417	2.68	14.76
20	[45/90/0/-45]s	5.8622	0.0085	95.89	15.36	11.973	0.00417	2.68	15.19
21	[45/-45/0/90]s	5.8622	0.0085	95.89	36.38	13.287	0.00417	2.68	35.14
22	[45/0/-45/90]s	5.8622	0.0085	93.68	30.28	16.606	0.00417	2.68	23.52
23	[45/90/-45/0]s	5.3415	0.0093	100.72	67.03	10.623	0.00470	3.67	28.37
24	[45/-45/90/0]s	5.6971	0.0087	102.53	65.70	11.514	0.00434	3.07	***41.57***
25	[0/90/0/0]s	4.4620	0.0110	115.60	3.08	11.348	0.00440	3.37	-1.35
26	[0/0/90/0]s	4.5446	0.0110	109.49	4.70	12.623	0.00396	0.94	-0.84
27	[0/90/90/0]s	4.4264	0.0112	90.91	1.30	10.507	0.00475	3.93	-1.26
28	[90/0/0/90]s	4.3516	0.0115	97.81	***1.020***	9.3146	0.00536	7.95	***-1.47***
29	[0/45/-45/0]s	7.1382	0.0070	***67.66***	15.94	16.241	0.00307	3.62	19.34
30	[0/0/0/0]s	4.7932	0.0104	98.04	8.45	13.320	0.00375	0.88	1.24
31	[90/90/90/90]s	2.2930	0.0218	185.53	3.22	6.3183	0.00792	***32.87***	3.09
32	[45/45/45/45]s	2.7697	0.0180	***222.63***	***86.07***	8.1645	0.00612	17.52	18.77
33	[-45/-45/-45/-45]s	2.7697	0.0180	222.63	86.07	8.1645	0.00612	17.52	18.77
Best	Minimum	***2.293***	***0.007***	***67.66***	***1.02***	***6.3183***	***0.00301***	***0.46***	***-1.47***
Worst	Maximum	***7.1382***	***0.0218***	***222.63***	***86.07***	***16.606***	***0.00792***	***32.87***	***41.57***

Table 4. Results for L-shaped brackets

		Cantilever Condition				Fixed-Fixed Condition			
S. No.	Stacking sequence	N.F. Third (Hz)	Shock duration (mm)	Maximum deflection (mm)	Fixedend reaction(N)	N.F Third. (Hz)	Shock duration (Sec)	Deflection (mm)	Fixedend reaction (N)
1	[0/90/45/-45]s	0.86175	0.058	103.82	2.53	5.1003	0.0098	0.84	6.05
2	[0/45/90/-45]s	0.93983	0.053	94.76	2.78	5.1664	0.0096	0.81	9.13
3	[0/-45/90/45]s	0.93983	0.053	95.89	2.12	5.1664	0.0096	0.81	8.44
4	[0/90/-45/45]s	0.86715	0.057	102.6	2.45	5.1003	0.0098	0.84	6.05
5	[0/45/-45/90]s		0.050	89.66	2.40	5.3844	0.0092	0.94	9.72
6	[0/-45/45/90]s	0.98447	0.050	89.66	2.40	5.3844	0.0092	0.94	9.72
7	[90/45/-45/0]s	0.48187	0.103	288.75	6.42	4.1573	0.0120	2.77	8.87
8	[90/-45/45/0]s	0.48187	0.103	288.78	6.42	4.1573	0.0120	2.77	4.40
9	[90/0/45/-45]s	0.71562	0.069	158.86	2.62	5.2796	0.0094	0.60	4.40
10	[90/45/0/-45]s	0.55964	0.089	248.07	6.71	4.8579	0.0100	2.36	7.18
11	[90/-45/0/45]s	0.55964	0.089	248.07	5.19	4.8579	0.0100	2.36	9.72
12	[90/0/-45/45]s	0.71562	0.069	158.66	2.62	5.2796	0.0094	0.60	4.40
13	[-45/0/90/45]s	0.78449	0.063	146.98	4.78	5.1402	0.0097	1.80	11.87
14	[-45/90/0/45]s	0.60993	0.081	231.03	7.66	4.9555	0.0100	1.50	12.29
15	[-45/45/0/90]s	0.69765	0.071	174.91	6.20	5.9869	0.0083	1.97	13.12
16	[-45/0/45/90]s	0.81614	0.061	133.28	4.81	5.4941	0.0091	1.84	11.93
17	[-45/90/45/0]s	0.54783	0.091	224.48	8.93	4.7417	0.0105	2.71	14.25
18	[-45/45/90/0]s	0.60691	0.082	220.21	6.49	5.2283	0.0095	1.82	13.02
19	[45/0/90/-45]s	0.78449	0.063	146.28	4.78	5.1402	0.0097	1.80	11.87
20	[45/90/0/-45]s	0.60993	0.081	231.03	6.23	4.9555	0.0100	1.50	12.96
21	[45/-45/0/90]s	0.69765	0.071	176.33	6.18	5.9869	0.0083	1.97	13.12
22	[45/0/-45/90]s	0.81614	0.061	133.28	4.81	5.4941	0.0091	1.84	11.93
23	[45/90/-45/0]s	0.54783	0.091	225.45	8.91	4.7417	0.0105	2.71	14.25
24	[45/-45/90/0]s	0.60691	0.082	220.21	6.49	5.2283	0.0095	1.84	13.02
25	[0/90/0/0]s	0.78321	0.063	104.96	2.54	4.860	0.0102	***0.50***	4.79
26	[0/0/90/0]s	0.84019	0.059	80.40	2.74	4.7166	0.0106	1.17	5.16
27	[0/90/90/0]s	0.74727	0.066	121.96	2.32	4.9328	0.0101	0.61	4.44
28	[90/0/0/90]s	0.68097	0.073	158.19	2.10	5.0693	0.0098	1.61	3.56
29	[0/45/-45/0]s	0.99462	0.050	88.76	2.08	5.3741	0.0093	0.81	9.90
30	[0/0/0/0]s	0.87003	0.057	***65.57***	2.85	4.630	0.0107	0.55	5.22
31	[90/90/90/90]s	0.28523	0.175	***423.00***	***1.64***	2.4514	0.0203	***9.05***	***1.49***
32	[45/45/45/45]s	0.5246	0.095	269.79	***11.13***	3.6639	0.0136	2.14	37.00
33	[-45/-45/-45/-45]s	0.5246	0.095	269.79	11.13	3.6639	0.0136	2.14	***37.00***
Best	Minimum	***0.28523***	***0.050***	***65.570***	***1.6***	***2.4514***	***0.00835***	***0.501***	***1.49***
Worst	Maximum	***0.99462***	***0.175***	***423.00***	***11.13***	***5.9869***	***0.02030***	***9.050***	***37.00***

6. Conclusion

Flight interface brackets of four different cases involving flat rectangular and L-shape geometries with cantilever and fixed-fixed boundary conditionswere analysed for shock loading. Thirty threestacking sequences were studied in all four cases of interface brackets. The one stacking sequence experiencing a minimum reaction load in bracket is considered as a best. Stacking sequence $[90/0/0/90]_s$ proved best for flat rectangular bracket with fixed-fixed and cantilever boundary conditions; and stacking sequence $[90/90/90/90]_s$ yielded best results for L-shape brackets with cantilever and fixed-fixed boundary conditions with minimum reaction load at fixed end. Analyses revealed thatbest stacking sequence of composite bracket subjected to shock loading is dependent on shape of brackets i.e. same stacking sequence does not yield best results for flat rectangular and L-shape bracket geometrieswhereas same stacking sequence proves best for both boundary conditions fora given bracket shape.

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Experimental Characterization of CFRP by NOL Ring Test

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Abstract

Carbon fiber composites are widely used in aerospace applications such as rocket motor casings, electronic packaging etc., to gainfully exploit their higher specific strength properties. Commercial availability of carbon fibers like T 700 with superior strength needs an epoxy matrix with higher ductility. In this paper, elaborate experimental results obtained on composite specimens made with T 700 carbon fibers in a special toughened epoxy matrix are presented. Tests in accordance with the relevant ASTM specifications were conducted on standard unidirectional tensile test specimens as well as National Ordnance laboratories (NOL) ring test. It was observed from the experimental results that the strength measured by NOL-Ring test is more reliable than the results of unidirectional tensile test. It was also found that the maximum frequency of repetition of failure stress is in between 1675-1725 M Pa. These results are very useful as reliable design inputs for aerospace and automobile applications.

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Keywords: Carbon Fiber, Filament winding, Tensile test, NOL Ring test

1. Introduction

Composites contain high performance fibrous reinforcements of small diameter, mixed with matrix material such as epoxy or soft metals like aluminum. Few of the reinforcement and matrix combinations which are popularly used are graphite- epoxy, Kevlar-epoxy, boron-aluminum etc. These materials find applications in commercial products [1, 2]. Composites of carbon fiber reinforced polymer (CFRP) are extensively used in various structural applications in aerospace, automobile, transportation etc. Carbon fibers are commercially available with a range of tensile modulus values. They possess exceptionally high specific tensile strength and modulus, very low coefficient of

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linear thermal expansion, high fatigue strengths, and good thermal conductivity in preferred directions [3, 4]. The low value of coefficient of thermal expansion provides the much needed dimensional stability in applications like space antennae. Carbon fibers have been extensively used in composites in the form of woven textiles, pre-pegs, continuous fiber, and chopped fiber. Composite parts can be produced by processes such as filament winding, tape winding, pultrusion, compression molding, vacuum bagging, resin transfer molding, and injection molding [5, 6].

Advanced composite materials are using T-700 carbon fiber in multifunctional epoxy resin in a matrix form. These are becoming popular for structural applications not only the aerospace, automobiles but also in the general engineering. CFRP composite materials have high strength and stiffness compared to other composite materials like Glass-Epoxy, Boron-Epoxy or Kevlar-Epoxy [7]. Mechanical performance of CFRP composites depend not only on the properties of reinforcing fiber and matrix, but also on the fiber/matrix interface. Many scientific efforts in the past were directed towards modifying the surface of carbon fibers by a variety of methods such as gas- phase, liquid-phase and continuous anodic oxidation [8, 9]. A very thin coating of a pre-polymer or resin applied to carbon fiber surface has improved the interfacial properties between the carbon fiber and matrix. This can prevent the fibers from damage through the process of manufacture. Properties of composite material depend on the properties of its constituents and their distribution, orientation, volume fraction, physical and chemical interactions [10-12].

The focus of researchers is to use a more ductile matrix material with higher elongation at break. This may give a lead to the availability of valid design inputs for pressure vessels which undergo progressive failure as against catastrophic failures associated with metallic vessels. It is felt that test results obtained on the unidirectional tensile specimen in accordance with ASTM would not give accurate failure stress of internally pressurized vessel [13, 14]. Under the actual service conditions, fracture of the fibers in composite is progressive. During the unidirectional tensile test done in accordance with ASTM fibers in the test specimen fracture simultaneously. This results in what is known as 'explosive *failure'* as defined in the failure modes in the standard [15]. The values of strength obtained in this kind of test tend to be high. In contrast, the strength test carried out using the NOL ring specimens simulates realistic conditions during pressurization, characterized by progressive failure of fibers. This is bound to happen due to the slight angular orientation of the fibers during the filament winding. The results obtained on NOL ring specimens are more realistic for application in pressure vessels.

2. Preparation of Experimental Samples

The samples need to be prepared with meticulous care using correct materials and processes to get the desired results. Specially synthesized Epofine 1555 is a toughened epoxy resin with a functionality of 3. The hot setting hardener (Fine hard 5200') was used as a curing agent. The two chemicals are thoroughly mixed in the ratio of 100:27 by weight and sufficient quantity is poured into the resin bath. High strength carbon fibers T-700 in the form of 12 K tows were used as reinforcement. The resin mix is preheated to a temperature of 50°C by using the in-built heaters in the resin bath to control the mix viscosity at 500 Centi Poise level. This is essential to ensure the uniform wetting of all fibers in the tow and to get the required volume fraction of fiber [16-17]. Tows are passed through a resin bath containing epoxy resin hardener mix. Hoop winding of the impregnated fibers is done on a rotating mandrel of appropriate diameter. A schematic view of the filament winding process is shown in Fig 1.

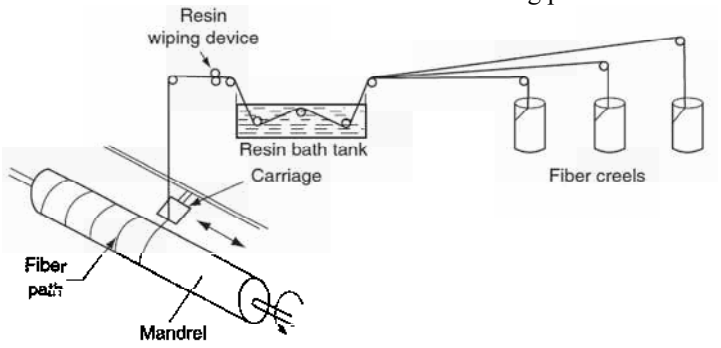

Fig 1: Schematic view of filament winding process

A hollow cylindrical steel tube of 146 mm dia and 300 mm length was used as a mandrel with suitable extension shafts. The working surface of the mandrel has a slight taper of 1degree to facilitate easy extraction of samples. The mandrel's work surface is thoroughly cleaned with acetone to make it free from any greasy deposits and dust. Two coats of Waxpol was applied uniformly to the surface of the mandrel as a parting agent for easy extraction of samples after curing. The mandrel was set up in the chuck of the filament winder and a rotational speed 50 RPM and angle of winding slightly less than 90^0 to match with a pre-programmed band width of 1.9 mm was set up through CNC for the hoop winding. A single spool of T 700 carbon fibers 12 K was deployed on the fiber creel stand and the fiber tow was routed through the resin bath and the fiber pay out eye with a tension of 1200 Grams as shown in figure 1. The mandrel is rotated at constant speed maintaining a band width of 1.9 mm and a band thickness of 0.4 mm. Five hoop layers were deposited over a length of approximately 200 mm to give sufficient number of NOL ring specimens. At the end of this process the outside diameter of the filament wound green composite came to 150 mm and outer surface is resin rich.

The mandrel along with the green composite is then cured in a hot air oven at a temperature of 120^0 C for 3 hours followed by another 3 hours at 160^0 C. At the end of the curing period and cooling to room temperature, the mandrel is mounted on a centre lathe and a light turning cut is given to remove the resin rich layer. At this stage, the diameter of the job is 149.2 and the thickness of the composite tube is approximately 1.6 mm. The cured cylindrical composite shell is separated into NOL ring specimens with a width of 6.35 mm by carefully giving parting cuts. The NOL rings are then extracted from the mandrel making use of the taper

The most common properties reported for fiber-reinforced polymers are those obtained from tensile testing of a unidirectional (UD) specimen in the fiber direction. In the tensile test, the specimen is subjected to increasing uniaxial tensile force while simultaneous observations were made on the elongation of the specimen. Tensile specimens with different layers are shown in Fig 2. The properties which can be measured in tensile testing are modulus of elasticity, ultimate tensile strength and tensile strain. The most common properties reported for fiber-reinforced polymers are obtained from tensile testing of a unidirectional composite in the fiber direction. The tensile test that measures these properties is very simple. To determine the modulus of elasticity and Poisson's ratio, strains are measured during the initial stage of the test, using strain gages or extensometers. Output of tensile test data is tabulated in Table 1. National Ordnance laboratories (NOL) ring test was performed on UTM with ring attachments as shown in Fig 3. Circular specimen samples obtained as described above and shown in Fig 5 were tested to measure tensile hoop stress. The tensile hoop stress values were obtained as per ASTM D3379 standards.

Fig 2: Tensile testing samples prepared from cylindrical specimen and test setup.

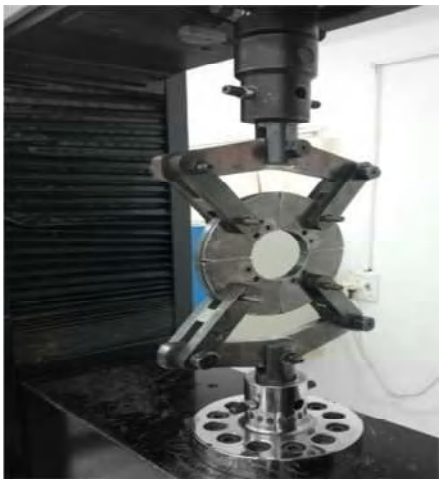

Fig 3: NOL Ring Test Experimental set up

Table 1: Tensile test output data

S.NO.	DIMENSIONS (mm)	MAX. DIPSLA-CEMENT (mm)	MAX. LOAD (KN)	TENSILE STRENGTH	TENSILE MODULUS
1.	14.94 x 1.25	7.744	41.3664	2215	148
2.	14.97 x 1.27	8.002	43.592	2334	148
3.	14.90 x 1.26	7.519	45.053	2400	146
4.	14.90 x 1.25	8.076	44.089	2348	147
5.	14.97 x 1.26	7.529	45.221	2397	146
6.	15.05 x 1.26	7.697	46.840	2470	149
7.	15.04 x 1.27	7.351	44.991	2355	143
8.	15.02 x 1.27	7.440	38.804	2034	147

3. Results and Discussion

The ability of the material to withstand force tending to pull it apart is called tensile strength. Maximum tensile stress sustained by the material being tested to its breaking point. Tensile test samples were prepared from the cylindrical specimen in the longitudinal direction of cylinder to find tensile strength. After the test samples failure mode in almost all the specimens was observed to be brooming or explosive fracture as shown in Fig 4. Ultimate tensile strength measured more than 2000 M Pa along the fiber direction. An internally pressurized cylinder may not withstand this high value of stress since all the fibers cannot fracture at the same time.

Fig 4: Tensile sample brooming fracture after test

Fabrication of composite structures by filament winding techniques are tested by NOL ring test to measure its hoop stress by exact simulate the cylindrical pressure. In this test, specimens have been developed for the evaluation of filament wounded composite cylinder structural properties. These methods have all been found for value making materials comparisons in research work and have also served as materials quality control techniques. The force can be applied to the ring shaped specimens similarly to the burst tests of actual pressure vessels but from outside as shown in Fig 3. It is important that the fracture behavior inside of the CFRP layers could be observed directly while it is impossible to observe the fracture under the surface of actual pressure vessels. A method of ring fabrication and testing techniques for determination of hoop tensile strength have been using most popularly. Test samples in circular ring shape and fractured specimen are is shown in Fig 5. Test data of NOL ring test on the composite is tabulated in Table 2.

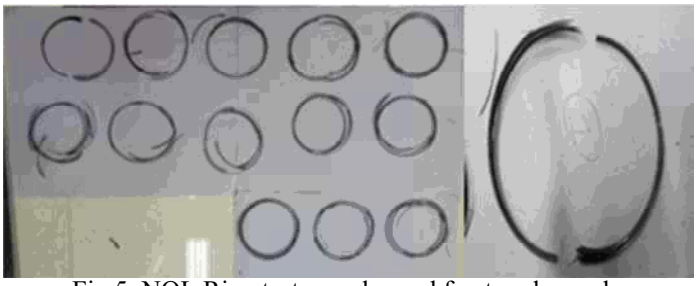

Fig 5: NOL Ring test samples and fractured sample

$$\sigma = \frac{Fd}{2t} \qquad (1)$$

NOL Ring test simulate pressure conditions and measure hoop stress of the ring. It should be noted that the tensile hoop strength, σ can be determined with help of equation 1. In the equation F is the ultimate burst force recorded in Newtons, whereas t and d are the thickness and diameter of the NOL-ring sample in millimeter respectively, according to ASTM D2290 standard. Total 23 tests are performed and ultimate strength was observed in the range of 1483 to 1962 MPa. Practically tensile strength of composite motor casing is under 2000 MPa. NOL-Ring test values of tensile strength is more appropriate for composite cylindrical shell than the results of UD specimen tests. The scatter in the values of NOL ring test is perhaps due to non-uniform tension during winding, damage caused to rings during extraction. Exact value of stress can be estimated by Weibull Analysis, which was reported by the authors [20]. Histogram of the test values is shown in figure 6. Even though the fracture stresses are different but few locations it was approximately same. From this graph it can observed that the maximum repetition of fracture stress could be between 1675-1725 MPA which was repeated 6 times. In this range of stresses composite can withstand repeated loads without much damage. This test method is relatively simple to conduct and requires a simple tool that has good alignment options and precise centering of the data. This method is often used in quality control and is suitable for comparative tests also.

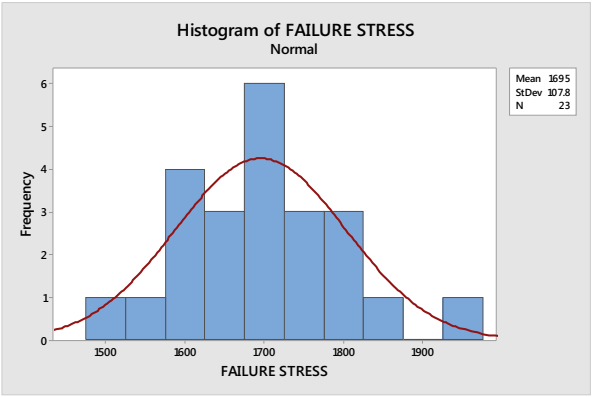

Fig. 6: HISTOGRAM Of failure stress

Table 2: NOL ring test output data

S.NO.	Specimen Dimension (mm)	Maximum Displacement (mm)	Max. Load (Kn)	Nol (MPa)
1.	6.46 x 1.58	7.589	34.257	1678
2.	6.57 x 1.55	8.842	39.963	1962
3.	6.60 x 1.55	7.488	32.367	1582
4.	6.50 x 1.57	8.091	36.204	1774
5.	6.58 x 1.59	7.986	35.889	1715
6.	6.45 x 1.56	7.909	35.486	1764
7.	6.48 x 1.58	8.345	36.726	1794
8.	6.54 x 1.60	8.263	36.708	1754
9.	6.49 x 1.61	8.152	37.248	1783
10.	6.47 x 1.60	7.644	34.848	1683
11.	6.60 x 1.60	8.269	38.117	1845
12.	6.60 x 1.62	7.779	36.499	1707
13.	6.33 x 1.63	7.219	33.513	1624
14.	6.56 x 1.65	7.780	36.420	1682
15.	6.64 x 1.66	8.227	39.437	1789
16.	6.49 x 1.49	6.393	29.507	1526
17.	6.52 x 1.52	6.168	29.400	1483
18.	6.38 x 1.54	6.618	31.092	1583
19.	6.52 x 1.54	7.176	34.289	1708
20.	6.48 x 1.53	7.068	32.919	1660
21.	6.59 x 1.60	7.082	34.737	1648
22.	6.72 x 1.60	7.151	34.211	1591
23.	6.56 x 1.53	7.059	33.211	1654

4. Conclusion:

Based on the experimental results and analysis made on CFRP composites following conclusions were made.

1. The properties of the composite material cannot be defined or standardized its properties vary from one component to another as it is process dependent. It was observed that the desired properties are only obtained if all process parameters are execute properly.
2. The failure stress is more accurately measured by NOL-Ring test than unidirectional tensile test.
3. With all the process parameters the NOL rings produced were within the ASTM standards and was suitable for testing. Material could bear a stress of 1430 MPA without getting deformation and failure chances are nil.
4. It was also found that the maximum frequency of repetition of failure stress is between 1675-1725 MPA.

5. Acknowledgments

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Performance improvement in wireless sensor networks by removing the packet drop from the node buffer

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ABSTRACT

In Wireless Sensor Networks (WSNs) typed applications, the node buffer plays a vital role to store the processed data before transmitting it further to the base node through neighbor nodule. Nowadays, in Multi-Application Wireless Sensor Networks (MAWSNs) scenario, to improve network performance of the node buffer has to be maintained or efficiently balanced. Because, for implementing various applications, at the same time in MAWSNs, the processing, transmitting capability of the node should be enhanced and the node storage capacity (Buffer) should be maintained. Since, if the node buffer exhausted then automatically it drops the data packet and the data will be lost and hence performance degradation will occur in the network. It will also affect the network lifetime. Hence, this paper implements a mechanism to enhance the node buffer for improving network performance. The work is implemented on Network Simulator i.e., NS2 version 2.34/2.35. Our work outperforms in comparison with the existing work and improves network performance.
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1. Introduction

Wireless Sensor Networks (WSNs) are the wireless typed network that contains thousands of or sometimes millions of sensor nodes (in MAWSNs) [1]. All these nodes in the network are having constraint energy as well as a buffer. These nodes suppose to do the basic operations like sensing of information, processing the data, and transmit it to the neighbor node. These nodes with a constrained buffer will become a bottleneck node when a huge data is transmitted towards it. Hence, by only considering the node energy by neglecting the node buffer will affect the network performance. In the case of delay in the network automatically the overflow will occur at the node buffer and hence the data packet will drop through the node buffer and information will lose. This loss of information will directly affect network performance [2] (Figs. 1 and 2 and Table 1).

The WSN consists of a large number of wireless nodes that have constrained energy, as well as storage space. The major tasks of these nodes are data gathering and forwarding them to the Sink node (BS) [3]. Hence, network performance becomes one of the major criterions for the effective design of the network in WSN. Hence, in this paper, a cluster head is elected for each cluster to reduce the buffer utility of the source nodes to optimize source exploitation [4].

The buffer-efficient routing can be obtained by the nodes that have a maximum residual buffer. Hence, the highest residual buffer nodes were selected to forward the data to BS. It helps to provide a better packet delivery ratio with lesser resources utilization. The results show that the proposed work outperforms the existing balanced routing protocol and LEACH Protocol in terms of packet delivery ratio, and end-to-end delay. It also improves overall network performance.

Till now the researchers are working on the energy-efficiency of the node to enhance network performance. But, at the same time, the network buffer also plays a very important role to avoid performance degradation in the network. Because, due to sufficient energy, that satisfies the threshold value, if a node gets bulky data packets, then due to its constrained buffer the node buffer gets overflow and becomes the bottleneck node and drops the data packets [5].

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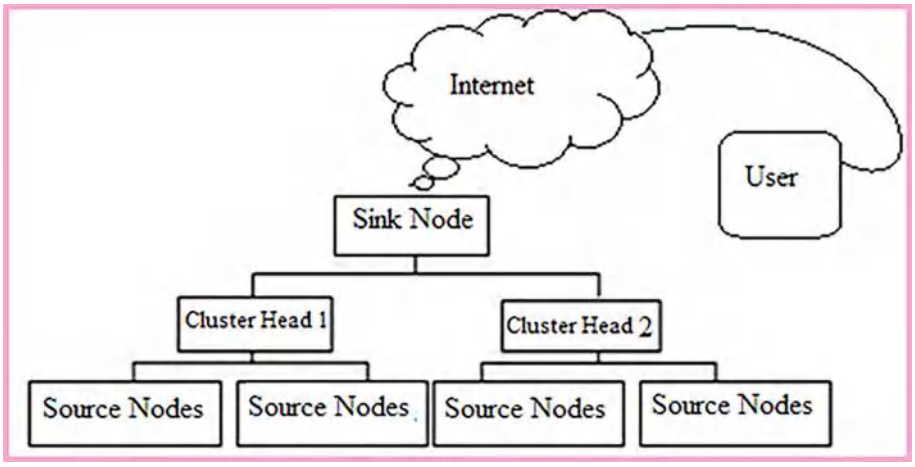

Fig. 1. Basic working of wireless sensor network.

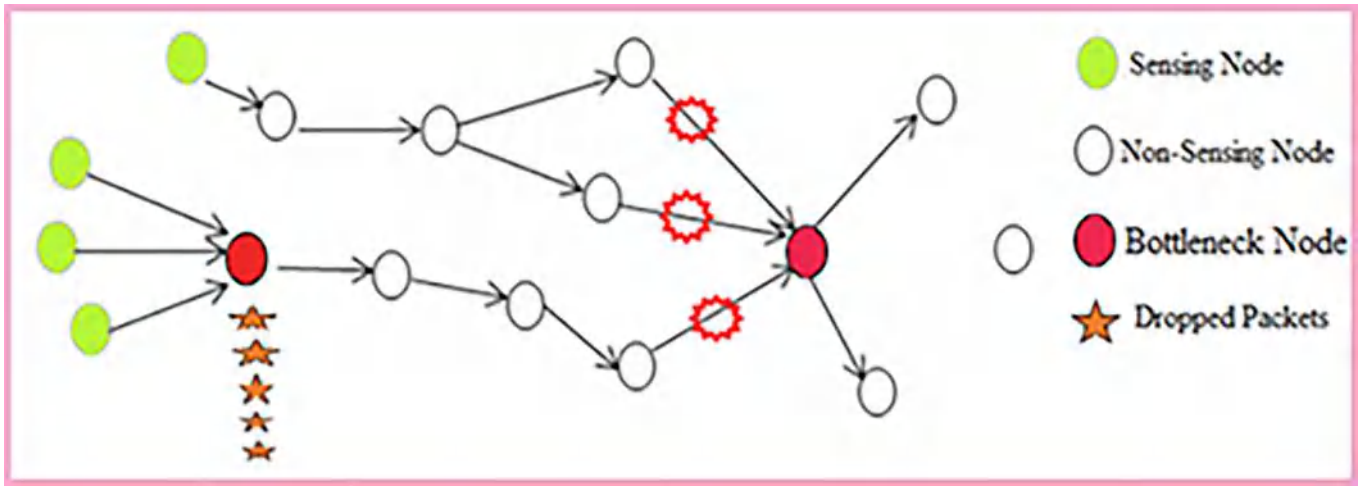

Fig. 2. Scenario of node becoming bottleneck node in WSNs.

Table 1
Parameters used in the network simulation.

Parameters used	values
Time for Simulation	1000 s
Quantity of Nodes	100–500
Layer	Logical Link
MAC protocol	802.11
The Mobility Concept used	RWP
The Network layer	Projected
The Communication Mechanism	Two-Ray Ground Theory
Method of Queuing	The Priority Based on Drop-Tail
Energy Supply	300j
Model of Traffic	Constant bit rate
Network Area	1000 m × 1000 m

2. Literature survey

All these developments associated with the routing mechanism in WSNs are essentially linked with its application. However, in WSN, routing protocols design must contain buffer balancing to manage the available resource of the nodes [6]. The study says that there are generally two factors that play a vital role while selecting the node neighboring to the sender; those are energy and load (Buffer). Thus, in this work, we develop an efficient routing protocol that selects an efficient path by considering the residual buffer capacity of the neighbor node. For achieving this goal, primarily we have to work out on node buffer and then calculate the remaining status of the present buffer status of the node. Furthermore, the appropriate solution to overcome the bottleneck issue for the node is to change the sink node position base on the residual buffer status of the intermediate nodule. Thus, in this work, we are designing a routing protocol to expand further the network's performance by implementing the mobile sink node.

WSN is a collection of very small wireless nodes as source nodes to gather the data for the ecological actions for doing computations on them depends on applications. Later on, the collected data transmitted through to the sink node i.e., the base node through the neighbor node in the network [7]. Different researchers worked on the proper buffer utility of the source node in the network. Because all the wireless nodes work in synchronization with the other nodes to make data transmission successfully. These wireless nodes constantly in the dynamic form to take delivery of the data packets and broadcast them to the base node. As these nodes are battery-operated, this nonstop monitoring action decreases the lifetime of the source nodes [8]. On the other hand, buffer sufficiency also plays an important role in the lifetime of the source node. Because the lifetime of a single node in the network will affect the whole network's performance. Hence, the efficient management of buffer is a significant constraint for the best design for a WSN. Thus, a routing protocol is significantly desirable to make the

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WSN with balanced buffer. Hence, in this paper, a complete observation and investigation of the existing routing protocol with energy efficiency are discussed. The LEACH routing protocol that creates energy as well as buffer balance in the network saves the node buffer and increases the lifetime of the network [9] is discussed.

3. Proposed work

From the last few years, the researchers are working on the node energy and considering it as a sole metric to advance the network performance as well as lifetime. But, at the same time, the buffer also plays an imperative role to increase network performance. Because, if due to sufficient energy if a node gets a higher number of data packets, then at the same time, due to the constrained buffer of the node, an overflow will occur at the node buffer and hence data packet will drop through the buffer [10]. This will cause the node to become a bottleneck node in the network. Due to this performance degradation will occur in the network and hence the network lifetime also decreases. Hence, in this paper, we are implementing the Knapsack Algorithm to maintain the node buffer. Because by using this (Knapsack) algorithm we can maintain the node buffer capacity to store the information packets [11]. As per the LEACH concept, different clusters are created in the network. In our concept, a node with higher remaining buffer capacity is elected as a Cluster Head (CH) for that particular cluster instead of selecting randomly like in the LEACH protocol. The main aim of the cluster head is to aggregate the data for avoiding the repetition of the data and hence network performance can be improved [12].

To maintain the node buffer, the data aggregation of the information is done at the nodal centers that are at the cluster heads. The basic equation for the residual buffer of the node is given by,

$$B_{Existing} = B_{Total} - B_{Packets\ in\ the\ Queue} + B_{Packet\ Drop} \quad (1)$$

where,

$B_{Existing} = The\ Residual\ Buffer\ of\ the\ node$
$B_{Total} = Total\ Buffer\ at\ the\ time\ of\ Deployment$
$B_{Packets\ in\ the\ Queue} = Buffer\ utilized\ by\ the\ Packet\ in\ the\ Buffer$
$B_{Packet\ Drop} = Buffer\ Space\ Created\ by\ the\ Dropped\ Packet$

Thus the paper computes the residual packet capacity of the node in its available energy as follows:

1. Considering a multi-hop WSN with several nodes outfitted with E joules of energy and it can handle the n number of packets. The energy required to process the packet P_i is determined by the following equation:
2. The number of traffic queued at the sensor node buffer is determined by the help of Random Early Detection (RED) gateways follows:

$$Averagenewqueue(Q_{avrg}) = (Weighted\ constant) * Instant\ Queue + (1 - Weighted\ constant) * Averageoldqueue \quad (2)$$

3. Weighted constant value is determined by the time constant value of the low pass filter.

Threshold queue value of buffer size is kept in this approach is

$$Thresholdbuffer(Q_{Th}) = 75\%\ of\ the\ Buffer\ size \quad (3)$$

4. The mobile sink node position must be changed if the neighbor node of the sensor node buffer queue size is below the threshold queue value of buffer size.

The proposed Algorithm:-

1. Dynamic replacement of the node $(N, CRP, CRP_{Th}, Q_{avrg}, Q_{Thre}, D)$
2. Attain the positions of the N nodes along with their respective values of CRP and Q_{avrg}

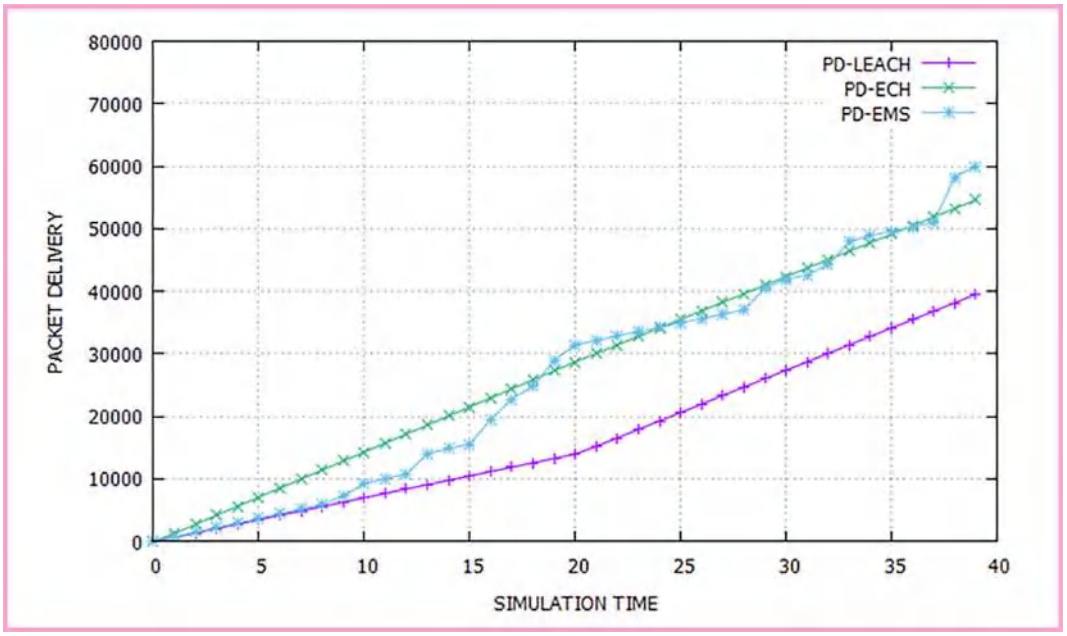

Fig. 3. Performance of packet delivery for proposed vs. existing approach.

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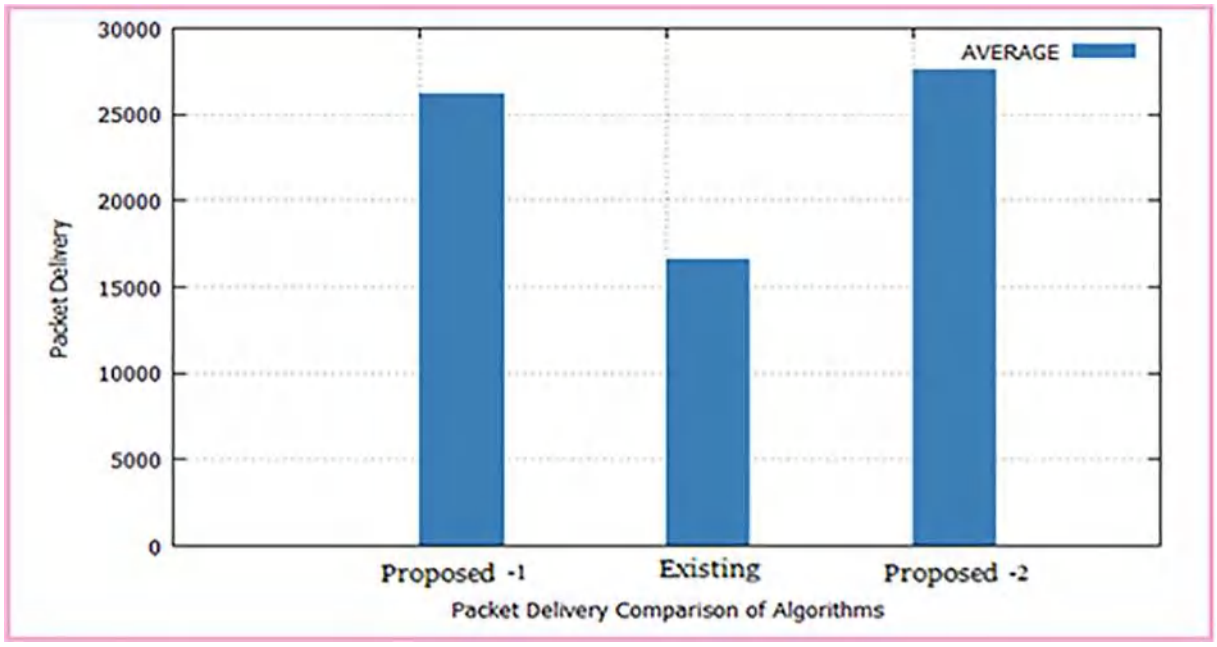

Fig. 4. Packet delivery relationship between existing & proposed work with average values.

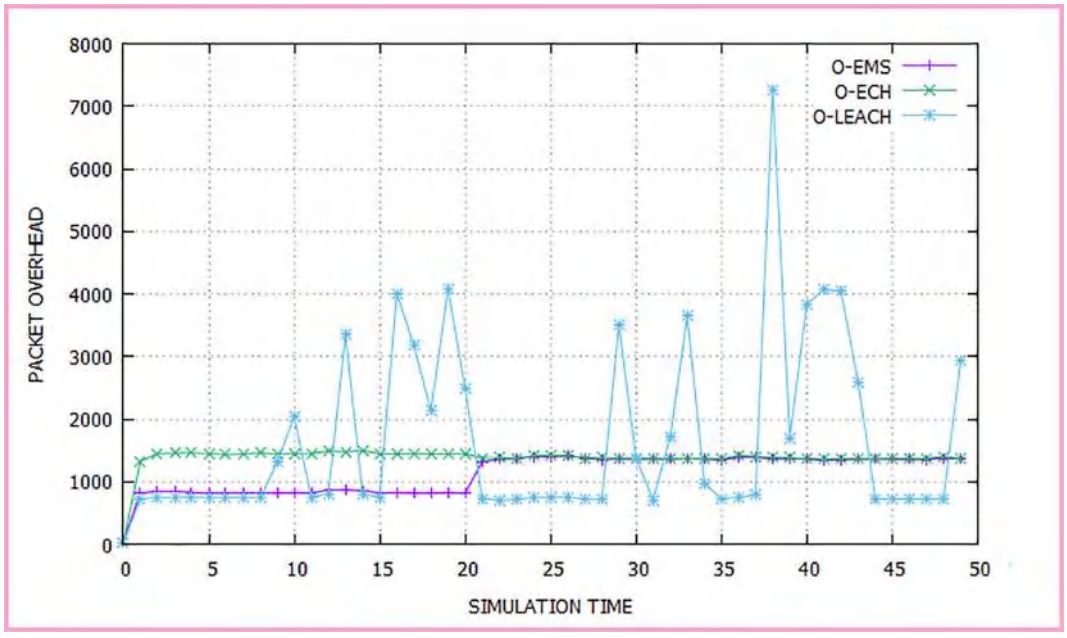

Fig. 5. Overhead comparisons (proposed vs. existing).

3. The provision of the neighbor node of the sink is given by

if $(CRP \geq CRP_{Th})\&\&(Q_{avrg} \geq Q_{Thre})$
{
Sink location do not modify
}
Else
{

Find out the nodes that satisfies the threshold status about the buffer also calculate the distance between sink and the sensor nodes.

Find out the neighbor node, which fulfill the threshold status of the buffer for the storage of the packet.

Relocate the sink to present location to the neighbor position to the node as per the threshold values of the buffer capacity
}

4. Performance outcomes

4.1. The packet delivery

The considered metric, Packet Delivery (PD), defined as the number of packets forwarded through the supply to the target node. The network packet delivery is computed with the variable number of nodes and simulation time in the presence of a misbe-

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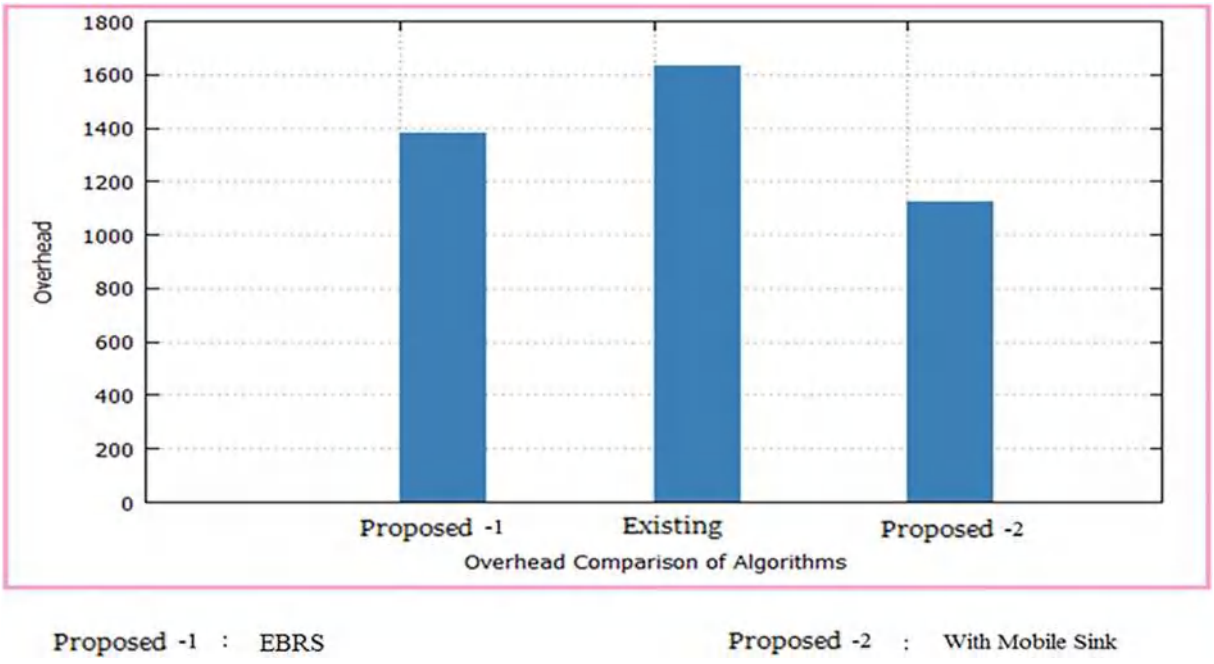

Fig. 6. Average packet overhead comparison in respect with a varying number of nodes between projected and existing approaches.

having node (packet dropping node). The figures below depict that the PD performance of the LEACH protocol is less, as this approach did not prevent the packet dropping nodes from the routing path due to the constrained resource.

Fig. 3 above gives the packet delivery performance comparison of the proposed and existing work concerning the simulation time. The figures depict that packet delivery of proposed work is better than the existing protocols.

Fig. 5, gives the performance comparison between proposed and existing routing protocol under different mobility environments about packet delivery. The results show that in the proposed protocol, Packet Delivery is outperformed in comparison with the existing protocol. The figure shows the performance comparison of the average throughput of proposed and existing routing protocols concerning a changeable number of nodes (Fig. 6).

4.2. The overhead

The overhead of the network is computed in control packets concerning the number of nodes. It computes the number of control packets used by the algorithm in one complete communication session, apart from the data packet.

Fig. 4 shows the comparison of control packets overhead of proposed and existing routing protocols concerning the number of nodes. It is obvious from the figure that the LEACH control packets are very much high as it sends the acknowledgment for every data packets. Proposed routing protocol control packets overhead are very much less as it sends the acknowledgment packets after a specified time interval. ECH protocol control packets overhead is less than LEACH and EMS, as it did not consist of acknowledgment packets.

5. Conclusion

Hence, by maintaining the node buffer efficiently and removing the repeated information packets we can improve the network performance as well as lifetime. In our proposed work by removing the bottleneck problem we can improve the network performance intern it will give high packet delivery by removing the packet drop. The performance outcome shows that our proposed work outperforms in contrast by means of the existing work.

The network performance can be further improved by the Sink mobility concept which is our upcoming work.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Characterization of Inconel 718 at sub-zero temperatures

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ABSTRACT

Nickel based super alloys have excellent properties in extreme temperature conditions which make them strong contender in industries such as power generation, chemical Industries etc. These materials have very good applications in turbines, power plants due to their excellent mechanical properties. Large grades of these alloys have been used extensively in the industry but Inconel 625, Inconel 718 are the more popular. In this study characterised Inconel 718 and predict mechanical properties at sub-zero temperatures. Conducted tensile tests on the specimen at different orientations, temperature ranging from room temperature to −70 °C, at strain rate of 0.01/s. investigated the mechanical properties of this material at sub-zero temperatures. This study shows that as the temperatures increases yield strength of the materials decreases but ultimate tensile stress increases. This indicates that plastic region of the materials enhances at sub-zero temperatures, which shows that formability of material improves at this temperature.
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Selection and of the scientific committee of the 10th International Conference of Materials Processing and Characterization.

1. Introduction

In the present-day industry, there have been an increase demand for materials which need to have resistant to corrosion at higher temperature and high strength, toughness. Nickel based superalloy are widely used in the applications in extreme temperatures conditions. They have been using in the field of power generation, aircraft, turbines, nuclear power plants, rocket engines and other application [1].

Inconel 718 is a nicked based super alloy which has precipitation hardened nickel chromium iron-based super alloy, developed by H. L. Eiselstein of International Nickel Company [2]. Inconel 718 have FCC crystal structure with polycrystalline Ni-base wrought superalloy consisting of significant amount of Fe, Nb and Mb with lesser amount of Ti and Al. It can be manufacture by conventional melting and casting techniques. Inconel 718 shows good mechanical properties with corrosion resistance. These alloys are well known for their creep – rupture strength and oxidation resistant at higher temperatures due to the contents of Chromium and Molybdenum [3]. Xiaoming Zhao et al. [4] in their work have studied Inconel 718 prepared using Laser rapid forming from the gas atomized and plasma rotated electrode preparation powders and was evaluated for mechanical properties comparing GA and PREP methods and their facture surfaces were checked for to understand the difference in properties. Appa Rao et al. [5] have studied a specific process of hot isostatic pressing (HIP) route unfortunately due to microstructural phases in material has decreased ductility strength of the material when compared with wrought alloy. Janaki Ram [6] in his study the mechanical properties of Inconel 718 sheet when welded using the electron beam welds and compare properties between post weld aging and non-aged welds. This study concluded that the aged weldments were inferior to the base metal and have showed lower tensile and stress rupture properties. Shi-Hong Zhang et al. [7] has studied the mechanical properties of Inconel 718 with varying alpha phase content. It is found that the strain hardening exponent was reported higher when compared two deformation methods were used. The flow stress behaviour of Inconel 718 is studied by Guary mahalle et al. [8] depending on the variation of temperatures and slightly variant with the strain rate. At high temperatures, increases the mechanical properties like yield stress, Ultimate tensile strength, which are increases the workability of the Inconel718. And also studied the

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SEM micrographs of the broken test samples which confirms the ductile fracture at high temperatures. Hall et al. [9] The complex interdependence of microstructure, composition, heat treatment and its effect on Inconel 718 alloy mechanical properties was studied. The main result of the analysis is an increase in Ti-content (by weight percent) in alloy composition, an increase in yield strength but a decrease in the percentage of elongation which also decreases in the properties of stress rupture. High cycle fatigue properties were investigated at the cryogenic temperatures with a mean gamma grain size of 25 mm, and he studied the SEM micrographs at 4 k, 77 k, 293 k and observed that Crack initiation is vary from various temperatures [10]. M. Sandeep et al. [11] investigated the mechanical properties at 0 °C, −25 °C −50 °C with different crosshead velocities in three orientations like Rolling, Nominal and Transverse direction. The objective of this project is to quantified the tensile properties by using Taguchi robust design. HRB335, HRB400 reinforcing steels mechanical properties Jian Xie et al. [12] investigated at various cryogenic temperatures −165 °C to 20 °C, he observed that ultimate tensile strength and yield strengths age increases with decreases of the temperatures from room temperature to sub-zero temperatures and also decreases the fracture strains. Ageladarakis et al. [13] studied the tensile properties at Room and Cryogenic Temperatures and also analyse the fracture behaviour with help of Scanning Electron Microscope which confirms toughness of fracture increases with decreasing of temperatures. Evaluating and comparing the mechanical properties of ASS316L at 0 °C, −25 °C, −50 °C in 0, 45, 90 orientation to rolling directions with different cross head velocities and found that, the plastic behaviour of ASS316L strain rate is more impact compared to variation of temperatures [14–18]. R.L. Tobler et al. [19] Tensile properties and fracture behaviour of inconel 718 at cryogenic temperatures range from 295 k to 4 k and he found that at −270 °C the yield strength is 20% greater than the room temperature.

In the present work investigate the tensile properties of Inconel 718 at sub-zero temperatures. Tensile specimens were prepared from cold rolled INCONEL 718 sheet, which were tested at temperatures ranging from room temperature to −70 °C at −15 °C intervals at $0.01/s^{-1}$. Estimated the various tensile properties like yield strength, ultimate tensile strength, young's modulus, K, n etc. Try to understand the material behaviour and try to predict forming behaviour at zero temperatures.

Table 1
Chemical composition of Inconel 718 alloy.

Element	Ni	Cr	Nb	Mo	Fe	Other
Wt%	50.63	18.966	4.786	3.214	19.80	Rest

2. Material and experimental

2.1. Material and specimen

Inconel 718 is an alloy from the family of super alloys of Nickel. It is one of the most widely used material in the industry for specific applications like Turbine rotor, gas turbines blades. In addition to the above they are also used in applications where the environmental conditions are harsh. The chemical composition evaluated by optical emission spectrometry is shown in the table below. In this study, the tensile samples are prepared by wire cut EDM from a sheet of Inconel 718 using cold rolling process. The samples were cut in three different direction namely Rolling, Nominal and Transverse direction measured with respective to the rolling direction. The dimensions of the specimens are as per ASTM E08/E8M-11 (Tables 1 and 2).

2.2. Tensile experimentation

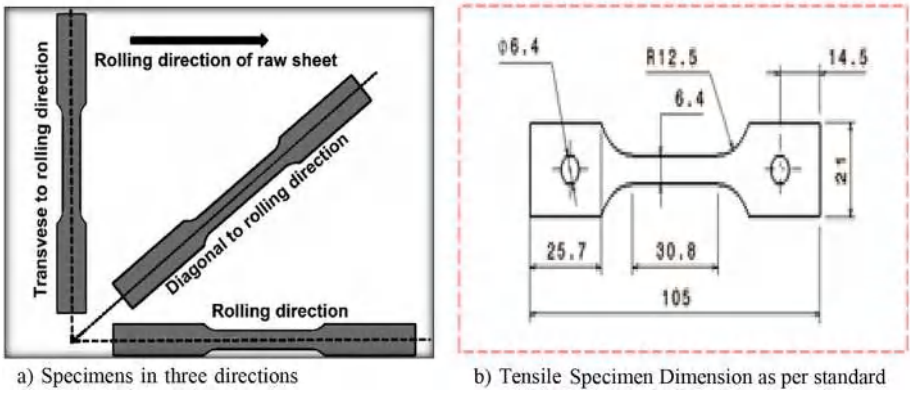
The experiments were done on a precision Universal Testing Machine (UTM) at room and sub-zero temperatures. The temperatures used were Room Temperature, 0 °C, −15 °C, −30 °C, −45 °C, −60 °C, −70 °C. Experiments have conducted on uniaxial tensile test at the above temperature with various process parameters like Strain rate (0.01/s) and Orientation (0, 45, 90) with rolling direction. We have taken the Force and Elongation output from the experiment and calculated the Material Properties. The experimental setup is as shown in the figure with specimens at subzero temperatures in the chamber of the Universal testing machine (Figs. 1–4, Table 3).

3. Results and discussion

All the properties of materials estimated from experimental data are tabulated in Table 3. Load and displacement data were

Table 2
Mechanical properties of base metal Inconel 718.

Base Metal	Density (g/cm	Youngs modulus (GPa)	UTS (MPa)	Yield Strength (MPa)	%Elongation	Poisons Ratio
Inconel 718	8.19	29	965	550	30	0.294



a) Specimens in three directions b) Tensile Specimen Dimension as per standard

Fig. 1. a) Specimens in three directions b) Tensile Specimen Dimension as per standard.

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Fig. 2. (a) Experimental setup (b) Specimen at subzero temperature (c) Specimen after fracture.

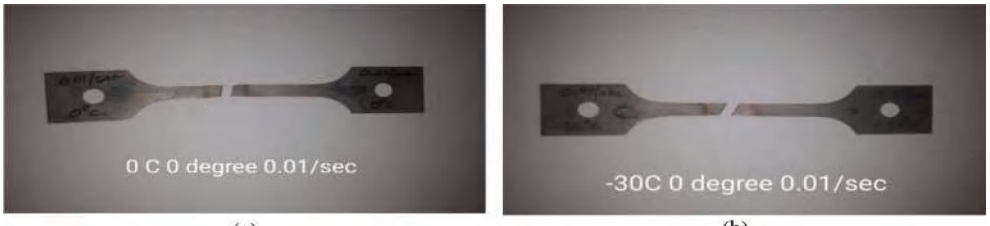

Fig. 3. Fractures specimens after testing.

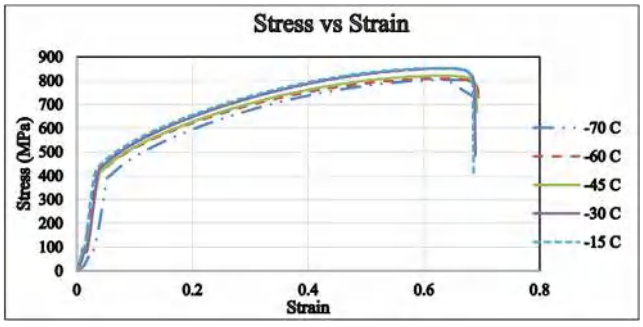

Fig. 4. Stress Vs Strain Diagrams at Sub Zero temperatures.

measured by experimental setup. By using mathematic calculations all the material properties are calculated from the available data. The tensile stress vs strain diagram of all the specimens are consolidated in the graph show in Fig. 5. It is observed that as the temperature decreases yield strength and ultimate strength of materials changing. At lover temperature yields strength of material decreases but UTS is increased. The range between yield point and UTS point is increases, this shows that plastic deformation of the materials increases and materials become more ductile at sub-zero temperature.

Fig. 5 showing the scanning electron microscope (SEM) images of fractured surfaces of specimen at −15 °C and −70 °C. In fracture surface showing dimples which are represents ductile nature of

Table 3
Tensile test results temperature from Room Temp to −70 °C.

Operating temperature °C	Orientation (placement Angles) in °	Youngs Modulus (E) GPa	Yield stress, MPa	Ultimate tensile strength (UTS) MPa	% Elongation	Strength Co-efficient (K) MPa	Strain hardening exponent (n)
26 (RT)	0	13.271	381.269	759.597	67.334	13.2143	0.1535
26	45	12.679	403.518	769.881	69.796	6.1343	0.2599
26	90	13.72	398.884	770.255	68.369	6.9524	0.2443
0	0	12.85	432.329	803.163	82.623	9.9055	0.1932
0	45	10.597	461.606	807.637	72.617	9.9125	0.1844
0	90	11.04	425.037	801.379	71.577	16.2875	0.124
−15	0	11.259	414.851	769.881	70.999	3.6626	0.3028
−15	45	16.591	422.563	812.429	71.681	3.7378	0.285
−15	90	9.514	439.994	809.007	71.616	1.8539	0.1907
−30	0	10.155	434.167	821.74	70.001	4.2995	0.2778
−30	45	11.68	457.584	826.816	74.042	3.3387	0.3023
−30	90	9.555	452.701	820.942	70.579	2.9244	0.3172
−70	0	14.046	442.062	853.99	69.868	2.2512	0.3654
−70	45	11.854	477.632	850.619	70.962	0.2936	0.6454
−70	90	14.142	475.854	871.686	70.073	9.3026	0.1993

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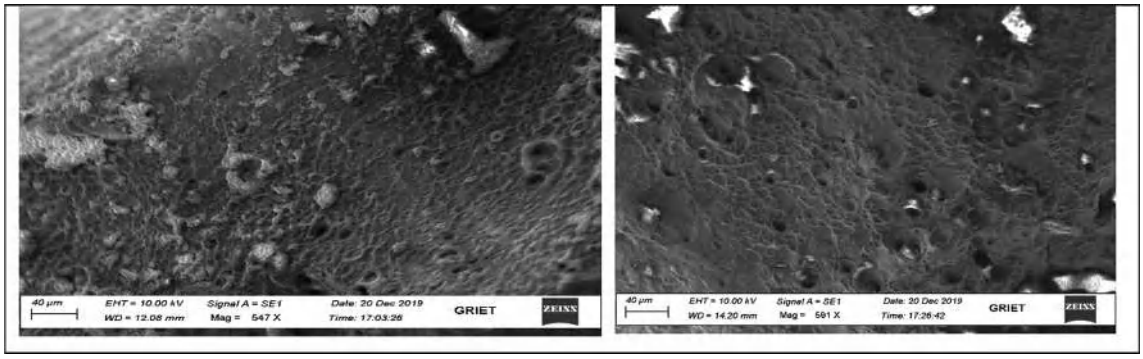

Fig. 5. Fractured surface under SEM at −15 °C and −70 °C.

materials. At lower temperature intensity and size of dimples are enhances which is evidence that as the temperature decreases ductility of materials not decreases. At −70 °C the size of dimples appeared on fractured surface is small in size but higher in number, which shows that ductility at this temperature is improved further, than higher temperatures. It evident that as temperature decreases material not become brittle but still it is ductile. The dimples in fracture surface indicates near-complete ductile fracture by cup and cone formation. It is believed that fracture occurred along the interface of the grains. With decrease in temperatures size of the plane of fracture was decreased.

4. Conclusion

This work involves characterisation and microstructure study of Inconel 718 alloy at sub-zero temperatures have following conclusions.

- Inconel materials yield strength and UTS are least effect by decrease in temperatures.
- Temperature at −70 °C material yields strength decreases but UTS increases.
- Plastic region between yield point and UTS point increases as temperatures decreases, which shows ductility of the materials enhances at lower temperature up to −70 °C.
- Fracture of materials predominantly ductile fracture even at −70 °C.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Performance improvement in wireless sensor networks by removing the packet drop from the node buffer

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ABSTRACT

In Wireless Sensor Networks (WSNs) typed applications, the node buffer plays a vital role to store the processed data before transmitting it further to the base node through neighbor nodule. Nowadays, in Multi-Application Wireless Sensor Networks (MAWSNs) scenario, to improve network performance of the node buffer has to be maintained or efficiently balanced. Because, for implementing various applications, at the same time in MAWSNs, the processing, transmitting capability of the node should be enhanced and the node storage capacity (Buffer) should be maintained. Since, if the node buffer exhausted then automatically it drops the data packet and the data will be lost and hence performance degradation will occur in the network. It will also affect the network lifetime. Hence, this paper implements a mechanism to enhance the node buffer for improving network performance. The work is implemented on Network Simulator i.e., NS2 version 2.34/2.35. Our work outperforms in comparison with the existing work and improves network performance.
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1. Introduction

Wireless Sensor Networks (WSNs) are the wireless typed network that contains thousands of or sometimes millions of sensor nodes (in MAWSNs) [1]. All these nodes in the network are having constraint energy as well as a buffer. These nodes suppose to do the basic operations like sensing of information, processing the data, and transmit it to the neighbor node. These nodes with a constrained buffer will become a bottleneck node when a huge data is transmitted towards it. Hence, by only considering the node energy by neglecting the node buffer will affect the network performance. In the case of delay in the network automatically the overflow will occur at the node buffer and hence the data packet will drop through the node buffer and information will lose. This loss of information will directly affect network performance [2] (Figs. 1 and 2 and Table 1).

The WSN consists of a large number of wireless nodes that have constrained energy, as well as storage space. The major tasks of these nodes are data gathering and forwarding them to the Sink node (BS) [3]. Hence, network performance becomes one of the major criterions for the effective design of the network in WSN. Hence, in this paper, a cluster head is elected for each cluster to reduce the buffer utility of the source nodes to optimize source exploitation [4].

The buffer-efficient routing can be obtained by the nodes that have a maximum residual buffer. Hence, the highest residual buffer nodes were selected to forward the data to BS. It helps to provide a better packet delivery ratio with lesser resources utilization. The results show that the proposed work outperforms the existing balanced routing protocol and LEACH Protocol in terms of packet delivery ratio, and end-to-end delay. It also improves overall network performance.

Till now the researchers are working on the energy-efficiency of the node to enhance network performance. But, at the same time, the network buffer also plays a very important role to avoid performance degradation in the network. Because, due to sufficient energy, that satisfies the threshold value, if a node gets bulky data packets, then due to its constrained buffer the node buffer gets overflow and becomes the bottleneck node and drops the data packets [5].

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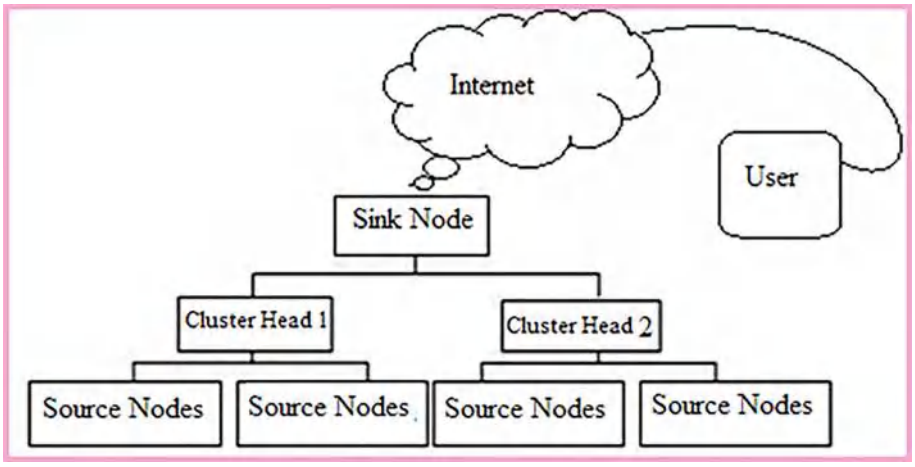

Fig. 1. Basic working of wireless sensor network.

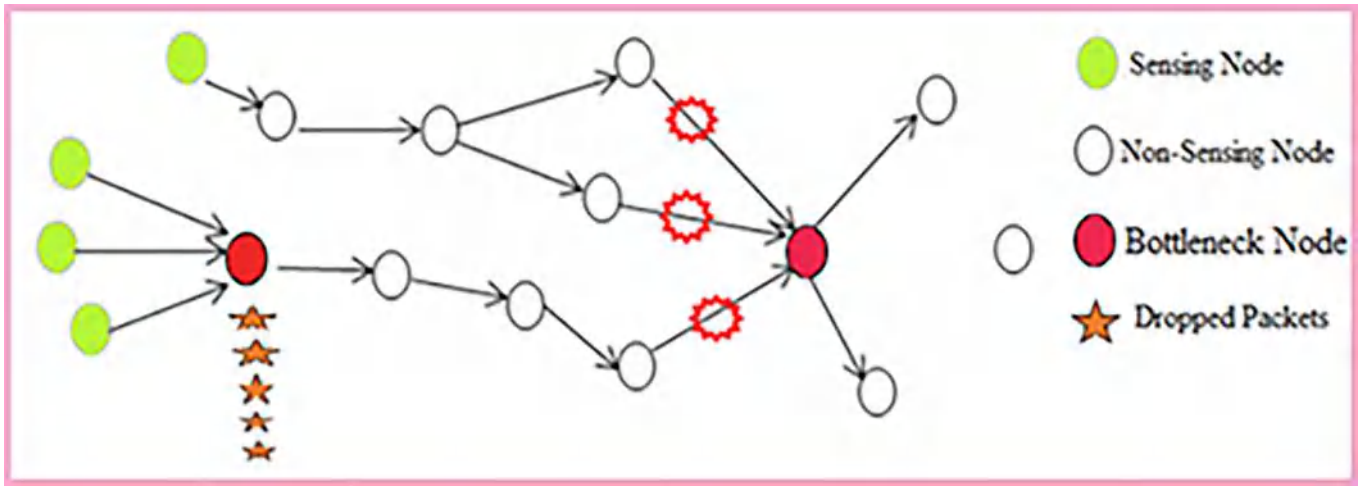

Fig. 2. Scenario of node becoming bottleneck node in WSNs.

Table 1
Parameters used in the network simulation.

Parameters used	values
Time for Simulation	1000 s
Quantity of Nodes	100–500
Layer	Logical Link
MAC protocol	802.11
The Mobility Concept used	RWP
The Network layer	Projected
The Communication Mechanism	Two-Ray Ground Theory
Method of Queuing	The Priority Based on Drop-Tail
Energy Supply	300j
Model of Traffic	Constant bit rate
Network Area	1000 m × 1000 m

2. Literature survey

All these developments associated with the routing mechanism in WSNs are essentially linked with its application. However, in WSN, routing protocols design must contain buffer balancing to manage the available resource of the nodes [6]. The study says that there are generally two factors that play a vital role while selecting the node neighboring to the sender; those are energy and load (Buffer). Thus, in this work, we develop an efficient routing protocol that selects an efficient path by considering the residual buffer capacity of the neighbor node. For achieving this goal, primarily we have to work out on node buffer and then calculate the remaining status of the present buffer status of the node. Furthermore, the appropriate solution to overcome the bottleneck issue for the node is to change the sink node position base on the residual buffer status of the intermediate nodule. Thus, in this work, we are designing a routing protocol to expand further the network's performance by implementing the mobile sink node.

WSN is a collection of very small wireless nodes as source nodes to gather the data for the ecological actions for doing computations on them depends on applications. Later on, the collected data transmitted through to the sink node i.e., the base node through the neighbor node in the network [7]. Different researchers worked on the proper buffer utility of the source node in the network. Because all the wireless nodes work in synchronization with the other nodes to make data transmission successfully. These wireless nodes constantly in the dynamic form to take delivery of the data packets and broadcast them to the base node. As these nodes are battery-operated, this nonstop monitoring action decreases the lifetime of the source nodes [8]. On the other hand, buffer sufficiency also plays an important role in the lifetime of the source node. Because the lifetime of a single node in the network will affect the whole network's performance. Hence, the efficient management of buffer is a significant constraint for the best design for a WSN. Thus, a routing protocol is significantly desirable to make the

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WSN with balanced buffer. Hence, in this paper, a complete observation and investigation of the existing routing protocol with energy efficiency are discussed. The LEACH routing protocol that creates energy as well as buffer balance in the network saves the node buffer and increases the lifetime of the network [9] is discussed.

3. Proposed work

From the last few years, the researchers are working on the node energy and considering it as a sole metric to advance the network performance as well as lifetime. But, at the same time, the buffer also plays an imperative role to increase network performance. Because, if due to sufficient energy if a node gets a higher number of data packets, then at the same time, due to the constrained buffer of the node, an overflow will occur at the node buffer and hence data packet will drop through the buffer [10]. This will cause the node to become a bottleneck node in the network. Due to this performance degradation will occur in the network and hence the network lifetime also decreases. Hence, in this paper, we are implementing the Knapsack Algorithm to maintain the node buffer. Because by using this (Knapsack) algorithm we can maintain the node buffer capacity to store the information packets [11]. As per the LEACH concept, different clusters are created in the network. In our concept, a node with higher remaining buffer capacity is elected as a Cluster Head (CH) for that particular cluster instead of selecting randomly like in the LEACH protocol. The main aim of the cluster head is to aggregate the data for avoiding the repetition of the data and hence network performance can be improved [12].

To maintain the node buffer, the data aggregation of the information is done at the nodal centers that are at the cluster heads. The basic equation for the residual buffer of the node is given by,

$$B_{Existing} = B_{Total} - B_{Packets\ in\ the\ Queue} + B_{Packet\ Drop} \quad (1)$$

where,

$B_{Existing} = The\ Residual\ Buffer\ of\ the\ node$
$B_{Total} = Total\ Buffer\ at\ the\ time\ of\ Deployment$
$B_{Packets\ in\ the\ Queue} = Buffer\ utilized\ by\ the\ Packet\ in\ the\ Buffer$
$B_{Packet\ Drop} = Buffer\ Space\ Created\ by\ the\ Dropped\ Packet$

Thus the paper computes the residual packet capacity of the node in its available energy as follows:

1. Considering a multi-hop WSN with several nodes outfitted with E joules of energy and it can handle the n number of packets. The energy required to process the packet P_i is determined by the following equation:
2. The number of traffic queued at the sensor node buffer is determined by the help of Random Early Detection (RED) gateways follows:

$$Averagenewqueue(Q_{avrg}) = (Weighted\ constant) * Instant\ Queue + (1 - Weighted\ constant) * Averageoldqueue \quad (2)$$

3. Weighted constant value is determined by the time constant value of the low pass filter.

Threshold queue value of buffer size is kept in this approach is

$$Thresholdbuffer(Q_{Th}) = 75\%\ of\ the\ Buffer\ size \quad (3)$$

4. The mobile sink node position must be changed if the neighbor node of the sensor node buffer queue size is below the threshold queue value of buffer size.

The proposed Algorithm:-

1. Dynamic replacement of the node $(N, CRP, CRP_{Th}, Q_{avrg}, Q_{Thre}, D)$
2. Attain the positions of the N nodes along with their respective values of CRP and Q_{avrg}

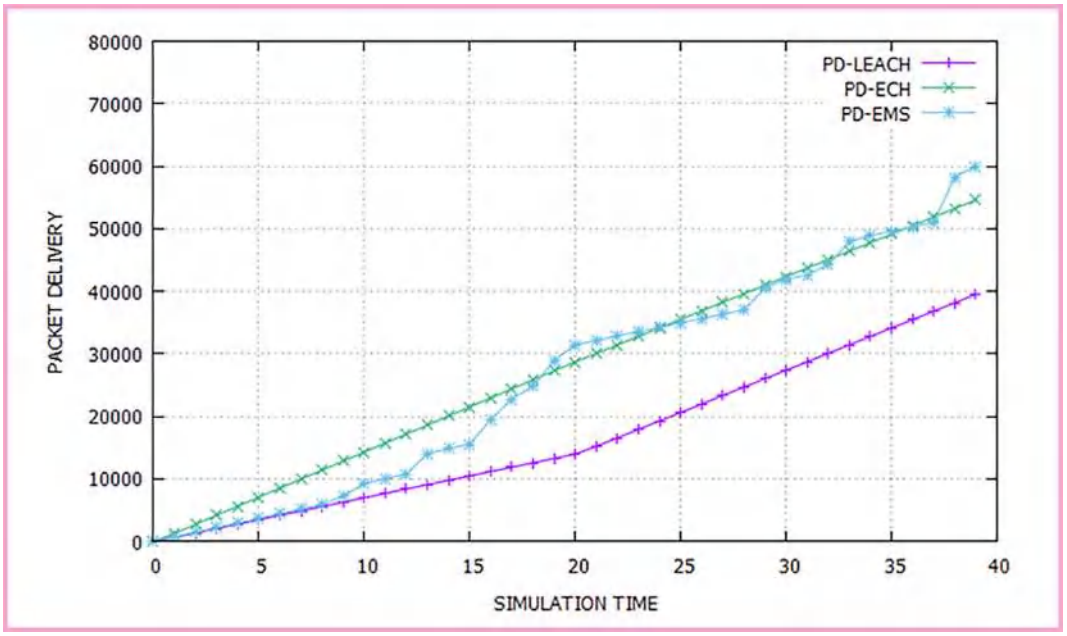

Fig. 3. Performance of packet delivery for proposed vs. existing approach.

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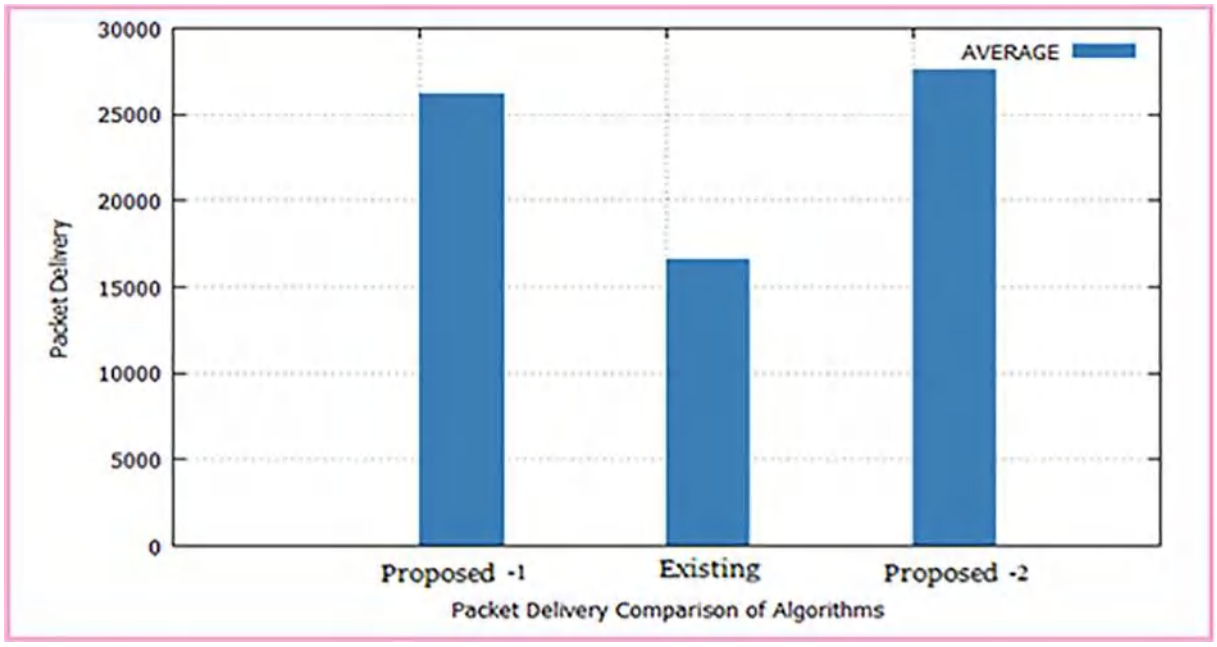

Fig. 4. Packet delivery relationship between existing & proposed work with average values.

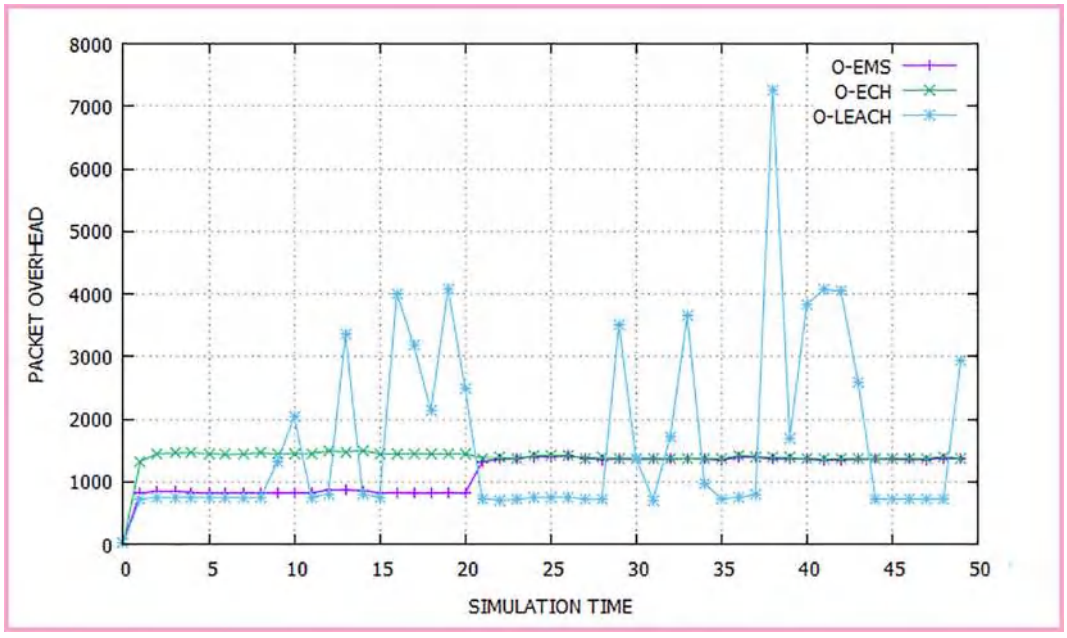

Fig. 5. Overhead comparisons (proposed vs. existing).

3. The provision of the neighbor node of the sink is given by

if $(CRP \geq CRP_{Th})\&\&(Q_{avrg} \geq Q_{Thre})$
{
Sink location do not modify
}
Else
{

Find out the nodes that satisfies the threshold status about the buffer also calculate the distance between sink and the sensor nodes.

Find out the neighbor node, which fulfill the threshold status of the buffer for the storage of the packet.

Relocate the sink to present location to the neighbor position to the node as per the threshold values of the buffer capacity
}

4. Performance outcomes

4.1. The packet delivery

The considered metric, Packet Delivery (PD), defined as the number of packets forwarded through the supply to the target node. The network packet delivery is computed with the variable number of nodes and simulation time in the presence of a misbe-

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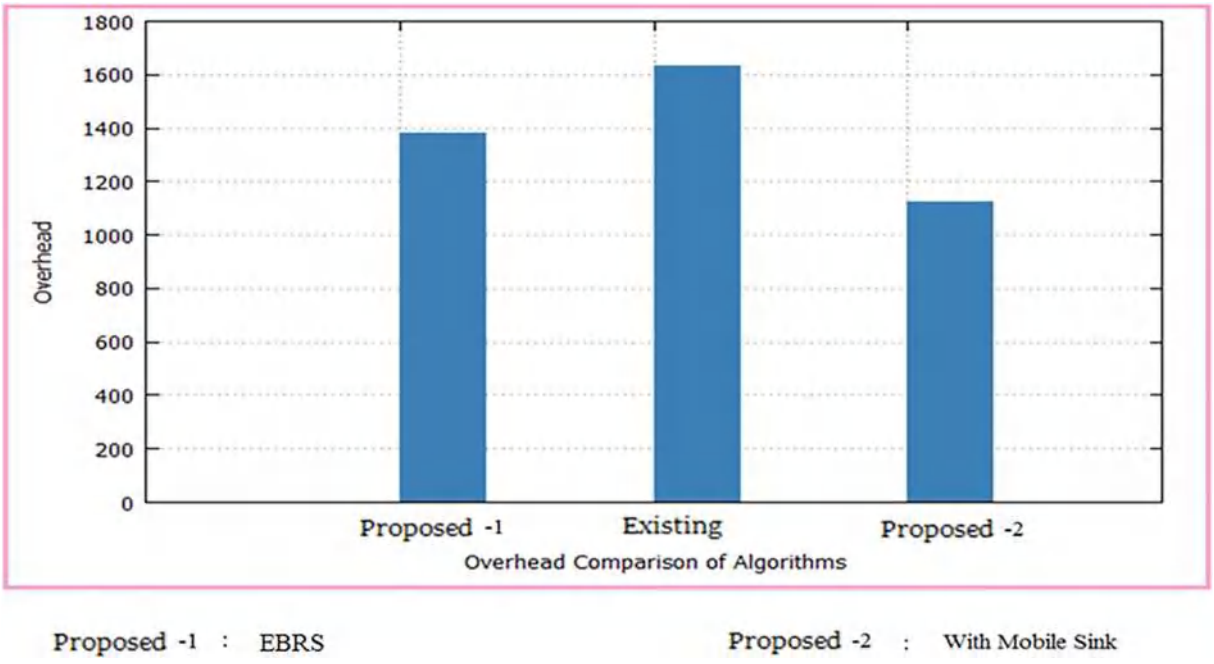

Fig. 6. Average packet overhead comparison in respect with a varying number of nodes between projected and existing approaches.

having node (packet dropping node). The figures below depict that the PD performance of the LEACH protocol is less, as this approach did not prevent the packet dropping nodes from the routing path due to the constrained resource.

Fig. 3 above gives the packet delivery performance comparison of the proposed and existing work concerning the simulation time. The figures depict that packet delivery of proposed work is better than the existing protocols.

Fig. 5, gives the performance comparison between proposed and existing routing protocol under different mobility environments about packet delivery. The results show that in the proposed protocol, Packet Delivery is outperformed in comparison with the existing protocol. The figure shows the performance comparison of the average throughput of proposed and existing routing protocols concerning a changeable number of nodes (Fig. 6).

4.2. The overhead

The overhead of the network is computed in control packets concerning the number of nodes. It computes the number of control packets used by the algorithm in one complete communication session, apart from the data packet.

Fig. 4 shows the comparison of control packets overhead of proposed and existing routing protocols concerning the number of nodes. It is obvious from the figure that the LEACH control packets are very much high as it sends the acknowledgment for every data packets. Proposed routing protocol control packets overhead are very much less as it sends the acknowledgment packets after a specified time interval. ECH protocol control packets overhead is less than LEACH and EMS, as it did not consist of acknowledgment packets.

5. Conclusion

Hence, by maintaining the node buffer efficiently and removing the repeated information packets we can improve the network performance as well as lifetime. In our proposed work by removing the bottleneck problem we can improve the network performance intern it will give high packet delivery by removing the packet drop. The performance outcome shows that our proposed work outperforms in contrast by means of the existing work.

The network performance can be further improved by the Sink mobility concept which is our upcoming work.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Review on heat recovery technologies for building applications

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ABSTRACT

Recently, there is growing demand for energy saving technologies in buildings due to global warming and environmental impact issue. As a result to this, energy-efficient technologies are becoming more popular amongst researchers and designers. In this regards, to fulfil energy conservation demands, researchers have focused on the development of advance heat or energy recovery with energy-efficient ventilation system. The aim of this paper is to review heat or energy recovery technologies for building applications. The reviews were discussed according to the concept and classification of heat or energy recovery based on types and flow arrangement. The developments of these technologies in integrated energy-efficient system such as mechanical and passive ventilation, air conditioning, dehumidification and photovoltaic panel have also been presented.

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1. Introduction

As stated by Perez-Lombard et al. [1] building energy consumption has increased as a result of economic growth, expansion of building sectors and spread of heating, ventilation and air conditioning (HVAC) system. Since buildings have a long life span, lasting for 50 years [2] or more it is therefore, in conserving the energy, strategies to recover energy consumption in building is strictly important. From the reviewed literatures, it can be said that a large amount of energy is lost due to heating, air-conditioning and ventilation, it is thus very important to recover this energy by adopting heat or energy recovery system for building applications. Besides, heat recovery technology also offers an optimal solution: fresh air, better climate control and energy efficiency [3]. Heat recovery in building applications comes into widespread use in some Europe countries, especially in the high latitude nations such as Germany and Sweden [4,5]. Acknowledgement is worthwhile to new regulatory, policies, standards and energy-efficient technologies development on this field for the last decades, the heat recovery system has currently become a requirement in building designs.

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Nomenclature

BiPV	building integrated photovoltaic
CFD	computational fluid dynamics
ERV	energy recovery ventilator
HRV	heat recovery ventilator
HVAC	heating, ventilation and air conditioning
IAQ	indoor air quality
NTU	number of transfer unit
PCMs	phase change materials
PVT	photovoltaic thermal

For instance, in Germany, the building code for the year 2000 contains prescripts for well insulated and tight buildings so the energy demand for heating from ventilation air tends to reach about 60% of the total annual energy demand for the building [6]. Using heat recovery it has been shown that the final energy consumption can be reduced up to 20% in cold climates [5]. While in China, more and more commercial buildings and single-family houses use air-to-air heat recovery ventilator as energy saving units for recovering heat from the exhaust air in ventilation systems in the current years [7].

2. Definition and concept

Heat recovery term is referring to an air-to-air heat or energy recovery system which is defined as the process of recovering energy (heat/mass) from a stream at a high temperature to a low temperature stream that is effective and economical to run [8]. On the other hand, Shurcliff [9] defines that heat or energy recovery is any device that removes in terms of extracts, recovers or salvages heat or mass from one air stream and transfers it to another air stream. This means that the energy that would otherwise be lost is used to heat the incoming air, helping to maintain a comfortable temperature. While in industries, it is abbreviated as HRV or ERV (heat recovery ventilation) and became a general use within them. There are many different types of heat recovery systems are available for transferring energy from the exhaust air to the supply air or vice versa [5,10,11]. These include sensible heat recovery and enthalpy (sensible and latent) heat recovery [12]. The heat transfer surfaces based in sensible heat recovery can only transfers sensible heat between the makeup and exhaust air, while in the enthalpy recovery, it can transfers both sensible and latent heat (moisture) however, have greater maintenance requirement and costly than sensible heat recovery [4]. Above all, these systems are significantly proved as the most efficient single energy saving method of building in a cold climate.

Heat recovery systems typically recover about 60–95% of the heat in exhaust air and have significantly improved the energy efficiency of buildings. There are a number of possibilities and concepts for heat recovery from exhaust air in ventilation. The concept to be chosen depends on the possibilities for utilizing the recovered energy [13]. Heat recovery systems are utilized to recover a fraction of the energy loss. Besides offering energy saving, this system also gives some advantages such as, reduces heat loss rather than create heat which is relatively to cost effective. This system also gives effective ventilation where open windows are security risk and in windowless room like bathrooms and toilets. It can also operate as ventilation system in summer, by passing the heat transfer system and simply replacing indoor air with fresh outdoor air. While, during winter, it can reduce indoor moisture, as cooler outside air will have lower relative humidity. Heat recovery system certainly would save energy for fresh air treatment and the efficiency of the heat recovery system is often used to calculate the energy saving [14]. The impact of unintentional airflows on the performance of ventilation units with heat recovery is discussed on the basis of single room ventilation units in Manz et al. [15]. It is shown that the unintentional airflows can considerably reduce the performance of ventilation units in terms of efficiency.

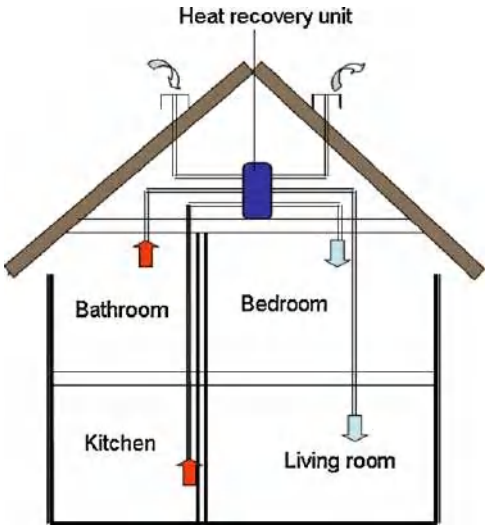

Fig. 1. Heat recovery system.

A typical heat recovery system in building consists of ducts for incoming fresh air and outgoing stale air, a heat exchanger core, where heat or energy is transferred from one stream to the other and two blower fans; one is to exhaust stale air and supply fresh air via the heat exchanger core. Fig. 1 shows a typical heat recovery system installed in ventilation system. In the core, the fresh air stream is automatically preheated or pre-cooled (depending on the season) by the exhausted air and distributed to the interior part of the buildings. The outgoing and incoming air passes next to each other but do not mix in the heat exchanger. They are often installed in a roof space or within the building interior, recover heat from the internal air before it is discharged to the outside and warm the incoming air. In an advance design of this system, sometimes the incoming air is filtered to reduce the incidence of pollen and dust while the outgoing air is filtered to protect the heat exchanger and internal components. This system is also used in building HVAC energy recovery systems, where building exhaust heat is returned to the comfort conditioning system. This device lowers the enthalpy of the building supply during warm weather and raises it during cold weather by transferring energy between the ventilation air supply and exhaust air streams.

Zhou et al. [6] presented a simulation model of heat recovery system based on the new-generation dynamic building energy simulation program called EnergyPlus with the function of heat recovery called ERV in this context to reduce the fresh-air intake load via total heat recovery as shown in Fig. 2.

In order to evaluate the performances of heat recovery system in building ventilation system, Lazzarin and Gasparella [4], discussed a technical and economical analysis to illustrate the possibility of using this system even for small ventilation flow rates. Fehrm et al. [5] gave a review on the development and economics of the technique of heat recovery in Sweden and Germany. In addition, Routlet et al. [14] presented a theoretical analysis of real energy with air handling units and recommended for the heat recovery choice with the experimental data.

3. Types of heat recovery for building applications

Generally, these systems can be categorised according to their applications which are process to process, process to comfort and

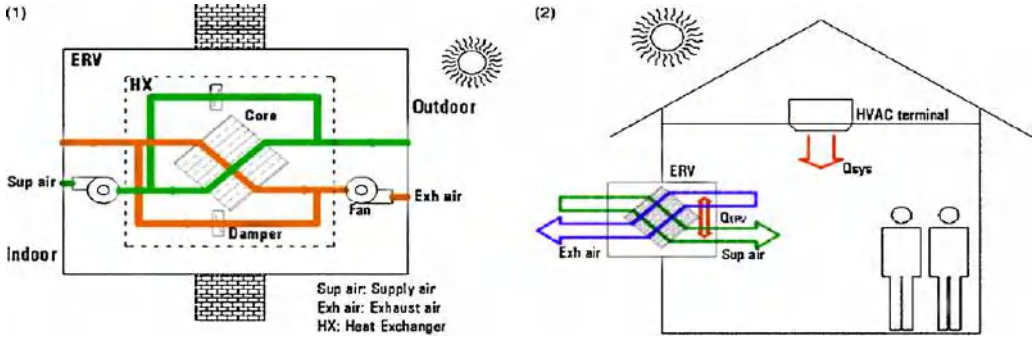

Fig. 2. Structure (1) and air energy-flow (2) schematic diagram of ERV.

Source: [6].

comfort to comfort. In process-to-process system, heat is captured from the process exhaust stream and transferred to the process exhaust stream and transferred to the process supply air stream. Equipment is available to handle high temperatures level. These devices generally recovers sensible heat and do not transfer latent heat. Whist, in process-to-comfort system heat is captured from a process exhaust heats building makeup air during winter. The process-to-comfort devices generally recover sensible heat only. Heat recovery device in comfort-to-comfort lowers the enthalpy of the building supply air during warm weather and raises it during cold winter and this system transfers both sensible and latent energy.

Specifically, heat recovery or air-to-air heat recovery systems are made in so many types, sizes, configurations and flow arrangements. There are many types of heat recovery units which are in use in building applications and these types of heat recovery systems are depending on the heat exchanger core. Shah and Sekulic [16] presented classifications of heat exchangers based on several features: geometry, flow direction, number of different working fluids and so on. Over the last few decades, several types of heat recovery systems such as fixed plate, heat pipe, rotary wheel and run-around coil have been used to recover energy between the supply and exhaust airflows. The following discussion considers the classification based on construction type of heat exchanger which is the heart of heat recovery system.

3.1. Fixed-plate

Fixed-plate heat recovery is the most common type of heat recovery device which is obviously named by the construction of its exchanger. In this unit, the plate exchanger surfaces normally are constructed of thin plates that are stacked together or consist of individual solid panel with several internal airstreams (Fig. 3).

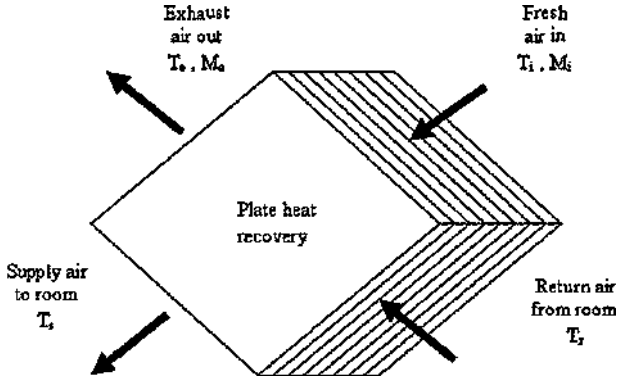

Fig. 3. Fixed-plate heat recovery.

The plates maybe smooth or may have some form of corrugation. It operates by transferring thermal energy from outgoing to incoming air streams via plate heat exchanger surfaces. Figure shows the schematic diagram of heat transfer of fixed-plate. Typical effectiveness of sensible heat transfer is 50–80% and airflow arrangements are counter-flow, cross-flow and parallel flow [17].

Fixed-plate types provide an excellent means of achieving highly efficient heat recovery because their high heat transfer coefficients, coupled with counter-current flow, enable them to produce close end-temperature differences [18]. Han et al. [19] have performed a study to investigate the effect of outdoor weather conditions on the performance of the plate-type heat recovery ventilator. The experiments have been carried out to measure sensible, latent and enthalpy efficiencies by varying outdoor temperature and humidity conditions with the indoor conditions fixed at the standard heating or cooling conditions. They have introduced the coefficient of energy to quantify recovered energy in comparison with the electric power consumption. As a result, they have found that temperature exchange efficiency under winter conditions shows larger values than in summer conditions due to the heat generation by an internal fan.

On the other hand, experiments were conducted by Persily [20]) to test the effectiveness of a cross-flow heat recovery which was constructed of plates and fins made from treated paper capable of moisture transfer. The heat recovery efficiency was determined by comparing the actual heat loss to that expected due to the mechanically induced ventilation and he had found that the exchanger (core of heat recovery) recovered 55–60% of the heat contained in the outgoing airflow depending on the fan speed. In another study, Zhang and Jiang [21] conducted an experimental investigation of the performance of rectangular cross-flow fixed-plate made of membrane to study the heat transferred to recover energy in air conditioning system. They have developed a numerical model and validated the data against the experimental results and found that the highest heat transfer occurred near the inlet area. In accordance to this study, Niu and Zhang [22] investigated a similar study of a square shaped of fixed-plate made of the same membrane and found that the temperature in a cross flow heat exchanger configuration are more evenly distributed in comparison with Zhang and Jiang [21] results.

With the motivation of fixed-plate made of membrane results, Nasif et al. [23] then have came out with a thermal performance of a fixed plate utilized a porous membrane as the heat and moisture transfer surface that can recover both sensible and latent energy with new developed Z-flow configuration as shown in Fig. 4. The effectiveness was found to approximately 75% for sensible and 60% for latent.

In another study, Min and Su [24] have carried out a performance analysis of a fixed-plate called membrane-based energy recovery ventilator as shown in Fig. 5 in order to investigate the effects of

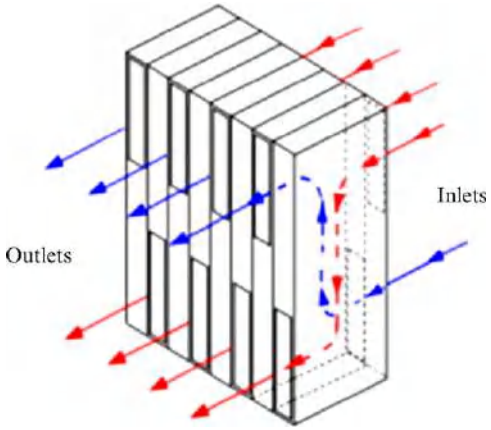

Fig. 4. Z-flow fixed plate utilized a porous membrane as the heat and moisture transfer surface.
Source: [23].

the membrane spacing (channel height) and membrane thickness on the ventilator performance under equal fan power conditions. The results found that for a fixed fan power, as the channel height increased, the total heat transfer rate initially increased.

Recently, more options of fixed-plate material are introduced as the market growth. In regard to this, Lu et al. [25] have developed and investigated the performance of a plastic film plate heat recovery ventilator that works under cross-flow mode by both simulation and experiment. The results indicated that the thin film vibrated when airflow passed through the channels which enhanced heat exchange performance. In addition, the effectiveness of the heat recovery varies from 65 to 85% with airflow rate and the pressure drop is less than 20 Pa. On the other hand, Fernandez-Seara et al. [26] have conducted the experimental analysis of an air-to-air heat recovery unit equipped with fixed-plate heat exchanger made of a sensible polymer for balanced ventilation systems in residential buildings as shown in Fig. 6. Results showed that relative humidity decreased from 95% to around 34%, the heat transfer rate were 672 W and 80% of thermal efficiency.

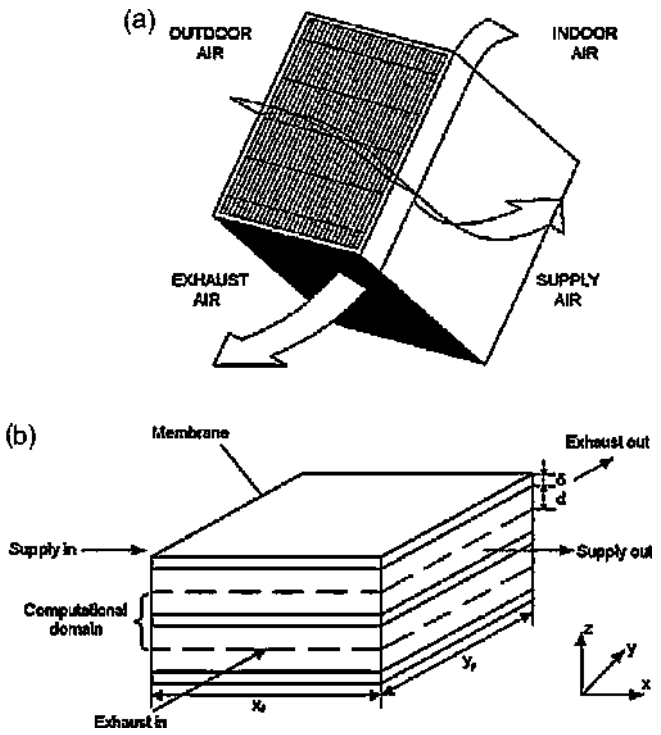

Fig. 5. (a) The core of a typical membrane-based energy recovery ventilator. (b) Physical model.
Source: [24].

3.2. Heat pipe

Heat pipe recovery is a sealed self-contained, fluid evaporating condensing system (Fig. 7). It is a heat transfer device in which the latent heat of vaporization is utilized to transfer heat over a long distance with a corresponding small temperature difference [27]. The unit is divided into two sections for heat/energy exchanges between exhausts and supply air which are evaporator and condenser. Heat is transferred from hot incoming gas to the evaporator section of the heat pipe. Thermal efficiency of heat pipes is between 45% and 55%. There are some advantages in term of flow resistance, such as no moving parts, no external power requirements and so high reliability, no cross contamination, compact and suitable for all temperature application in heating, ventilation and air-conditioning, fully reversible and easy for cleaning. In addition, large quantities of heat can be transported through a small cross-sectional area over a considerable distance with no additional power input to the system [28].

Heat pipe recovery units are suitable to use in naturally ventilated buildings because of they offer several advantages over conventional heat recovery device [13]. They have conducted a performance study of heat pipe recovery system in naturally ventilated building and found that the efficiency of 50% was achieved with the pressure loss about 1 Pa. In another study, Gan and Riffat [29] have investigated the performance of different heat pipe recovery units by experimental measurements and evaluate the pressure loss characteristics using CFD modelling in a two-zone chamber for naturally ventilated buildings. It has been found that the effectiveness decreased with increasing velocity and poor thermal contact between fins and pipes drastically reduces the effectiveness of heat-pipe recovery unit. The numerical modelling indicated that at low velocities the pressure loss coefficient in heat pipe recovery unit decreases with increasing air velocity but the total pressure loss increase with the velocity.

On the other hand, Shao et al. [3] have conducted a study of pressure loss and heat recovery efficiency of heat pipe units using experimental and computational approaches. The results found that heat recovery efficiency of close to 50% have been achieved for a single bank plain-fin unit and for a double bank unit was 40% higher with the pressure loss coefficient reduced as velocity increased. On the other hand, Yau [30] has conducted a theoretical study to investigate the overall effectiveness of heat pipe exchangers operating in naturally ventilated tropical buildings based on NTU method. Heat pipes are also suitable for energy recovery in air conditioning system in tropical countries where incoming fresh air at high ambient temperature could be pre-cooled by the cold exhaust air stream before it enters the refrigeration equipment [31]. El-Baky and Mohamed [10] have carried out a study to investigate the thermal performance and effectiveness of heat pipe for heat recovery in air conditioning applications by measuring the temperature difference of fresh warm and return cold air through the evaporator and condenser site as illustrates in Fig. 8. The results shown that the effectiveness and heat transfer for both evaporator and condenser sections have increased to about 48%. The temperatures change of fresh and return air was increased with the increasing of inlet temperature of fresh air.

With the growing climate change and the thermal comfort issue in tropical hot and humid regions such as Malaysia and other South East Asian countries, heat pipe recovery has taken its place in dehumidification system. Yau [32] has conducted a baseline performance characteristic study of heat pipe in dehumidification system

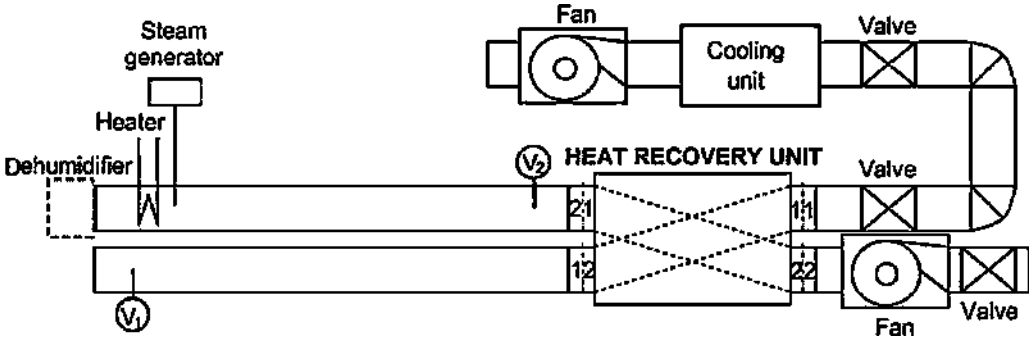

Fig. 6. Layout of the experimental facility.

Source: [26].

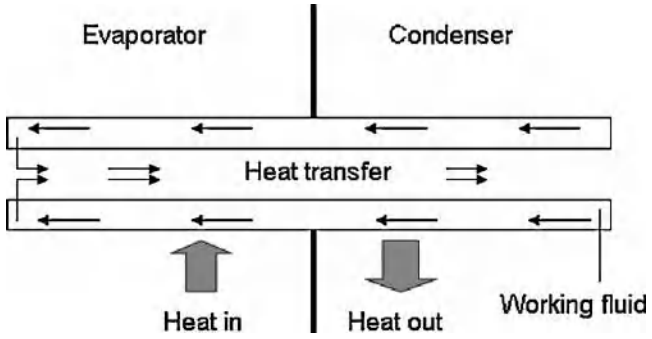

Fig. 7. Heat pipe.

for tropical climates as shown in Fig. 9. By good results obtained, he has recommended that HVAC system in tropical climates should installed heat pipe in their dehumidification systems.

In addition, heat pipe are also widely used in heat recovery systems in domestic appliances such as dishwasher, air conditioner or freezer. In regard to this, Lin et al. [33] provided a thermal model for simulating the performance of a heat pipe system for recovering waste heat in the drying cycle in a domestic appliance as presented in Fig. 10. The results showed that the utilization of heat pipe recovery in the drying cycle of domestic appliances might lead to a significant energy saving in the domestic sector.

3.3. Rotary wheel

Rotary wheel recovery consists of a rotor with permeable storage mass fitted in a casing which operates intermittently between a hot and cold fluid (Fig. 11). The rotor is driven by a motor so that the exhaust air and fresh air are alternately passed through each section. Rotor speed is normally relatively low and in a range of 3-15 rpm. A unique advantage of rotary wheels is the capability of recovering both sensible and latent heat.

Rotary wheels are widely used and the units are known for their high efficiency and trouble-free operation. Temperature efficiencies above 80% are not uncommon. Researches on this field keep active in recent years and involve many theoretical and experimental aspects of rotary wheel recovery for building applications [34]. One of the earliest investigations of rotary wheel recovery was performed by Sauer and Howell [35]. They used the AXCESS energy analysis computer program to evaluate the energy requirements of a two-story office building located in St. Louis on an hour-by-hour basis for a full year using local weather data. Their results showed

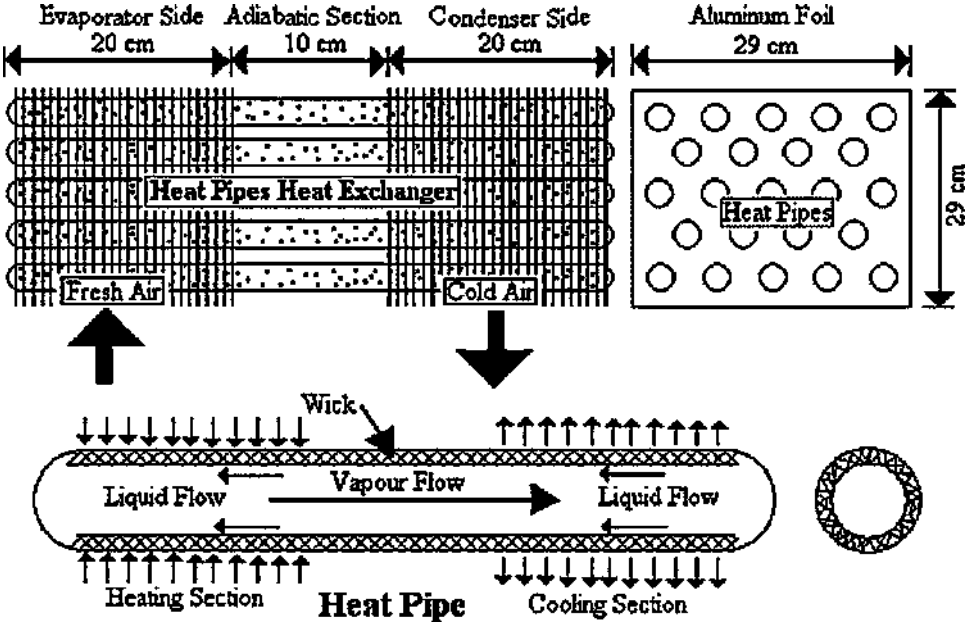

Fig. 8. Heat pipe recovery in air conditioning system.

Source: [10].

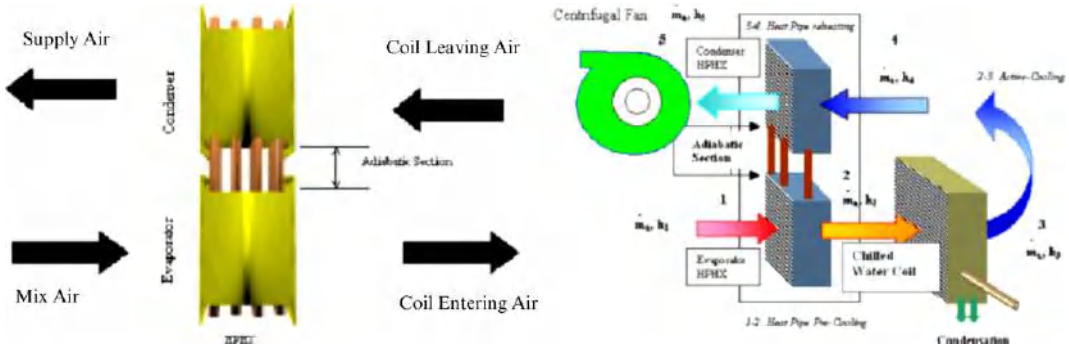

Fig. 9. Heat pipe in HVAC system for tropical climates.

Source: [32].

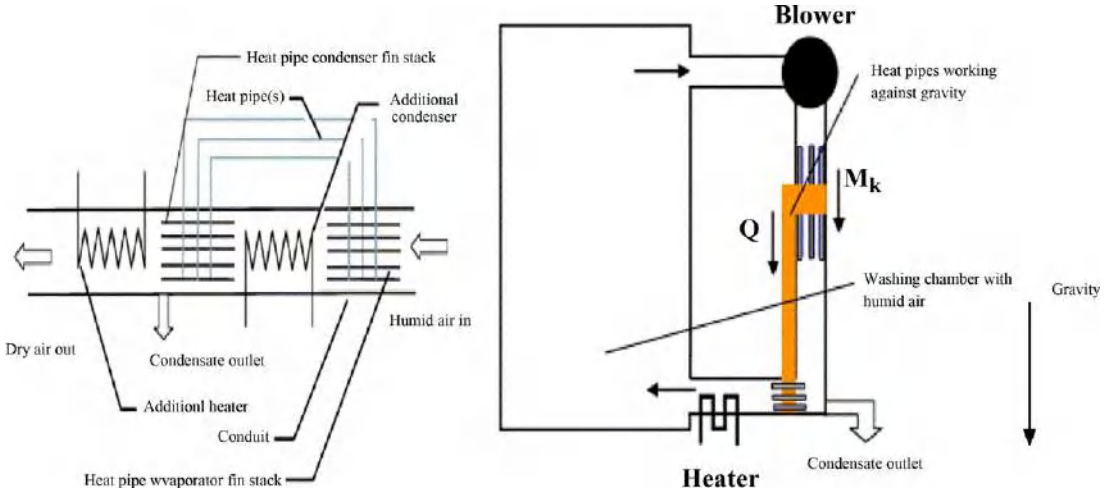

Fig. 10. Heat recovery system using heat pipe solution in drying cycle.

Source: [33].

that energy recovered by the rotary wheel was around 2.5 times greater that the heat recovered by a sensible heat exchanger. By looking to its mechanism, rotary wheel transfers energy from an exhaust to a supply air. The rotary wheel spans two adjacent ducts. One duct carries the exhaust air; the other carries the incoming air, which is to be heated. It also transfers moisture as well as sensible energy between air streams depending on the type of matrix. Rotary wheel was proven as one of the most efficient solution to handle the moisture carried by the ventilation air as to dump the excess moisture within the fresh air supply back to the atmosphere [36].

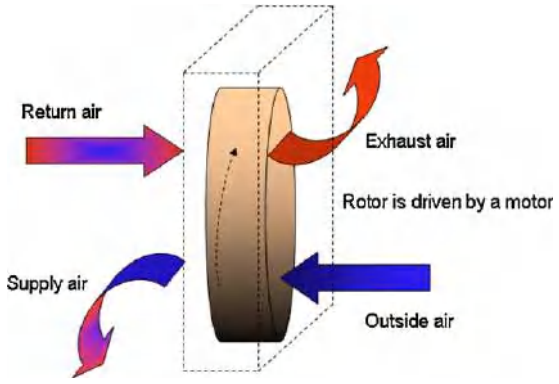

Fig. 11. Rotary wheel recovery.

In regard to this, Nobrega and Brum [37] developed a modelling and simulation to describe the heat and mass transfer in rotary wheel which was validated by comparing the work with independently obtained results. The results showed that heat wheels can be far less efficient than enthalpy recovery wheels depending on the atmospheric conditions. In addition, in rotary wheel system, airflow arrangement is usually counter-flow and increases with rotation speed. Ghodsipour and Sadrameli [38]) estimated maximum effectiveness as a function of rotational speed and hot/cold air velocities. In another study, Simonson and Besant [39], [40] have presented the effectiveness correlations to predict sensible, latent and total effectiveness.

For balanced ventilation systems, the recovered heat power can be at the same rate. Unfortunately, the disadvantage of the rotary wheel is the greater cross-contamination between exhaust and fresh supply air. Due to the rotation device, there will always be a direct and indirect connection between exhaust and fresh supply air. Cross contamination through rotary heat recovery units comes from two mechanisms which are leakage and carryover. In conjunction to this, Hemzal [41] has carried out a performance study of rotary wheel and found that the penetration of airflow (leakage) through the untightness were connected with transfer of contaminants and by the heat which influenced the efficiency. With the encouraging previous results in its efficiency, some researches made intensive studies on the optimal operation of rotary wheel recovery. Dallaire et al. [42] have portrayed a conceptual optimization of rotary wheel with a numerical model where internal

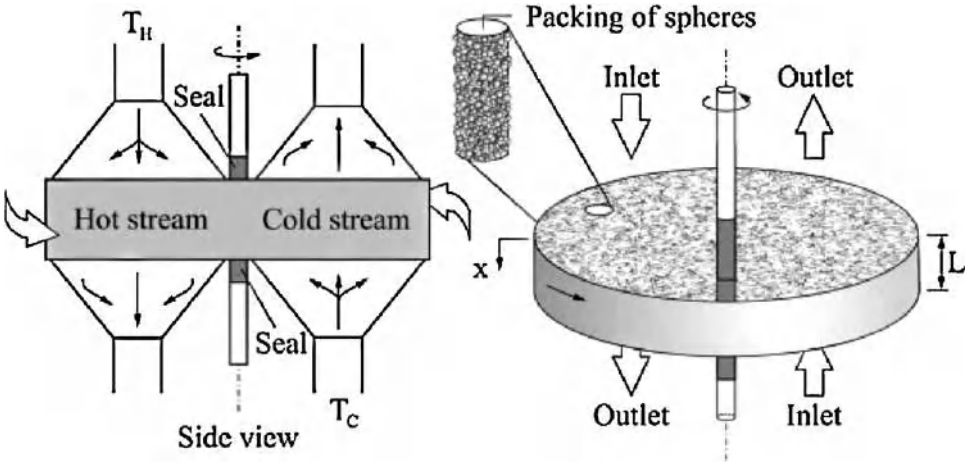

Fig. 12. Schematic representation of the rotary wheel.

Source: [42].

structure was a porous medium in their research. The schematic presentation of the rotary wheel studied is shown in Fig. 12. The numerical results showed that the figure of merit was substantially affected by both design variables and that optimal value of length and porosity could be obtained. On the other hand, San and Hsiau [43]) discussed the effects of NTU and Bi numbers on the performance with one dimensional model that included the axial heat and mass resistance. On the other hand, Abe et al. [44], [45] have presented the analytical model for predicting the effectiveness of rotating air-to-air energy wheels using the characteristic measured on the same non-rotating wheels exposed to a step change in temperature and humidity. Nowadays, with the ability to recover both sensible and latent heat, rotary wheels have been used as desiccant wheels for humidity treatment for dehumidification [46], [47] and enthalpy recovery [35,39,40].

3.4. Run-around

Run-around heat recovery system is the name given to a linking of two recuperative heat exchangers by a third fluid which exchanges heat with each fluid in turn as shown diagrammatically in Fig. 13. Run-around heat recovery use two physically separated heat exchangers (coils) in the air supply and exhaust ducts to recover and transfer heat between them. This system may require an expansion tank to accommodate expansion and contraction of heat transfer fluid. Unlike other heat recovery devices, the run-around system does not require the supply and exhaust air ducts to be located side by side. This gives run-around system an advantage over other available system when cross contamination is a concern [48].

The heat is transferred from the exhaust to supply air using an intermediate heat transfer fluids such as water. The main advantage of this system is that supply and extract duct can be physically separated, even in different part of the building. This provides maximum possible flexibility, as well as no possibility of cross contamination between air streams. The main disadvantages of this system is that because an intermediate fluid is used as a heat transfer medium, the system's efficiency is reduced and electricity is required for pumping fluid. However, pumping liquids remain significantly less energy-intensive than moving air with fans. Thermal efficiency of this type is normally from 45% to 65%.

One of the first studies on the run-around heat recovery system was published by London and Kays [49]. It was found that at a constant NTU, the system had its optimum performance when the

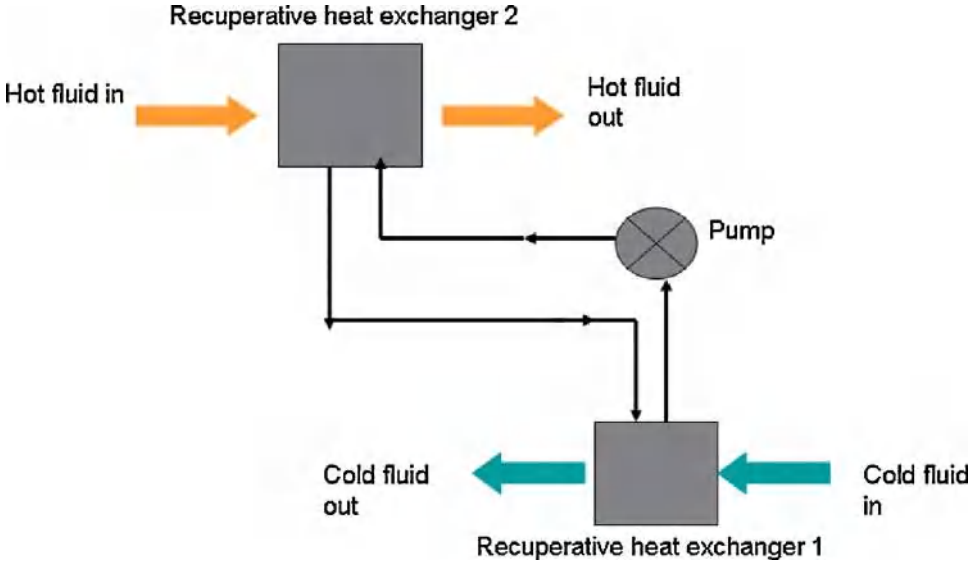

Fig. 13. Run-around system.

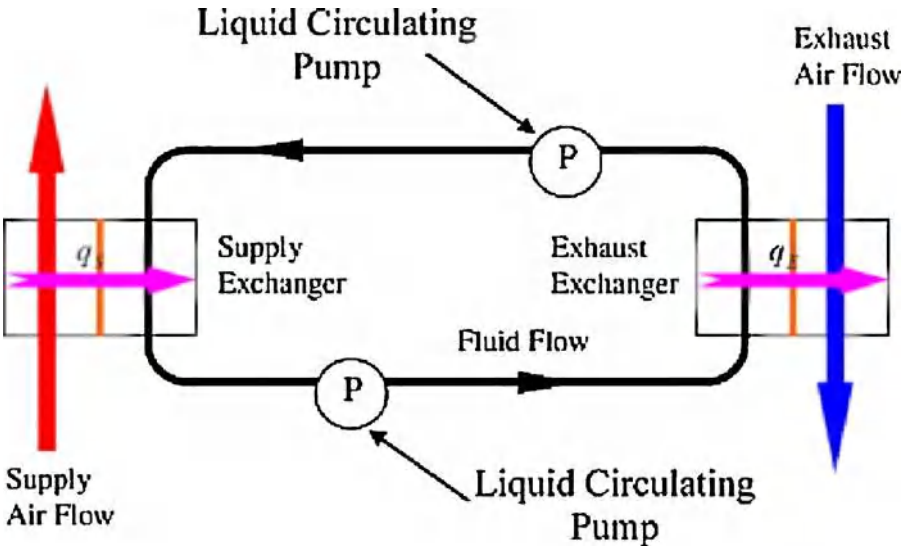

Fig. 14. Schematic diagram of a run-around heat recovery.

Source: [48].

heat capacity rates of the air and coupling liquid were equal. Emerson [50] developed a design of a run-around heat recovery system. He found that the performance of a run-around coil system was sensitive to the rate of circulation of the secondary fluid and that the optimum rate changed with changes in the flow rates of the primary fluids or in the fouling resistances. He also suggested a simple method of monitoring the system to verify that the optimum rate of circulation. Wang [51] has proposed a straight-forward explicit thermal design procedure in his study of run-around heat recovery system. Based on the allowable air pressure drop, the design started with a minimum number of rows and proceeds until all specifications have been met. Hence the smallest possible coil can be obtained by this approach. Forsyth and Besant [52] then developed a numerical simulation to investigate the performance and design of run-around heat recovery with two coil heat exchangers.

On the other hand, Dhital et al. [53] studied the maximum outdoor air ventilation rate and the energy performance of office buildings with and without the run-around heat recovery systems to investigate the energy saving. The results indicated that using a run-around heat recovery system in a building could have significant amount of energy and allow the ventilation airflow rate to be increased without the increasing the energy consumption. Recently, Vali et al. [48] have developed a numerical model to study the heat transfer in a run-around coil heat recovery system with two combinations of counter and cross flow heat exchanger as shown in Fig. 14. The simulated results showed that the effectiveness of each counter/cross flow heat exchanger and overall run-around system were used to develop effectiveness correlation. For a given total surface area of the exchangers, the highest overall sensible effectiveness was achieved with exchangers which have a small exchanger aspect ratio. In another study, Ahmadi et al. [54], [55] have conducted an investigation on transient behaviour of run-around heat and moisture exchanger system.

4. Heat recovery in integrated energy-efficient system for building application

Integrating heat recovery system in energy-efficient system represents significant progress for building applications. The integration of the system leads to a reduction of thermal ventilation losses of the building and to a reduction of the required energy support. This section reviews the previous works of various type heat recovery systems in combination with other low carbon technologies conducted by various researchers.

4.1. Heat recovery in mechanical ventilation system

Since more than 90% of a person's time is spent indoor, therefore it is substantial to maintain the indoor environment within comfortable conditions for the occupants. For this purpose, mechanical ventilation system used in buildings to control indoor air quality and at the same time ventilates the indoor environment. Attempting to improve indoor air quality of buildings, the earliest study of mechanical ventilation system with heat recovery a study has been done in Denmark by using of mechanical ventilation heat pump recovery and the results demonstrated it was beneficial in terms of reduction in mite populations in mattresses and carpets. After that, the study of mechanical ventilation system with heat recovery was conducted by Nazaroff et al. [56]. They have presented a study of mechanical ventilation system with a counter-flow heat recovery in order to determine the effectiveness of this system as an energy-efficient control technique for indoor radon concentration in houses. As a result, they have found that the strategy of building tight houses and the use of mechanical ventilation systems with heat recovery may satisfy energy conservation goals in a cost-effective manner without comprising indoor air quality.

Mechanical ventilation consumes a large amount of electricity for input power and in some cases; it increased a household's electrical power consumption by up to 50% [57]. In respond to this, several researchers have investigated the ability of heat recovery unit coupled in this system to recover the energy loss. In mechanically ventilated buildings, heat recovery from ventilation air is the single most important means of reducing ventilation energy consumption [58]. In regard to these, Nguyen et al. [59] have studied the overall performance of mechanical ventilation heat pump system with heat recovery during forced ventilation. The methods for recovering sensible heat during ventilation process have been evaluated experimentally in four types of ventilation which are type A, B, C and D the results have been compared with the case of none heat recovery ventilation. For type A, no heat recovery is used while in Type B, a separate sensible heat recovery was used. In type C, single heat recovery was used for recovery heat in an integrated heating-ventilation and in type D, double heat recovery was used to recover heat and heat pump as the second heat recovering

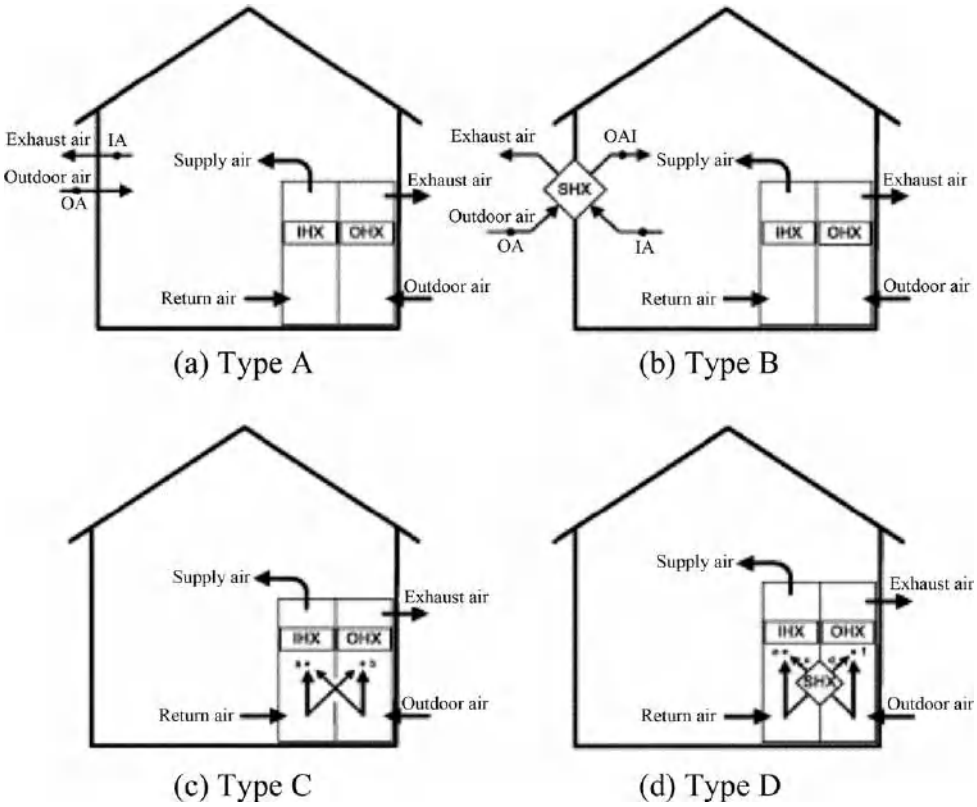

Fig. 15. Mechanical ventilation heat pump system with four types of ventilation heat recovery.

Source: [59].

mechanism as shown in Fig. 15. In this study, it was found that the integrated mechanical double heat recovery pump system is most efficient for saving energy for an indoor space.

It is obviously known in literatures that mechanical ventilation with heat recovery system is efficient to remove pollutants and adequate sufficient ventilation to buildings. An advanced mechanical ventilation heat recovery incorporating heat pump system has been developed by Riffat and Gillott [60] which has a low capital cost and little maintenance as shown in Fig. 16. The results indicated that the air changes per hour complied with the ASHRAE Standard to maintain indoor air quality.

Manz and Huber [57] have presented mechanical ventilation that united two functions: fluid transport and heat recovery. This unit was investigated by means of experiments and simulations. It was shown that using this concept, it was possible to realize a mechanical ventilation unit with high efficiency of heat recovery. In another research, Manz et al. [61] presented performance of single room ventilation units with recuperative or regenerative mechanical ventilation heat recovery by means of experiments and numerical simulations. It was shown that using these units, rooms could be efficiently ventilated at a good level of thermal comfort, temperature efficiencies up to 78% at low levels of electric energy input.

Jokisalo et al. [62] on the other hand, have performed a simulation study using a dynamic thermal modelling of various mechanical supply and exhaust ventilation system incorporating heat recovery in typical Finnish residential apartment building in Finland. The systems studied were based on cost efficient realistic component available in the market. According to this study, energy efficiency in a residential building can be improved remarkably by using this system as the results showed that a traditional exhaust ventilation system can use up to 67% more energy than a heat recovery system having 80% efficiency and 41% more energy that a heat recovery system having 60% energy recovery efficiency. The efficiency of heat recovery has a significant effect on energy consumption as the results showed total annual specific energy consumption at 80% temperature efficiency was 11% less than 60% efficiency.

Mechanical ventilation with heat recovery is often considered as one of the key elements of a low energy residential building in cold winter regions [63]. However, in extremely cold or arctic climates where they have long winter season, it is difficult to obtain a traditional mechanical ventilation heat recovery system to operate as intended due to continuous moisture problems and inlet air below the freezing point. Researchers and designers devote much attention to frost formation and to means of getting rid of the frost. In respond to these problems, Kragh et al. [64] have constructed a novel mechanical ventilation heat recovery with the capability of continuously defrosting itself without using supplementary heating suitable for cold or arctic climates. The experiment's results showed that the heat recovery efficiency is still high and capable to defrost below the freezing point.

4.2. Heat recovery assisted passive ventilation

The term passive in this context indicates the opposite of active or mechanical ventilation where the fresh air is provided by fans or heat pumps. An early attempt in the field of heat recovery for passive or natural ventilation solutions was based on a vertical counter-flow air-to-air heat exchanger and achieved a heat recovery efficiency of 40% [65]. Riffat and Gan [8] have been undertaking a project on heat pipe recovery with solar-assisted natural ventilation in a glazed solar chimney as an integral part of the system with heat recovery efficiency close to 43%. In this study, a heat pipe recovery unit used was a heat exchanger consisting of externally finned sealed pipe containing a volatile fluid such as methanol

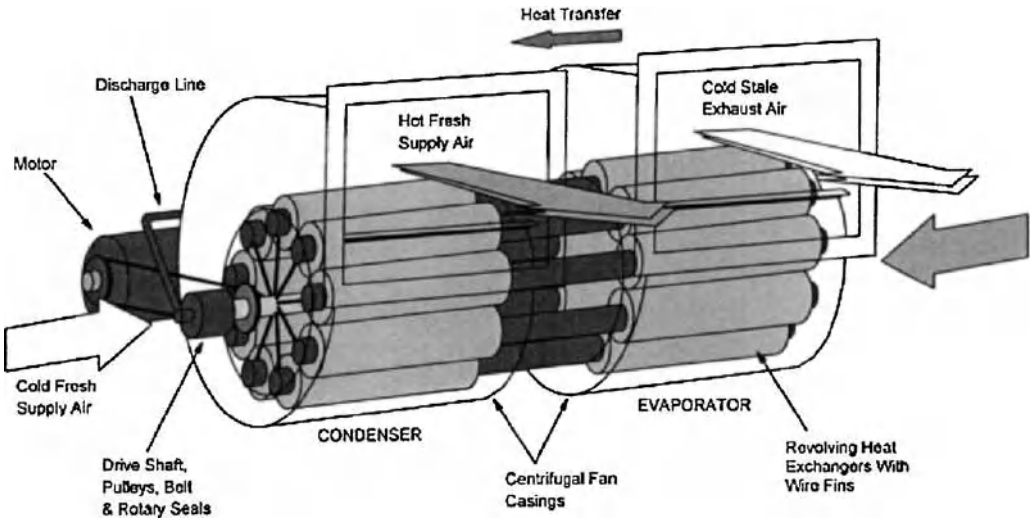

Fig. 16. MVHR heat pump system.

Source: [60].

which has an operating temperature range from -40°- 100 °C as shown in Fig. 17. This unit was divided into evaporator and condenser sections. They have found that installing heat-pipe recovery in the chimney increased the flow rates in naturally ventilated buildings and also decreased the thermal buoyancy effect and thus they have suggested, in order achieving required airflow rates in naturally ventilated buildings with heat recovery, use should be made of wind forces.

Recently, Hviid and Svendsen [66] have presented an analytical and experimental analysis of heat recovery concept that has been developed for passive ventilation systems suitable for temperate climates as shown in Fig. 18. The total pressure loss and temperature exchange efficiency of heat recovery was measured and found to be 0.74 Pa and 75.6%, respectively for a design flow rate of 560L/s.

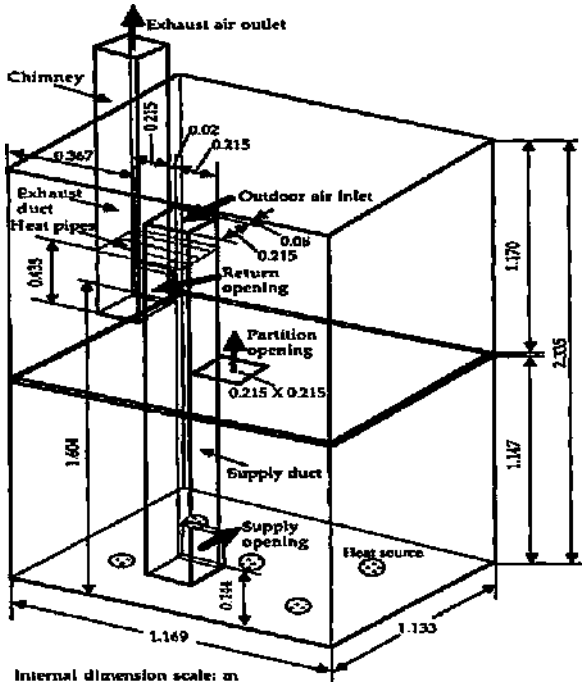

Fig. 17. Schematic diagram of the naturally ventilated room with heat pipe recovery unit.

Source: [8].

4.3. Heat recovery assisted-cooling or air conditioning

Within the buildings, most of energy is for provision of heating, cooling and air conditioning [67]. It is observed that plentiful waste condensing heat from traditional air conditioning system is directly exhausted to the environment, especially in summer time when the system operates on air conditioning mode [68]. Many methods have been attempted to tackle these problems. In regard to this, several researchers tried to add a heat recovery system on the air conditioning systems [69]. In a conventional air conditioning system, the humidity is controlled by cooling the supply air stream below its dew point temperature. The cold air is then reheated to a temperature that is suitable for the conditioned space. The earliest study reported by Yau and Ahmadzadehtalatapeh [27] declared that the application of heat recovery unit of heat pipe type in the conventional air conditioning system could be an efficient technique to control humidity and reduce the amount of heat energy required. Recently, El-Baky and Mohamed [10] also stated that by the application of the heat pipe recovery between two streams of

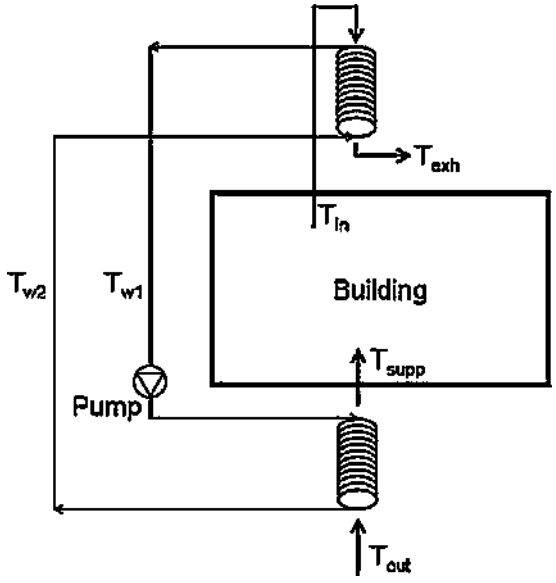

Fig. 18. Schematic of the heat recovery concept.

Source: [66].

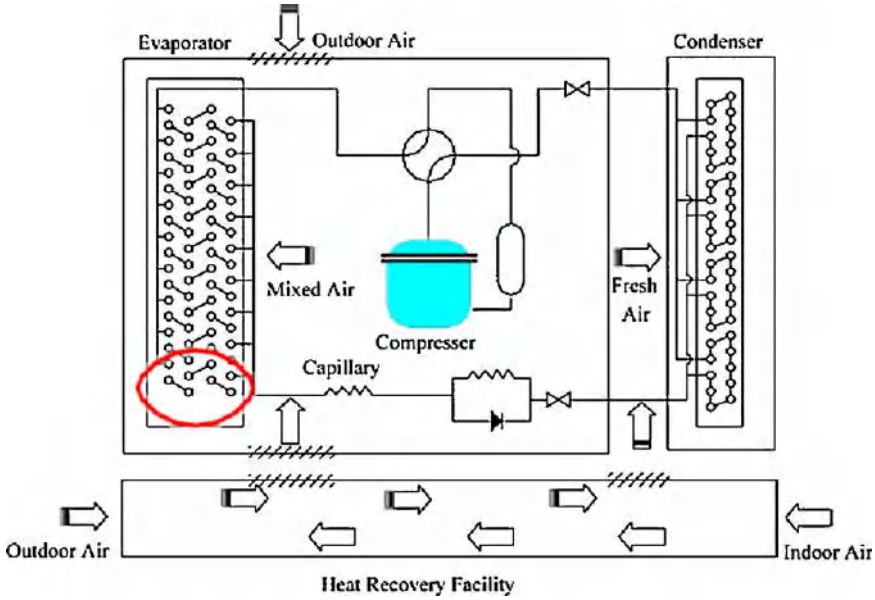

Fig. 19. Schematic diagram of the window-type air conditioner with heat recovery facility.

Source: [70].

fresh and return air in an air conditioning system, the incoming fresh air could be cooled down.

On the other hand, Zhang and Jiang [21] have presented a detailed heat and mass transfer model for an energy recovery ventilator with a porous hydrophilic membrane core to increase the efficiency of the air conditioning system. It is found that the sensible heat exchange, moisture exchange and the enthalpy exchange was promising. A study of window-type air conditioner with heat recovery system has been investigated by Liu et al. [70]) as shown in Fig. 19. With the heat recovery system, they have found that the temperature of the mixed air would increase while in terms of relative humidity, would depend on the properties of the indoor air and outdoor air and their ratios. Gu et al. [71] have developed a heat recovery system using phase change materials (PCMs) to store rejected (sensible and condensation) heat from air conditioning system. A new heat recovery technique for air conditioning system was then proposed by Gong et al. [68] employing a compound air-cooling and water cooling condensing module to replace the traditional sole air-cooling condensing module. This proposed system was found had the ability to improve cooling and heating effects and recover condensing heat for heating sanitary water.

A heat recovery unit was installed in study of central forced-air heating and cooling system to control indoor air quality (IAQ) conducted by Persily [20] in residential buildings. In this study, the heat recovery ventilator withdrew air from the return side of the forced-air system and replaced it with outdoor air drawn through the heat exchanger. The actual outdoor airflow rate during operation was selected to provide an air change rate of 0.35 h^{-1} through heat recovery system. The outcome of this study stated that the tight Miami houses met the ASHRAE minimum air change rate on the hot day but still far short on the cold days.

In another study, Martinez et al. [72] have designed a mixed-air heat recovery system, consisting of two heat pipes and indirect evaporative recuperators for air conditioning whereas the energy characterization of the mixed heat recovery system was performed by means of experimental design techniques. In their study, they have analysed the influence of temperature, flow, relative humidity, and water flow on the basic characteristics defined by the mixed system. The results found that by application of the mixed heat recovery system in the air conditioning system installations consisting of two heat pipes and indirect evaporative systems, part of the energy from the return airflow could be recovered, thus improving energy efficiency. They also found that the heat recovery factors show a lineal dependence in relation to temperature and outdoor airflow factors.

Nasif et al. [23] have performed experiments on thermal performance of an enthalpy heat exchanger as the heat and moisture transfer surface for air conditioning energy recovery systems as shown in Fig. 20. It has been shown that in humid climate a saving of up to 8% in annual energy consumption can be achieved when this enthalpy exchanger used as a heat recovery instead of a conventional air conditioning system. Mahmud et al. [73] have done a performance testing of a run-around heat recovery system for air conditioning which could transfer sensible and latent energy with non-adjacent ducting as shown in Fig. 21.

4.4. Heat recovery combined with dehumidification system

Due to the scarcity of conventional air dehumidification system, many efforts have been made since decades ago. With the demands of energy conservation in dehumidification system recently, Zhang et al. [74] have proposed a fresh air processor with liquid desiccant total heat recovery in order to improve indoor air quality and decrease the energy consumption of the air conditioning system. In another research, Zhang [75] has proposed four independent air dehumidification systems with heat recovery strategies. These systems were compared with a mechanical dehumidification system with no heat recovery. The results showed that the system of mechanical dehumidification with membrane total heat recovery consumes the least primary energy. Recently, a performance study involving modelling and experimental of air dehumidification system combined with membrane-based total heat recovery study was carried out by Liang et al. [76], [77] in order to improve the efficiency of a conventional dehumidification system in hot and humid regions as shown in Fig. 22. The results indicated that as compared to conventional dehumidification system, the air dehumidification rate (ADR) of the new developed system is 0.5 higher and it has the ability to perform well under harsh hot and humid weather conditions.

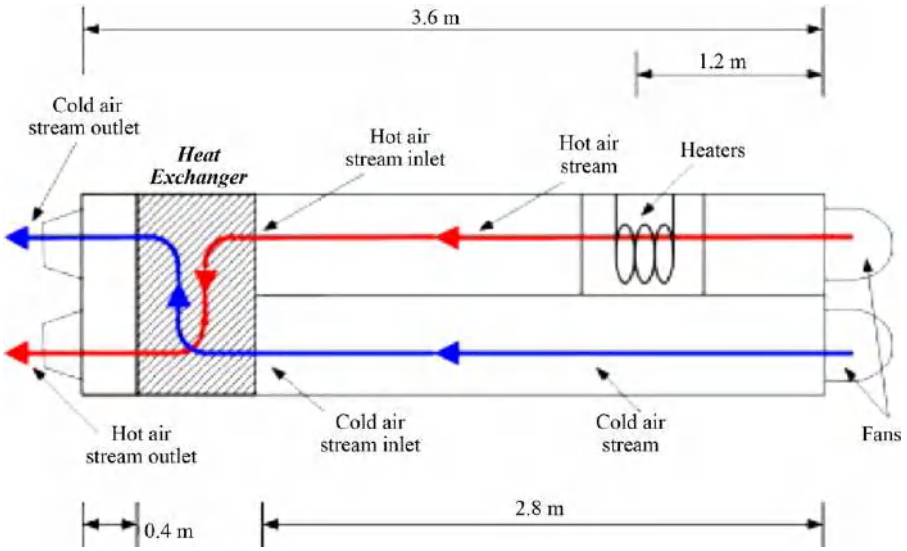

Fig. 20. Heat and mass recovery system in air conditioning.

Source: [23].

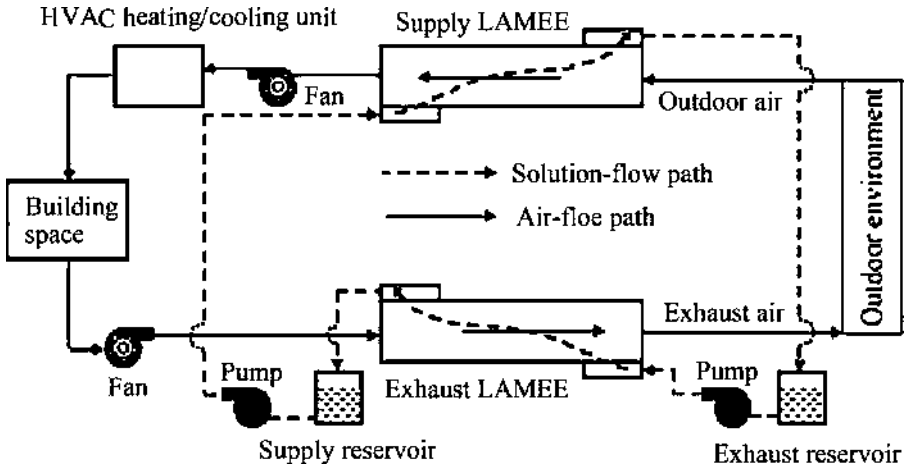

Fig. 21. Schematic of a run-around heat recovery system in a air conditioning.

Source: [73].

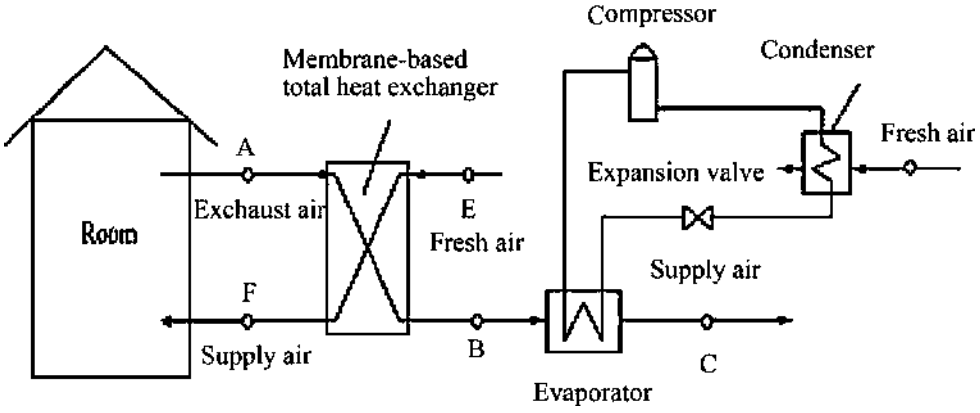

Fig. 22. Schematic of air dehumidification system combined with membrane-based total heat recovery.

Source: [76].

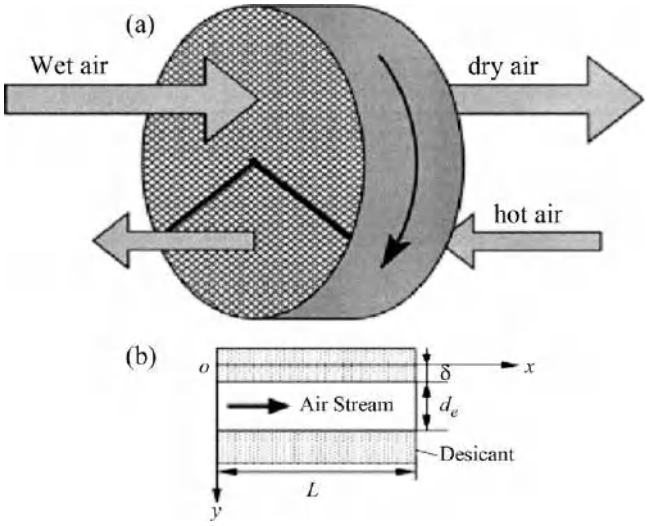

Fig. 23. Schematic of the rotary desiccant wheel for dehumidification and enthalpy recovery.
Source: [78].

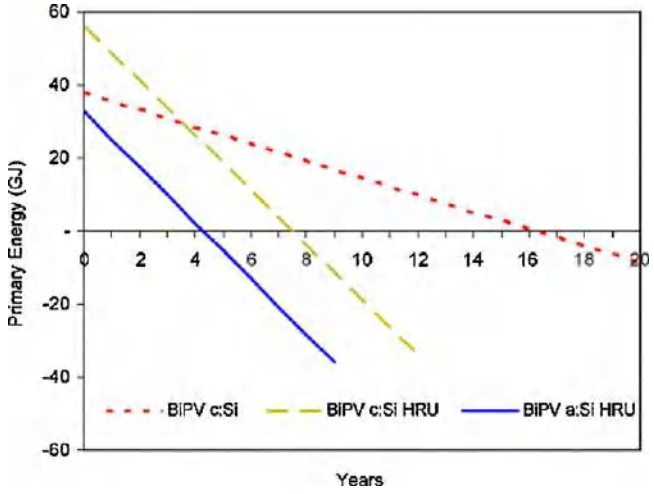

Fig. 25. BiPV with heat recovery energy payback periods.
Source: [81].

Zhang and Niu [78] in their paper presented the performance of rotary wheel so-called desiccant wheel for air dehumidification and enthalpy recovery as illustrated in Fig. 23. Effects of rotary speed, number of transfer units and the specific area on the performance of the wheel were investigated and compared.

Liu et al. [70] have combined a rotary wheel heat recovery with rotary desiccant wheel in a dehumidification system as shown in Fig. 24 to analysis its energy consumption. The results showed that, compared to conventional system, energy savings were possible to be gained.

4.5. Heat recovery coupled with photovoltaic/solar panel

Heat recovery coupled with photovoltaic/solar panel is an advanced energy-efficient system which is developed is developed in accordance to the weakness of solar panel when exposed to high temperature which resulting low efficiency. Maffezzoni et al. [79] has stated that the presence of cooling interface improves the electrical efficiency of the solar cell and in addition increase the lifetime of the system. Thus, heat recovery unit in this system works to cool the photovoltaic panels while providing a heat source for the occupants. Only few researches have been performed in the integration of heat recovery system with photovoltaic panel. Bazilian and Prasad [80] have conducted a modelling study of a photovoltaic heat recovery system for buildings professional and validating with experimental data. The results indicated that the model helped to stimulate of a modular heat recovery unit addition to a building integrated photovoltaic system and could be customised to appropriately meet the needs of the users. On the other hand, Crawford et al. [81] have presented the results of a life-cycle energy analysis of a building integrated photovoltaic system with heat recovery unit. The thermal output from heat recovery units was calculated by adding the thermal and electrical output for each system and subtracting the fan energy use. They have found that the energy pack periods between 4 and 16.5 years was obtained with BiPV with heat recovery has the highest embodied energy for all three systems as shown in Fig. 25.

Recently, a study of condenser heat recovery with a PVT air heating collector has been conducted by Sukamongkol et al. [82] as shown in Fig. 26. They have carried out an experimental test to investigate the validity of developed simulation model in predicting the dynamic performance of condenser heat recovery and found that the model agree satisfactorily with the results observed in experiments. This system can save energy by approximately 18% with the use of a photovoltaic thermal combined with the heat recovered from the condenser.

Another modelling and simulation of a hybrid photovoltaic module equipped with a heat recovery system was carried out by Maffezzoni et al. [79]. Using the numerical model, he investigated the effects of temperature profile along the photovoltaic cells and the analysis of the model can be used to predict the current voltage levels that can be sustained by the solar panel. However, many aspects still need further investigations to include the direct heat

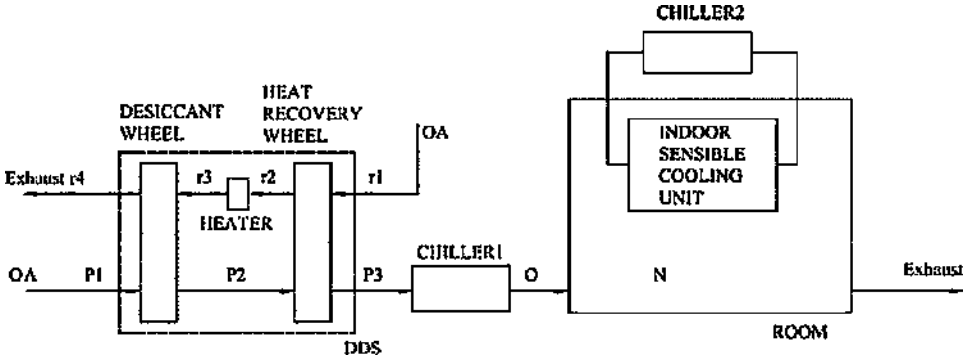

Fig. 24. Schematic a rotary wheel heat recovery with rotary desiccant wheel in a dehumidification system.
Source: [70].

Table 1
Heat recovery types, efficiency and advantages.

Types of heat recovery	Typical efficiency	Advantages
Fixed-plate	50–80%	Compact, highly efficient due to high heat transfer coefficient, no cross contamination, can be coupled with counter-current flow which enabling to produce close en-temperature differences
Heat pipe	45–55%	No moving parts, no external power requirements, high reliability, no cross contamination, compact, suitable for naturally ventilated building, fully reversible, easy cleaning
Rotary wheel	Above 80%	High efficiency, capability of recovering sensible and latent heat
Run-around	45–65%	Does not require the supply and exhaust air ducts to be located side by side, supply and exhaust duct can be physically separated, no cross contamination

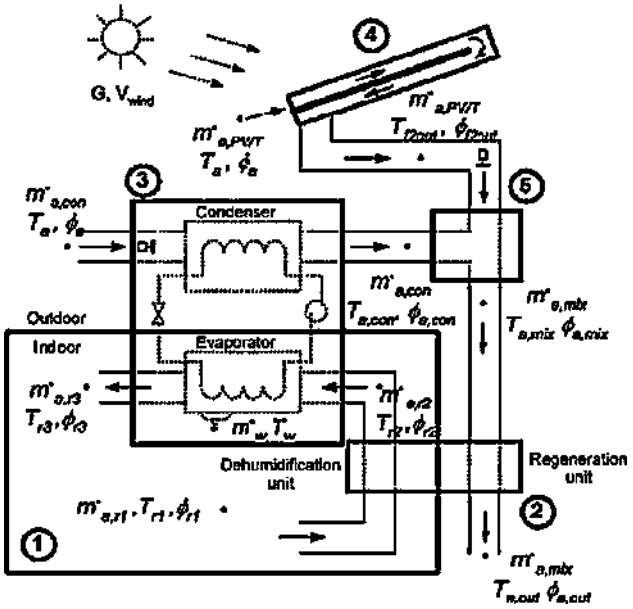

Fig. 26. Schematic diagram of a condenser heat recovery with a hybrid photovoltaic/thermal.
Source: [82].

exchange between the lower face of the photovoltaic cell and the air within the collector.

5. Conclusions

Findings from literature review shown that there are different of heat recovery types in the market nowadays such as fixed plate, heat pipe, and rotary wheel and run-around units utilized to recover energy loss. Table 1 summarized their efficiency and advantages.

Throughout the literatures, it is found many works have been done since 1980s' in relation to heat recovery systems. In the past, the works had emphasized more on heat or mass transfer in heat exchanger until the buildings standards are introduced then the efficiency and performance of heat recovery in building applications such as ventilation, air conditioning and dehumidification systems come into concerns. For natural or passive ventilation heat pipe recovery has been used since no moving part is required in this system. For mechanical ventilation, researchers tend to integrate heat pump so-called mechanical ventilation heat pump recovery while rotary wheel recovery has widely been used in desiccant dehumidification to recover heat and moisture. On the other hand, many theoretical and experimental works in literature has been conducted for integration heat recovery system with mechanical ventilation, natural ventilation, air conditioning and dehumidification systems. However, combination of heat recovery with low carbon technologies such as evaporative cooling and desiccant dehumidification is just a handful amount and very limited studies have been done to integrate them in one system. Besides, the integration of heat recovery with photovoltaic panel is still new and only few researches have been found.

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Performance improvement in wireless sensor networks by removing the packet drop from the node buffer

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ABSTRACT

In Wireless Sensor Networks (WSNs) typed applications, the node buffer plays a vital role to store the processed data before transmitting it further to the base node through neighbor nodule. Nowadays, in Multi-Application Wireless Sensor Networks (MAWSNs) scenario, to improve network performance of the node buffer has to be maintained or efficiently balanced. Because, for implementing various applications, at the same time in MAWSNs, the processing, transmitting capability of the node should be enhanced and the node storage capacity (Buffer) should be maintained. Since, if the node buffer exhausted then automatically it drops the data packet and the data will be lost and hence performance degradation will occur in the network. It will also affect the network lifetime. Hence, this paper implements a mechanism to enhance the node buffer for improving network performance. The work is implemented on Network Simulator i.e., NS2 version 2.34/2.35. Our work outperforms in comparison with the existing work and improves network performance.
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1. Introduction

Wireless Sensor Networks (WSNs) are the wireless typed network that contains thousands of or sometimes millions of sensor nodes (in MAWSNs) [1]. All these nodes in the network are having constraint energy as well as a buffer. These nodes suppose to do the basic operations like sensing of information, processing the data, and transmit it to the neighbor node. These nodes with a constrained buffer will become a bottleneck node when a huge data is transmitted towards it. Hence, by only considering the node energy by neglecting the node buffer will affect the network performance. In the case of delay in the network automatically the overflow will occur at the node buffer and hence the data packet will drop through the node buffer and information will lose. This loss of information will directly affect network performance [2] (Figs. 1 and 2 and Table 1).

The WSN consists of a large number of wireless nodes that have constrained energy, as well as storage space. The major tasks of these nodes are data gathering and forwarding them to the Sink node (BS) [3]. Hence, network performance becomes one of the major criterions for the effective design of the network in WSN. Hence, in this paper, a cluster head is elected for each cluster to reduce the buffer utility of the source nodes to optimize source exploitation [4].

The buffer-efficient routing can be obtained by the nodes that have a maximum residual buffer. Hence, the highest residual buffer nodes were selected to forward the data to BS. It helps to provide a better packet delivery ratio with lesser resources utilization. The results show that the proposed work outperforms the existing balanced routing protocol and LEACH Protocol in terms of packet delivery ratio, and end-to-end delay. It also improves overall network performance.

Till now the researchers are working on the energy-efficiency of the node to enhance network performance. But, at the same time, the network buffer also plays a very important role to avoid performance degradation in the network. Because, due to sufficient energy, that satisfies the threshold value, if a node gets bulky data packets, then due to its constrained buffer the node buffer gets overflow and becomes the bottleneck node and drops the data packets [5].

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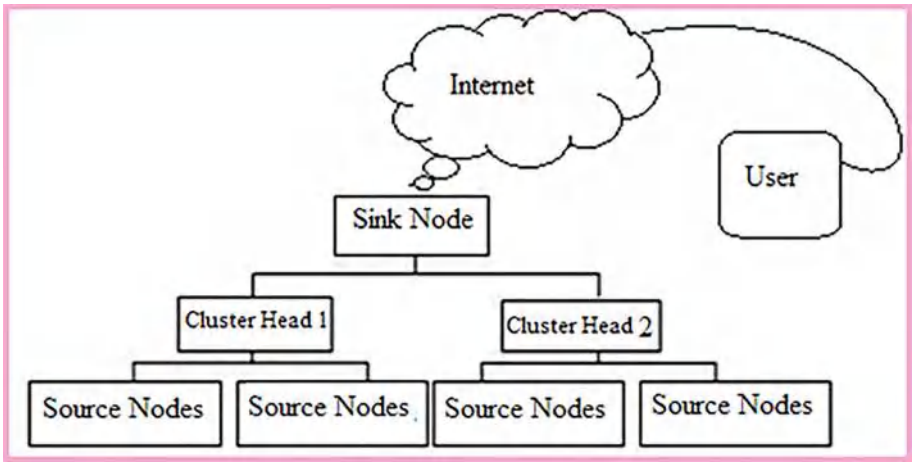

Fig. 1. Basic working of wireless sensor network.

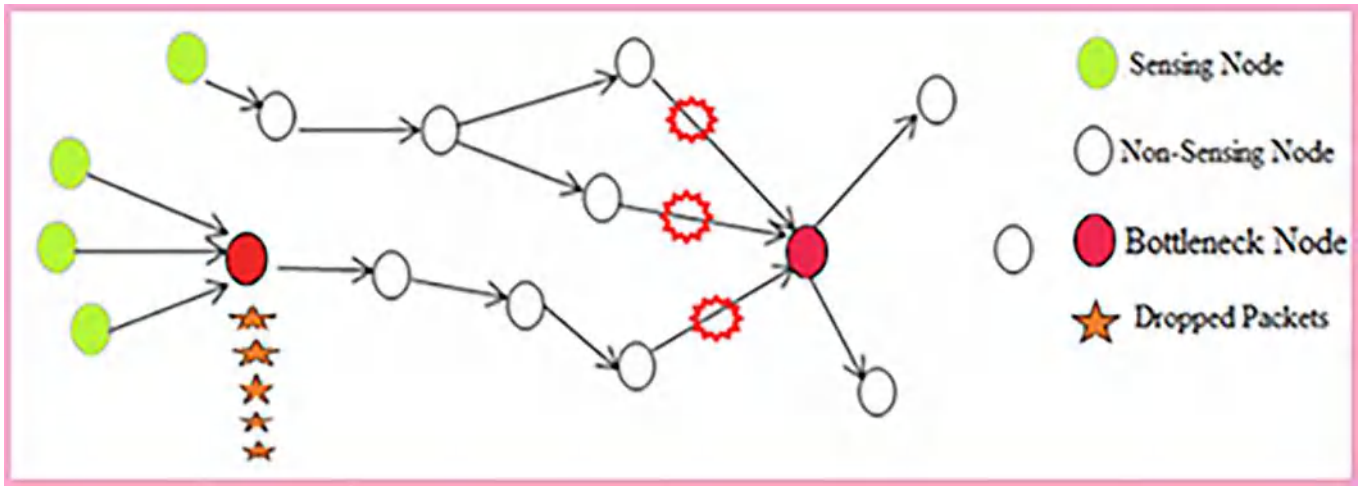

Fig. 2. Scenario of node becoming bottleneck node in WSNs.

Table 1
Parameters used in the network simulation.

Parameters used	values
Time for Simulation	1000 s
Quantity of Nodes	100–500
Layer	Logical Link
MAC protocol	802.11
The Mobility Concept used	RWP
The Network layer	Projected
The Communication Mechanism	Two-Ray Ground Theory
Method of Queuing	The Priority Based on Drop-Tail
Energy Supply	300j
Model of Traffic	Constant bit rate
Network Area	1000 m × 1000 m

2. Literature survey

All these developments associated with the routing mechanism in WSNs are essentially linked with its application. However, in WSN, routing protocols design must contain buffer balancing to manage the available resource of the nodes [6]. The study says that there are generally two factors that play a vital role while selecting the node neighboring to the sender; those are energy and load (Buffer). Thus, in this work, we develop an efficient routing protocol that selects an efficient path by considering the residual buffer capacity of the neighbor node. For achieving this goal, primarily we have to work out on node buffer and then calculate the remaining status of the present buffer status of the node. Furthermore, the appropriate solution to overcome the bottleneck issue for the node is to change the sink node position base on the residual buffer status of the intermediate nodule. Thus, in this work, we are designing a routing protocol to expand further the network's performance by implementing the mobile sink node.

WSN is a collection of very small wireless nodes as source nodes to gather the data for the ecological actions for doing computations on them depends on applications. Later on, the collected data transmitted through to the sink node i.e., the base node through the neighbor node in the network [7]. Different researchers worked on the proper buffer utility of the source node in the network. Because all the wireless nodes work in synchronization with the other nodes to make data transmission successfully. These wireless nodes constantly in the dynamic form to take delivery of the data packets and broadcast them to the base node. As these nodes are battery-operated, this nonstop monitoring action decreases the lifetime of the source nodes [8]. On the other hand, buffer sufficiency also plays an important role in the lifetime of the source node. Because the lifetime of a single node in the network will affect the whole network's performance. Hence, the efficient management of buffer is a significant constraint for the best design for a WSN. Thus, a routing protocol is significantly desirable to make the

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WSN with balanced buffer. Hence, in this paper, a complete observation and investigation of the existing routing protocol with energy efficiency are discussed. The LEACH routing protocol that creates energy as well as buffer balance in the network saves the node buffer and increases the lifetime of the network [9] is discussed.

3. Proposed work

From the last few years, the researchers are working on the node energy and considering it as a sole metric to advance the network performance as well as lifetime. But, at the same time, the buffer also plays an imperative role to increase network performance. Because, if due to sufficient energy if a node gets a higher number of data packets, then at the same time, due to the constrained buffer of the node, an overflow will occur at the node buffer and hence data packet will drop through the buffer [10]. This will cause the node to become a bottleneck node in the network. Due to this performance degradation will occur in the network and hence the network lifetime also decreases. Hence, in this paper, we are implementing the Knapsack Algorithm to maintain the node buffer. Because by using this (Knapsack) algorithm we can maintain the node buffer capacity to store the information packets [11]. As per the LEACH concept, different clusters are created in the network. In our concept, a node with higher remaining buffer capacity is elected as a Cluster Head (CH) for that particular cluster instead of selecting randomly like in the LEACH protocol. The main aim of the cluster head is to aggregate the data for avoiding the repetition of the data and hence network performance can be improved [12].

To maintain the node buffer, the data aggregation of the information is done at the nodal centers that are at the cluster heads. The basic equation for the residual buffer of the node is given by,

$$B_{Existing} = B_{Total} - B_{Packets\ in\ the\ Queue} + B_{Packet\ Drop} \quad (1)$$

where,

$B_{Existing} = The\ Residual\ Buffer\ of\ the\ node$
$B_{Total} = Total\ Buffer\ at\ the\ time\ of\ Deployment$
$B_{Packets\ in\ the\ Queue} = Buffer\ utilized\ by\ the\ Packet\ in\ the\ Buffer$
$B_{Packet\ Drop} = Buffer\ Space\ Created\ by\ the\ Dropped\ Packet$

Thus the paper computes the residual packet capacity of the node in its available energy as follows:

1. Considering a multi-hop WSN with several nodes outfitted with E joules of energy and it can handle the n number of packets. The energy required to process the packet P_i is determined by the following equation:
2. The number of traffic queued at the sensor node buffer is determined by the help of Random Early Detection (RED) gateways follows:

$$Averagenewqueue(Q_{avrg}) = (Weighted\ constant) * Instant\ Queue + (1 - Weighted\ constant) * Averageoldqueue \quad (2)$$

3. Weighted constant value is determined by the time constant value of the low pass filter.

Threshold queue value of buffer size is kept in this approach is

$$Thresholdbuffer(Q_{Th}) = 75\%\ of\ the\ Buffer\ size \quad (3)$$

4. The mobile sink node position must be changed if the neighbor node of the sensor node buffer queue size is below the threshold queue value of buffer size.

The proposed Algorithm:-

1. Dynamic replacement of the node $(N, CRP, CRP_{Th}, Q_{avrg}, Q_{Thre}, D)$
2. Attain the positions of the N nodes along with their respective values of CRP and Q_{avrg}

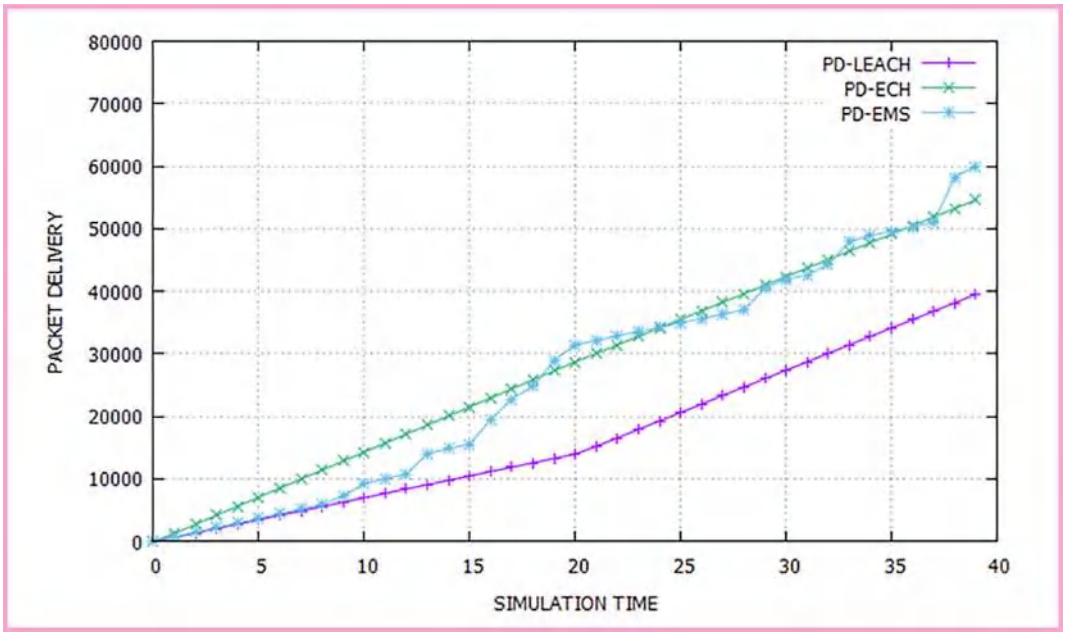

Fig. 3. Performance of packet delivery for proposed vs. existing approach.

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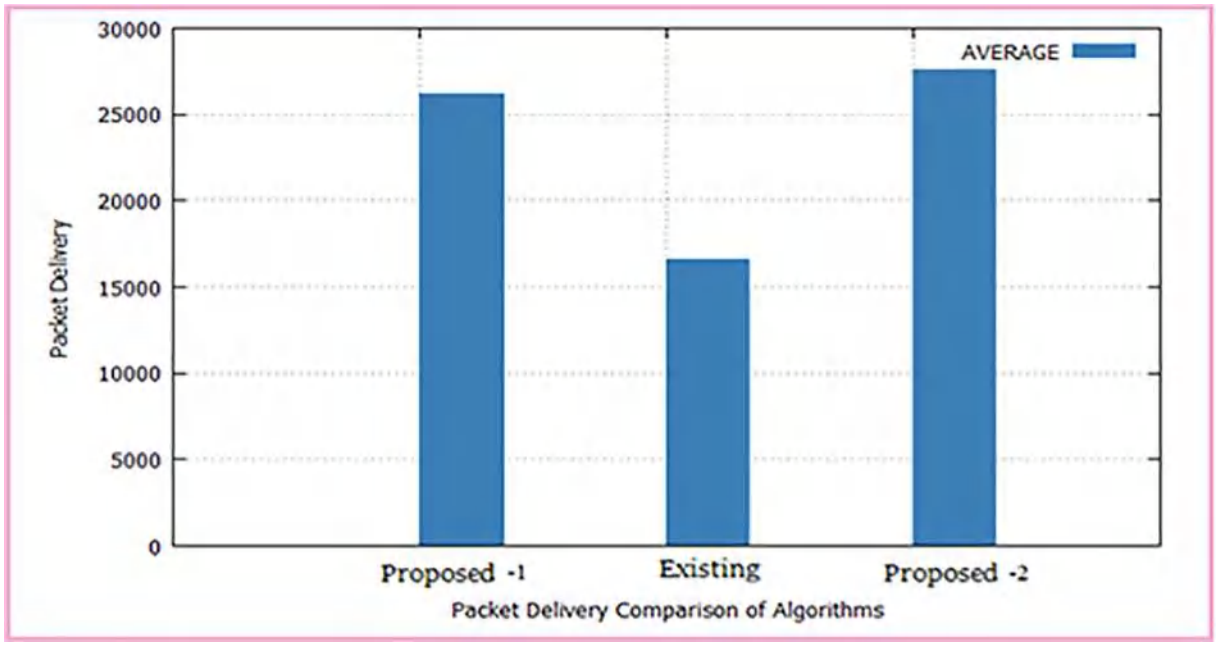

Fig. 4. Packet delivery relationship between existing & proposed work with average values.

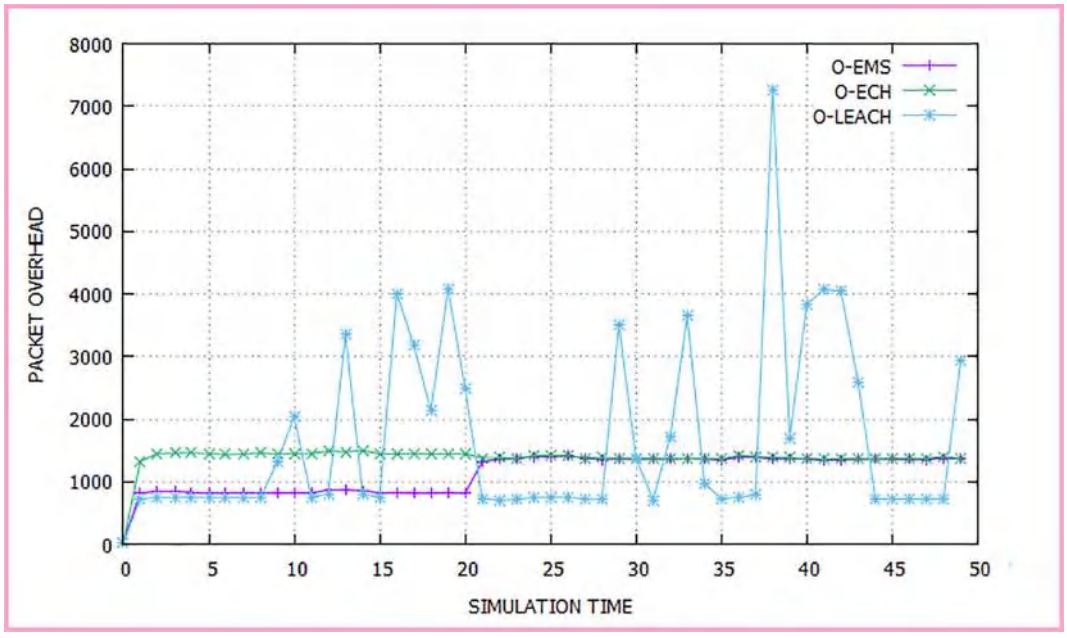

Fig. 5. Overhead comparisons (proposed vs. existing).

3. The provision of the neighbor node of the sink is given by

if $(CRP \geq CRP_{Th})\&\&(Q_{avrg} \geq Q_{Thre})$
{
Sink location do not modify
}
Else
{

Find out the nodes that satisfies the threshold status about the buffer also calculate the distance between sink and the sensor nodes.

Find out the neighbor node, which fulfill the threshold status of the buffer for the storage of the packet.

Relocate the sink to present location to the neighbor position to the node as per the threshold values of the buffer capacity
}

4. Performance outcomes

4.1. The packet delivery

The considered metric, Packet Delivery (PD), defined as the number of packets forwarded through the supply to the target node. The network packet delivery is computed with the variable number of nodes and simulation time in the presence of a misbe-

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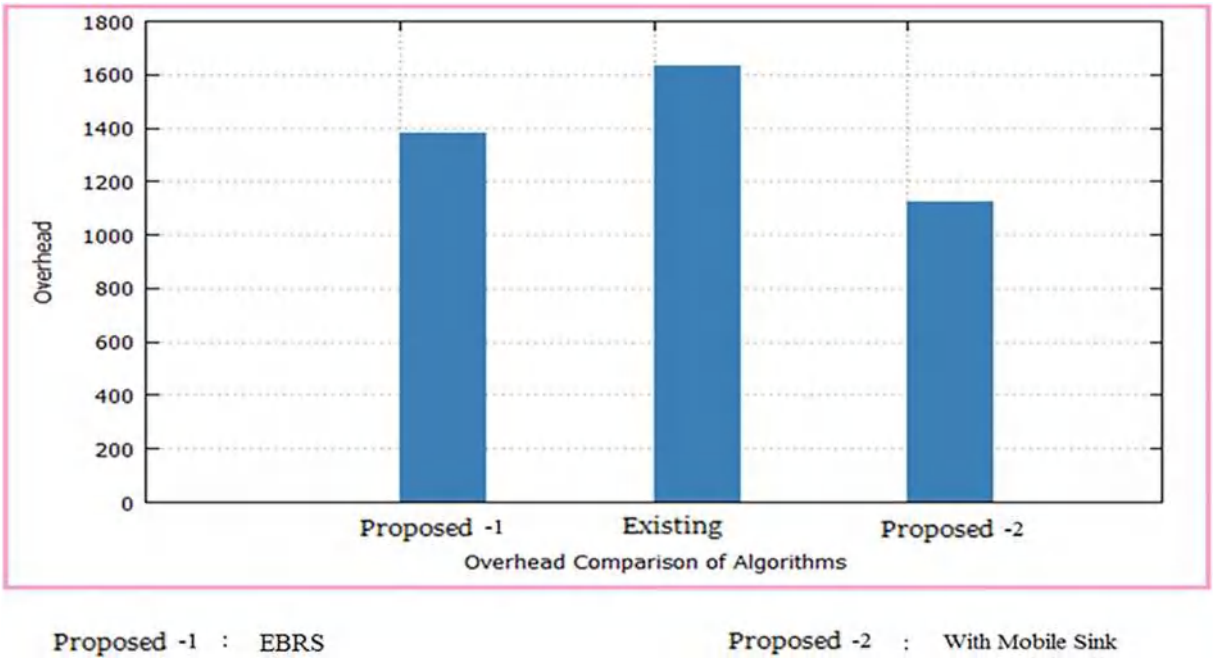

Fig. 6. Average packet overhead comparison in respect with a varying number of nodes between projected and existing approaches.

having node (packet dropping node). The figures below depict that the PD performance of the LEACH protocol is less, as this approach did not prevent the packet dropping nodes from the routing path due to the constrained resource.

Fig. 3 above gives the packet delivery performance comparison of the proposed and existing work concerning the simulation time. The figures depict that packet delivery of proposed work is better than the existing protocols.

Fig. 5, gives the performance comparison between proposed and existing routing protocol under different mobility environments about packet delivery. The results show that in the proposed protocol, Packet Delivery is outperformed in comparison with the existing protocol. The figure shows the performance comparison of the average throughput of proposed and existing routing protocols concerning a changeable number of nodes (Fig. 6).

4.2. The overhead

The overhead of the network is computed in control packets concerning the number of nodes. It computes the number of control packets used by the algorithm in one complete communication session, apart from the data packet.

Fig. 4 shows the comparison of control packets overhead of proposed and existing routing protocols concerning the number of nodes. It is obvious from the figure that the LEACH control packets are very much high as it sends the acknowledgment for every data packets. Proposed routing protocol control packets overhead are very much less as it sends the acknowledgment packets after a specified time interval. ECH protocol control packets overhead is less than LEACH and EMS, as it did not consist of acknowledgment packets.

5. Conclusion

Hence, by maintaining the node buffer efficiently and removing the repeated information packets we can improve the network performance as well as lifetime. In our proposed work by removing the bottleneck problem we can improve the network performance intern it will give high packet delivery by removing the packet drop. The performance outcome shows that our proposed work outperforms in contrast by means of the existing work.

The network performance can be further improved by the Sink mobility concept which is our upcoming work.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Blockchain based EHR system architecture and the need of blockchain inhealthcare

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ABSTRACT

Purchases are concurrently safe and secure as well as credible because of making use of cryptographic guidelines. Recently, blockchain technology has become extremely cool and trendy and infiltrated various domain names, usually as a result of the appeal of cryptocurrencies. One field where blockchain technology possesses significant ability is medical care, because of the requirement for an extra patient-centric method to medical care systems and to link inconsonant devices and also boost the reliability of digital medical care files (EHRs). In this organized review, an analysis of cutting edge blockchain research study in the field of health care is carried out. It's own' prospective in the multi-stakeholder operated market like health and wellness has been responsible for several expenditures, researches, and executions. Electronic Health Records (EHR) devices typically made use of for the swap of wellness details amongst healthcare stakeholders have been criticised for centralising energy, failures and attack-points along with exchange records protectors. EHRs have battled when faced with multi-stakeholder as well as unit criteria while adhering to safety and security, privacy, reliable as well as other regulative constraints. Blockchain is promising among others to attend to the many EHR challenges, largely trustless and also protected swap of health-relevant information among stakeholders. This paper provides the demand for blockchain in medical care and also blockchain-based EHR device architecture.
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1. Introduction

A blockchain initially blocks chain, is, in fact, a flexing check-list of reports, called blocks, that are hooked up using cryptography. Each block has a cryptographic hash of the previous block, a timestamp, and also operate information. Purposefully, a blockchain is unsusceptible to alteration of the reports. It is actually "a quickly on-call, circulated publication that might promptly video clip costs in between a set of events efficiently as well as additionally in a reputable as well as a long-term strategy". For consumption as a moved magazine, a blockchain is generally managed to make use of a peer-to-peer unit with each other adhering to a procedure for inter-node communication besides confirming new blocks. As promptly as videotaped, the relevant information in any kind of sort of type of offered block might swiftly absolutely not be altered retroactively without renovation of all developing blocks, which requests for the view of the system mass. Although blockchain papers are not unmodifiable, blockchains might be taken a look at guarded uniquely, also, to also present a circulated computer system alongside high Asian oversight resistance. Decentralized package has consequently been stated along with a blockchain. Fig. 1.Fig. 2.

The first business a cryptographically gotten chain of blocks was divulged in 1991 along with Stuart Haber in addition to furthermore W. Scott Stornetta. They organized to take advantage of a figure where record timestamps might undoubtedly certainly not be ruined. In 1992, Bayer, Haber in addition to Stornetta mixed Merkle floras to the principle, which increased its very own performance by allowing a selection of paper certifications to become collected right into one block.

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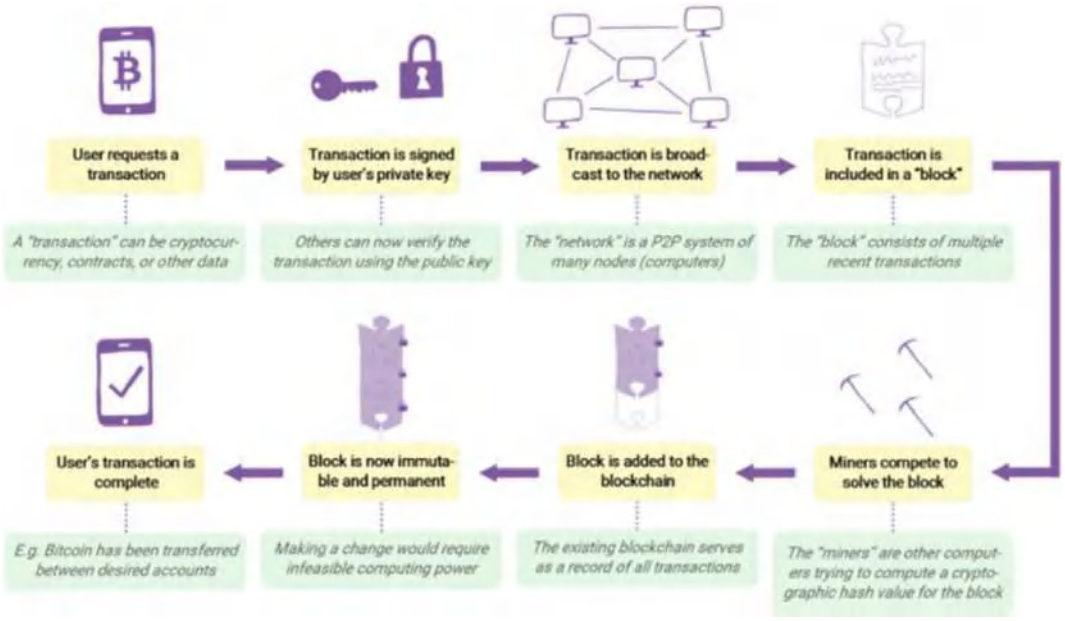

Fig. 1. Operational flow of blockchain system.

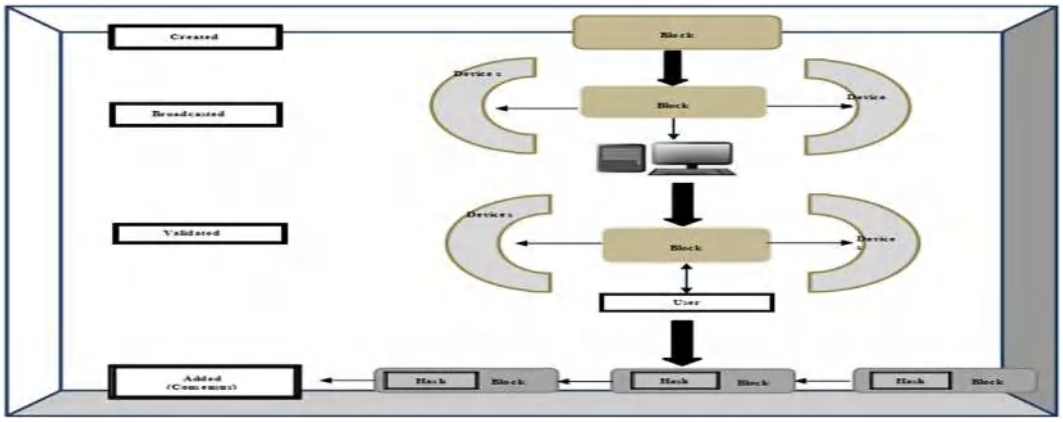

Fig. 2. Blockchain Workflow.

The initial blockchain was contemplated making use of a particular (and even workers of people) gotten in touch with Satoshi Nakamoto in 2008. Nakamoto boosted the type in a crucial means using a Hashcash-like technique to timestamp blocks without asking for every one of each of all of them to come to be recognized through a count on the job in addition to additionally supplying a difficulty criterion to maintain price together with which blocks are featured in the chain. The concept was conducted the prospering year using Nakamoto as an essential component of the cryptocurrency bitcoin, where it acts as every person publication for all investments on the system.

In August 2014, the bitcoin blockchain data measurements, having documents of all bundles that have happened on the system, obtained twenty GIGABYTES (gigabytes). In January 2015, the dimensions had broadened to 30 GIGABYTES and also coming from January 2016 to January 2017, the bitcoin blockchain boosted arising from fifty GIGABYTE to one hundred GIGABYTES in dimensions. The publication size had gone beyond 200 GiB with fairly early 2020.

Key phrases block and also chain were made use of independently in Satoshi Nakamoto's first paper, nevertheless were inevitably marketed as an anomalous term, blockchain, making use of 2016.

Relying on to Accenture, paperwork of the flow of improvement suggestion recommends that blockchains are gotten a 13.5% nurturing price within cost-effective agencies in 2016, therefore communicating to the remarkably very early adopters period. Industry organization teams joined to develop the Worldwide Blockchain Online Conversation Online Forum in 2016, a task of the Unit of Digital Service Provider.

In Might 2018, Gartner found out that simply 1% of CIOs suggested any type of sort of kind of form of type of blockchain sowing within their associations, and also merely 8% of CIOs stayed in the brief "coordinating and likewise [considering] spirited hit and miss in addition to blockchain".

Blockchain safeguarded awareness as a spread publication technology staying with the Bitcoin white paper discharged in Oct 2008 [1] As the embedding technology for Bitcoin, the vital power of blockchain remains in truth that it implements the substitution of digital components together with guests in a dispersed physical body system without the necessity for a featured, depending on the 3rd party. Procurements featuring the swap of a digital device of

money in between individuals or even companies have generally counted on a relied upon 3rd celebration (TTP), consisting of a banking company, as a moderator. The reliance on a TTP is not feeling free to for a wide variety of major descriptions. A relied upon 3rd celebration may malfunction, forget or even possibly be wrecked maliciously to give the monetary system not readily on call or even perhaps insecure; consequently, a TTP endangers a resource perhaps as a distinctive portion of stopping working. A TTP in a similar way asks for acquisition prices along with mixes some price cut hold-ups. The creative thinking responsible for Bitcoins is, because of that, to hammer these limitations linked with the dependence on TTP in electronic bargains.

Electronic Wellness File (EHR) body systems [1] have been significantly used as an effective method to section customers' records along with numerous health centres. Possessing mentioned that, it is still a challenge to access to spread individual files through several EHRs considered that existing EHRs are regionally restricted or concern associated medical facilities. Based upon the documentation discharged due to the Office of the National Organizer for Health Infotech (ONC) [2], the major limitation to accessibility specific re- cords depends upon the trouble to find business's manage. Until now, there have been a variety of tasks to pound these issues; having mentioned that, the solutions they have produced are challenging as well as consist of redesigning or maybe improving existing EHR body systems, which will demand significant costs. Among every one of them, one of the complete most definitely on-going plannings is worked by CommonWell Health Alliance [3] in the United States, a non-revenue connection. They assist EHRs, treatment providers, and also medical care infotech (SMASH HIT) merchants to attach to their national interoperability device using accredited mixture units and also middlemen. They take advantage of a centralized gadget that makes it possible for individuals and additionally medical professionals to hunt for a client's spread case study. Such a central concept has some disadvantages that it may experience the danger of single-point-of-failure in addition to obstruction of information circulation when the system finds yourself being larger.

In an EHR body, when client files are accessed by coincidence, the recent record of all such tasks need to become documented in a log proclaim later study on availability files. The document data is utilized for restoring recent ailment of the medical record, and likewise, it may be symbolized as a legal record. Thus, our company require to securely defend the record documents coming from prohibited availability and also make it unalterable ideally.

Within this paper, our group layout a decentralized system to care for problems in discussing individual files among EHRs without counting on a costs central device. Our unit has 3 primary functions: (1) a depended on the list of client info in EHRs which guarantees access along with the stability of the info by itself, (2) enriched safety in handling client information using making use of a particular file encryption planning and additionally delivering a straightforward and also indisputable audit route based upon firm ease of access log, along with (3) offering scalability to cover several existing EHRs of local or maybe core healthcare resources with the minimum customization and also a schedule of the system without relying on a central jurisdictional device.

Our team make the system adhering to the Medical insurance coverage Transportability and Responsibility Action (HIPAA) focused safeguard and ISO/TS 18308 [4] for the interoperability, details security, auditability, and also the supply of the system. To finish our aim ats, our staff use blockchain technology, especially the permission range kind, utilizing the Hyperledger Component (HLF) platform. Numerous health centres get to comprise a range possessing a personal peer-to-peer unit, as well as additionally permission to join it is found out based upon viewpoint along with the members.

2. Blockchain background

Blockchain is a peer-to-peer distributed journal technology that went, to begin with, taken advantage of in the private sector. Based upon just exactly how the identification of an individual is defined within a unit, one can perhaps review permissioned as well as likewise permissionless blockchain systems. A permissionless device is one through which the identifications of guests are either pseudonymous and also discreet as well as every consumer might add a brand new block to the publication. On the other hand, in case of a permissioned blockchain, the identification of a consumer is managed with a recognition company. The identification company is relied on sustain gain access to control within the system as well as likewise the individual's rights to sign up with the viewpoint, and even legalize a new block. Following our specialists launch 2 very most widely known requests of the blockchain technology: Ethereum as well as Hyperledger.

2.1. Implementation of permissionless blockchain

Ethereum is an implementation of a permissionless programmable blockchain that allows any sort of kind of individual to create as well as additionally execute the regulation of arbitrary algebraic difficulty on the Ethereum unit: Ethereum Virtual Machine (EVM). "Funds" of a set of kinds may be created on EVM. Ostensibly had an account (EOA) is an account taken care of with a unique key of a buyer. Offer profile is the second type of profiles that may be seen as an independent agent that keeps in the Ethereum execution environment and is regulated through its setup code: dazzling arrangement. The smart contract is made use of to secure relative condition change components, making it possible for people to produce physical bodies in addition to different capabilities by strengthening the logic of the system into the requirement.

Code conclusion in Ethereum must be paid out. The acquisition price limits the variety of computational measures for the code conclusion thus as to stay clear of limitless loopholes or different other computational profligacy. Consumers might perhaps join an opinion process to acquire the tokens to be acquired purchase implementation. In Ethereum, the opinion is attained by using a proof-of-work (PoW) technique. PoW is based upon "expedition": finding a nonce input to the formula to guarantee the leading hash of a brand-new genuine block pleases certain demands. These standards readied the concern limit for the method of discovering the nonce.

The concern limitation determines the amount of power to end up being devoted to finding such nonce. For instance, the loudness of electrical power made use of via Bitcoin expedition approaches the Irish countrywide energy consumption. Existing PoW blockchains can quickly accomplish throughput of certainly not above 60 purchases every second without substantially influencing the blockchain's monitoring. These set of searching for existing that PoW may detrimentally affect the system scalability and also general throughput.

Proof-of-Stake (PoS) as well as Proof-of-Burn (PoB), or even electronic exploration systems, have been merely lately organized as substitutes to PoW. Instead of possessing people mine through trading their riches for computational information (which are afterwards swapped for exploration benefits), in electronic mining, individuals can probably trade their wide variety directly for the ability to tag on a brand-new block to the publication. For instance, in PoS, collection of a participant that is going to create a brand-new block is based upon the volume of tokens possessed by the guest, in PoB-- based on the volume of gifts "burnt" (sent out to an unspendable deal with). Nevertheless, using a strenuous argu-

ment for and even versus the security of virtual exploration remains to be free of charge issue.

2.2. Implementation of permissioned blockchain

When it comes to a permission unit, individuals accomplish not have an incentive to swindle as their identity is exposed to the identity holding web server. Also, engagement in consensus tracking is limited to a predefined collection of consumers. This opens up a possibility to use a disorder equipment replication protocol (like PBFT) as a deal device. Hyperledger-- a completion of a permission blockchain-- is an offered resource blockchain campaign held by the Linux Structure. Hyperledger has a modular concept that makes it feasible for connecting in different consensus devices, including PBFT. Hyperledger services may be rationally set up in 3 teams: Registration business, Blockchain companies, and also Chaincode providers.

Enrollment firms deal with identification, personal privacy, along with privacy on the system. A consumer is assigned a username as well as a security password that is heading to be utilized to discharge the Registration certification (ECert) to pinpoint every enlisted consumer. It is possible to utilize different Purchase licenses (TCert) related to the similar ECert for every single purchase to assure their unlinkability (a using between TCert and Ecert are just recognized to the registration solution). Blockchain companies manage the spread publication through a peer-to-peer process improved HTTP/2. In Hyperledger, intelligent contracts are executed as a result of the chain code. Chaincode services provide a safe means to carry out prudent bargains on confirming nodules.

In Hyperledger, prudent arrangements are carried out through chaincode which contain Reasoning and additionally linked Planet State (Condition). The reasoning of the chain code is a collection of rules that figure out just how acquisitions are going to be performed along with exactly how Health condition is going to alter. Problem is a data bank that conserves the information in a form of methods along with good worths that are arbitrary byte arrays. The Health condition additionally consists of the block assortment to which it corresponds. Journal takes care of blockchain by including an effectively cryptographic hash of the Disorder when tagging on a block. This allows trustworthy synchronization if a nodule was brief off-line, reducing the volume of maintained information at the node11.

Over the last few years, an investigation relating to the blockchain as well as additionally intelligent journals has entered beauty due to the introduction of cryptocurrencies, consisting of Bitcoin as well as also Ethereum. Blockchain stores and quantities documents in a circulated, relied and likewise upon firm strategy, dealing with intermediates, in addition to absolutely not asking for a centralized dependency for browsing through investments. Visibility in blockchain delivers a much less challenging approach for accessing ledger-based trans- activities over systems; it contacts various processing electrical powers stemming from different nodes in the blockchain body, making it quite strong relative to rundown speed.

3. Applications of blockchain technology

There are considerable amounts of treatment including blockchains like Cryptocurrencies and similarly Internet of Attributes

Cryptocurrencies are the downright very most widely known treatments of the blockchain device. Blockchain ends up the customer's requirements anonymously along with therefore guarantees security and also safety and security. Considering that financial investments presently occur in between the countries that have several needs and likewise guidelines one of all of them, the regular monetary system is obtaining hindered. The boom in the worth of the bitcoin provided an understanding of the blockchain to the general public and also invites reality delivered a whole lot much more self-esteem on cryptocurrencies.

Bitcoin is only some of the absolute most generally utilized and also the extremely first made use of cryptocurrency. It is estimated that buildup truly worth of the entire cryptocurrencies have intercrossed $200 billion. Bitcoin has created the tag ‘‘digital gold”. The price of this volume of money is particularly unforeseeable in addition to also may effortlessly boost every second. The worth of each bitcoin is really around half of the comprehensive truly worth of numerous other cryptocurrencies. Nevertheless, it's own truly worth capped in 2017 as well as likewise routed to its very own existing market price. The working of cryptocurrencies comparison stemming from the typical loan. Given that it is decentralised, the marketplace values customizations based on the marketplace, as a result, it has acquired considerable amounts of anticipations.

It can properly resolve the issues connecting to the cost-effective world. The fees for assets handling is greater for the international movement which can be done away with making the most of cryptocurrencies. It can lessen the instant taken in addition to also red-tapism linked with the purchases. It may also apply for the 3rd occasion traits supervisors for that reason eliminating the hazard of losing the cash loan. It might develop assurances by itself for a wide array of celebrations that conduct not count on each other because of its reputable make use of awareness.

World wide web of Details

The several methods whereby we involve together with the setup and likewise each other has modified significantly. The Web of Factors (IoT) technology, being an incredibly everywhere technology, is encouraged to mould human life, for that reason creating substantial money-saving comforts. Diverse hurdles increase from IoT in addition to the Blockchain technology can be used to look after these difficulties. World Wide Web of Aspects (IoT) provides considerably to a selection of elements of our day-to-days live as well as rides lots of usages stemming from many markets just like treatment, development and so forth. IoT takes part in a vital feature in customizing properties straight into efficient homes in addition to areas into smart urban areas. Numerous complicated difficulties inherent in the IoT are coped with via blockchain. Blockchain is separated among many physical bodies. Including blockchain with IoT creates depend on in between affairs together with tools, lowers costs like securing intermediates as well as also dramatically quicken plans. If you want to do work in the path of Blockchain mixture, mostly for IoT functions, there is a requirement to form connections in between a variety of A couple of concerns like scalability, interoperability in addition to added safety and security need to come to be shaken off via Blockchain in IoT. Blockchains for each one of all of them to change one-another's endurance. Blockchain in addition to IoT is working together with one another as well as likewise are also extending greatly. Blockchain is, in fact, ferocious for the options that IoT products it as well as likewise IoT is losing faith for the functions that Blockchain maintains.

4. Requirement for blockchain inhealthcare

Keeping the medical records of individuals is substantial in healthcare. These data are extremely vulnerable together with consequently on top of that a focal point on for cyber-attacks. It is needed to get all the sensitive information. An additional component controls over information which will ideally be dealt with because of the individual. Consequently, discussing and also furthermore accessing the demand of people' treatment documents is an addi-

tional use condition which can take advantage of remarkable modern developments. Blockchain technology is remarkably hard versus strikes in addition to additionally breakdowns, and things numerous strategies of ease of access management. Because of that, blockchain products an excellent system for treatment data. Among the areas where blockchain is thought about to possess fantastic capability is health care. To boost medical care, the emphasis must be provided to the management of information that might probably get from the prospective to connect inconsonant tools and additionally enrich the stability of EHRs. Blockchain technology may be capitalized on to assist medicine prescribed and also supply chain monitoring, maternity in addition to any kind of sort of danger reports checking along with support get access to command, relevant information sharing as well as additionally moderating of a study course of clinical activities. Many several other medical care places that can conveniently maximize blockchain technology are supplier certifications, healthcare settlement, getting, case study substitution, medical tests, as well as anti-counterfeiting drugs. Medical care remedies are enhancing to permit a patient-centric approach. Blockchain-based healthcare devices could enrich monitoring and likewise the consistency of people' applicable details given that clients will have monitoring over their health care papers. Those tools can additionally support resolve personal records, allowing the alternative of filing around several clinical establishments.

Exempting the medical record of consumers is incredibly important in healthcare. This relevant info is fairly fragile and additionally consequently on top of that a prime aim for cyber-attacks. It is essential to protect all fragile details. An additional element resides in reality management over the info which is going to essentially be handled due to the person. Ultimately, discussing in addition to also accessing the control of people' treatment records is, nevertheless, an extra consumption condition which may profit from sophisticated contemporary modern innovations. Blockchain technology is very sturdy versus strikes along with failings, and additionally promos various strategies to access control. For that reason, blockchain uses an outstanding construct for health care information.

For personal medical records, the best enough kind of a blockchain will be a personal blockchain. Depending upon to the Würst as well as likewise Gervais choice design, a blockchain may be benefited from in a situation where several celebrations that achieve undoubtedly not depend on each other need to associate with enhancement to trade conventional records, however, are mosting likely to absolutely certainly not similar to include a depended on the third event (TTP). Their style shows different aspects which require to need to have to end up being dealt with when examining whether an information instance requires blockchain. Regarding conserving, there are numerous aspects (fears) that need to become checked out:

- Is there a necessity for socking away records (when it concerned the authors of a particular condition)?
- Do you need to have a great deal of generating acquire availability to?
- Is a TTP obtainable and additionally can one that is constantly online be utilized?

In the beginning, our team needs to have to determine the need for records consistently keeping (in regular circumstances this is an information bank).

5. Proposed approach

Distinct procedures as well as also configurations for the block investment in the network are established. In the suggested device, a mutual in proportion technique along with personal essential make it achievable for the EHR to become spread to various other participants in the blockchain unit.

5.1. Proposed Patient-Centered blockchain model

We propose a medical data manage body system utilizing risk-free blockchain technology as well as permits customers to keep possession over their reports while permitting hospitals to possess incredibly easy access (note the noting Fig. 3). Our company locate our body on the Ethereum answer, a decentralized system that makes it possible for coders to jog functions on a tailored blockchain. Since a lot of opportunities, blockchains perform certainly not innately provide adequate storage, our pros keep the actual filings on a decentralized cloud storage room including Ethereum Group, a native bottom level solution of the Ethereum web3 stack that functions as a dispersed holding system. Each filing then possesses an unrivalled group hash, which blended with the decryption trick, produces the beginning component. Merely those that recognize the promotion to the original part may effortlessly access the component. Consequently, the source pieces are securely and firmly stashed in smart arrangements with the blockchain in addition to being released just under information disorders.Fig. 4.

To deal with the complication of records possession and also demand, our company partner with multi-signature (multisig) contracts. Multisig asks for several consumers, in this particular case the individual as well as likewise the clinical facility, to each utilize their exclusive tricks to authorize a bargain for proof. Through this, the individual can easily certainly not modify the file without authorization of the medical facility, yet he still has administration over that might access his documentation. A brand-new group hash must be produced each opportunity after the records have been accessed (because the old flock hash is today understood), therefore our pros add a "last accessed" timestamp. The modification in the information will immediately completely transform the flock hash, which can easily at that point be guarded once more till it gets the needed authorizations to gain access to. This type surely not just delivers the monitoring as well as immutability offered with blockchain, yet similarly delivers a multisig remedy to reports ownership and additionally ease of access.

6. System architecture

Records are strengthened as well as likewise recognizable to every client in the blockchain device. The companies, like specialists along with the laboratory team, may inquire required records over the network. If the customer gives access to take a look at along with improving their documents right into the EHR journal system, afterwards the specialist or lab individual can look into and also upgrade whenever demanded approval reports of the patients.

The entire framework is arranged right into a system. Fig. 5 represents that the significant bunch has a flow of the configuration of the generated or perhaps risky tool along with hyperledger addictions. During organizing, the bunch's project is in fact to apply the EHR device that is connected to the caliper information hyperledger atmospheres. Throughout the training program of the 2nd period, the principal hold arrangement of the experiment comes with the calliper framework. Later on, the system of dimension has pursued the calliper in addition to hyperledger bunches. Throughout measurements, all nodes have kept an eye on via setting up Cable television- a shark that catches the packages in addition to tcpdump and likewise blended surrounding loopback throwing server of the docker compartment. Along with using the Wireshark unit efficiency unit, the action quest opportunity of the system, TCP pcap file, and so on are evaluated and likewise

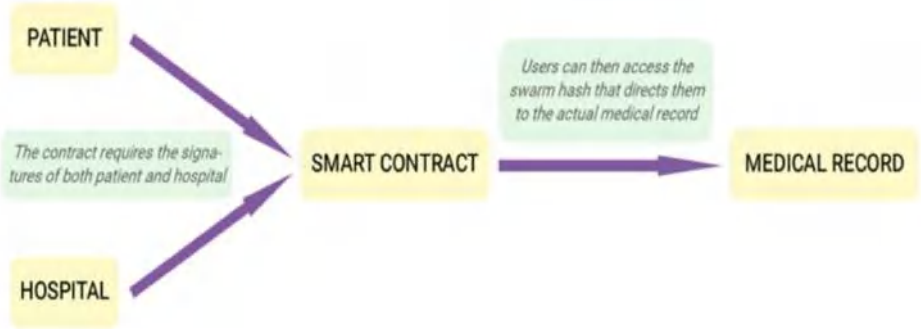

Fig. 3. Proposed blockchain healthcare modelOverview.

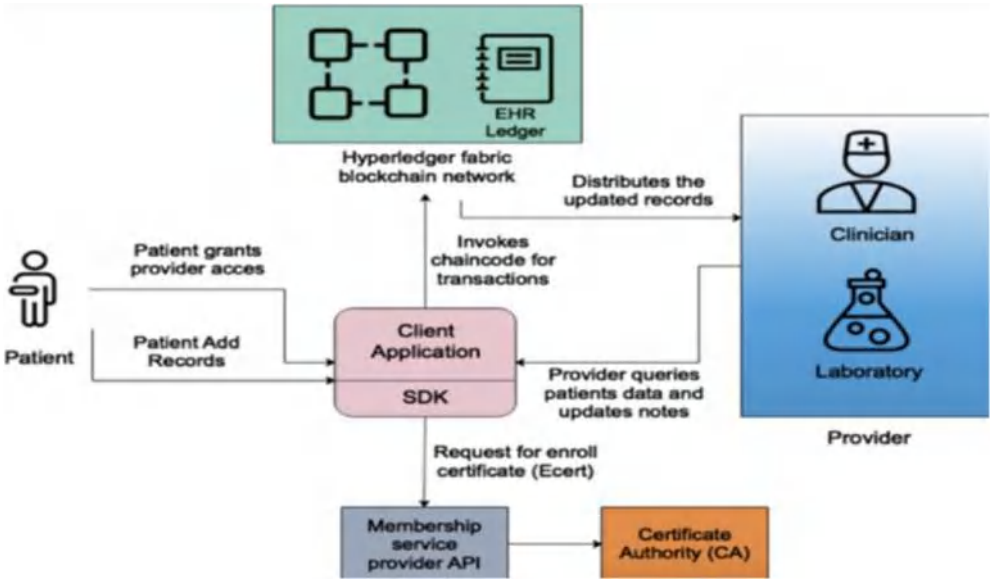

Fig. 4. System architecture.

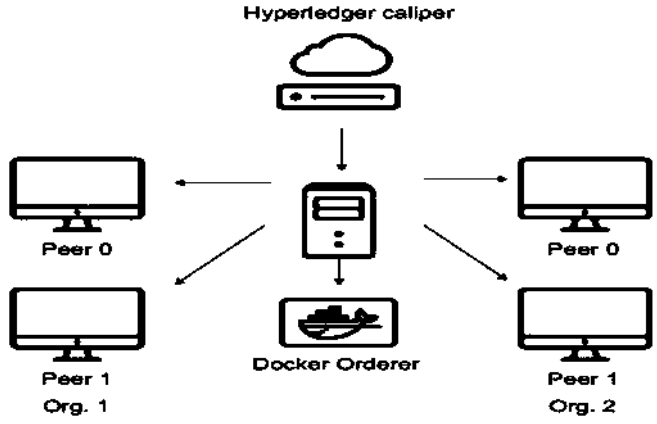

Fig. 5. Network structure.

kept an eye on. Using producing the pcap file, all the presence of the plans as well as device nodules are overall. Hyperledger cloth consists of peers, orderers in addition to Certificate Authorization (CA).

7. Conclusion

One field where blockchain technology has enormous potential is healthcare, due to the demand for an extra patient-centric method to medical care systems as well as to link diverse bodies as well as raise the reliability of electronic medical care files. This paper has demonstrated that though there is a surge of enthusiasm and analysis in blockchain in healthcare, most published research studies are still visionary, structure- work proposition, and speculative prototypes with marginal real-word application or pilots. Considering that blockchain makes the best use of security and also availability, the technology may be utilized in many different locations of the healthcare body, such as for holding and sharing case histories as well as insurance policy info both in healthcare venues and in mobile phone requests and also remote surveillance systems, and for medical trials. Research study about blockchain's treatments to health care is currently confined, yet much more study appears each day.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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ASSESSMENT AND FORECASTING OF STUDENT EDUCATIONAL CONDUCT USING DATA MINING APPROACHES

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ABSTRACT

The nature of instruction in any establishment can be accomplished by assessing the understudy execution which should be possible by forecast and investigation. It ends up being successful if the instructive organizations have the data or the information on the understudies in their separate foundations. This will assist them with sifting through the feeble, normal and splendid understudies. In this, we have made a framework that can assist colleges with assessing the exhibition of understudies previously. For this reason, a few information mining philosophies, for example, characterization have been utilized. We have made an informational collection that has data about understudies regarding their sex, rank and checks in placement test and the outcomes in third year of past bunch of students. Later the informational collections have been assessed to get the eventual outcome. The characterization procedures partition the information into classes and the regulated learning technique is utilized to generate rules for arranging test information into foreordained gatherings marked preparing information is required. The total cycle goes through two stages. Initially, the learning stage where the preparation information is investigated and runs are created. The subsequent stage includes the test information to be characterized into classes concerning truing informational collection. Atlas, the assessment of third year understudies for future tests is finished utilizing the ID3 (Iterative Dichotomize 3), C4.5, Improved weighted altered ID3 grouping calculations on this data. In this way we would have the option to decide the future extent of understudies

INTRODUCTION

So as to anticipate performance of understudies in future scholastics, it's appropriate if an instructive association have an estimated earlier skill of all selected understudies in their establishment. This earlier information will turn into an important aspect for instructional organization to upgrade understudies the individuals who might presumably to get significantly less checks and also find good student. As an answer we are attempting to help a framework which will help a scholarly organization to prefigure the general exhibition of understudies from their previous working. So as to accomplish this we will utilize standards of information mining strategies below Classification. The significant goal of this project is to utilize information mining philosophies to consider understudies generally execution in the courses. Information mining gives numerous obligations that should be utilized to get some answers concerning the understudy execution.

Understudies under different classes from various areas, instructive foundation and with different rankings in selection tests like CAT, JEE take affirmations in instructive establishments every year. This placement test helps in enrolment of understudies in different fields. In addition, designing schools may likewise be associated with a lot college. Every school has sizable assortment of subjects in their educational plan. So as to flexibly a superior perspective on most probably working of undergrads in future, past in general execution of conceded understudies are needed to be investigated. It has gotten hard for the colleges and universities to keep up the people execution in their tests. In this we have thought about a few elements to decide the future exhibition of understudies. As the opposition develops between different organizations, an ever-increasing number of procedures have been concocted to assess the understudy execution. This eventually prompts the positioning of the organization dependent on understudy appraisal. The information mining strategies alongside the AI calculations have been demonstrated to be full of feeling in actualizing this task by the utilization of information mining grouping calculations this can appropriately be finished by our framework. It has been seen that for instructive network of higher learning, it is urgent issue to uncover the development of understudy's instructional exercise execution.

Students are the fundamental resource for different colleges. Colleges and students assume a significant function in delivering alumni of high characteristics with its scholarly presentation accomplishment. Scholarly execution accomplishment is the degree of accomplishment of the understudies' instructive objective that can be estimated and tried through assessment, appraisals and other type of estimations. Be that as it may, the scholarly exhibition accomplishment shifts as various sort of understudies may have distinctive degree of execution

accomplishment. The student academic performance is usually stored in student management system, in different formats such as files, document, records, images and other formats. These available students' data could be extracted to produce useful information. However, the increasing amount of students' data becomes hard to be analysed by using traditional statistic techniques and database management tools [4]. Thus, a tool is necessary for universities to extract the useful information.

LITERATURE SURVEY

DSS are an exact kind of modernized realities device that helps business endeavor and organizational decision-production exercises. A true planned DSS is an intuitive programming-based gadget proposed to help leaders unite valuable records from uncooked information, archives, non-public information, or potentially endeavor models to recognize and resolve issues and decide. A DSS is a PC programming that examines business endeavor realities and manages it so clients can make business determinations extra without any problem.

Choice tree picking up information on calculation has been solidly utilized in master structures in taking pictures information. The foremost task completed in these structures is utilizing inductive techniques to the given point of attributes of an ignorant item to choose awesome characterization as per choice standards with the assistance of utilizing C4.5 calculation. Verifiably ID3 calculation used to be utilized to assemble the Decision tree. ID3algorithm is to settle on the decision tree through by method of on down, greedy search with offered units to survey each ascribe at each hub. We built up a metric data gain which helps in choosing the characteristic for grouping given dataset. C4.5 is an expansion of Quinlan's up to this point ID3 calculation. C4.5 is normally named as a statistical classifier. At the stop of stage ID3 is analyze with C4.5 by method of improving Prediction precision & computational intricacy of DT.

DESCRIPTION OF THE PROJECT WORK

Prior it was exceptionally hard for the colleges to examine the presentation of the understudies selecting into the different courses. The educators would not be capable of recognize the brilliant and the frail understudies which by implication prompted the moderate development of an association or the foundation. On the off chance that this data about future execution of the understudies is known already, the foundation would do investigation on it and help the understudies in improving their scholastic records. The instructors will have the option to guide the understudies who are west in specific subjects. This earlier information prepares for the achievement of the foundation. In the event that the forecast is done on understudy assessment conduct, it gets simpler for the colleges to screen the advancement and guide them to achieve a lot better grade. All these cycles have been utilized information mining grouping calculations, for example, ID3 AND C4.5 algorithms.

Faculty Support System

Shana and Venkatacalam has proposed a structure named Faculty Support System (FSS) which is low in cost as it utilizes savvy open source examination programming, WEKA to dissect the understudies' presentation in a course offered by Coimbatore Institute of Technology of Anna University [1]. FSS can examine the understudies' information progressively as it can refresh of understudies' information powerfully with the progression of time to make or add another standard. The update of new standard is conceivable with the assistance from space master and the standard is controlled by information mining procedure, for example, characterization method. Characterization strategy is utilized to foresee the understudies' presentation. Furthermore, FSS center on the ID of elements that add to execution of understudies in a specific course.

Student Performance Analyser

SPA is existing secure online electronic programming that empowers instructors to see the understudies' exhibition and monitor the school's information. The SPA is an instrument intended for examining, showing, putting away, and getting criticism of understudy evaluation information [3]. It is a ground-breaking analyser apparatus utilized by schools worldwide to perform investigation and showcases the examination information once crude understudy information is transferred to the framework. The investigation is finished by following the understudy or class to get the general exhibition of understudy or class. It assists with distinguishing the understudies' presentation which is beneath the normal level, at anticipated level or over the normal level. This would permit the instructors or staffs to recognize the current understudies' presentation without any problem. Other than that, it empowers different sorts of understudies' presentation report, for example, progress report and accomplishment report to be created.

Intelligent Mining and Decision Support System (InMinds)

InMinds assists Universiti Malaysia Sarawak (UNIMAS) with monitoring the exhibition of different zones in each UNIMAS's specialties [2]. The framework empowers top and mid-administration in

UNIMAS to have an unmistakable look on the regions that required consideration by taking a gander at the figures, incomes and dangers. The highlights, usability and adaptability gave by the framework makes the exhibition examination in UNIMAS to be acted in an ideal arrangement. Graphs are given by the framework to simplicity of understudy execution's translation.

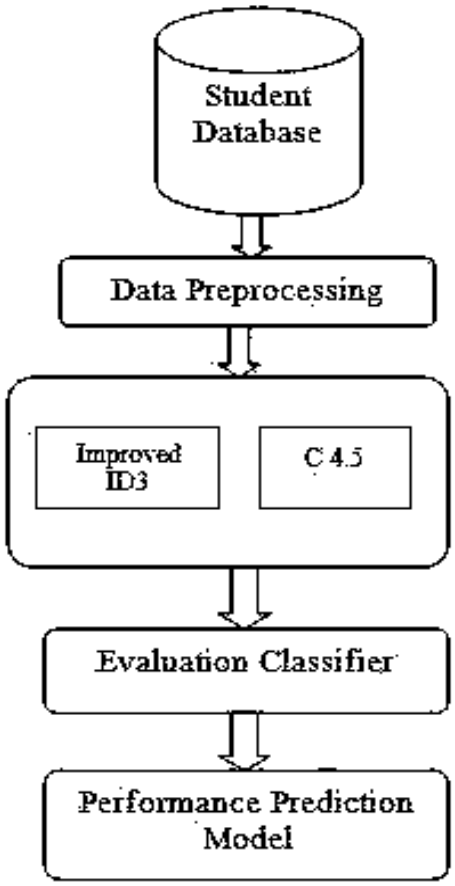

Fig 1: System Architecture

The cycle is completed in a few stages. The initial step includes putting away the information in the understudy information base on which the investigation is finished. The educators transfer information into the information base. At that point the preprocessing is performed to eliminate the traits that are no longer considered for future handling and any commotion or futile information is additionally taken out. The ID3 and C4.5 and improved ID3 is applied on the training information to get the choice trees. The understudy information is applied in fourth stage lastly the outcome is achieved giving production of execution in the type of diagrams and charts.

PROPOSED RESEARCH WORK

In this framework, we made an endeavor to make a framework that benefits the establishments in evaluating the understudy's performance. An informational collection has been fabricated dependent on understudy imprints, sexual orientation and results in third year understudies of past understudies. The directed learning calculations are utilized to deliver rules so as to classify information into classes. The whole cycle is done in two stages which is surveying the training information to get the characterization controls and acquired and in the second stage the test information is orders into classes. Different AI algorithms are performed on the informational index, for example, previous ID3 and C4.5 calculations. In this venture, we attempt to improve the ID3 classifier so we get the precise outcomes and improve the exactness of the classifier. We settled on a comparison between various choice tree calculations, for example, ID3 and C4.5 and improved ID3.

PROPOSED ADVANTAGES

- This system has made easier for universities to analyse performance with the help of graphs and charts.
- Reports can be produced easily on student performance.
- Tracking of the student performance in various course and semester is easily done with the help of this system.

MODULES

Data Source

The understudy data is put away in information base. The data like personality number, marks, name, gender, affirmation name, course id is put away in the document configurations or records. The information about the teachers related with every division is additionally given to the data set on which the information mining calculations are performed. This is gainful technique for examining understudy conduct in future and constantly evaluate the advancement of them.

Pre-processing

This is the initial phase in any information mining measure which channel out the superfluous information which might be commotion or exceptions or the attributes that is of no utilization in the later phases of framework improvement. It is basically the information cleaning measure that is essential to be done in the information revelation and expectation techniques.

Evaluation Classifier

In this the metrics utilized for the classifier is the information gain and top down ravenous hunt which discovers the attribute at every hub of the tree. The

characteristic is picked at each progression and to acquire a tree, it utilizes ideas, for example, entropy and data gain. The proposed framework eliminates the hindrance of characteristic having more qualities. Differentiating the differences in calculations happens among ID3, C4.5 and Improved ID3 giving the student forecast in his scholastics.

Student Analysis

Finally, the investigation of the third-year understudies is done to anticipate their last year results. The various diagrams and outlines are acquired demonstrating the measurements and from them a report are settled recognizing the more splendid and more vulnerable understudies.

RESULTS

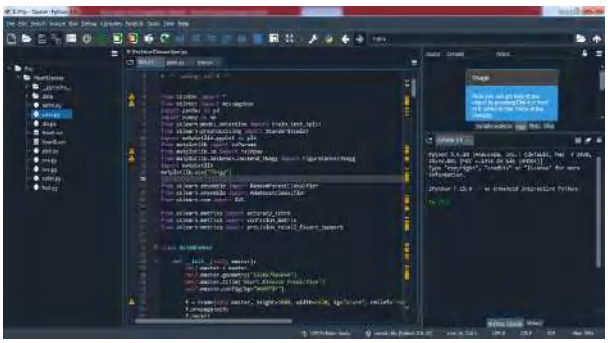

Fig 2: Home Page

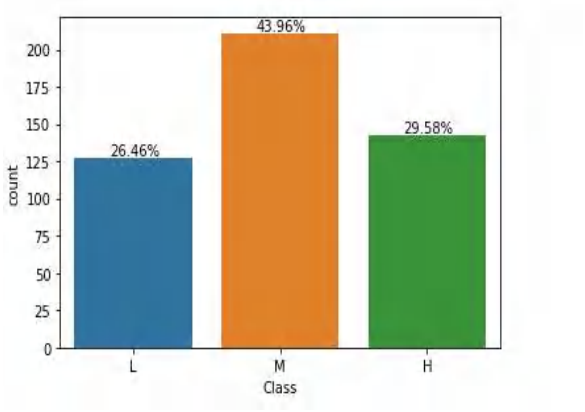

Fig 3: Class vs Count

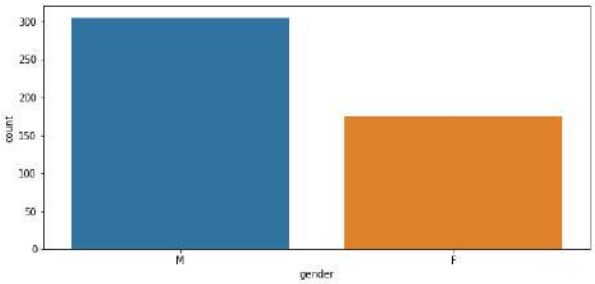

Fig 4: Gender vs Count

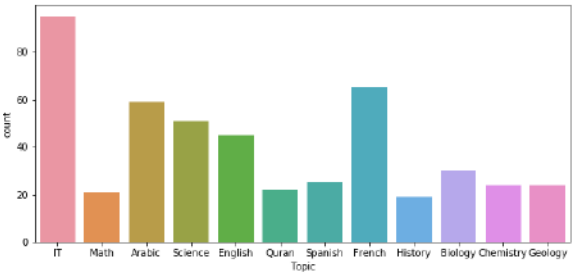

Fig 5: Topics Vs count

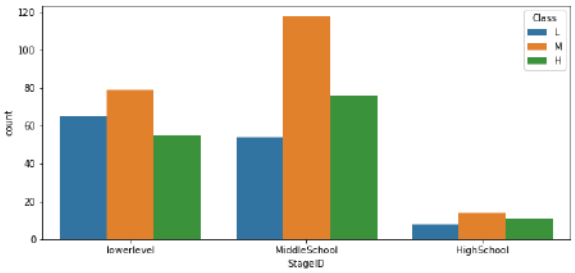

Fig 6: Count vs classes

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Minimum Accuracy Score:   0.48611111
Maximum Accuracy Score:   0.77083333
Average Accuracy Score:   0.65036111
Minimum Prediction Misses:   33
Maximum Prediction Misses:   74
Average Prediction Misses:   50.35
RBF Minimum Accuracy Score:   0.63194444
RBF Maximum Accuracy Score:   0.84027778
RBF Average Accuracy Score:   0.74305556
-------------------------------------------------
Linear Minimum Accuracy Score:   0.66666667
Linear Maximum Accuracy Score:   0.85416667
Linear Average Accuracy Score:   0.75804861
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Fig 7: Accuracy Score

CONCLUSION

The positioning of any educational establishment is estimated regarding the exhibition of the understudies. Hence it has gotten vital to decide the imprints and grades of the understudies in their forthcoming appraisal. A few approaches has been intended to help this need. The information found from

the understudy's current performance can be examined so as to anticipate their future result. This will profit the colleges in giving the high-quality education to understudies. The instructors would have the option to recognize brilliant and frail understudies which help them to guide the more fragile ones for advancement.

In this, a framework is intended to predict the understudy conduct in scholastics with the use of information ming philosophies of classification. The task likewise exhibits the total result in definite year of third year understudies. The prior approaches managed calculations like ID3, C4.5 which end up being inadequate. In our framework we attempted to draw a correlation between these algorithms and has effectively improved accuracy of the ID3 calculation while indicating the investigation on understudies as diagrams and graphs.

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RECOGNIZING HANDWRITTEN CHARACTERS USING MULTI-LAYER PERCEPTRON – A COMPARATIVE STUDY

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ABSTRACT

Handwritten Character Recognition (HCR) is an intriguing area for applying artificial intelligence. It is a popular belief that the doctor's handwriting is not so legible. But when it comes to the other languages especially the regional languages it becomes more difficult to interpret the scribbled nature of various types of handwritten letters, scriptures, postcards, diary entries, paper post it messages to name a few. Its not a difficult job for a literate human to recognize the characters or '*lipi*' of a language, but when it comes to using Artificial intelligence as a cutting-edge technology, interpretation becomes easy. The handwritten text is partitioned based on its understanding, into three levels viz, directly understandable, moderately understandable and troublesome. A Handwritten Character Recognition method is proposed which is totally dependent on Artificial Intelligence, using the Multi-Layer Perceptron (MLP) calculations. The manually written textual styles utilized here are multi-content, which comprises of pictorial datasets of Bangla Textual Style, Latin Style and MNIST Style. Different pictures utilized in this trial are preprocessed using the OCR. The originally image set was the MNIST, Latin and Bangla text style set in a test to quantify the adequacy of this exploration. The trial and the outcomes show more precise consequences of this framework contrasted with the other methodologies.

Keywords: Handwritten Character Recognition, Multi-Layer Perceptron, OCR, Bangla data, Latin data, MNIST

1. INTRODUCTION

Manually Written Character Recognition is a difficult subject in the field of artificial intelligence. This technique encourages the interpretation of various types of scribbled texts of various types of handwritten letters, scriptures, postcards, diary entries, paper post it messages etc. The complexity based in understanding it is isolated into three levels, basic (Fig 1), moderate (Fig 2) and troublesome (Fig 3) as appeared in the figure's underneath.

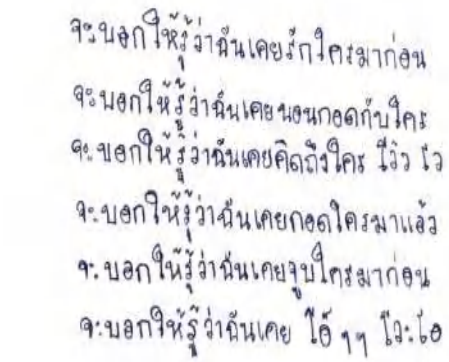


Fig. 1. A Basic Handwriting

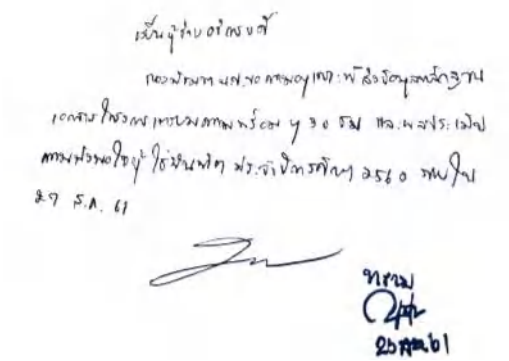


Fig. 2. A Moderate Handwriting

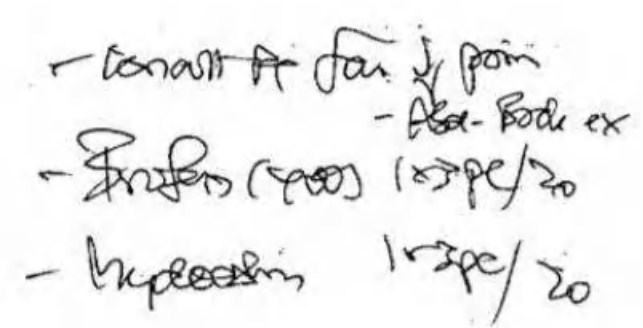


Fig. 3. A Troublesome Handwriting

In this paper, we examine a proper technique to build up another calculation for penmanship recognition using artificial insight dependent on the applied structure of research. The test and the outcomes show better results of

this framework contrasted with the Support Vector Machine (SVM) calculation.

The Data Set models viz Bangla, Latin and MNIST is given in the Fig. 4, Fig.5, and Fig.6 separately. Bangla is the second most mainstream language in India. It consists of 50 basic alphabets which includes 11 vowels and 39 consonants. Even though its a widely used language, there has not been much research conducted on the handwriting recognition of this language, compared to English. Latin is utilized for Identifying measurable names and utilizing the firemaker informational index as manually written notes. MNIST informational index is a digitized picture that is scaled to the norm and fixated on a manually written static size. The MNIST database (Modified National Institute of Standards and Technology database) is an enormous database of handwritten digits which are used usually for training various image processing systems. The database is also widely used for training and testing in the field of machine learning.

Fig. 4. Bangla Data Set

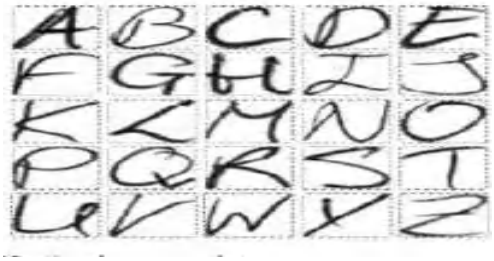


Fig. 5 Latin Data Set

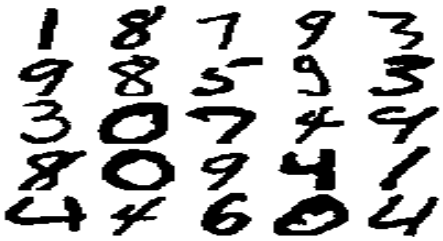


Fig. 6. MNIST Data Set

2. LITERATURE REVIEW

Earlier works by researchers [1] is delivers a group of character fragments (fraglets). Utilizing a codebook of fraglets from a free set, the likelihood appropriation of fraglet shapes was figured for an autonomous set. Another study [2] discusses the various informational collections utilizing the field of archive examination, to show that new techniques can possibly outflank conventional strategies applied to diagram portrayals. In [3] the dissemination of samples is seen by the closest neighbor investigation and network examination, the two of which don't make any estimate and subsequently don't degenerate the subtleties of the circulation. Vapnik Etal in their study suggest that the Support Vector Machine (SVM) calculation was applied to numerous sorts of acknowledgment issues. Straight SVM valuable for arrangement issues and will locate the best hyperplanning, with the greatest separation at the preparation guide close toward the hyperplane. Non-Linear SVM issues are for various gatherings which it does by making and joining numerous parallel identifiers.

3. PROPOSED METHODOLOGY

The proposed handwritten character recognition methodology has been implemented using Optical Character Recognition (OCR)**.** The change of pictures of printed, transcribed or composed content is finished by Optical Character Reader (OCR). The Conversion of pictures is done from a checked archive, a photograph of the record.

Broadly utilized as a type of data whether it is identification information, it is a typical technique for digitalizing printed messages so they can be electronically altered, looked, put away more minimally, showed on-line, and utilized in machine interpretation, (extricated) text-to-discourse, key information and text mining. OCR is a tremendous field of examination in design acknowledgment, artificial knowledge and PC vision. It is a process of classifying optical patterns with respect to alphanumeric or other characters.

Optical character recognition process includes segmentation, feature extraction and classification. Text capture converts Analog text-based resources to digital text resources. And then these converted resources can be used in several ways like searchable text in indexes so as to identify documents or images.

1. Preprocessing
2. Segmentation
3. Feature Extraction
4. Class Prediction

As the first stage of text capture a scanned image of a page is taken. And this scanned copy will form basis for all other

stages. The very next stage involves implementation of technology Optical Character Recognition for converting text content into machine understandable or readable format. OCR analysis takes the input as digital image which is printed or handwritten and converts it to machine readable digital text format using the Multilayer Perceptron Learning Algorithm developed is pertaining to the stages as described below:

Step 1: Initializes the Network, with all the weights and set to random numbers between -1 to +1.

Step 2: Presents the First Training Patter and Obtain the Output.

Step 3: Compares the Network Output with the Target Output.

Step 4: Propagates the error backwards. We need to correct the weights of the output layer and then Correct the input weights.

Step 5: Takes the average difference between the target and the output vector to calculate the error.

Step 6: Repeats Step 2 to 5 for each pattern in the training set. (one complete epoch).

Step 7: Shuffle the training set randomly.

Step 8: Repeat Step 2 for a set number of epochs, or until the error ceases to change.

The OCR then processes this digital image after performing the MLP algorithm into small components for analysis of finding text or word or character blocks. And again, the character blocks are further broken into components and are compared with dictionary of characters.

Preprocessing

Information Preprocessing alludes to the means which are applied to make information more appropriate for information mining. The means utilized in Data Preprocessing are generally of two classifications:

• Selecting information objects and characteristics for the examination.

• Creating/changing the traits.

Segmentation

Picture division is the way toward separating advanced picture into various sections. The point of division is to rearrange, change the picture into something more significant and simpler to examine. Picture division is commonly used to find articles and limits which are typically lines, bends and so on in pictures.

Feature Extraction

Feature Extraction in Image handling for handwriting recognition begins with estimated information and manufactures inferred values, which are expected to be educational, which encourages the ensuing learning and speculation steps, prompting better human understandings.

Highlight Extraction is the most basic aspect of this theory, consequently expounding some more subtleties. The eight-neighbor contiguous philosophy is utilized for extraction data on the limit of a manually written character. Limit of the character is examined and identified by checking it in the parallel picture design. Clockwise bearing inquiry is completed. The Two pixels are associated on the off chance that they are neighbors and their grayscale levels are in accordance with the predefined exactness of closeness. The informational collection of the apparent multitude of pixels associated P is called part containing P. This is appeared in Fig.7.

P1	P2	P3
P8	P	P4
P7	P6	P5

Fig. 7. Pixel P with 8-Neighbors

At the point when a white pixel is identified, it checks another new white pixel and afterward that pixel again checks another white pixel, etc the way toward finding the white pixels proceed. The following follows on persistently till the limit is naturally got. The limit is reserved as appeared in Fig. 8.

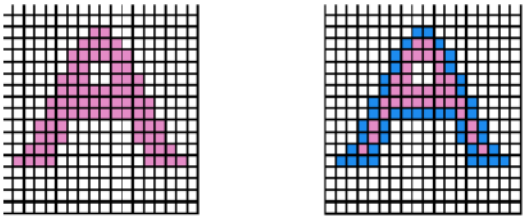


Fig. 8. Images showing the boundary

The Inner Boundary Tracing is finished utilizing the Inner Boundary Tracing Algorithm. Right off the bat the picture from upper left until a pixel of another area is found is looked, this pixel P1, at that point has least section estimation of the apparent multitude of pixels of that locale having a column esteem. At that point search the 3x3 neighborhood of the flow pixel in hostile to clockwise bearing. The if the flow limit component P1 is same to the second limit component P2, and if the past fringe component Pn-1 is same as P1, stop, else then keep on looking through the 3x3 neighborhood of the current pixel. The internal limit is distinguished and spoken to by pixels P1 … .. Pn-2.

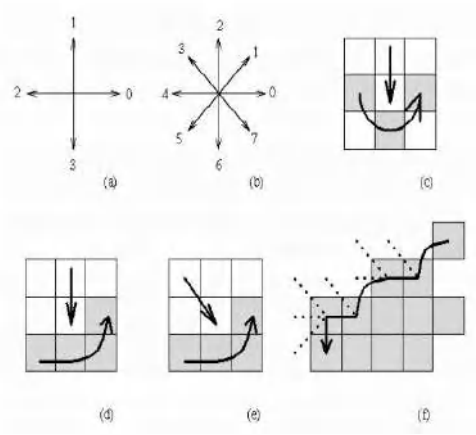


Fig. 9 Inner Boundary Tracing:

9(a) Direction Notation, 4-connectivity;
9(b) It depicts the 8-boundary;
9(c) This is the Pixel Neighborhood search sequence in 4-connectivity;
9(d) and 9(e) These are the search sequences in 8-connectivity;
9(f) Boundary Tracing in 8-connectivity with the dashed lines showing pixels tested during the border tracing.

The Outer Boundary Tracing is finished by utilizing the Outer Boundary Tracing Algorithm. Here right off the bat the internal district of the limit in 4-availability is done work it is obviously got. At that point all the non-locale pixels from the external limit which are pertinent that were tried during the inquiry cycle is done; on the off chance that a few pixels were tried more than once, at that point they are recorded more than once in the external limit list which is appeared in Fig. 10.

Once the boundaries are earmarked and found. The Fourier Descriptors are involved in finding the Discrete Fourier coefficients through equations (1) and (2) as given below.

$$a[k] = 1/L \Sigma x[m]e^{-jk(2\pi/L)m} \quad (1)$$

$$b[k] = 1/L \Sigma y[m]e^{-jk(2\pi/L)m} \quad (2)$$

Once the Discrete Fourier Coefficients are derived, they are computed by eliminating the size of the character and thus the Feature is extracted.

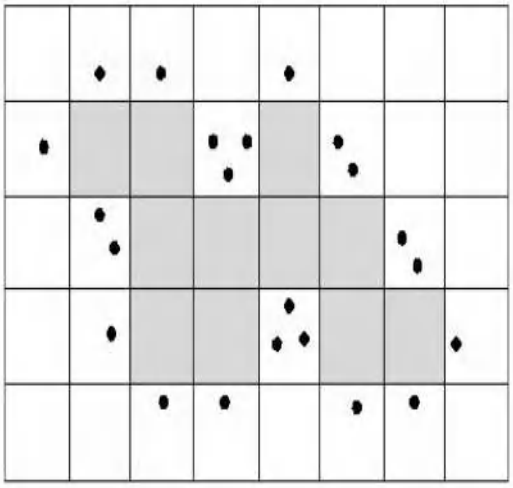


Fig. 10. Outer Boundary Tracing. The Dots denoted the out-boundary elements.

Class Prediction

Yield of the Algorithm is alluded as "Expectation", after it has been prepared on verifiable dataset and applied to new information when attempting to estimate the probability of a specific result. The calculation creates plausible qualities for an obscure variable in the new information for each record, permitting the model developer to recognize what that worth will in all likelihood.

4. EXPERIMENTAL INVESTIGATIONS

In view of the different examination measures depicted the productivity of the calculation and strategies introduced were tried and the exactness of the proposed calculation is determined. This paper manages perceiving transcribed characters from 3 informational indexes of characters from different analyst's dependent on artificial knowledge. The difficulties of these characters are comparative. Bangla is second most famous language in India and comprises of 45 classes and 4,627 classes for the preparation set and 900 models in the test suite. Latin transcribed characters were in Dutch with 251 journalists who had 37,616 characters ie., 26,329 practice models and 11,287 examples. MNIST informational index was a bigger information bases of numbers which is frequently utilized for preparing picture handling frameworks. The underneath Table 1. sums up the Handwritten Data Series.

Data set	Class	Training set	Testing set
Bangla	45	4,627	900
Latin	25	26,329	11,287
MNIST	10	60,000	10,000

Table 1: Summary of the Handwritten Data Series for Bangla, Latin and MNIST

The Handwritten Character Recognition system to recognize or show measured values close to actual values was Evaluated. To Calculate the accuracy or precision the following equation was used. This paper compares the methodology used by Support Vector Machine; k Nearest Neighbor and Multi Layered Perceptron (MLP) on the above Data., Bangla, Latin and MNIST. The results of the classification accuracy is shown in the Table 2.

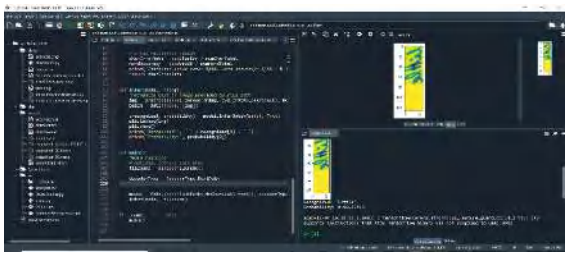
Data Set	Accuracy Rate		
	MLP	kNN	SVM
Bangla	91.05	85.60	90.5
Latin	94.58	93.31	93.8
MNIST	94.8	94.11	94.6

Table 2. Accuracy Rates using 3 Handwritten Character Sets from the Comparison (%) of SVM, kNN and MLP

The accuracy of the handwriting recognition on MNIST data set with MLP was Bangla set up to 91.05 %, Latin set up to 94.58 %, and MNIST set up to 94.8 %. Therefore, the MLP Character Recognition can be recognized as the better alternative.

5. IMPLEMENTATION & RESULTS

Python programming language was used to develop an application, the Server process is maintained by using the TensorFlow. It has a huge library we can import the library for performing OCR task. A use of python includes analysis, algorithm development, computation and much more. The following screen shots Screenshots 1 to 5, showcase the implementation of the recognition of handwritten language characters successfully.



Screenshot 1

Screenshot 2

Screenshot 3

Screenshot 4

Screenshot 5

6. CONCLUSION

This study aims to devise a new progressed calculation for manually handwritten frameworks. This examination utilizes a lot of in sequential order pictures in Bangla, Latin and MNIST textual styles, which are regularly utilized in the current case for character acknowledgment. During the various stages the pictures utilized in this analysis are separated into arrangement of pictures sets. The originally set was the Bangla, Latin and MNIST textual style set in a test to check the exactness of this examination. The test picture is a very much shaped textual style between the content and the foundation where the foundation of the image is white.

This analysis and the outcomes show improved outputs of this framework compared with the Multi-Layer Perceptron (MLP) algorithm performance. The comparative analysis shows that the accuracy of the Bangla set up to 91.05 %, Latin set up to 94.58 %, and MNIST set up to 94.8 % which indicates that the performance of Multi-Layer Perceptron (MLP) is better than is counterparts.

7. FUTURE ENHANCEMENTS

In future there is extent of expanding the quantity of the shrouded layers as much as we need i.e., the Input Layer and the Output Layer will be normal. Also, the model can be made more unpredictable by utilizing different number of centers concealed layers for numerous preparing of the picture information type for exact outcomes.

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Hybrid Mobile Sink Routing Protocol for Wireless Sensor Network based on residual status of an intermediate node

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Abstract - Achieving energy efficiency and extending network lifetime is an active research area in wireless sensor network. One can achieve it by managing the data quantity, multi hops routing path in transmission. But the node nearer to the sink node become bottleneck and start to drops the packet and exhaust quickly due to the high load, as nodes in a network have limited energy and buffer capacity. In order to overcome a problem one possibility is to change the node which is neighbor node to sink node and responsible to send the sensing information for network to sink node via it. However, the nodes deployed in WSN are static and fixed to particular location and we cannot change the position of sensing nodes. One possible solution is to make the sink node to mobile from one place another place according to neighbor node properties with respect to energy and load. Thus the aim is to change the position of sink to achieve the energy efficiency and extend the network lifetime, in other words provide the mobility to sink node. Aiming at this concern, we investigate the method that provides the sink node to mobile for achieving the network lifetime and energy efficiency by removing the problem of neighbor node of sink to become bottleneck node. Proposed method uses the cluster based approach to implement the hybrid sink mobile routing protocol, where sink changes its position based on the node status with respect to load and energy. Simulation results indicate that proposed routing protocol enhance the network lifetime and energy efficiency of WSN with respect to existing routing protocols proposed for WSN.

I. Introduction

In Wireless sensor network, designing energy efficient routing protocol is an active research area [1]. Number of routing protocols are proposed to achieve the energy efficiency. These multi-hop protocols are based on the static sink in the basis of funnel shaped i.e., n-1. Here, all the

communication packets are transmitted to sink node through an intermediate node, which is nearer to sink. This node receives the heavy traffic and becomes bottleneck node to drops the packet due to insufficient load and also exhaust the node due to lack of energy. In order to overcome the problem of bottleneck intermediate node, the appropriate solution is to change the sink node position based on the status of sink node intermediate node with respect to energy and load. Thus we design a routing protocol to extend the energy efficiency and network lifetime by mobile sink named as hybrid energy-load aware mobile sink routing protocol for WSN (HELMS), which performs the better in terms of lifetime and energy consumption.

Remaining paper is organized as follows. Next section discuss about the LEACH routing protocol designed for WSN and random mobile sink routing protocols. Section III discuss about proposed routing protocol i.e., ELWSN. The paper ends with simulation and results followed by conclusion.

II. LEACH

LEACH routing protocol [2] is based on time division multiple access based routing protocol. The principle point of this routing protocol is to enhance the network lifetime by reducing the energy consumption. The protocol comprises of two stages i.e., set up phase and steady phase. Protocol operation consist of several stages with two rounds in each stage, and it is hierarchical structure. This protocol is self-organized and adaptive.

LEACH protocol is cluster based routing protocol for WSN. The aim is to randomly select the sensor nodes as cluster head and uses them to router to sink node. Cluster head selection is changed based on remaining energy consumption of node in particular time period. The threshold value for selecting the cluster head is based on the following formula, i.e., $T(n)$.

$$T(n) = \begin{cases} \dfrac{p}{1-p\times[r \bmod(1/p)]}, n \in G \\ 0, others \end{cases} \quad (1)$$

Where,

$p = desired\ percentage\ to\ become\ a\ cluster\ head$

$r = current\ round$

$G =$ set of nodes that have not been cluster-heads in the last $\frac{1}{p}\ rounds$

After the clusters are formatted, the cluster-head node creates a TDMA [7] schedule noticing each node when it can transmit data to the cluster-head [8]. The cluster-head also aggregates the data before transmitting these data to the sink.

We consider the random way point mobility model for sink mobility to communicate with intermediate node. Thus mobile node stay at particular place for a some interval of time for communication then change its location by random way point mobility model. After this interval time node change the position to other intermediate node based on node status. Initially sink select the node randomly for its first time and move nearer towards it and communicate through it. Then sink node selects the new intermediate node for communication and moves towards it by random way point mobility model [minspeed, maxspeed].

III. Energy-Load aware mobile sink routing protocol for WSN

Network Model - We assume that the sensor nodes are distributed in the sensor field with one mobile sink node. Every sensor node has constrained recourses such as energy and buffer and they are static and cannot move after deploying. Where, mobile sink node has unlimited energy and sufficient buffer for communication. Sensor nodes know their location through GPS system [3]. We cannot consider the initial location of mobile sink node.

Energy and Load awareness - The aim of proposed routing protocol selects the neighbor node of mobile sink node based on its buffer and energy status so that intermediate node must not drop the packets and also should not exhaust. Here we consider the two considerable parameters in a single process to calculate the routing path between communication entities. Cluster head must compute the status regarding energy and buffer or load. In this work we computed it proactively as, maximum number of packets it can process (receive, proceed and transmit) with in its available energy. Every node in a network needs to calculate its load status. In this work we computed it reactively as, the queue present in a node is less than or greater than predefined threshold value. Two factors are used to remove node to become bottleneck intermediate node there by reducing packet loss.

1. **Proactive status of node regarding energy**

Reducing the packet drop by an intermediate node due to its constraint energy is overcome by the multi objective optimization process. That is capacity optimized maximum packets can be processed by an intermediate node in its current battery of energy. Let us consider that an intermediate node equipped with a battery capacity (E) joules, and it can be processed maximum of $'n'$ number of packets in its current battery of energy.

2. **Multi objective optimization**

    1. Energy of node
    2. Energy is required to process the packet

Energy consumed by an intermediate node for processing one packet let $'P_1'$ is computed by, equation 1.

$$E(P_1) = E_r(P_1) + E_p(P_1) + E_t(P_1) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where,

$E_r(P_1) = energy\ require\ to\ recive\ the\ packet\ 'P_1'$

$E_p(P_1) = energy\ require\ to\ process\ the\ packet\ 'P_1'$

$E_t(P_1) = energy\ require\ to\ transmit\ the\ packet\ 'P_1'$

Now remaining energy of node after processing $'P_1'$ packet is given by equation 2.

$$E(residual) = E - E(P_1) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

In order to compute the capacity optimized maximum packets can be processed by an intermediate node in its current battery of energy is achieved by two dimensional array with entries, as given below.

$$K\ [P_i\ , E(residual)\ ] \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where,

$i = 1,2, \ldots . number\ of\ packets$

$E(residual) = enrgy\ required\ to\ process\ the\ packe$

Computation of capacity of optimized maximum packets can be processed by an intermediate node in its current battery of energy is given by equation 4

$$K\,[P_i\,, E(residual)\,] = \max(K\,[P_i - 1\,, E(residual)]\,,\; K_i + \; K\,[P_i - 1\,, E(residual)])\ldots(4)$$

$$\forall\; 1 \leq\; P_i \leq n$$

$$and$$

$$0 \leq E(residual)\; \leq E$$

Here $K\,[P_i\,, E(residual)\,]$, provides the capacity of optimized maximum packets can be processed by an intermediate node in its current battery of energy.

3. **Reactive status of node regarding Load**

Reducing the packet drop by an intermediate node due to its buffer overflow is overcome by the queuing mechanism. An intermediate node reactively calculate its buffer status by number of packets arrived in current interval of time as well as number of packets departure from node. If packet arriving rate is greater than its departure rate then packets will get drop from an intermediate node. If the arrival rate is less than departure rate then queue is created at node buffer based on difference between arrival and departure rate. Node compute arrival and departure rate using exponential moving average method [4].

Average Packet arrival rate =

$(Weighted\ constant)\ *\ Average\ number\ of\ packets\ arrived\ in\ previous\ time$ interval +

$(1 - Weighted\ constant) * Average\ number\ of\ packets\ arrived\ in\ current\ time$ interval

……..(5)

Similarly

Average Packet Departure rate =

$(Weighted\ constant) * Average\ number\ of\ packets$Departure$din\ previous\ time$ Interval +

$(1 - Weighted\ constant) * Average\ number\ of\ packets$ Departured *in current time* interval ……. ..(6)

Packet arrivals or departures at time zero or no packet arrival or departure in previous time interval as event zero. Weighted constant values are decided based on time constant of receiving circuit. Number packets queued at an intermediate node is computed by queuing theory [4], by equation 7.

$queue\ size =$ Average Packet Departure/(Average Packet Departure rate − Average Packet Arrival rate) ∗ bytes ……..…… (7)

If queue size is greater than the buffer packet holding capacity then packet drop from node. Thus while selecting an intermediate node, source node must consider the two factors such as buffer and energy so as to reduce the packet loss in network there by enhance the network performance and efficiency.

4. Mobile Sink Routing Schedule Model

Mobile sink node maintain the distance table of the cluster head location nodes in its memory table. Initially network create a cluster based network model with the help of existing LEACH protocol. Then mobile sink node moves randomly using random way point mobility model to collect the location of cluster head. Then cluster head computes the average distance between cluster heads by following equation [5]

$$D_{avg} = \frac{\sum_{i=0}^{m-1} \sqrt{(X_i - X_c)^2 + (Y_i - Y_c)^2}}{m-1} \quad i \neq c$$

Where,

$(X_i, Y_i) = Location\ of\ the\ cluster\ head$

$(X_c, Y_c) = Location\ of\ the\ current\ cluster\ head$

$m = Total\ number\ of\ cluster\ heads$

After particular time interval the memory table of mobile sink node is updated or it also updated whenever new cluster head is selected. Mobile sink selection about intermediate node/cluster

head by two factor energy and load, which is calculated in previous section, and moves towards it for communication. The control packets are used to inform the cluster head that the mobile sink is visited to it. Every cluster head in LEACH protocol is act for particular amount of time regarding its energy parameter. If new cluster head is elected for the cluster then mobile sink compare its residual status with remaining cluster heads residual status, if it find the another node has more status than current cluster head status. Then cluster head moves towards new cluster head and this process is go on.

The proposed algorithm is explained as follows

1. Divide the network into clusters and elect the cluster head based on LEACH routing protocol
2. Cluster heads compute their current status of load and energy based on previous section
3. Mobile sink collect the cluster head distance and their current status information and maintain in vector table by moving nearer to them
4. Decide the life time of cluster head according to the vector table and decide it as the time period “T”. This is the time for which sink node will collect the information from the current cluster head, and create the communication session between it and cluster head
5. Now cluster head collect the sensing information from cluster members and transmit it to sink node
6. After this communication session, cluster head reselection process is began and now it is based on their load and energy status. If cluster head is selected then the sink node is computes the distance and status and updates the vector table and compare the status value with other cluster head values. If it found greater then sink set the communication session time interval and start the communication. Otherwise sink node moves to that cluster head which is having higher status regarding energy and buffer and start communication with it.
7. This process is continue

IV. Performance Analysis

Performance of proposed work is carried out by network simulation NS 2.34 [6] and compared it with existing random mobility model routing protocol in similar network environment. Performance evaluation metric is network lifetime, it is a time duration of one sensor node dies due to exhaust of energy. In our simulation every node equipped with battery of 10j energy initially and fixed radio transmission range of 250m and IEEE 802.11 MAC card with data rates of 2 Mbps. The receiving power is 300mW and transmission power is 600mW. Number of sensor nodes are 100 and disseminated in the communication area of 100* 100 meters. The number of cluster heads are 4 and the mobility of sink is move according 10 m/s and data size for communication is 512 bytes.

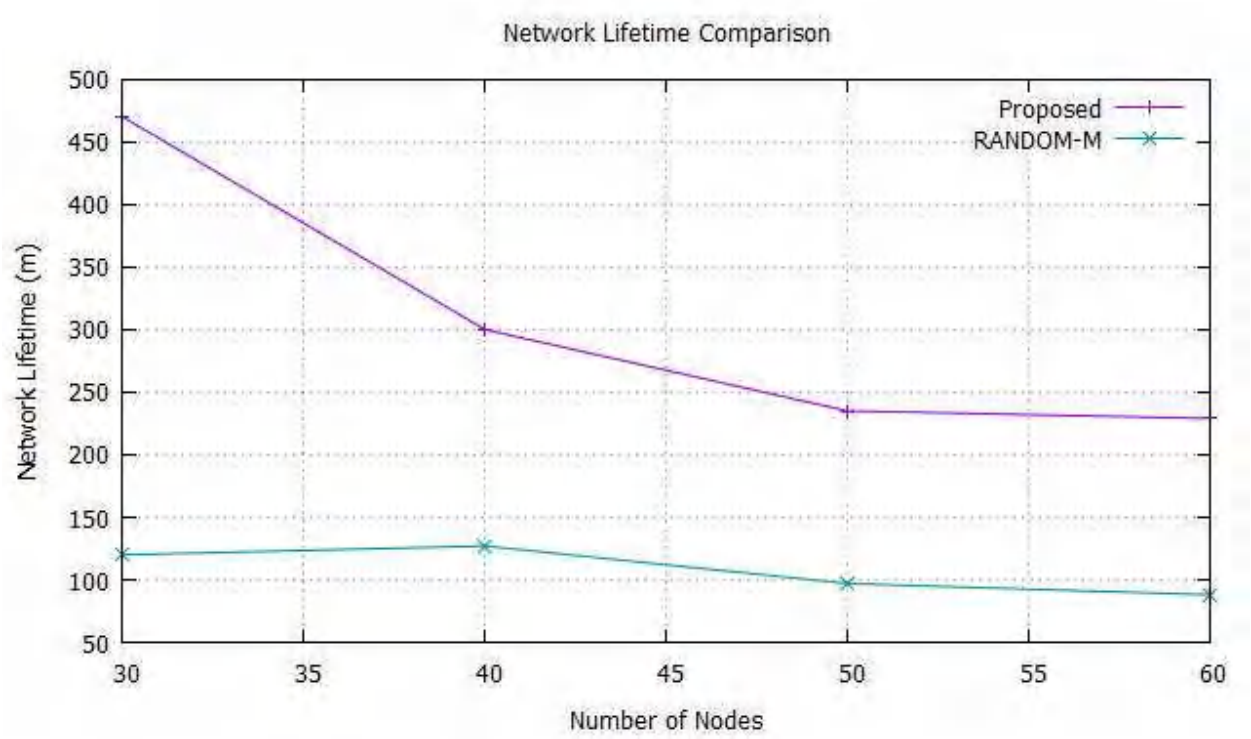

Figure 1: Comparison of network lifetime of proposed work with random mobility based sink routing protocol with respect to number of nodes

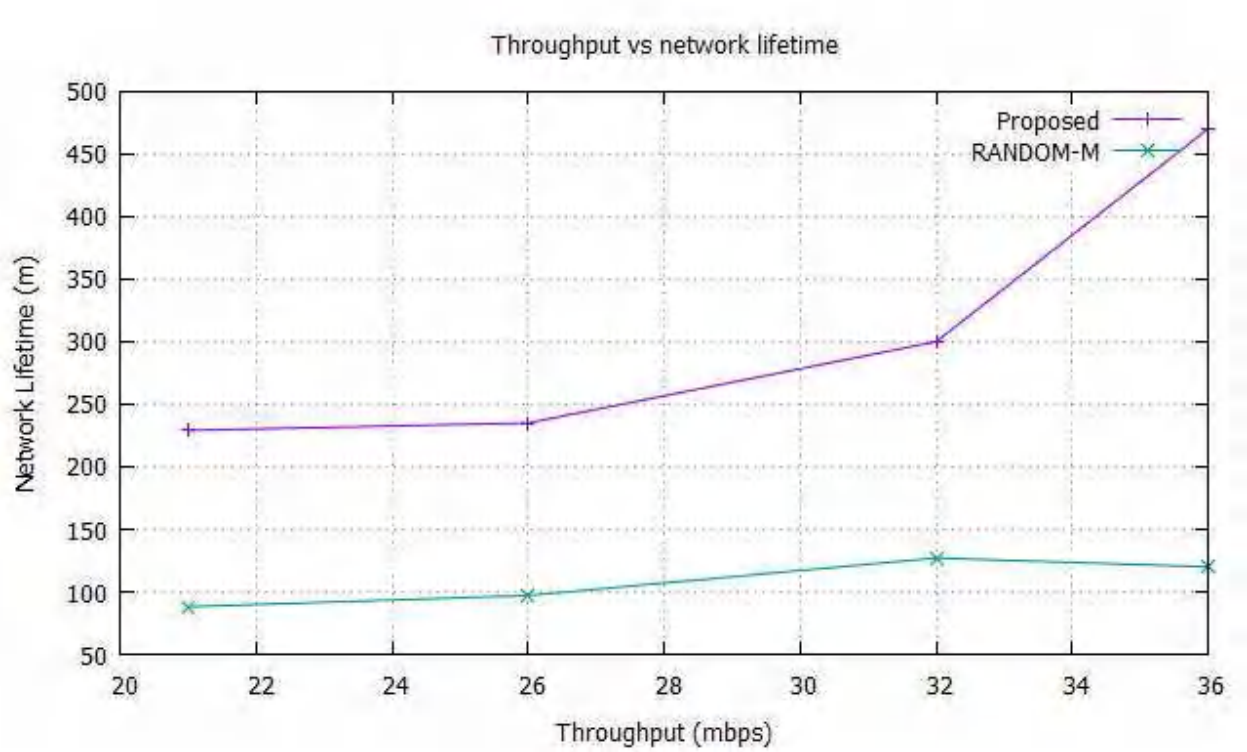

Figure 2: Comparison of network lifetime of proposed work with random mobility based sink routing protocol with respect to throughput

Figure 1 and 2 clearly shows that the proposed routing protocol extends the network lifetime of the network. Thus mobility of sink extends the network life time and reduces the packet loss through the particular nodes, such as the becoming the bottleneck.

V. Conclusion

Achieving energy efficiency and extending network lifetime is an active research area in wireless sensor network. One can achieve it by managing the data quantity, multi hops routing path in transmission. But the node nearer to the sink node become bottleneck and start to drops the packet and exhaust quickly due to the high load, as nodes in a network have limited energy and buffer capacity. In order to overcome a problem one possibility is to change the node which is neighbor node to sink node and responsible to send the sensing information for network to sink node via it. However, the nodes deployed in WSN are static and fixed to particular location and we cannot change the position of sensing nodes. One possible solution is to make the sink node

to mobile from one place another place according to neighbor node properties with respect to energy and load. Thus the aim is to change the position of sink to achieve the energy efficiency and extend the network lifetime, in other words provide the mobility to sink node. Aiming at this concern, we investigated the method that provides the sink node to mobile for achieving the network lifetime and energy efficiency by removing the problem of neighbor node of sink to become bottleneck node. Proposed method uses the cluster based approach to implement the sink mobile routing protocol, where sink changes its position based on the node status with respect to load and energy.

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USING MACHINE LEARNING METHOD IN DETECTION OF RUMOURS IN SOCIAL MEDIA: AN INNOVATIVE APPROACH

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ABSTRACT

In the most recent years social networks have developed as a basic mean for data spreading. Disregarding all the positive outcomes this wonder brings, unconfirmed and instrumentally significant data explanations available for use, named as rumours, are turning into an expected danger to the general public. As of late, there have been a few examinations on theme autonomous rumour detection on Twitter. In this paper, a novel rumour detection framework is presented which centres on a particular subject, which is wellbeing related rumours on Twitter. At this point, it was rather simplified by building another subset of highlights including influence potential and organization attributes highlights. Using this kind of methodology on a genuine dataset watching promising outcomes, as it can effectively distinguish about 94% of rumours, with adequate degrees of precision. With the interruption of social media into individual, social and political space of the present world, the tyrannies related with it have additionally discovered a spot to flourish. One such noxious act is the spread of rumours through social networks. This study investigates the different spaces where social media discovers its significance and has an extensive effect. It additionally investigates different examinations done on the idea of rumours, the qualities of rumours and the investigations distinguishing the significant highlights for the social media-based rumours. Further, the most recent improvements in the field of rumour detection through the methodologies of Machine learning and Deep learning have likewise been talked about.

INTRODUCTION

Social networks are a basic mean through which data and social practices spread. Specifically, social miniature sites have developed as the most utilized social organization benefits these days: they permit clients to be continually associated and to remain side by side with continuous occasions. Regardless of the apparent multitude of positive angles this sort of wonder brings, it has likewise a few drawbacks: as great and dependable data spreads, additionally rumours and bogus news effectively arrive at a wide scope of individuals in brief timeframe, turning into an expected danger to the general public. For example, in 2013 the official Twitter record of the Associated Press was hacked and it conveyed a rumour about the blast of two bombs at the White House and the US President being harmed in the assault. This news caused deep frenzy in such an expansive scope that finished with an emotional, however concise, crash of the financial exchange [1]. Alongside this occasion, other comparative scenes of deception causing catastrophes can be found in numerous spaces, for example, crisis circumstance the board, wellbeing and health, governmental issues, and so on.

Problematic and tricky news is by and large alluded to as rumour. Albeit in some cases rumours are considered as establishing data which is eventually regarded bogus [3], this definition forgets about each one of those newsworthy stories that have a similar degree of vulnerability and expected danger at a first time spread and that just in the end uncover themselves to be valid. The most utilized and thorough definition is the one that considers rumours as unconfirmed and instrumentally important data articulations available for use [4]. It is clear that the social micro-blogs accessible online could be influenced by rumours. Twitter is a social micro-blog that tallies a huge number of clients from everywhere the world, encouraging continuous engendering of data to a huge gathering of individuals and permitting clients to do various activities, for example, posting 140-character-long messages, known as tweets, answering to such posts, or re-tweeting them.

This makes it an ideal situation for the dispersion of breaking news straight forwardly from the news source and the geological area of occasions. Online social micro-blogs can be clearly influenced by rumours. The chance of remembering them could be a ground-breaking intend to forestall missed data spreading, alongside the potential results this could cause. Therefore, a rumour detection framework for social media is sought after. In the writing there have been a few investigations in rumour detection for social networks, for example, Twitter and Weibo. Existing commitments in the writing have been proposed to identify rumour spreading in different spaces and not in a particular one. To this point, one of the highlights typically utilized is from the earlier information on tweet theme. Moreover, they likewise channel the discussion structure considering just the most compelling clients or the most jam-packed discussions in the organization. In any case, a procedure that utilizations such descriptors might be not legitimately material when the rumour detection framework needs to manage a particular theme since semantics of words and sentences may vary when the point changes, just as the utilization of from the earlier information on tweet subject is negligible. Hence, in this paper a novel rumour detection framework is introduced for Twitter which investigations theme explicit rumour, in particular the wellbeing related point. Among all the data areas, this field is specifically compelling for two primary reasons: first, the writing has demonstrated that rumours pack in some particular subjects [5], for example, medical problems and, second, these days individuals regularly search for wellbeing information and advices on online administrations, yet not every one of these assets give precise or dependable data [6]. To distinguish wellbeing related rumours, the two degrees of highlights, named as client and organization level, are investigated separately. For each level, there are three sorts of highlights including impact potential, individual intrigue and organization attributes. Specifically, other than generally utilized highlights, for example, client insights and estimation of tweets, additionally new highlights including the probability that a tweet is re-tweeted and the probability of a URL to be shared, discussion size, division of client adherents of root, and part of tweets with URLs in a discussion are flourished. The utilization of general highlights random to the specific theme considered would permit to build up a methodology that could be utilized later on in different examination on various explicit areas.

LITERATURE REVIEW

Disinformation or fake news which isn't true intentionally to dupe people, including health-related fake news, false facts, fake reviews through inaccurate sources while most of the rumours are passed unverified on various communication channels. Social media platforms are said to be double edge knifes; on one side, they allow for social connectivity, on the other side, they collectively share the information which is not accurate. In these cases, users not only contribute for spreading rumours, but also sometimes held as victims for misleading. In order to pull-out these rumours, the city cyber police have a set of dedicated teams to monitor the social media platforms which keeps an eye on follow-up trends for the identification of the pattern.
An American micro-blog, *Twitter* is the highest receiving end of such inflammatory content (rumours). On the other side, twitter is also an awesome way for promoting events, new releases, addressing the society, and also the interrogation that is available online. The researches done on analysis and detection of rumours exploit dataset, system model, using various techniques, some of them includes machine learning and deep learning.

Artificial intelligence insights Machine learning and deep learning approaches. Number of algorithms using machine learning method has been studied. Various techniques and strategies have been reviewed to detect and to pull-out the rumours. Machine Learning method is generally used to assess the data, to generate the patterns, helps to make better and critical decisions to provide the development of the computer programs. Software Applications like Pinterest, Facebook, Twitter uses Machine Learning Algorithm in some cool ways. Machine Learning Algorithm works on the system to achieve high-level task without using explicit coding. The Machine Learning tasks can be implemented by training the system with loads of data. A very good background in linear algebra and vector algebra helps to catch the working of the algorithm. Some of the algorithms in Machine Learning are Vector machines, Neural networks, Decision Tree, K-NN and Naive Bayes. Verily I have focused on support Vectors to detect the rumours. All the above algorithms have been used in various ways to detect and analyse the rumours.
The paper named "Rumor Detection in Twitter" has shed the light on, the basic way to identify the rumour. The study shows detection of rumours or the correction of rumours can be done by re-tweeting on the rumour leading the recognition of rumour in the form of re-tweet ratio. This paper has focused on one-way communication medium; i.e a specific micro-blog, what if there is no way to reply back or re-tweet. What should be the further steps to segregate and pull out the data which is considered to be the rumour. This paper helps to find the potential and characteristics and as well as properties of the rumour.

The other article I have gone through is "Rumor Detection on Twitter with Tree-structured

Recursive Neural Networks". This paper includes long short-term memory used for detection and classification of the rumour based on tree-structure neural network. The decision tree structure and neural networks helps to model the data which has relationships among variables, they both can handle the interaction and somewhat are interconnected to each other. Neural Network algorithm is mostly used when we have loads of data and at that point accuracy matters us the most to get the desired output. On the other side decision tree has considered as one of the modelling approaches used in statistics, data mining and machine learning. A decision tree simplifies the question and recommend the answer based on yes or no strategy, and further splits the tree into sub trees.

Another paper named" Analysis of Techniques for Rumor Detection in Social Media" This paper gives an overview of rumour detection, datasets, application areas, and performs comparative analysis of the state-of-the-art rumour detection approaches. Multiple dataset models have been discussed based on various approaches i.e (machine learning and deep learning) to classify and analyse the rumours. In the above paper, Benchmarked datasets has been talk over. The most generally used dataset for rumour detection in this article is, every tweet is annotated for its connection towards the rumour as connected or unrelated.

Some of the datasets includes LIAR and PHEME Dataset. The dataset LIAR includes 12,836 short statements labelled for genuine, subject, context/venue, speaker, state, party, and prior history. PHEME dataset is a kind of storehouse of rumours and non-rumours generated on Twitter during breaking news. In this dataset, rumours are set in the form of events where they accurately annotated using the values True, false and unverified. Spreading of data over a social network not only propagates through text but also in the form of audio, video or an image, to detect this kind of rumours, an evidence tool should be implemented. This paper gave a review on the comparison of strategies done using different techniques, which includes classifying, labeling the data sets accurately.

In the article, "Rumor Detection model and tools for social networking sites". The survey compares the various RDM strategies and Tools that were proposed earlier for identifying the rumour words in social media platforms. A new classification algorithm was proposed using statistical metrics for segregation of rumours and non-rumours twitter posts based on user frequency of interaction, structure and network establishment and linguistic features. The dataset needs to be updated frequently for the detection of rumours which spreads through social networking sites. Machine Learning techniques have been used by various architectures, which consume time but can be improvised with the use of rules based on predefined knowledge through semantic ontology. A major drawback of these rumour datasets is time taken for processing to generate an alert and report to the servers is delayed.

In many of the rumour detection strategies I have found that machine learning approaches requires frequent training of system using the labelled dataset in case of supervised strategy. After a determined observation of various datasets through different domains it is suggested that domain specific rumour words need to be used in a particular context for desirable precision rate.

OBJECTIVES:

To detect health-related rumours, two levels of features have been explored, named as user and network level, respectively. For each level,

There are three types of features including influence potential, personal interest and network characteristics. In particular, besides widely used features such as user statistics and sentiment of tweets, new features including the likelihood that a tweet is re-tweeted and the likelihood of a URL to be shared, conversation size, fraction of user followers of root, and fraction of tweets with URLs in a conversation has been developed. The use of general features unrelated to the particular topic considered would allow for the development of an approach that could be employed in the future in other analysis on different specific domains.

The undertaking's cycles comprise of principally of three steps (as appeared in Fig1)– Data extraction from Twitter which discloses utilization of Twitter's Stream API, Sentimental Analysis in which the information acquired from Twitter is dissected to extricate double cross arrangement that shows the total estimations of the client towards an item. This time arrangement is then given as a contribution to the Dynamic Pricing Model system to conjecture costs over a future selling period and to show that when the new estimating model is utilized there is a stamped increment in the income produced.

So as to get live information from Twitter, the Streaming API was utilized. The Streaming API empowers engineer's low dormancy admittance to Twitter's worldwide stream of information. A legitimate usage of the streaming customer will push messages showing Tweets and different occasions happened. The POST status/channel end point was utilized, which returns statuses that coordinate at least one channel predicates. Steps are associated with the information extraction measure executed in the task: 1) Twitter Application Creation. An application was made on. *https://apps.twitter.com* to get the API keys required for live gushing of information. When this was made, the Consumer key, Consumer mystery, Access Token and

Access Token Secret were acquired from the OAuth tab. 2) Java venture Creation for Data Extraction. The Twitter Stream API permits clients to interface with Twitter's worldwide stream of tweet information, permitting messages to be pushed to us as opposed to pulling them. To utilize the Twitter Stream, a determined association with the worker must be kept up. So as to accomplish this, a Java venture was made utilizing Maven as the fabricate instrument. The program designs the OAuth subtleties, makes a solicitation object, set certain Twitter headers, sends the solicitation and makes a cushioned stream per user that peruses the reaction stream and then keeps in touch with the record of decision. This gushing of information was accomplished for around in 10 days(close to 30,000 tweets) removing tweets with the watchword "electric".

Streaming with Tweepy

First let's cover streaming tweets from Twitter. You're going to need a Twitter dev account. Sometimes Twitter uses dev.twitter.com to advertise various things they expect dev to be interested in. The problem is they sometimes make it hard to get to where you want to be. Just in case they've done this and the video's method isn't available, here's the link: Twitter Apps

Next, make a new application, filling in your name, description, website, agree to their terms, do the captcha , and create the application.

Once submitted successfully, you should be presented with a page where you can see your consumer key and consumer secret. Now you need an access token, so scroll down and click on "create my access token."

After a few moments, refresh, and you should be able to see the access key and access token. Once you have that, you're going to need to get Tweepy, which is a Python module for streaming Twitter tweets.

Tweepy makes it easier to use the twitter streaming api by handling authentication, connection, creating and destroying the session, reading incoming messages, and partially routing messages.

This page aims to help you get started using Twitter streams with Tweepy by offering a first walk through. Some features of Tweepy streaming are not covered here. See streaming.py in the Tweepy source code.

API authorization is required to access Twitter streams. Follow the Authentication Tutorial if you need help with authentication.

Step 1: Creating a StreamListener

This simple stream listener prints status text. The on_data method of Tweepy's StreamListener conveniently passes data from statuses to the on_status method. Create class MyStreamListener inheriting from StreamListener and overriding on_status.

Step 2: Creating a Stream

We need an api to stream. See Authentication Tutorial to learn how to get an api object. Once we have an api and a status listener we can create our stream object.

Step 3: Starting a Stream

A number of twitter streams are available through Tweepy. Most cases will use filter, the user_stream, or the sitestream. For more information on the capabilities and limitations of the different streams see Twitter Streaming API Documentation.

PROPOSED WORK

Proposed work includes Data extraction, Data Pre-Processing, Classification and Prediction rumours. which shows implementation of push messages done by the client. Finding the Approximation of the missing data to fill the voids. Later, are classified in the form of tweets which are viewed positively or not.

A. Data Extraction from Twitter

In order to get live data from Twitter, the Streaming API was used. The Streaming API enables developer's low latency access to Twitter's global stream of data. A proper implementation of the streaming client will push messages indicating Tweets and other events occurred. The POST statuses/filter end point was used, which returns statuses that match one or more filter predicates. Steps are involved in the data extraction process implemented in the project:

1) Twitter Application Creation. An application was created on https://apps.twitter.com to get the API keys required for live streaming of data. Once this was created, the Consumer key, Consumer secret, Access Token and Access Token Secret were obtained from the OAuth tab.

2) Java project Creation for Data Extraction. The Twitter Stream API allows users to connect to Twitter's global stream of tweet data, allowing messages to be pushed to us instead of pulling them. To use the Twitter Stream, a persistent connection to the server has to be maintained. In order to achieve this, a Java project was created using Maven as the build tool. The program configures the OAuth details, creates a request object, set certain Twitter headers, sends the request and creates a buffered stream reader that reads the response stream and then writes to the file of choice. This streaming of data was done for approximately in 10 days (close to 30,000 tweets) extracting tweets with the keyword "electric".

B. Data Pre-Processing

Stock prices data collected is not complete understandably because of weekends and public

holidays when the stock market does not function. The missing data is approximated using a simple technique. Stock data usually follows a concave function. So, if the stock value on a day is x and the next value present is y with some missing in between. The first missing value is approximated to be (y+x)/2 and the same method is followed to fill all the gaps.

Tweets consists of many acronyms, emoticons and unnecessary data like pictures and URL's. So tweets are preprocessed to represent correct emotions of public. For preprocessing of tweets, three stages of filtering are employed, i.e Tokenization, Stop words removal and regex matching for removing special characters.

1) Tokenization: Tweets are split into individual words based on the space and irrelevant symbols like emoticons are removed. We form a list of individual words for each tweet.

2) Stop word Removal: Words that do not express any emotion are called Stop words. After splitting a tweet, words like a, is, the, with etc. are removed from the list of words.

3) Regex Matching for special character Removal: Regex matching in Python is performed to match URLs and are replaced by the term URL. Often tweets consists of hash tags(#) and @ addressing other users. They are also replaced suitably. For example, #Microsoft is replaced with Microsoft and @Billgates is replaced with USER. Prolonged word showing intense emotions like coooooooool! is replaced with cool! After these stages the tweets are ready for sentiment classification.

C. Classification

Let's build a sentiment analysis of Twitter data to show how you might integrate an algorithm like this into your applications. We'll first start by choosing a topic, then we will gather tweets with that keyword and perform sentiment analysis on those tweets. We'll end up with an overall impression of whether people view the topic positively or not.

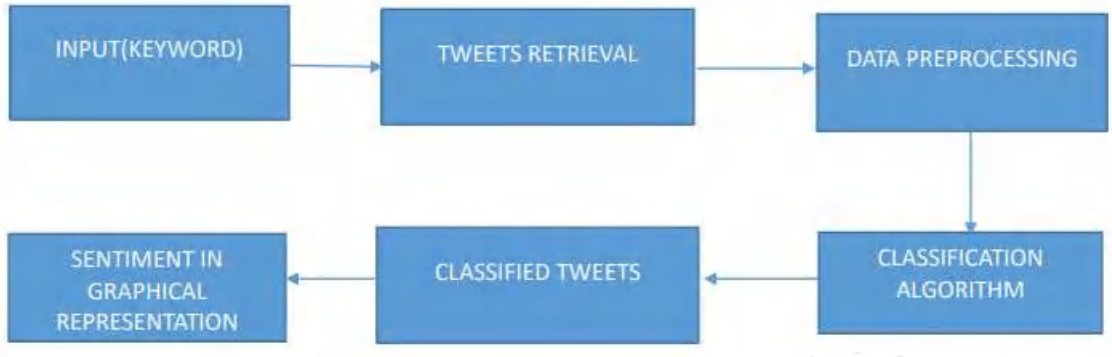


Fig1- System Architecture

D. Predicting Rumour

Support Vector Machine: SVM is a supervised machine learning algorithm. It is mostly used in classification problems. This has a training phase in the initial. we need to give the data to the SVM algorithm shows the data which is classified and labelled already. Completing the prime stage of the training. Then data is given to the algorithm which will be classified with the help of the less stimulation of the human. It has a step called feature selection that it identifies to know the classes, in which they are connecting and also in which they are identifying. we will use SVM when the prediction node is needed for the unknown sample, also the feature selection evenly. These both are also used for identifying the keysets. That is involved in different process that helps to differentiate the classes.

In machine learning, support vector machines (SVMs, also support vector networks) are supervised learning models with associated learning algorithms that analyse data used for classification and regression analysis.

A Support Vector Machine (SVM) is a discriminative classifier formally defined by a separating hyper-plane. In other words, given labeled training data (supervised learning), the algorithm outputs an optimal hyper-plane which categorizes new examples.

An SVM model is a representation of the examples as points in space, mapped so that the examples of the separate categories are divided by a clear gap that is as wide as possible.

In addition to performing linear classification, SVMs can efficiently perform a non-linear classification, implicitly mapping their inputs into high-dimensional feature spaces.

Given a set of training examples, each marked as belonging to one or the other of two categories, an SVM training algorithm builds a model that assigns

new examples to one category or the other, making it a non-probabilistic binary linear classifier.

COMPARATIVE ANALYSIS FOR RUMOUR DETECTION IN SOCIAL MEDIA

Unlikely, we have left the era of traditional communication medium, i.e television and newspapers, on the other side internet has become the crucial part of our life.

A Micro-blog, Twitter has been considered as one of the public domain social networking site, where people not only shares the information, but also spread rumours. A Rumour is said to be the information that people usually spreads, talks about, which is not certainly true.

Growth of these kind of rumours do effect people in a long-term negative impact.

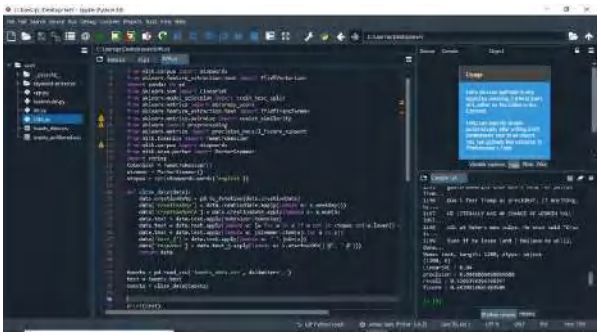
SI no.	TITLE	OBJECTIVE	STRATEGY/TECHNIQUE	REMARKS
1.	Rumor Detection model and tools for social networking sites	This survey compares the various RDM strategies and Tools that were proposed earlier for identifying the rumour words in social media platforms.	A new classification algorithm was proposed using statistical metrics for segregation of rumours and non-rumours twitter posts based on user's frequency of interaction, structure.	The dataset needs to be updated frequently for the detection of rumours which spreads through social networking sites.
2.	Rumor detection on twitter	Analysis shows, a correction on twitter works effectively against rumours, by retweeting the rumour to find the characteristics and potential of the rumour.	Tweet correction using re-tweet was established in the form of retweet ratio.	This paper focused only on specific micro-blog, twitter. And the rumours which spreads through multi-media networks and one-way communication medium is still in a search.
3.	Rumor Detection on Twitter with Tree-structured Recursive Neural Networks	Proposed two recursive neural models based on a bottom-up and a top-down tree-structured neural networks for rumour representation learning and classification.	Implemented a Decision tree classifier and Random forest classifier using Weka5, SVM-based models using LibSVM6 and all neural-network-based models with Theano7 .	Types of rumours, properties and characteristics and effects of rumours made and spread by the people need to be explored.
4.	Analysis of Techniques for Rumor Detection in Social Media	This paper gives an overview of rumour detection, datasets, application areas, and performs comparative analysis of the state-of-the-art rumour detection approaches.	Multiple dataset models have been discussed based on various approaches; i.e (machine learning and deep learning) to classify and analyse the rumours.	Spreading of rumour over a social network do not only propagates through Text but also in the form of audio, video or an image, to detect this kind of rumours, an evidence tool should be implemented.

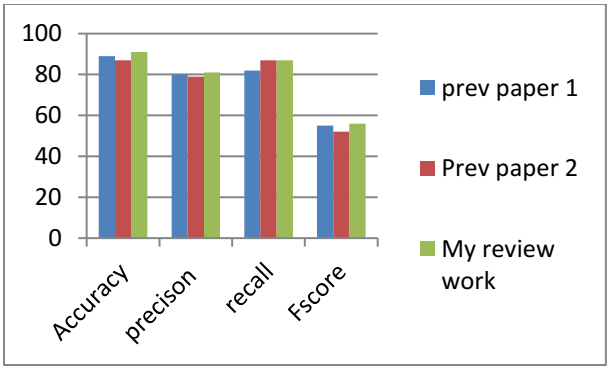
Table 1- Comparative Analysis for Rumour Detection in Social Media

DISCUSSION AND RESULTS:

The below screen shows the veracity of support vector machine. The comparison was made among previous papers and my review work to observe the accuracy, precision, recall and Fscore rate. I have received the 94% of accuracy rate when compared to other techniques used in previous papers for detection of rumours on various micro-blogs.

Snapshot1-Accuracy of SVM





Graph1- Comparison of Accuracy of SVM

CONCLUSION:

In this work i have reviewed an approach to detect rumour in a single topic domain related to health news using Twitter data. The restricted scale made the detection problem different from the literature, as it excludes the possibility of using the topic information as a feature, of making any a theoretical assumption on the nature of the network, and of making a theoretical assumption on user's characteristics and properties. To represent those samples i have used not only features available in the literature, but also explored new descriptors inspired by the study of the graph theory and the social influence models including the likelihood that a tweet is re-tweeted and the likelihood of a URL to be shared, conversation size, fraction of user's followers of root, and fraction of tweets with URLs. Experimental study on a real dataset demonstrated the effectiveness of this system and new features which can correctly detect about 94% of rumours, with acceptable levels of precision.

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ABSTRACT

In the most recent years social networks have developed as a basic mean for data spreading. Disregarding all the positive outcomes this wonder brings, unconfirmed and instrumentally significant data explanations available for use, named as rumours, are turning into an expected danger to the general public. As of late, there have been a few examinations on theme autonomous rumour detection on Twitter. In this paper, a novel rumour detection framework is presented which centres on a particular subject, which is wellbeing related rumours on Twitter. At this point, it was rather simplified by building another subset of highlights including influence potential and organization attributes highlights. Using this kind of methodology on a genuine dataset watching promising outcomes, as it can effectively distinguish about 94% of rumours, with adequate degrees of precision. With the interruption of social media into individual, social and political space of the present world, the tyrannies related with it have additionally discovered a spot to flourish. One such noxious act is the spread of rumours through social networks. This study investigates the different spaces where social media discovers its significance and has an extensive effect. It additionally investigates different examinations done on the idea of rumours, the qualities of rumours and the investigations distinguishing the significant highlights for the social media-based rumours. Further, the most recent improvements in the field of rumour detection through the methodologies of Machine learning and Deep learning have likewise been talked about.

INTRODUCTION

Social networks are a basic mean through which data and social practices spread. Specifically, social miniature sites have developed as the most utilized social organization benefits these days: they permit clients to be continually associated and to remain side by side with continuous occasions. Regardless of the apparent multitude of positive angles this sort of wonder brings, it has likewise a few drawbacks: as great and dependable data spreads, additionally rumours and bogus news effectively arrive at a wide scope of individuals in brief timeframe, turning into an expected danger to the general public. For example, in 2013 the official Twitter record of the Associated Press was hacked and it conveyed a rumour about the blast of two bombs at the White House and the US President being harmed in the assault. This news caused deep frenzy in such an expansive scope that finished with an emotional, however concise, crash of the financial exchange [1]. Alongside this occasion, other comparative scenes of deception causing catastrophes can be found in numerous spaces, for example, crisis circumstance the board, wellbeing and health, governmental issues, and so on.

Problematic and tricky news is by and large alluded to as rumour. Albeit in some cases rumours are considered as establishing data which is eventually regarded bogus [3], this definition forgets about each one of those newsworthy stories that have a similar degree of vulnerability and expected danger at a first time spread and that just in the end uncover themselves to be valid. The most utilized and thorough definition is the one that considers rumours as unconfirmed and instrumentally important data articulations available for use [4]. It is clear that the social micro-blogs accessible online could be influenced by rumours. Twitter is a social micro-blog that tallies a huge number of clients from everywhere the world, encouraging continuous engendering of data to a huge gathering of individuals and permitting clients to do various activities, for example, posting 140-character-long messages, known as tweets, answering to such posts, or re-tweeting them.

This makes it an ideal situation for the dispersion of breaking news straight forwardly from the news source and the geological area of occasions. Online social micro-blogs can be clearly influenced by rumours. The chance of remembering them could be a ground-breaking intend to forestall missed data spreading, alongside the potential results this could cause. Therefore, a rumour detection framework for social media is sought after. In the writing there have been a few investigations in rumour detection for social networks, for example, Twitter and Weibo. Existing commitments in the writing have been proposed to identify rumour spreading in different spaces and not in a particular one. To this point, one of the highlights typically utilized is from the earlier information on tweet theme. Moreover, they likewise channel the discussion structure considering just the most compelling clients or the most jam-packed discussions in the organization. In any case, a procedure that utilizations such descriptors might be not legitimately material when the rumour detection framework needs to manage a particular theme since semantics of words and sentences may vary when the point changes, just as the utilization of from the earlier information on tweet subject is negligible. Hence, in this paper a novel rumour detection framework is introduced for Twitter which investigations theme explicit rumour, in particular the wellbeing related point. Among all the data areas, this field is specifically compelling for two primary reasons: first, the writing has demonstrated that rumours pack in some particular subjects [5], for example, medical problems and, second, these days individuals regularly search for wellbeing information and advices on online administrations, yet not every one of these assets give precise or dependable data [6]. To distinguish wellbeing related rumours, the two degrees of highlights, named as client and organization level, are investigated separately. For each level, there are three sorts of highlights including impact potential, individual intrigue and organization attributes. Specifically, other than generally utilized highlights, for example, client insights and estimation of tweets, additionally new highlights including the probability that a tweet is re-tweeted and the probability of a URL to be shared, discussion size, division of client adherents of root, and part of tweets with URLs in a discussion are flourished. The utilization of general highlights random to the specific theme considered would permit to build up a methodology that could be utilized later on in different examination on various explicit areas.

LITERATURE REVIEW

Disinformation or fake news which isn't true intentionally to dupe people, including health-related fake news, false facts, fake reviews through inaccurate sources while most of the rumours are passed unverified on various communication channels. Social media platforms are said to be double edge knifes; on one side, they allow for social connectivity, on the other side, they collectively share the information which is not accurate. In these cases, users not only contribute for spreading rumours, but also sometimes held as victims for misleading. In order to pull-out these rumours, the city cyber police have a set of dedicated teams to monitor the social media platforms which keeps an eye on follow-up trends for the identification of the pattern.
An American micro-blog, *Twitter* is the highest receiving end of such inflammatory content (rumours). On the other side, twitter is also an awesome way for promoting events, new releases, addressing the society, and also the interrogation that is available online. The researches done on analysis and detection of rumours exploit dataset, system model, using various techniques, some of them includes machine learning and deep learning.

Artificial intelligence insights Machine learning and deep learning approaches. Number of algorithms using machine learning method has been studied. Various techniques and strategies have been reviewed to detect and to pull-out the rumours. Machine Learning method is generally used to assess the data, to generate the patterns, helps to make better and critical decisions to provide the development of the computer programs. Software Applications like Pinterest, Facebook, Twitter uses Machine Learning Algorithm in some cool ways. Machine Learning Algorithm works on the system to achieve high-level task without using explicit coding. The Machine Learning tasks can be implemented by training the system with loads of data. A very good background in linear algebra and vector algebra helps to catch the working of the algorithm. Some of the algorithms in Machine Learning are Vector machines, Neural networks, Decision Tree, K-NN and Naive Bayes. Verily I have focused on support Vectors to detect the rumours. All the above algorithms have been used in various ways to detect and analyse the rumours.
The paper named "Rumor Detection in Twitter" has shed the light on, the basic way to identify the rumour. The study shows detection of rumours or the correction of rumours can be done by re-tweeting on the rumour leading the recognition of rumour in the form of re-tweet ratio. This paper has focused on one-way communication medium; i.e a specific micro-blog, what if there is no way to reply back or re-tweet. What should be the further steps to segregate and pull out the data which is considered to be the rumour. This paper helps to find the potential and characteristics and as well as properties of the rumour.

The other article I have gone through is "Rumor Detection on Twitter with Tree-structured

Recursive Neural Networks". This paper includes long short-term memory used for detection and classification of the rumour based on tree-structure neural network. The decision tree structure and neural networks helps to model the data which has relationships among variables, they both can handle the interaction and somewhat are interconnected to each other. Neural Network algorithm is mostly used when we have loads of data and at that point accuracy matters us the most to get the desired output. On the other side decision tree has considered as one of the modelling approaches used in statistics, data mining and machine learning. A decision tree simplifies the question and recommend the answer based on yes or no strategy, and further splits the tree into sub trees.

Another paper named" Analysis of Techniques for Rumor Detection in Social Media" This paper gives an overview of rumour detection, datasets, application areas, and performs comparative analysis of the state-of-the-art rumour detection approaches. Multiple dataset models have been discussed based on various approaches i.e (machine learning and deep learning) to classify and analyse the rumours. In the above paper, Benchmarked datasets has been talk over. The most generally used dataset for rumour detection in this article is, every tweet is annotated for its connection towards the rumour as connected or unrelated.

Some of the datasets includes LIAR and PHEME Dataset. The dataset LIAR includes 12,836 short statements labelled for genuine, subject, context/venue, speaker, state, party, and prior history. PHEME dataset is a kind of storehouse of rumours and non-rumours generated on Twitter during breaking news. In this dataset, rumours are set in the form of events where they accurately annotated using the values True, false and unverified. Spreading of data over a social network not only propagates through text but also in the form of audio, video or an image, to detect this kind of rumours, an evidence tool should be implemented. This paper gave a review on the comparison of strategies done using different techniques, which includes classifying, labeling the data sets accurately.

In the article, "Rumor Detection model and tools for social networking sites". The survey compares the various RDM strategies and Tools that were proposed earlier for identifying the rumour words in social media platforms. A new classification algorithm was proposed using statistical metrics for segregation of rumours and non-rumours twitter posts based on user frequency of interaction, structure and network establishment and linguistic features. The dataset needs to be updated frequently for the detection of rumours which spreads through social networking sites. Machine Learning techniques have been used by various architectures, which consume time but can be improvised with the use of rules based on predefined knowledge through semantic ontology. A major drawback of these rumour datasets is time taken for processing to generate an alert and report to the servers is delayed.

In many of the rumour detection strategies I have found that machine learning approaches requires frequent training of system using the labelled dataset in case of supervised strategy. After a determined observation of various datasets through different domains it is suggested that domain specific rumour words need to be used in a particular context for desirable precision rate.

OBJECTIVES:

To detect health-related rumours, two levels of features have been explored, named as user and network level, respectively. For each level,

There are three types of features including influence potential, personal interest and network characteristics. In particular, besides widely used features such as user statistics and sentiment of tweets, new features including the likelihood that a tweet is re-tweeted and the likelihood of a URL to be shared, conversation size, fraction of user followers of root, and fraction of tweets with URLs in a conversation has been developed. The use of general features unrelated to the particular topic considered would allow for the development of an approach that could be employed in the future in other analysis on different specific domains.

The undertaking's cycles comprise of principally of three steps (as appeared in Fig1)– Data extraction from Twitter which discloses utilization of Twitter's Stream API, Sentimental Analysis in which the information acquired from Twitter is dissected to extricate double cross arrangement that shows the total estimations of the client towards an item. This time arrangement is then given as a contribution to the Dynamic Pricing Model system to conjecture costs over a future selling period and to show that when the new estimating model is utilized there is a stamped increment in the income produced.

So as to get live information from Twitter, the Streaming API was utilized. The Streaming API empowers engineer's low dormancy admittance to Twitter's worldwide stream of information. A legitimate usage of the streaming customer will push messages showing Tweets and different occasions happened. The POST status/channel end point was utilized, which returns statuses that coordinate at least one channel predicates. Steps are associated with the information extraction measure executed in the task: 1) Twitter Application Creation. An application was made on. *https://apps.twitter.com* to get the API keys required for live gushing of information. When this was made, the Consumer key, Consumer mystery, Access Token and

Access Token Secret were acquired from the OAuth tab. 2) Java venture Creation for Data Extraction. The Twitter Stream API permits clients to interface with Twitter's worldwide stream of tweet information, permitting messages to be pushed to us as opposed to pulling them. To utilize the Twitter Stream, a determined association with the worker must be kept up. So as to accomplish this, a Java venture was made utilizing Maven as the fabricate instrument. The program designs the OAuth subtleties, makes a solicitation object, set certain Twitter headers, sends the solicitation and makes a cushioned stream per user that peruses the reaction stream and then keeps in touch with the record of decision. This gushing of information was accomplished for around in 10 days(close to 30,000 tweets) removing tweets with the watchword "electric".

Streaming with Tweepy

First let's cover streaming tweets from Twitter. You're going to need a Twitter dev account. Sometimes Twitter uses dev.twitter.com to advertise various things they expect dev to be interested in. The problem is they sometimes make it hard to get to where you want to be. Just in case they've done this and the video's method isn't available, here's the link: Twitter Apps

Next, make a new application, filling in your name, description, website, agree to their terms, do the captcha , and create the application.

Once submitted successfully, you should be presented with a page where you can see your consumer key and consumer secret. Now you need an access token, so scroll down and click on "create my access token."

After a few moments, refresh, and you should be able to see the access key and access token. Once you have that, you're going to need to get Tweepy, which is a Python module for streaming Twitter tweets.

Tweepy makes it easier to use the twitter streaming api by handling authentication, connection, creating and destroying the session, reading incoming messages, and partially routing messages.

This page aims to help you get started using Twitter streams with Tweepy by offering a first walk through. Some features of Tweepy streaming are not covered here. See streaming.py in the Tweepy source code.

API authorization is required to access Twitter streams. Follow the Authentication Tutorial if you need help with authentication.

Step 1: Creating a StreamListener

This simple stream listener prints status text. The on_data method of Tweepy's StreamListener conveniently passes data from statuses to the on_status method. Create class MyStreamListener inheriting from StreamListener and overriding on_status.

Step 2: Creating a Stream

We need an api to stream. See Authentication Tutorial to learn how to get an api object. Once we have an api and a status listener we can create our stream object.

Step 3: Starting a Stream

A number of twitter streams are available through Tweepy. Most cases will use filter, the user_stream, or the sitestream. For more information on the capabilities and limitations of the different streams see Twitter Streaming API Documentation.

PROPOSED WORK

Proposed work includes Data extraction, Data Pre-Processing, Classification and Prediction rumours. which shows implementation of push messages done by the client. Finding the Approximation of the missing data to fill the voids. Later, are classified in the form of tweets which are viewed positively or not.

A. Data Extraction from Twitter

In order to get live data from Twitter, the Streaming API was used. The Streaming API enables developer's low latency access to Twitter's global stream of data. A proper implementation of the streaming client will push messages indicating Tweets and other events occurred. The POST statuses/filter end point was used, which returns statuses that match one or more filter predicates. Steps are involved in the data extraction process implemented in the project:

1) Twitter Application Creation. An application was created on https://apps.twitter.com to get the API keys required for live streaming of data. Once this was created, the Consumer key, Consumer secret, Access Token and Access Token Secret were obtained from the OAuth tab.

2) Java project Creation for Data Extraction. The Twitter Stream API allows users to connect to Twitter's global stream of tweet data, allowing messages to be pushed to us instead of pulling them. To use the Twitter Stream, a persistent connection to the server has to be maintained. In order to achieve this, a Java project was created using Maven as the build tool. The program configures the OAuth details, creates a request object, set certain Twitter headers, sends the request and creates a buffered stream reader that reads the response stream and then writes to the file of choice. This streaming of data was done for approximately in 10 days (close to 30,000 tweets) extracting tweets with the keyword "electric".

B. Data Pre-Processing

Stock prices data collected is not complete understandably because of weekends and public

holidays when the stock market does not function. The missing data is approximated using a simple technique. Stock data usually follows a concave function. So, if the stock value on a day is x and the next value present is y with some missing in between. The first missing value is approximated to be (y+x)/2 and the same method is followed to fill all the gaps.

Tweets consists of many acronyms, emoticons and unnecessary data like pictures and URL's. So tweets are preprocessed to represent correct emotions of public. For preprocessing of tweets, three stages of filtering are employed, i.e Tokenization, Stop words removal and regex matching for removing special characters.

1) Tokenization: Tweets are split into individual words based on the space and irrelevant symbols like emoticons are removed. We form a list of individual words for each tweet.

2) Stop word Removal: Words that do not express any emotion are called Stop words. After splitting a tweet, words like a, is, the, with etc. are removed from the list of words.

3) Regex Matching for special character Removal: Regex matching in Python is performed to match URLs and are replaced by the term URL. Often tweets consists of hash tags(#) and @ addressing other users. They are also replaced suitably. For example, #Microsoft is replaced with Microsoft and @Billgates is replaced with USER. Prolonged word showing intense emotions like coooooooool! is replaced with cool! After these stages the tweets are ready for sentiment classification.

C. Classification

Let's build a sentiment analysis of Twitter data to show how you might integrate an algorithm like this into your applications. We'll first start by choosing a topic, then we will gather tweets with that keyword and perform sentiment analysis on those tweets. We'll end up with an overall impression of whether people view the topic positively or not.

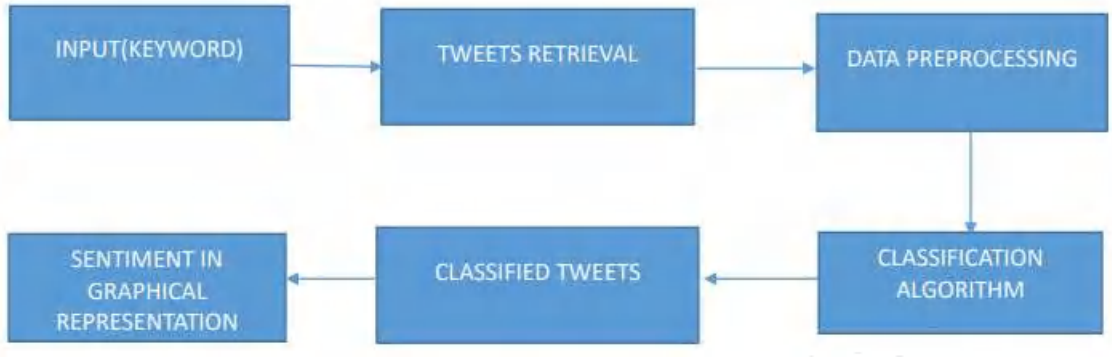


Fig1- System Architecture

D. Predicting Rumour

Support Vector Machine: SVM is a supervised machine learning algorithm. It is mostly used in classification problems. This has a training phase in the initial. we need to give the data to the SVM algorithm shows the data which is classified and labelled already. Completing the prime stage of the training. Then data is given to the algorithm which will be classified with the help of the less stimulation of the human. It has a step called feature selection that it identifies to know the classes, in which they are connecting and also in which they are identifying. we will use SVM when the prediction node is needed for the unknown sample, also the feature selection evenly. These both are also used for identifying the keysets. That is involved in different process that helps to differentiate the classes.

In machine learning, support vector machines (SVMs, also support vector networks) are supervised learning models with associated learning algorithms that analyse data used for classification and regression analysis.

A Support Vector Machine (SVM) is a discriminative classifier formally defined by a separating hyper-plane. In other words, given labeled training data (supervised learning), the algorithm outputs an optimal hyper-plane which categorizes new examples.

An SVM model is a representation of the examples as points in space, mapped so that the examples of the separate categories are divided by a clear gap that is as wide as possible.

In addition to performing linear classification, SVMs can efficiently perform a non-linear classification, implicitly mapping their inputs into high-dimensional feature spaces.

Given a set of training examples, each marked as belonging to one or the other of two categories, an SVM training algorithm builds a model that assigns

new examples to one category or the other, making it a non-probabilistic binary linear classifier.

COMPARATIVE ANALYSIS FOR RUMOUR DETECTION IN SOCIAL MEDIA

Unlikely, we have left the era of traditional communication medium, i.e television and newspapers, on the other side internet has become the crucial part of our life.

A Micro-blog, Twitter has been considered as one of the public domain social networking site, where people not only shares the information, but also spread rumours. A Rumour is said to be the information that people usually spreads, talks about, which is not certainly true.

Growth of these kind of rumours do effect people in a long-term negative impact.

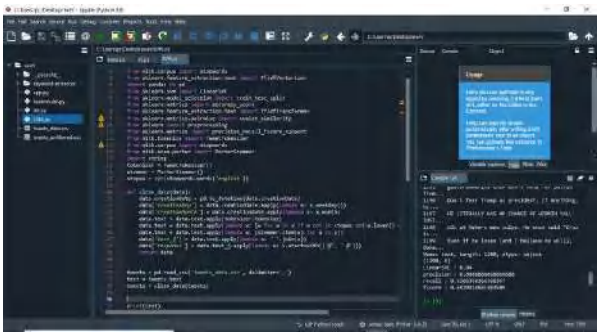
SI no.	TITLE	OBJECTIVE	STRATEGY/TECHNIQUE	REMARKS
1.	Rumor Detection model and tools for social networking sites	This survey compares the various RDM strategies and Tools that were proposed earlier for identifying the rumour words in social media platforms.	A new classification algorithm was proposed using statistical metrics for segregation of rumours and non-rumours twitter posts based on user's frequency of interaction, structure.	The dataset needs to be updated frequently for the detection of rumours which spreads through social networking sites.
2.	Rumor detection on twitter	Analysis shows, a correction on twitter works effectively against rumours, by retweeting the rumour to find the characteristics and potential of the rumour.	Tweet correction using re-tweet was established in the form of retweet ratio.	This paper focused only on specific micro-blog, twitter. And the rumours which spreads through multi-media networks and one-way communication medium is still in a search.
3.	Rumor Detection on Twitter with Tree-structured Recursive Neural Networks	Proposed two recursive neural models based on a bottom-up and a top-down tree-structured neural networks for rumour representation learning and classification.	Implemented a Decision tree classifier and Random forest classifier using Weka5, SVM-based models using LibSVM6 and all neural-network-based models with Theano7 .	Types of rumours, properties and characteristics and effects of rumours made and spread by the people need to be explored.
4.	Analysis of Techniques for Rumor Detection in Social Media	This paper gives an overview of rumour detection, datasets, application areas, and performs comparative analysis of the state-of-the-art rumour detection approaches.	Multiple dataset models have been discussed based on various approaches; i.e (machine learning and deep learning) to classify and analyse the rumours.	Spreading of rumour over a social network do not only propagates through Text but also in the form of audio, video or an image, to detect this kind of rumours, an evidence tool should be implemented.

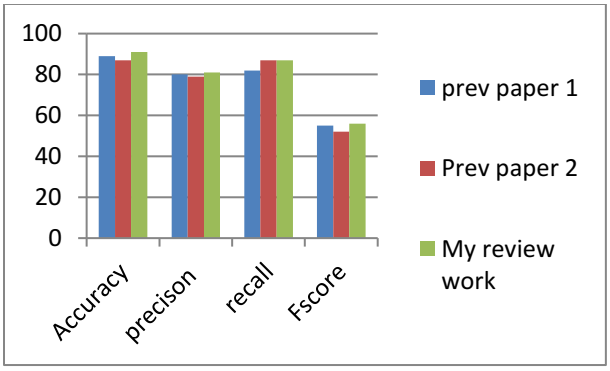
Table 1- Comparative Analysis for Rumour Detection in Social Media

DISCUSSION AND RESULTS:

The below screen shows the veracity of support vector machine. The comparison was made among previous papers and my review work to observe the accuracy, precision, recall and Fscore rate. I have received the 94% of accuracy rate when compared to other techniques used in previous papers for detection of rumours on various micro-blogs.

Snapshot1-Accuracy of SVM





Graph1- Comparison of Accuracy of SVM

CONCLUSION:

In this work i have reviewed an approach to detect rumour in a single topic domain related to health news using Twitter data. The restricted scale made the detection problem different from the literature, as it excludes the possibility of using the topic information as a feature, of making any a theoretical assumption on the nature of the network, and of making a theoretical assumption on user's characteristics and properties. To represent those samples i have used not only features available in the literature, but also explored new descriptors inspired by the study of the graph theory and the social influence models including the likelihood that a tweet is re-tweeted and the likelihood of a URL to be shared, conversation size, fraction of user's followers of root, and fraction of tweets with URLs. Experimental study on a real dataset demonstrated the effectiveness of this system and new features which can correctly detect about 94% of rumours, with acceptable levels of precision.

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ENHANCED TRUSTWORTHINESS OF DATA IN CLOUD USING BLOCKCHAIN

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Abstract: The storage and management of data in the cloud servers has become the order of the day but parallelly it has its own security issues. In order to be used and accepted, any service needs to be trustworthy that's where the data integrity has an important role to play. For this data needs to be audited through public verification procedures to be carried out by auditors, Things go awry when these auditing procedures are not carried out in a timely manner and are delayed henceforth. Also, a majority of public verification schemes are based on the public key infrastructure which extensively work with the management of digital certificates, and has its own sets of issues. A Public Verification Scheme using Block Chain (PVSBC) is proposed in this work which excludes the certification procedures to overcome the delayed auditing by the auditors, by use of blockchain enhancements. Auditors make an entry of every verification output into a blockchain as a record. The blockchain transactions are temporal in nature ensuring time stamps of every entry. It is here that the auditing work can be verified at the client level thereby ensuring timeliness by the auditors. Since this work is omitting the certification procedures, we ensure proper measures to ensure security of PVSBC and ultimately retaining the client's trustworthiness with respect to the cloud data and its services.
Index Terms—Data integrity, public verification scheme, blockchain, auditing.

1. INTRODUCTION

Data is stored in cloud storage, after which clients access the information distantly over the web by redistributing their data with the clients through the cloud services [1] which give clients an effective approach to handle their information, and liberation from neighborhood storage costs [2]. Information reappropriating has further raised the fundamental security issues [3] which is information trustworthiness. Subsequently, clients are constantly stressed over the information authenticity i.e., regardless of whether the redistributed information is very much kept up on cloud workers.

The trustworthiness of reappropriated information is held at stake by disguising episodes of information debasement for good standing, or may delete information bits [4]. Hence, the integrity of redistributed data has to be confirmed periodically. The verification can be performed by the clients themselves.

Public verification procedures enable the clients to redistribute the data verification to a TPA (Third part Auditor), who in turn checks the information authenticity, and updates the clients that the if the information is invalidated once, the verification is not affirmative [5]. Generally, in the available public verification schemes, the auditor is assumed and expected to be reliable and upright by default. But in the opposite case, these schemes would be negated for this unreliability. It may be possible that an insincere auditor may create an authenticity report without carrying out the verification procedures to evade the verification costs, thereby, the whole practice of the audit diluted. Also, an erring auditor may collaborate with cloud workers to produce an inclination verification result to ditch the clients for benefits. After every verification, the auditor records the data used to check the data integrity, which enables the client to review the legitimacy of the auditors' conduct.

Existing public verification schemes require the auditor to play out the verification frequently so that the information defilement can be identified at the earliest within the time limit. We consider this practice of the auditor as a delaying one as it diverges from the main goal of public verification schemes.

Most public verification schemes are based on the public key infrastructure (PKI), where the auditor needs to handle the client's certificate to pick the right public key for verification. Thus, these schemes experience the ill effects of the certificate the executives issue including certificate renouncement, storage, appropriation, and verification, which is exorbitant and embarrassing [6], [7].

In this paper, public verification scheme is proposed that avoids delaying tactics of auditors through blockchain (viz. Bitcoin and Ethereum) [8], [9], which reassurance to direct transactions without a focal power. In PVSBC, the auditor is needed to make another transaction after every verification, where the data corresponding to the verification is incorporated into the exchange, and the evaluator directs the transaction. After the transaction is recorded into the blockchain, the client can confirm when the reviewer plays out the verification by checking the age season of the transaction. We stress that for a blockchain framework, the more members in it, the more grounded security promise it can give. In this manner, we develop PVSBC on an entrenched and generally utilized blockchain framework (e.g., Ethereum). Also, PVSBC does not use the certificate for cryptography and stays away from the certificate issue. The contributions of this proposed work are summed up as follows.

- The existing public verification schemes are examined, and it is shown that current schemes can't avoid a

delaying auditor who may not work out the information verification honestly on time.

- A public verification scheme, PVSBC, is proposed which excludes certification process and which overcomes delayed auditors, where every verification performed by the evaluator is time-stamped by incorporating it into a transaction of blockchain-based standards, e.g., Ethereum. Such system empowers the client to check when the reviewer perform-s the verification. PVSBC tends to the certificate the executives issue existing in the majority of existing public verification schemes.

We present favorable security evidences to demonstrate that PVSBC is secure against the delaying nature of auditors in this work.

The remainder of this paper is organized as follows. Related Work in Section 2, Motivation for PVSBC in Section 3, and define the system model, adversary model, and design goals and present preliminaries in Section 4. We propose PVSBC in Section 5, Results in Section 6, and draw the conclusions and present some future scopes in Section 7.

2 RELATED WORK

Security saving public check has also pulled in considerations in the ongoing writing. A security saving public check plot empowers the evaluator to confirm the respectability of our sourced information without learning the substance of the information. The greater part of existing security safeguarding schemes, for example, [12], [13], require the cloud worker to use an arbitrary cover to dazzle the proof data to such an extent that the evaluator can check the validity of the proof data without separating the information content. For our plan, to secure clients' information against the reviewer, we encode the information prior to creating the labels. Since in PVSBC, we consider that the reviewer may conspire with the cloud worker, the cloud worker would clear send the information to the examiner to disregard the information security of clients.

To defer from overseeing certificates in a public check plot, a few schemes [17] built on the personality-based signature schemes were favorable to presented. Some certificate less open check schemes with upgraded security were proposed [7]. These schemes are built on the homomorphic certificate-less signature schemes. Consequently, the examiner in these schemes doesn't have to deal with the clients' certificates without confronting with the digital key issue.

3. PROBLEM STATEMENT

3.1 Public Verification of Data Integrity

The area of concentration of the public confirmation procedure is that the client distributes the information into different squares, processes a signature for everyone, and re-appropriates the information integrity just as relating signatures to the cloud worker. At the point when the evaluator confirms the information trustworthiness, it picks an arbitrary subset of all information blocks (e.g., test 250 squares from 10000 ones) and sends the inspected squares' records (as a challenging message) to the cloud worker. The cloud worker reactions with the comparing proof, the inspector checks the integrity of challenged blocks by confirming the validity of the proof. In the event that the confirmation passes, the trustworthiness of whole informational index is guaranteed. The key method utilized here is totaled signature [10], which empowers the evaluator to confirm various squares at the same time without downloading the information.

3.2 On the shortcomings of PKI-based public verification schemes

The vast majority of existing public confirmation schemes are based on the public key foundation (PKI), where a completely confidential certificate authority gives the members' certificates, and the examiner needs to deal with clients' certificates to pick the right open keys for the check. Eliminating the certificate issue could be monetary and ideal practically speaking.

4 DEFINITIONS AND PRELIMINARIES

4.1 System model

The system model is shown in Fig. 1. There are four different entities in PVSBC: cloud user (data owner), cloud server, third-party auditor (TPA), and key generation center (KGC).

In this paper, we have proposed a public verification scheme excluding the certification part PVSBC which uses the on-chain monetary standards, where every confirmation performed by the evaluator is incorporated into an exchange on the square chain of on-chain monetary forms. The security analysis shows that PVSBC furnishes the most grounded security ensure contrasted and existing schemes. We have also directed a far-reaching execution analysis, which shows that PVSBC has steady correspondence overhead.

4.1.1 User Interface Design

In this module we plan the windows for the task. These windows are utilized for secure login for all users. To interface with server user must give their username and secret key then no one but they can ready to associate the server.

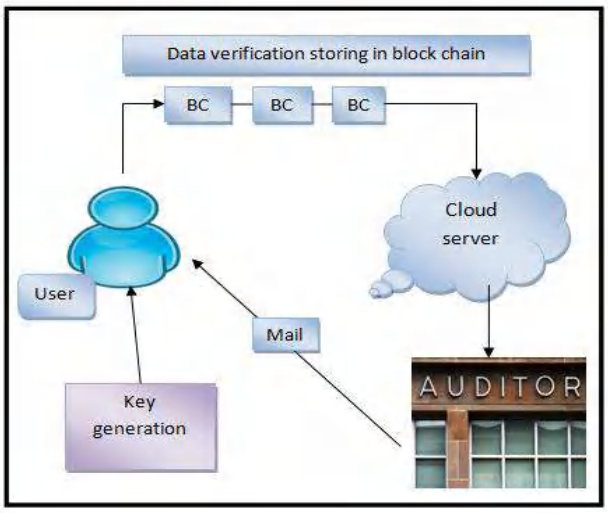

Fig. 1. System Analysis Process

In the event that the user already exits legitimately can login into the server else user must enlist their details, for example, username, secret phrase and Email id, into the server.

4.1.2 User

The user is the data owner, who re-appropriates her/his data to the cloud server and gets to the re-appropriated data varying. In the event that user needs to store any data in cloud first user need to enroll and login with a valid Email-Id and secret key. After data redistributing, the user employs a TPA, concurs a check period with TPA, and let TPA periodically confirm the data trustworthiness. For each confirmation user will get mail warnings from evaluator for security reason. For each exchange key generation plant will create key for a user.

4.1.3 Block Chain

This is the important module in this undertaking by utilizing this innovation we are isolating the record depiction into blocks and interface individually utilizing hash code system.

4.1.4 Cloud Server

Cloud will store the data of user. It will store all the exchange details of every single user and it will give security to those exchanges and user details. Furthermore, the exchange details given to inspector for confirmation and after check from the evaluator it will store all the details of every single exchange with confirmation status. What's more, confirmation status is given to user.

4.1.5 Third Party Auditor (TPA)

TPA works for the user. TPA gets the exchange details of users and checks those exchanges and forward the confirmation details to user. In the event that TPA attempts to get other user details the alert message shipped off that specific user for security reasons.

4.2 Design goals

In this paper, we propose the secure public verification scheme of data integrity for cloud storage systems, in which there exist two challenges:

1) How to avoid the delay by the TPA without introducing any trusted participant. Existing public schemes assume that TPA would perform the data integrity verification at the prescribed time. However, this auditor would not detect the data corruption as soon as possible, and it might be too late to recover the data loss or damage. Such procrastination is hardly to be detected by the user without a trusted participant's help.

2) How to avoid the certificate management. As discussed before, certificate management is cumbersome and cost-ly in practice. Enabling TPA to verify the data integrity without managing users' certificates could be economic and favorable in practice.

To enable secure verification of outsourced data integrity in cloud storage under the aforementioned model, the following objects should be achieved.

• **Efficiency:** The communication and computation overhead should be as efficient as possible; TPA is able to verify the data integrity without managing the users' certificates and bearing a priori bound on the number of verification interactions; TPA should be stateless, and is not required to maintain and update state during verification.

• **Security:** When a cloud server passes the TPA's verification, it must possess the specified data intact; A malicious TPA and a procrastinating TPA cannot deceive the user; Collusion between any two participants cannot break the security of the proposed scheme.

4.3 Public blockchain and on-chain currencies

A blockchain is a straight assortment of information components, where every information component is called block. All squares are connected to frame a chain and made sure about utilizing cryptographic hash work. Each square typically contains a hash pointer as a connect to a past square, a timestamp, and exchange information [8]. Just if an exchange's validity is checked, it tends to be recorded into the square. Generally, the blockchain method can be ordered into two kinds: private blockchain and public blockchain. For a private blockchain (counting the consortium blockchain), the checks are performed by approved members, who might be utilized by the blockchain administrators or the directors themselves. For a public blockchain, the confirmations can be performed by any member in the network: an exchange can be recorded into a square, just in the event that it has been checked and acknowledged by a significant greater part [16].

The most unmistakable sign of public blockchain is on-chain monetary standards, for example, Bitcoin [8] and Ethereum [9]. In such monetary standards, the public blockchain is utilized to fill in as an open and dispersed record that effectively records exchanges between two members. Moreover, such record is unquestionable and characteristically impervious to adjustment of binded blocks, the members who play out the exchange checks are called excavator. Actually, the more diggers that take an interest in a blockchain framework, the more grounded security ensure the blockchain framework has. In this work, we use the Ethereum blockchain to build PVSBC, since Ethereum is more expressive than other on-chain monetary forms and Ethereum is the one of most mainstream blockchain frameworks.

5 THE PROPOSED PVSBC

5.1 Overview

We utilize the Ethereum blockchain as the underlying public blockchain. Fig. 2 shows the proposed PVSBC.

PVSBC consists of two phases. In the first phase, the auditor verifies the integrity of outsourced data. In the second phase, the user audits the auditor's behavior.

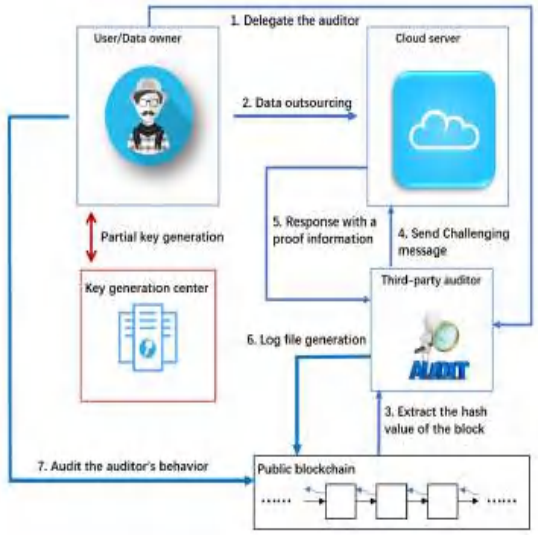

Fig. 2. The proposed PVSBC

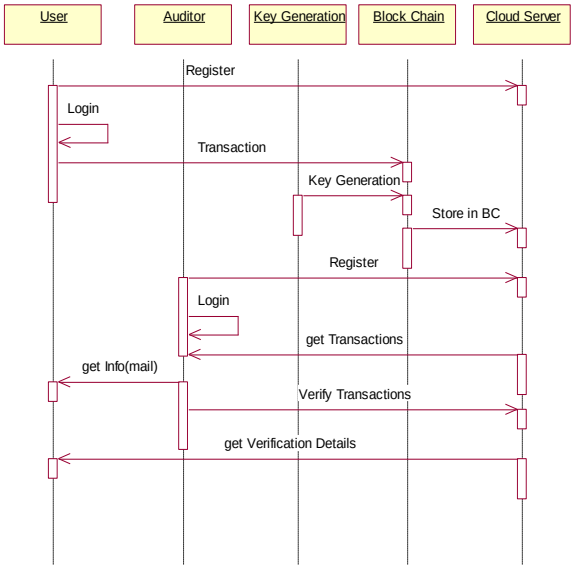

Fig. 3a. The proposed PVSBC Sequence Diagram

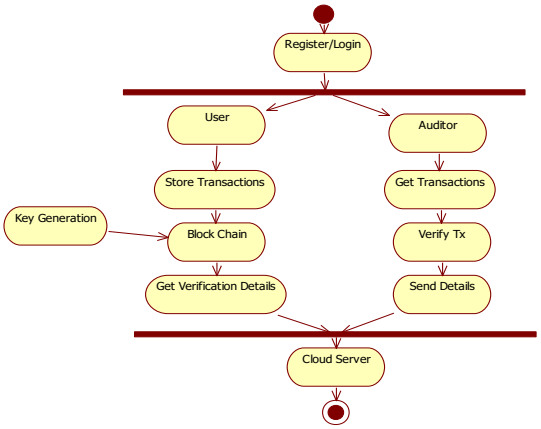

Fig. 3b. The proposed PVSBC Activity Diagram

6. RESULTS

The implementation has been done through J2EE(JSP, Servlets) with the backend MySQL 5.5 on ICE Eclipse. The following are few of the screenshots.

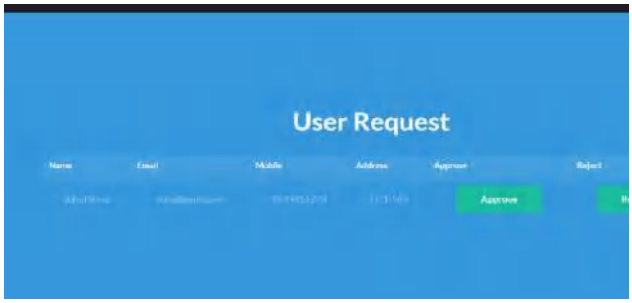

Fig 4. User Request for Auditor

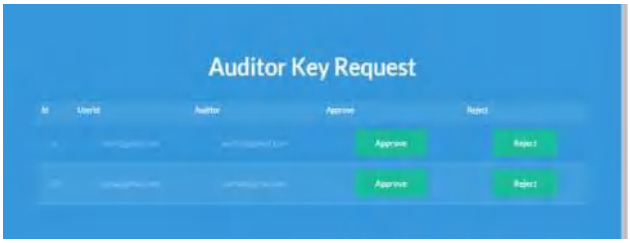

Fig 5. Auditor Request Key To KMC

Fig 6. User Viewing Audit Tracking Details

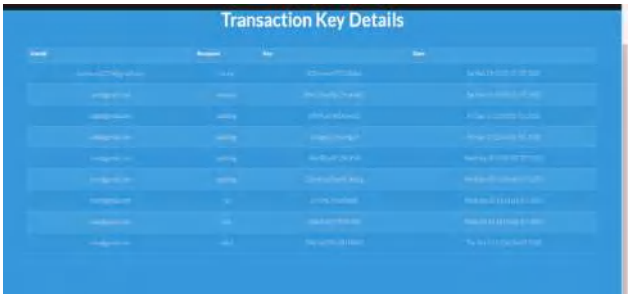

Fig 7. Cloud Viewing Transaction Key Details

7. CONCLUSION

In this research work, we have proposed a public verification scheme PVSBC without generation of certificates which exploits the on-chain currencies, where every verification performed by the reviewer is coordinated into a transaction on the square chain of on-chain currencies.

The organization of cloud storage services has significant benefits in overseeing data for users. Be that as it may, it also causes numerous security interest & one of them is data respectability. Public verification scheme can enable a user to utilize an TPA Third Party Auditor to confirm the data trustworthiness for self, whereas existing public verification proposals prove to be insufficient against delaying auditors who may not perform verification on schedule. Also, most of public verification proposals are constructed on the PKI & consequently suffer from endorsement the board issue. In this document, we suggest the PVSBC without certification, by using block chain innovation. The main area of concentration is to expect auditors to treat every verification result into a square chain as a transaction. Since transactions on the square chain are time-sensitive, the verification can be made temporal (marking time entries) after the corresponding transaction is entries into the square chain, which enables users to check whether auditors play out the verification at the prescribed time. Constructing PVSBC by using other square chain systems (eg: proofs of stake based square chain systems, Delegated proof of stake (DPoS), Byzantine adaptation to internal failure) which can give less energy consumption.

For the future work, we leave to the curious researchers to determine how to construct PVSBC on other blockchain systems. Since the main drawback of proofs of work (PoW) is the energy consumption, constructing PVSBC on other blockchain systems (e.g., proofs-of-stake-based blockchain systems) can save energy. However, it requires an elaborated design to achieve the same security guarantee while ensuring the high efficiency. The area which also needs to be investigated is how to utilize blockchain technology to enhance cloud storage systems in terms of security, performance, and functionality. As the outsourced data processing (e.g., outsourced computation and searching over encrypted data) has also played an important role in current information age, exploration of the integration of blockchain into existing schemes which should have a deep impact on outsourced data processing is also a future scope.

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Detection of Collaborative Wormhole Attack in Wireless Mobile Adhoc Network

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***Abstract*—**A Wireless Mobile Adhoc network (MANET) is a self-controlled group of multiple nodes establishing a temporary network. MANET nodes have the tendency to change the location from one point to another due to it's vulnerable and dynamic nature topography, which may invite for several types of cyber-attacks. One of the most dangerous attack is wormhole attack in which two or more malicious nodes could establish a tunnel between them and attract all the neighbours to send the packets though that tunnel by assuring that packet would be delivered to destination through the tunnel's optimal-route and also assure to deliver all the packets by taking small amount of time delay. Most of the proposed methods to guard against wormhole attack use either clock synchronization or round-trip time technique but our proposed method uses hop-to-hop count technique. The purpose of this research work is to make a solution to detect the most risky and dangerous wormhole attack in the context of mobile Adhoc networks that can drift the normal traffic flow completely. We named this solution as Detection of Collaborative Wormhole Attack in Wireless Mobile Adhoc Network (DC-WAN). An attempt has been done to make an Algorithm to detect Wormhole malicious node(s) based on reactive Adhoc on demand distance vector (AODV) protocol. Several times experiments were conducted on our solution by using NS2 and found that the PDR and Throughput is similar to AODV protocol but the Packet Drop Ratio is fluctuating as time changes.

***Keywords*—** MANET, Cyber attacks, Wormhole attack, AODV, hop-to-hop count

I. INTRODUCTION

MANET consists of a group of unguided wireless nodes which may vary their positions frequently within the domain of network as they are ready to form an un-centralized infrastructure-less topology [1]. MANET has a common characteristic to insert or delete nodes dynamically at any time. Hence, it may be utilized where guided fixed wired network could not be installed properly. The nodes are very portable devices such as mobile handheld devices, Laptops and palmtops etc. which could work with little amount of battery backup. They are connected together and communicate with each other with the help of routing protocols [2]. Initially AODV was developed by IETF community to solve loop-creation and count-to-infinity problems with the help of sequence numbers. AODV depends upon two main steps such as Route Discovery and Route Maintenance that may utilize the following messages: RREQ, RREP, RERR and HELLO [3]. It is very difficult to eradicate wireless communication from our daily life. Therefore Adhoc network could be installed in situation of military battlefield and emergency services.

Several researchers are involved to make solutions on wormhole attack but they are not efficient. Our proposed solution is efficient as it can detect the wormhole attack efficiently based on the performance as shown in different graph. The following sections are used in our paper: Section-I is about introduction to AODV protocol, IDS and wormhole attack, Section-II is purely related work done by multiple researchers, Section-III is our actual work with the proposed solution, Flow chart, some part of coding of wormhole node. Section-IV is about Simulation, Section-V shows Results and discussion and the last Section-VI is about conclusion.

I. I. Adhoc on Demand Distance Vector Protocol

Adhoc on demand distance vector (AODV) is one of the routing Protocols developed for mobile Adhoc networks

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(MANET). Our solution is tested with the combination of AODV protocol. It can establish a link between two nodes on demand. That's why this protocol is also known as on-demand routing protocol. AODV would work on routing tables which are required to forward packets from one node to another and also maintain the routes in the routing table to by using the following parameters: SA, DA, Seq.No., ID, h_count etc. Initially it starts with Route Discovery process later it maintain the routes by using Route Maintenance process [5]. In Route Discovery process the source node generates RREQ packets and broadcast to all neighbours that are connected to it. Flooding help us to broadcast RREQ packets. In turn, all the connected neighbours send the RREP to source and update their routing table in order to maintain the current status of nodes. Also the malicious node may generate the RREP and send back to source to assure that it has the best and shortest route to destination with minimum number of hops.

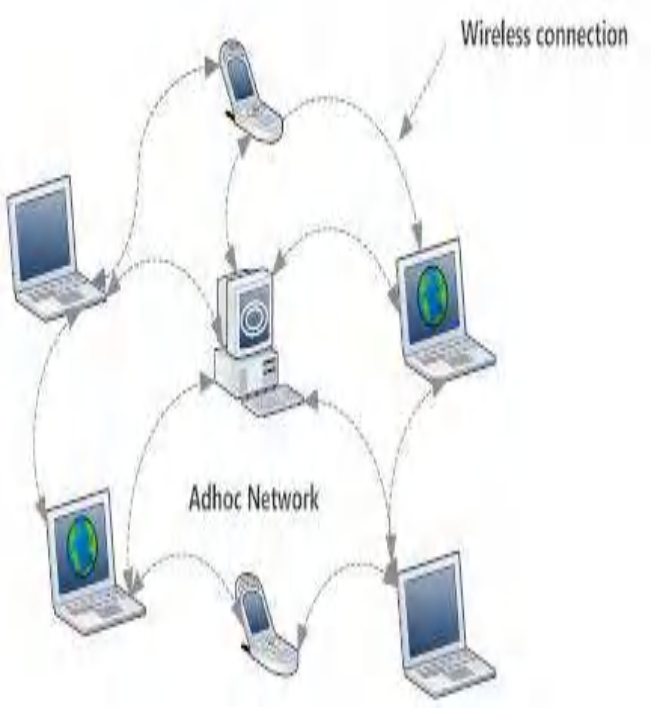

Fig-1: Mobile Adhoc Network

I.II. Intrusion Detection System (IDS)

Millions of people connect with each other through internet. As the size of internet grows there are more chances of cyber-attacks. To identify and detect the attacks we need to have some system which could monitor the entire Adhoc network.

This is exactly the role of Intrusion Detection System. Usually IDS try the look at the history of events and carry out the process to detect the malicious behaviour of a node by using simple rule of Algorithm. IDS can keep an eye on guided as well as unguided media types of networks. To have maximum level of security, it was suggested by many researchers to keep both Software and Hardware Intrusion Detection System in an organization. Over the two decades different categories of IDS have been developed.

I.III. Wormhole Attack

A Wireless Ad hoc network is vulnerable in nature and open for several types of cyber-attacks. One of the most dangerous attacks is wormhole attack in which two or more malicious nodes could establish a tunnel between them and attract all the neighbors to send the packets though that tunnel. It make sure that whenever data packets are send through that tunnel it would be delivered to destination with less number of hops and less delivery time. Most of the proposed methods to guard against wormhole attack use either clock synchronization or round-trip time technique but our proposed method uses hop-to-hop count technique.

Collaborative Wormhole attack consists of two or more malicious nodes that could make a strong tunnel between them and attract all the nodes to send data through it. Once they receive the packets they may either simply drop the packets or forward to any other malicious node if it is available in Adhoc network. This may lead to decrease the performance of system and eventually data packets may not be delivered to a particular destination. Therefore, our solution could identify and detects the malicious or bad guy(s) in MANET. The following Fig-2 consists of ten nodes from N1 to N10. We assumed that N1 is our source node and N10 is our destination. It is also assumed that a tunnel is formed between two bad guys namely N3 and N8. Initially N1 broadcast Route Request (RREQ) packets to all its adjacent neighbours in order to initiate communication. All the neighbours receive RREQ and try to generate a response in the form of Route Reply (RREP). Also one of the neighbours connected to Source is N3 which assure N1 that it has the optimal tunnel or channel to deliver data quickly with less amount of time delay. Every neighbour will be happy to deliver data though that tunnel but at the end both the bad guys will play with the packets and drop them. If the bad guys create the tunnel honestly and reliably than it is assumed that they will not harm the MANET and also provide useful service more efficiently [6].
In Fig-2 scenario, we assumed that N1, N2, N3……N10 are the nodes. N1 is a source, N10 is destination and N3 and N8 are malicious nodes which could establish a tunnel between them.

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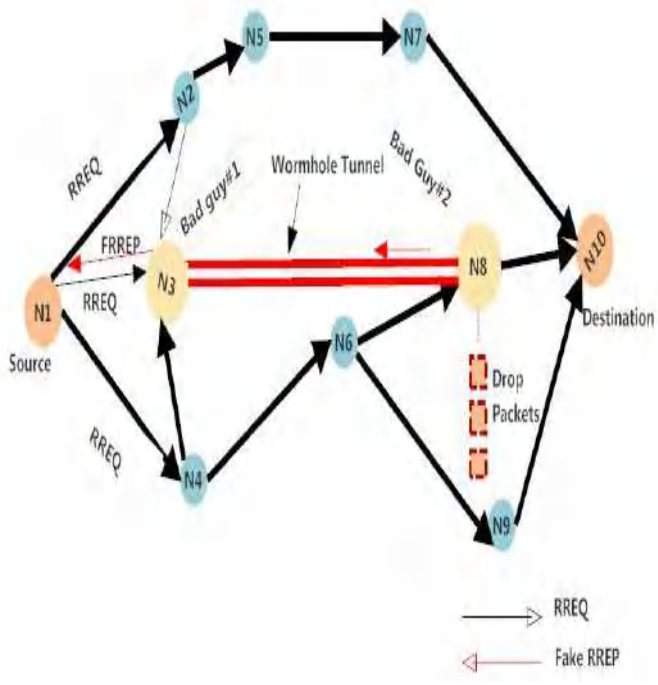

Fig-2: RREQ-RREP in Wormhole Adhoc Network

The Fig-2 is about RREQ-RREP and RREQ-FRREP which is purely based on AODV protocol:

- N1 floods RREQ to all adjacent neighbours (N2 and N4).
- N3 and N8 are malicious/bad guys which could form a tunnel.
- N3 will send FRREP to N1 in order to show best and optimal route through the tunnel.
- N1 update N3 route and store in database which is a false route to destination. N3 and N8 may drop the packets instead of forwarding to N10.

II. RELATED WORK

Several solutions have been developed to identify and detect Wormhole attacks in MANET which are as follows:

S.Young Shin, E.H. Hartono Halim [7] proposed a method to detect and separate wormhole attack in MANET. The idea here is to form multiple routes when sending Route Request packet (RREQ) from source to destination and these routes can be used as reference of each other to find malicious nodes with malicious behavior within the network. It is based on three steps: routes redundancy, routes aggregation and calculating round-trip time (RTT) of all listed routes.

M. Rmayti, Y. Begriche, R. Khatoun [8] proposed a novel detection model to allow a node to check whether a presumed shortest path contains a wormhole tunnel or not. This technique is based on the fact that the wormhole tunnel reduces significantly the length of paths passing through it.

R. Prakash, W. R Jeyaseelan [9] proposed a method in which a coordinator node is elected by wireless election algorithms to detect wormhole attack. The main function of the coordinator node is to separate and prevent any further attacks. Several experiments were carried out to check the performance under different situations. From the experiment results, they have identified that the suggested wireless protocol is adapted for improving the protection of resource constrained of wireless sensor networks.

T.Sundararajan, S. M. Ramesh [10] suggested a solution which is purely based on biological artificial intrusion detection system (BAIDS) and also combines the power of hybrid negative selection algorithm (HNSA) to identify and detect abnormal behavior in MANET. Also an action will be taken against the attackers. The detectors used in this research are involved to separate good behaving nodes from bad behaving with sufficient level of accuracy in a MANET.

R. Prakash, W. R. Salem [11] developed an algorithm for wormhole attack. Here the updated information of the packets can be changed frequently may give strong security. The solution of wormhole attack identifies the coordinator node which is selected by wireless election algorithms. The main task of the coordinator node is to monitor, and separate any further attacks in future.

III. METHODOLOGY

The following Algorithm will explain you the various steps of wormhole detection.

Assume [N1: Source, N2, N4 may be neighbours, RREQ: Route Request Packet, RREP: Route Reply Packet, Fake Route Reply (FREP), NL: Neighbours List THV: Threshold].

---

1. Procedure Wormhole( )
2. h_count=0; //hop count is initialized to Zero
3. for i = 1 to N // 1,2,3,….N number of neighbors
4. N0:Broadcast PREQ // Route Discovery
5. Ni ← PREQ // Neighbors receive PREQ
6. if (Ni(Addr) = = Destination Address && N1← NL) /* Check if there is an entry of source and destination Address in Routing table of source and Neighbor list stored in Source */

   N1←N2(RREP) // Correct Route Reply
   else
   N3-N8←Tunnel // Form a tunnel between N3 & N8
   N1 ←N3 (FRREP]) /* Wormhole node (N3 or N5) generate False FRREP & send to source */

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7. Ni+1← RREQ /* RREQ is forwarded to another neighbor. */
8. h_count = h_count + 1 /* hop count is incremented by 1 */
   end if
9. If (h_count > THV) /* Check whether if the value of hop count is greater than threshold value or not. */
   Print "Wormhole Node"
   else
   Print "Normal Node"
   end if
10. All routes to Tunnel is blocked
    end for loop
    end Wormhole Procedure

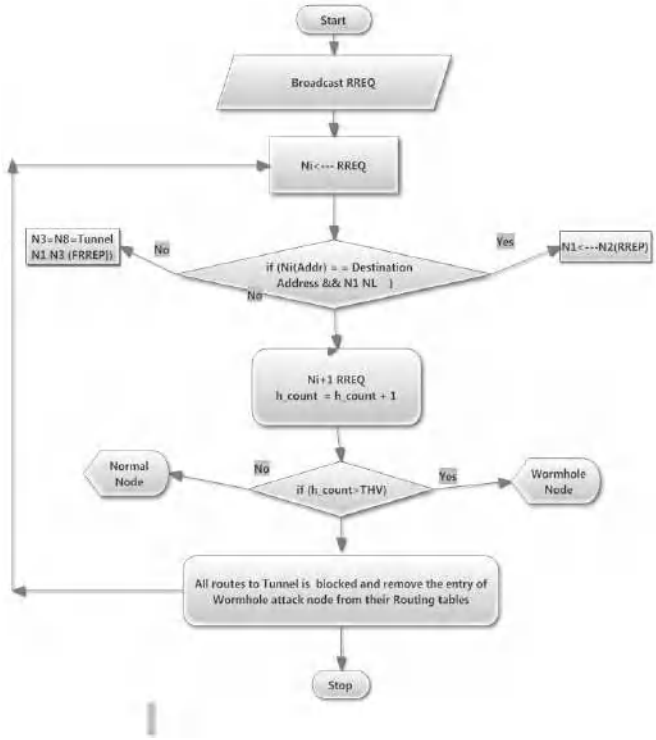

Fig-3: Flow chart of DC-WAN

1V. SIMULATION

To add Wormhole node just we need to update the following files which are available in ns-2.35/mac/ directory.

- **arp.cc**
- **ll.h**
- **ll.cc**

/* Under ll.h define elements for the wormhole peer list */

```
Class LL;

Typedef struct wormhole_peer_struct {

 LL* ll;

Int id;

Struct wormhole_peer_struct* next;

} wormhole_peer;
```

/* Under arp.cc add the following code for wormhole attack. */

```
wormhole_peer wormhole_head;
```

// For tracking overhead define the following integer variables

```
int routing_packet_count;
int routing_byte_count;
int data_packet_count;
int data_byte_count;
```

/* Under ll.cc add the following code for wormhole attack. */

```
Case NS_AF_INET:
dst=ch→ next_hop();

Case NS_AF_NONE:
If(IP_BROADCAST == (u_int32_t) dst)
{ mac_→ hdr_dst((char*) HDR_MAC(P),
MAC_BROADCAST);
IS_broadcast = 1;reak;
}
```

V. RESULTS AND DISCUSSION

NS-2.35 tool is used for simulating for our proposed solution. The malicious nodes N3 and N8 may establish a tunnel between them as they are interested to play in the network by either drop packets or forward them to another malicious node, which may result in degradation of the overall performance of a network. The proposed solution helps us to detect the malicious node and update their information to other nodes. The simulation work have been carried out in combination of AODV protocol with the following parameters: Malicious nodes: 1 or 2, number of nodes varies from 10 to 50 each time there is a step of ten and it is distributed in an area size of 900*900m using CBR traffic type.

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V.I. Performance Analysis of AODV and DC-WAN

Packet Delivery Ratio (PDR): It is defined as the ratio of total of data packets received to the total of data packets send. It is calculated by the following equation.

$$PDR(CD_WAN) = (\sum packets\ Received / \sum Pakets\ send) * 100$$

---------- (I)

Throughput: it is the total number of data bits delivered per second. It is measured in Kbps.

$$Throughput(CD-WAN) = Receive\ Line * (End\ time - Start\ time) * (8/1000)$$

---------- (II)

Packet Drop Ratio: It is the difference between Packets send & Packets received. The whole is divided by packets send.

$$Packet-Drop-Ratio\,(CD-WAN) = (Send\ Line - Received\ Line / Send\ Line) * 100$$

---------- (III)

Table-2: AODV Data

Time (msec)	Packet Send	Packet Received	PDR (%) AODV	P_Drop_Ratio (%) AODV	Throughput (Kbps) AODV
10	1188	1090	91.75	8.25	597.64
20	3579	3454	96.5	3.49	808.51
30	6625	6500	98.11	1.89	965.85
40	9635	9510	98.7	1.3	1036.01
50	12655	12530	99.01	0.99	1078.44

Table-3: DC-WAN Data

Time (msec)	Packet Send	Packet Received	PDR:DC-WAN	P_Drop_Ratio: DC-WAN	Throughput: DC-WAN
10	1188	1020	85.85	14.14	326.4
20	3579	3254	80.91	9.08	780.96
30	6625	6243	94.23	6	998.88
40	9635	9210	95.58	4.41	736.8
50	12655	12246	96.76	3.23	0

The Fig-4 shows that Time and PDR for DC-WAN keeps on changing with respect to time but at 30msec the PDR ratio is almost 86.24% which is very close to AODV.

Table-1: Simulation Parameters

No#	Parameters	Items
1.	Simulator Software	NS-2.35
2.	Topography	900m x 900m
3.	Routing Protocol	AODV
4.	Wireless Standard	IEEE 802.11 Layer
5.	Packet Size (Bytes)	512
6.	Total Number of Nodes	10
7.	Minimum Number of wormhole Node	1
8.	Simulation Time	10-50 msec
9.	Traffic Type	CBR
10.	Propagation	Random Waypoint
11.	Link Layer Type	LL

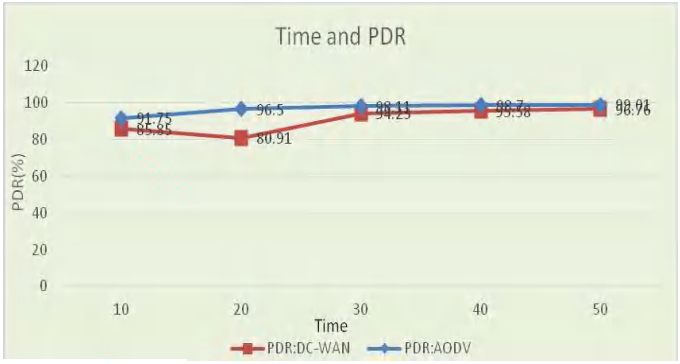

Fig-4: Time Vs PDR

The Fig-5 shows that Throughput also keep on changing with respect to time but It's close to AODV at 30 msec.

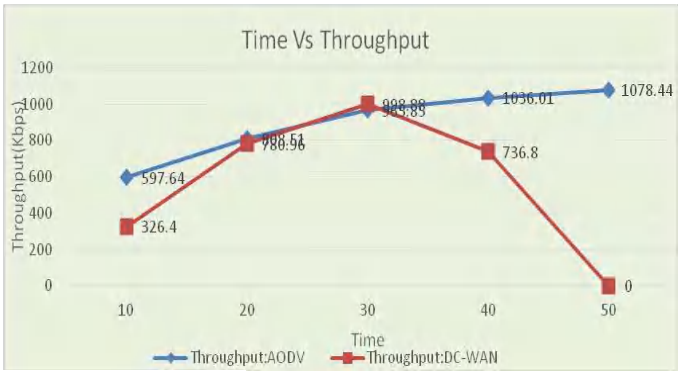

Fig-5: Time Vs Throughput

The Fig-6 shows that Packet-Drop-Ratio of CD-WAN. It keeps on changing with respect to AODV. The gap between AODV and DC-WAN throughout the graph is somewhat large but having a difference of 2.24% at time 50 msec.

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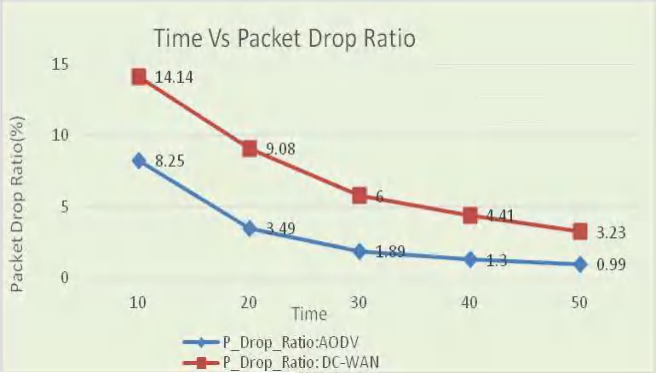

Fig-6: Time Vs Packet Drop Ratio

VI. CONCLUSION

MANET has no centralized infrastructure as it is setup with free of topology. So it is difficult to monitor what is happening in it. Thus we need to protect it from different types of attacks. One of the dangerous attacks in MANET is wormhole attack that creates a tunnel between malicious nodes that allow data packets to pass through it. Once packets are delivered to tunnel the wormhole attack is initiated and ultimately drops the packets. Our proposed technique uses hop-to-hop count technique to solve this issue. Our Simulation results as shown above are efficient with respect to PDR and Throughput, which is almost similar to that of original AODV protocol at time instant 30 msec. The Packet Drop Ratio keeps on changing but having 2.24% difference at 50 msec. Therefore, the proposed solution is efficient.

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Performance Analysis of the HVAC System in a Hospital Building in Hyderabad

Mohammed Ishaq, Raza Ahmed Khan, Mohammed Abdul Majeed

Abstract— Indoor air quality (IAQ) is a term which refers to the air quality within a building, especially as it relates to the health and comfort of building occupants. The hospital is a high risk indoor place which has airborne infection from patients. The complex hospital environment requires special attention to ensure healthy IAQ to protect patients and healthcare workers against hospital-acquired infections and occupational diseases. The aim of this study is to recommend effective guidelines for the control and management of hospital IAQ. A one week survey was carried out in the Continental Hospital and Research Centre situated at Gachi Bowli, Hyderabad. It is a massive eighteen storied structure, competently managed by senior professionals. In the experimental analysis for indoor air quality, measurements were recorded on four floors for Temperature, Relative Humidity and Carbon Dioxide. In the observation analysis the operation and maintenance of the HVAC system and the well-being of the occupants were observed.

Index Terms— CO_2, HVAC Systems, Indoor Air Quality, Occupant Comfort, Pollutants, Relative Humidity, Temperature

1 Introduction

Hospital buildings and health care facilities are among the most complex indoor spaces. In particular, the most demanding indoor zones are hospital operating theatres (suites) that comprise operating rooms (ORs) or surgical theatres, their interconnecting hallways and ancillary work areas. The indoor environmental quality (IEQ) in ORs, including thermal, visual and acoustical comfort and indoor air quality, affects the working conditions, well-being, safety and health of patient and the medical personnel who work in these environments. About 50% of the total number of doctors works in the ORs, as surgeons or with other responsibilities (e.g. anesthesiologist), while about 10% of the total medical staff also work in the OR. Heating, Ventilating and Air-Conditioning (HVAC) installations control indoor air quality and aseptic conditions, and secure health, safety and suitable indoor thermal (i.e. temperature, humidity, air quality and airflow) conditions for surgeons and medical staff, and of course, the patients. The air in an OR must be aseptic, at a reasonably constant temperature and humidity and have relatively low air velocity in order to avoid drafts and swirls that promote the recirculation of microbes and may disrupt the procedures during an operation. The ventilation rate is expressed as the volumetric air flow through the space divided by the volume of the space, e.g. number of air changes per hour (ACH). The desirable conditions can be met by proper design, installation, operation and maintenance of the electromechanical equipment, such as the HVAC equipment and lighting systems of the space. Due to their demanding indoor conditions, operating theatres constitute the most expensive sector of the healthcare establishment mandating an efficient management. Indoor air quality (IAQ) can be affected by gases (including carbon monoxide, radon, volatile organic compounds), particulates, microbial contaminants (mold, bacteria), or any mass or energy stressor that can induce adverse health conditions. Source control, filteration are the primary methods for improving indoor air quality in most health care facilities.

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2. HVAC System Investigation

The preliminary HVAC investigation involved the discussions with property owners and building management, walk through investigation of building and surrounding areas, interviewing HVAC operation & maintenance personnel, study of as-built drawings, review of maintenance schedule and preventative maintenance program.

Preliminary observation/review of the HVAC system was carried out. Direct instrument measurements of carbon dioxide, relative humidity, and temperature were recorded to know the status of IAQ and comfort of building occupants.

3. Hospital Occupant Survey

A hospital occupant's questionnaire was developed to get the demographic background and socio-economic status of the respondents such as personal information, health status, symptoms of sickness, and level of comfort inside the hospital. The questionnaire include the occupant's health status and symptoms of Sick building syndrome (SBS) such as chronic cough, cough with phlegm, chest tightness, and shortness of breath. Questionnaires also contain questions on the previous workplace, working history, and location of current workstation (near the entrance door, near to photocopied area, etc), and also working background such as overtime, shift work

schedule, duration of work per day, duration of work per week and the employment years at the office. Zoning of each worker's workstation then categorized accordingly with the reference of floor plan. Reported sick building syndrome (SBS) symptoms were recorded from the respective respondents on each day of IAQ assessment conducted and the score given in the analysis of data as shown in Fig. 1.

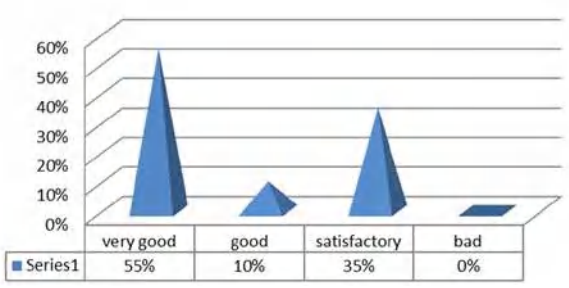


Fig. 1. Hospital occupant's perception of Indoor Air Quality

4. Hospital Building Infrastructure

The questionnaire was done in the Hospital Building in Hyderabad which is fully Air Conditioned controlled by Building Management Sysytem. A continuous data log of carbon dioxide, temperature, and relative humidity for approximately one week. Indoor air quality analysis was carried of the Hospital having buildup area of 1,20,000 sq mtrs with 18 floors of capcity 750 beds controlled and maintained by HVAC system of capacity 4000 Ton.The hospital requires close coordination among Medical staff, Support staff and patients along with the maintenance of diagnostic equipment along with disinfection and sterlization techniques in order to improve health of patients, avoid infections among patients and hazards for hospital occupants.

5. Parametric Measurement

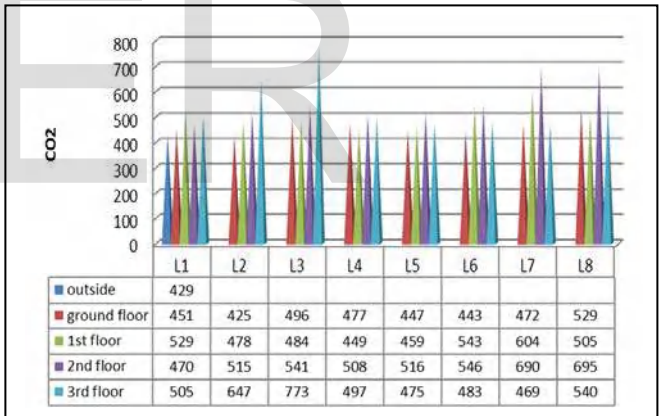
The parametric measurement of carbondioxide, Relative humidity and Temperature are major factors in health care facilities indoor air quality (IAQ). The interiors are deemed to be the most important indicators that the quality of the indoor air is good enough, when people themselves are the main source of emissions. Poor indoor air quality leads to tiredness, lack of concentration and can even bring about illnesses.

5.1 Carbon dioxide

Carbon dioxide (CO_2) level is considered to be an indicator for purpose of evaluation of indoor air quality (IAQ). Hospital occupants asre the main sourse of Carbon dioxise levels variation and air borne infections along with the concentration of body odour. Carbon dioxide is relatively varies with respect to seasons and even within a day, human traffic, occupants living habits. The useful approach is to measure surrogate for indoor pollutants emitted by humans, and correlates with human metabolic activity. Carbon dioxide at levels that are unusually high indoors may cause occupants to grow drowsy, to get headaches, breathing and pulse rate increase, nausea, unconscious, further exposure 100,000 ppm leads to death. Humans are the main indoor source of carbon dioxide in most buildings. Indoor levels are an indicator of the adequacy of outdoor air ventilation relative to indoor occupant density and metabolic activity.

To eliminate most complaints, total indoor carbon dioxide should be reduced to a difference of less than 600 ppm above outdoor levels. NIOSH considers that indoor air concentrations of carbon dioxide that exceed 1,000 ppm are a marker suggesting inadequate ventilation.These higher limits are concerned with avoiding loss of consciousness (fainting), and do not address impaired cognitive performance and energy, which begin to occur at lower concentrations of carbon dioxide.

Carbon dioxide concentrations increase as a result of human occupancy, but lag in time behind cumulative occupancy and intake of fresh air. The lower the air exchange rate, the slower the buildup of carbon dioxide to quasi "steady state" concentrations on which the NIOSH are based. Therefore, measurements of carbon dioxide for purposes of assessing the adequacy of ventilation need to be made after an extended period of steady occupancy as recorded in figure no 2. Portable instruments used to measure carbon dioxide should be calibrated frequently and outdoor measurements used for calculations should be made close in time to indoor measurements.



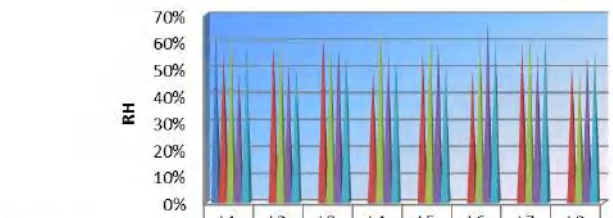
	L1	L2	L3	L4	L5	L6	L7	L8
outside	429							
ground floor	451	425	496	477	447	443	472	529
1st floor	529	478	484	449	459	543	604	505
2nd floor	470	515	541	508	516	546	690	695
3rd floor	505	647	773	497	475	483	469	540

Fig. 2. Carbon Dioxide values recorded at different floors

5. .2 Relative Humidity

Hospital buildings having high humidity levels can cause damage to sensitive hospital equipment and products used during surgery apart from discomfort to occupants. Sources of biological contaminants are major source of risk to patients health. Relative humidity also affects the shelf life and product integrity results unexpected malfunction. Air humidity must be maintained at acceptable levels because it is closely related to the space hygiene and thermal comfort conditions. Humidity control is most often accomplished by treating the ventilated air for lowering (dehumidification) or increasing (humidification) its water content, using proper equipment and controls. HVAC system configurations can achieve humidity targets for delivering the required supply air conditions, without energy wastage. High humidity levels favor the growth and transfer of bacteria that can be easily become airborne on wa-

ter molecules high humidity levels cause thermal discomfort. During low humidity level electro-medical equipment is effected by electrostatic discharge. The ventilation requirements influence humidity control. Depending on climatic conditions, additional ventilation may increase the dehumidification load more than the sensible cooling, imposing a disproportionate demand on the HVAC equipment. Low humidity levels (dry air) favor blood coagulation, which is undesirable during a surgery. In addition, moisture can be absorbed into the duct lining and building materials where it may support microbial growth. With the heavy use of electric equipment, low humidity levels may cause problems associated with static electricity on medical equipment and surfaces. In addition, this may even pose a fire hazard, as there may be flammable gases present in the environment. The recommended levels of indoor relative humidity are 30–60%, according to international regulations and standards. Most regulations establish where the use of in-flammable anaesthetic gases is possible, volatile liquids are used frequently, and in order to prevent the accumulation of static electricity should maintain a humidity of about 60%. Humidification may be necessary to increase low humidity levels, commonly encountered during winter. Special care must be exercised with humidification to assure that there is no potential for transferring bacteria through the ventilation system, since humidifiers may provide favorable environment for bacteria growth. Proper maintenance and cleaning practices will minimize this kind of risks. Humidification is best accomplished by supplying dry steam. Cold-water humidifiers in HVAC systems must be connected to a domestic water source and provided with a drain line to remove the water. Stand-alone, console-type humidifiers that re-circulate water for humidification should not be used because the water in these systems becomes contaminated with microorganisms rapidly and have been linked to outbreaks of Legionnaires' disease. Study recorded as shown in Figure no. 3.



	L1	L2	L3	L4	L5	L6	L7	L8
AT 03:00 outside	63%							
AT 03:00 ground floor	57.50%	68.5%	61.20%	50.80%	67.40%	89.10%	61.20%	61.10%
AT 03:00 1st floor	62.20%	63.40%	58.00%	65.40%	63.00%	62.30%	62.30%	59.00%
AT 03:00 2nd floor	49.60%	61.70%	67.30%	66.60%	60.60%	67.90%	65.90%	65.00%
AT 03:00 3rd floor	59.30%	63.70%	66.40%	63.40%	61.70%	62.10%	62.00%	67.70%

Fig. 3. Relative Humidity values recorded at different floors

5.3 Temperature

The indoor air temperature must be maintained within the recommended ranges to ensure acceptable conditions. The Indoor air temperature must be uniform within the space. Special care must be taken to operation theater account for the different internal loads (e.g. surgical lamp) by proper design of the air conditioned supply and exhaust vents and temperature of the air supply stream. The desirable indoor air temperature is usually 20–24°C, according to international regulations and standards. Use of lower or higher temperature is acceptable when patients' comfort and/or medical conditions require those conditions. For example, for specialized procedures, such as cardiac surgery, the indoor air temperature may be set as low as 17°C, on the other hand paediatric surgeries usually demand a higher indoor air temperature because children are more sensitive to lower temperatures. In any event, a high indoor air temperature may cause discomfort and offers more favorable growing conditions for bacteria or their mitigation from and to the patient. Practically, it is not possible to provide all occupants with 100% acceptable indoor thermal conditions. Similarly, the medical staff working in an Operation Room may have a different perception of prevailing indoor conditions due to different levels of activity and even working positions within the OR. In general, surgeons tend to feel from ''slightly warm'' to ''warm''. Regulatory sweating is also present very often. Anaesthetists and nurses, by Contrast, experience from ''slightly cool to cold'' thermal sensation. This is especially true for temperatures below 21°C. These are in agreement with other studies where preferable thermal comfort conditions were reported for aesthetics (23–24°C), for nurses (22–24.5°C) and for surgeons (18–19°C). For patient's, the recommended air temperature ranges between 24 and 26°C. Medical clothing will have a direct impact on personnel's thermal comfort conditions. Surgical scrub garments are typically worn by OR personnel to control airborne contamination, although there is no scientific data to support this practice as a means for preventing transmission of infection. Heavier gown requirements used by the surgical team for protective reasons during an operation (i.e. because of AIDS) may require an indoor temperature down to 18°C or even lower. The field measurement was conducted at various floors present in figure-4 at various locations.

	L1	L2	L3	L4	L5	L6	L7	L8
AT 03:00 outside	28.6							
AT 03:00 ground floor	24.6	25.1	24	26.2	24.3	29.3	25.6	27.3
AT 03:00 1st floor	26.3	26.2	24.6	26.6	24.3	26.2	26.5	26.1
AT 03:00 2nd floor	25.2	24.6	24.4	27.3	22.9	22.1	23.6	23
AT 03:00 3rd floor	25	26.6	23.3	21.9	25.2	24.9	24.2	24.5

Fig. 4. Temperature values recorded at different floors

Finally, asymmetric thermal radiation from surgical lights on the surgical staff is a potential source of thermal discomfort. Thermal radiation emitted from surgical lights regardless of the indoor air temperature.

6. BUILDING HVAC SYSTEM

The procedures used to calibrate indoor air quality of health

care facilities are as follows:

- Determine the effective volume of the hospital.
- Record the temperature and humidity conditions, the method of distribution of air (ceiling outlets, side wall, floor outlets, etc.) and the operation hours of the system.
- Collect the specifications of the airside system (type, capacity of supply air, fresh air and return air flow rate, control method, etc.) and the accessories such as fresh air damper, type of diffuser, etc.

To calculate the air change rate when the air-conditioning system was operating, the hospital was pressurized and infiltration is reduced.

The Outdoor air requirement is significant important for IAQ. The outdoor air requirement is related with the number of occupants and net available occupancy.

HVAC system should provide sufficient fresh air to avoid concentration of contaminated indoor air pollution. Supply air velocity for each supply air grill was measured by using anemometer. Airflow rate was designed and measured of supply air flow rate for fan coil units and Air Handling Unit.

7. Conclusion

The measurements were carried out to check the values Carbon dioxide (CO_2), Relative Humidity (R.H %) & Temperature (T). It was observed that throughout the week the values of CO_2, relative humidity and temperature were in acceptable range. It indicates that the overall performance of HVAC systems is good in this hospital building.

Since the feedback gathered from the occupants of the building also indicate that a majority of them feel comfortable inside the building and do not report of any severe complaints, it can be concluded that the HVAC systems is providing sufficient amount of fresh air along with maintaining the temperature and relative humidity.

The above measurements were recorded for a period of one week only. However, a long term field measurements have to be recorded to analyze the performance of HVAC systems and IAQ issues on a minute scale.

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A Comparative Study on Load Balancing Algorithms for SIP Servers

Abdullah Akbar, S. Mahaboob Basha and Syed Abdul Sattar

Abstract The widespread acceptance and usage of smartphones deployed with high end operating systems have made Voice over IP applications extremely popular and prevalent globally. A large set of users amongst these use a plethora of Internet based applications after configuring them on their devices. SIP Proxy servers are predominantly used in these VOIP networks for the routing challenges arising from the requirement of supporting millions of VOIP concurrent/subsequent calls and also increasing the QoS (Quality of Service) of the routed calls. For intelligent load balancing, call dispatchers are used to achieve high throughput and minimum response times by balancing the calls amongst SIP proxy servers. Several load balancing algorithms are used like round robin, Call-Join-Shortest-Queue (CJSQ), Transaction-Join-Shortest-Queue (TJSQ) and Transaction-Least-Work-Left (TLWL). In this paper, we present a comparative analysis of load balancing algorithms for SIP servers with respect to call response time and server throughput performance.

Keywords Session initiation protocol (SIP) · Dispatcher · Load balancing · High availability · Fault tolerance · Algorithm · Performance · Server

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1 Introduction

SIP or Session Initiation Protocol is a standard protocol used to for the control and maintenance of multimedia sessions in VOIP networks and is defined in RFC 2543 [1]. 3GPP (3rd Generation Partnership Project) has also accepted and adopted SIP for the management of media sessions in IMS (Internet Protocol Multimedia Systems). RFC 2543 explains that SIP is relevant in the application layer of OSI interconnection model for initiation, establishment, adjustment and termination of multimedia sessions. H.323 has been made defunct by SIP and has been widely replaced in VOIP software product lines. The ever-growing demand of enabling millions of VOIP clients and their calls have made leading ISPs use a cluster of servers. Dispatchers are required for logical distribution of incoming calls to SIP proxy servers. These important call dispatchers employ the use of various load balancing algorithms for intelligent decisions.

SIP uses addresses to locate callers and intended recipients/callee. An elementary SIP call flow is shown in Fig. 1. Location services are used to get the SIP address of the callee and a call is initiated by sending an INVITE request to the nearest proxy server. Users typically register addresses with SIP location servers.

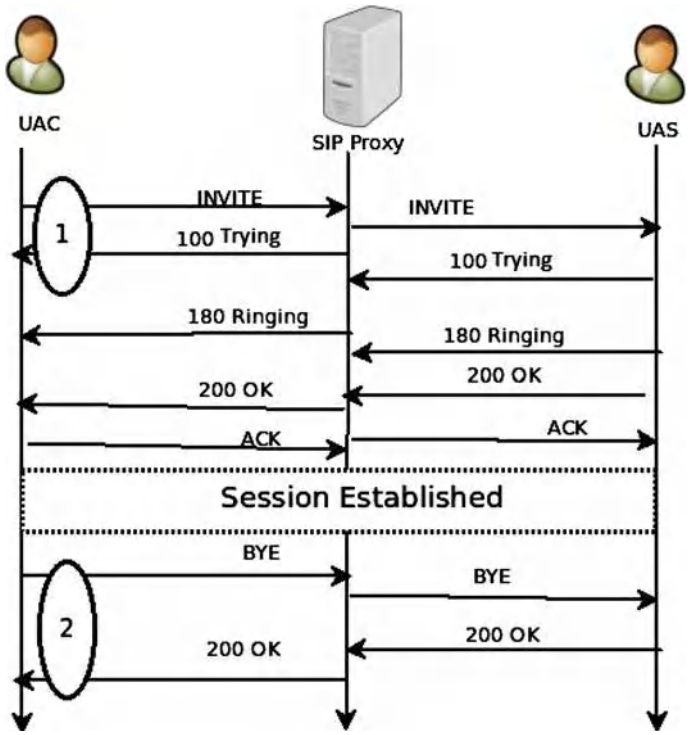

Fig. 1 An elementary SIP call flow

The proxy server forwards the INVITE request to the callee and responds with a 100 TRYING message. Once the callee phone starts ringing, it sends a 180 RINGING message to proxy server which retransmits it to the caller. If both the user agent server and client agree, the response is 200 OK. Then the proxy server is by passed for the media communication. SIP distinguishes clearly between call and transaction. SIP also makes it compulsory for all response messages to have the same value for parameters like Call-ID, CSEQ, TO, and FROM fields for their respective requests. This helps in the request response matching. SIP does not specify any particular transport protocol. For the transport layer, SIP can be used in combination with TCP (Transmission Control Protocol), Real-time Transport Protocol (RTP), UDP (User Datagram Protocol) or SCTP (Stream Control Transmission Protocol). A SIP invitation is considered successful when INVITE is responded with ACK. But ACK is not a part of the SIP transaction. Disconnection of a SIP call is done by either the caller or the callee sending the BYE request. 200 OK is required after the BYE request to conclude the SIP transaction flow. In case of proxy server failure, the redirect server forwards the INVITE requests.

This paper is about load balancing algorithms used in SIP network. Section 2 covers related work done in SIP server load balancing. In Sect. 3 we provide details of different load balancing algorithms. Section 4 gives implementation details and Sect. 5 gives experimental test bed infrastructure description to evaluate load balancing algorithms. Brief results evaluating INVITE response time, BYE response time, and throughput/good put are discussed in Sect. 6 and conclusion is drawn in Sect. 7.

2 Related Work

Solutions for web server load balancing and fail over mechanisms are evaluated by Ciardo et al. [2]. SIP differs from HTTP essentially with respect to session establishment and management. SIP call dispatcher is required to store the session information for correct proxy server call routing [3]. In web servers, high availability is achieved by IP address takeover and MAC address takeover schemes. Hong et al. divided the SIP overload algorithms in two main categories: Load reducing and/or Load balancing approach [4]. Load reducing is quite blunt and just rejects the incoming requests for new calls when an overload is detected. On the other hand, load balancing aims at equal distribution and redistribution of the SIP traffic among the servers. Again, load balancing methods are categorized as either static or dynamic. Cisco has used static load balancing based on DNS SRV in its architecture as well as Naming Authority Pointer records also. The decision taken by Load dispatcher for the server selection is on the basis of priority and weight pertaining to these records. Kundan Singh et al. employed web server redundancy techniques for SIP calls management. Their work has evaluated several load balancing methodologies relying on DNS, SIP header parameters, unused servers with exclusive IP addresses and NAT on a two tier architecture [5]. Their evaluative

study also took into consideration fail over mechanisms using DNS, clients, database replication and IP address takeover. Hongbo et al. have proposed a set of three dynamic algorithms for SIP server farms [6]. These algorithms make request assignments based with session data awareness. Transaction Least Work Left (TLWL) betters the performance of the other two algorithms in terms throughput and response time [7].

3 Load Balancing Algorithms

In this particular section we explain the load balancing algorithms used for selecting SIP server by the Load balancer. UAC's send INVITE, BYE request to the load balancer, load balancing algorithm selects a best SIP server to forward the request. The servers transmit responses like 100 trying, 180 ringing to the load balancer, then the load balancer forwards to UAC as shown in Fig. 2.

Load balancing algorithms are classified depending on where they have implemented such as Receiver Initiated, Sender Initiated. Static load balancing algorithms takes decision on predefined policy whereas dynamic load balancing algorithm takes decision on present CPU load, Memory Utilization, Response time parameters of SIP servers.

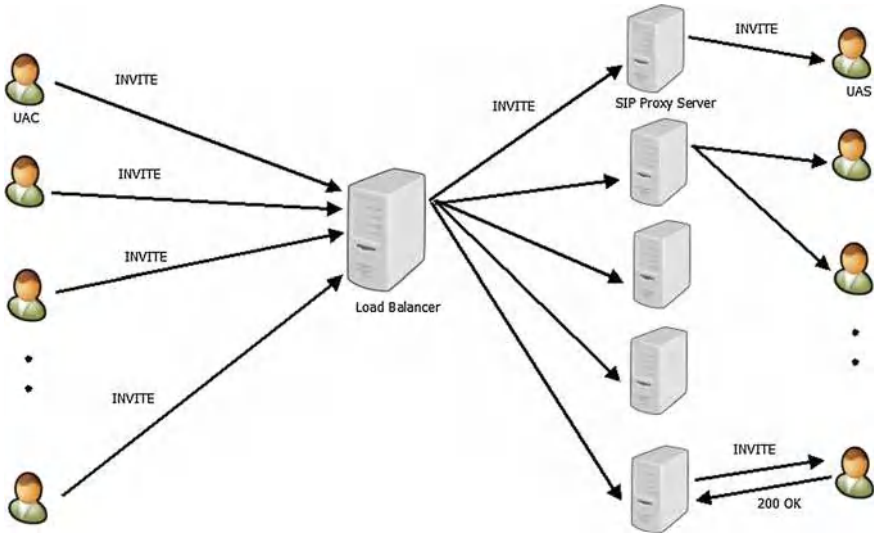

Fig. 2 Load balancer

3.1 Round Robin

Round Robin algorithm is the default algorithm implemented in most of practical Load balancers like Kamailio and Mobicents servers. It randomly select the SIP server for every fixed round-trip time. The algorithm does not consider the current load experienced SIP server and takes decision unconsciously so it has poor performance.

3.2 Call Join Shortest Queue (CJSQ)

Call Joint Shortest Queue algorithm keep tracks the number of calls dispatched to each SIP server by maintaining counters for each server. Load balancer routes the new requests to the server which have least number of calls. Counter is incremented when a new INVITE request is forwarded to the SIP server. The algorithm take decision on number of calls allocated to each SIP server. But it is not adequate because SIP protocol distinguishes between a call and transaction. Processing activity of the INVITE request requires more resources compared to the processing of the BYE request.

3.3 Transaction Join Shortest Queue (TJSQ)

Transaction Join Shortest Queue algorithm distinguish between calls and transactions. A SIP transaction is different from a call, a SIP call start by sending INVITE request and ends with BYE request. SIP transaction is the one in which INVITE request was sent and corresponding 200 OK was received. Load balancer which use TJSQ algorithm dispatches the new INVITE request to a server with minimum transactions. TJSQ algorithm keeps track of completion of call so that it has a finer grain control of loads to the server. Transaction Join Shortest Queue gets better performance than CJSQ because calls have variable durations. The number of calls routed to a server is not an accurate measure of load experienced by each SIP server.

3.4 Transaction Least Work Left (TLWL)

Transaction Least Work Left algorithm takes decision on least work (Load) to be done to route the new call to the SIP server. Here the load is calculated by giving relative weights to INVITE and BYE transactions. Since INVITE transaction consumes more resources compared to BYE transaction. INVITE needs database lookup whereas BYE transaction involves release of resources. Cost ratio of 1.75:1 was assigned for INVITE and BYE respectively.

4 Implementation

We had implemented load balancing algorithms by modifying dispatcher module of Kamailio [8]. Kamailio happens to be an excellent open-source SIP router present in many VOIP networks. Kamailio can be configured as a Proxy server, Registrar server, Back-to-Back User Agent client/server, Presence Server as well as Load Balancer. It supports both IP Version 4 and IP Version 6 addresses. Kamailio is a communication protocol which supports TCP, UDP, TLS and SCTP protocols. Kamailio can support thousands of calls per second even on low-budget hardware. I&I Internet AG one of leading ISP in Germany used Kamailio to provide service to millions of VOIP users. Kamailio has been written in C language. Apart from C it supports scripting languages such as LUA, Perl, java and python. Due to its modular design, Kamailio modules can be selectively loaded by changing the configuration file. Kamailio supports NAT traversal and database support. The core module of Kamailio provides basic functionality such as Transport Management, memory management and shared memory. Remaining features such as Presence, PSTN routing, accounting, load balancing, Security are implemented as separate modules.

In our implementation we has used dispatcher module for Load balancing of SIP requests. Dispatcher module of Kamailio provides stateless load balancer to dispatch SIP traffic. Many algorithms like round-robin, hash-over SIP attributes, Call load distribution and weight based load balancing already implemented in this module. We had added new load balancing algorithms such as Call Join Shortest Queue (CJSQ), Transaction Join Shortest Queue (TJSQ), and Transaction Least Work Left (TLWL) to the *ds_select_dst* function. Destination addresses of proxy servers are given as a list file.

5 Experimental Test Bed

For evaluation of the load balancing algorithms, we have designed an experimental test bed infrastructure. The system design was depicted in Fig. 3. We have used experimental test bed infrastructure consisting of three systems. The hardware configuration used in the test bed are listed in the Table 1. Standalone components of the test bed infrastructure have been described below.

5.1 Load Generator

Load generation for our experiments was done using SIPp, a popular industry used open source platform tool for load testing. The version of SIPp was 3.3. SIPp allows

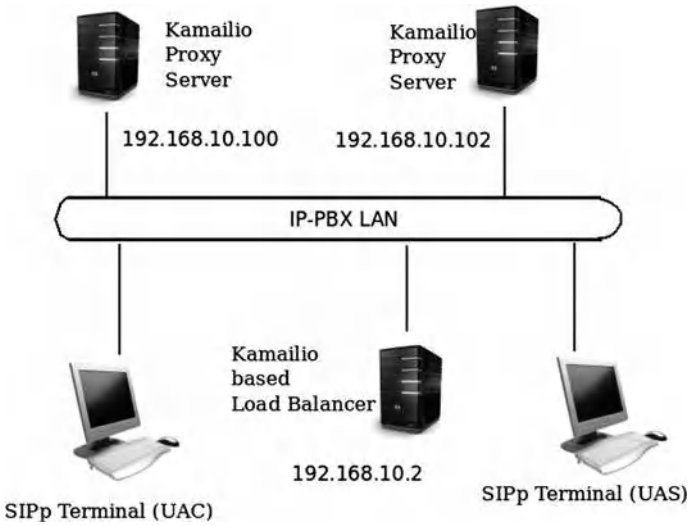

Fig. 3 SIP load balancing test bed

Table 1 Hardware test-bed characteristics

PC 1	
CPU	Intel Pentium D 3.0 GHz
RAM	1 GB
OS	Ubuntu 13.10
Role	UAC
PC 2	
CPU	Intel core i3
RAM	4 GB
OS	Ubuntu 13.10
Role	Upstream Proxy, UAS
PC 3	
CPU	Intel core i5
RAM	4 GB
OS	Ubuntu 13.10
Role	Downstream Proxy

for emulation of UAC or UAS depending on the XML configuration provided. Our UAC was emulated with our XML SIPp configuration and we used the SIPp features to record the statistics like response time. SIPp was also configured to increase the call rate by 5 cps for every 5 s till the maximum limit of 10,000 calls.

5.2 Load Balancer

The entity which performs load balancing is called Load balancer. Kamailio has a kernel type core which has implemented SIP protocol and takes care of memory management. Due to its modular architecture, Kamailio functionality can be configured by plugging additional modules. Kamailio configuration options provides a way to handle different SIP requests. The default configuration file provided by Kamailio server can be used for proxy server directly. For configuring the server as load balancer we have used a custom configuration file supported by Kamailio. The load balancing was implemented in dispatch module. The dispatch module provided by Kamailio has implemented round-robin, load based and identifier based algorithms. We modified the dispatcher module by incorporating novel algorithms such as Call-Join-Shortest-Queue (CJSQ), Transaction-Join-Shortest-Queue (TJSQ) and Transaction-Least-Work-Left (TLWL). Dispatcher module distribute the call requests to the proxy servers defined as list file or database. For simplicity we have used a list file consisting of five SIP proxy server addresses.

5.3 SIP Proxy Server

PJSIP is one of open source SIP stack written in C++. Its design has a small footprint and can be portable to any platform. To implement SIP Proxy server we developed an application based on PJSIP library which fulfils basic server functionality. We run SIP Proxy on five different ports on the same machine to simulate five SIP proxy servers.

5.4 User Application Server

For call termination, UAS was configured by instantiating the PJSIP stack platform. The UAS was used to send 200 OK for every request so that the SIP transaction is closed. This resulted in successful transactions for INVITE and BYE messages.

6 Results

Keeping in mind the end goal to quantify INVITE response time and BYE response time we have utilized a tweaked XML situation record in SIPp. At whatever point INVITE solicitation comes timer 1 began and it is ceased while the related 200 OK

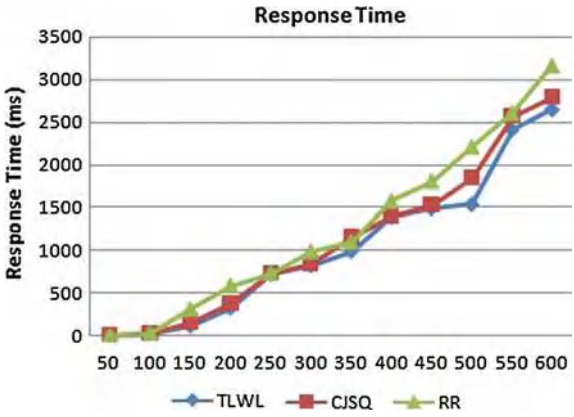

Fig. 4 Response time

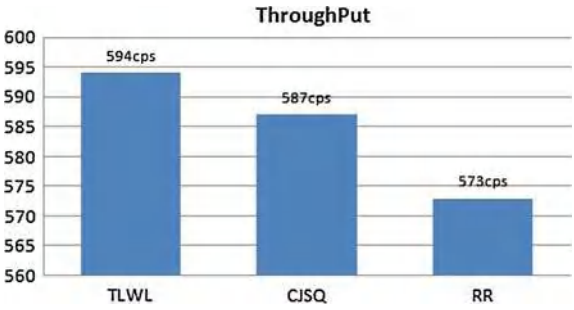

Fig. 5 Throughput

was received correspondingly timer 2 measured the BYE reaction time. We have collected the statistics employing—trace stat and—trace rtt options of SIPp. We had increased the SIP calls by bit by bit increasing the call rate until 600 cps was reached. In Fig. 4 response time for Round Robin, CJSQ, TLWL algorithm depicted. Transaction Least Work Left algorithm has minimum response time. In Fig. 5 throughput for Round Robin, CJSQ, TLWL algorithm depicted.

7 Conclusion

We have compared novel load balancing methods for SIP proxy servers in terms of throughput and response time. The algorithms are implemented using Kamailio server which is a famous open source SIP Proxy server. The results have proven that Session Aware Request Assignment based algorithms dramatically increase the good put/throughput and decrease the response time.

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Cluster Head Selection by Optimized Ability to Restrict Packet Drop in Wireless Sensor Networks

Amairullah Khan Lodhi and Syed Abdul Sattar

Abstract Wireless sensor networks (WSNs) are comprised of spatially distributed autonomous nodes attached to the sensors to detect and maintain physical and environmental states. Energy efficiency is an important challenge in wireless sensor networks, in which the batteries are equipped with these sensors with limited amount of power and act as a power source, which having limited storage capacities. Thus, energy efficient routing techniques are required incorporate operations of wireless sensor networks to provide the network connectivity and routing of data with less energy consumption. Clustering in WSNs is greatest widespread mechanism in routing processes. Existing energy efficient clustering algorithms selects the cluster head based on energy status. However, these protocols cause the cluster head to become bottleneck and drops the packets due to insufficient buffer. Thus in this work, we propose a novel efficient metric to select the cluster head known as "optimized ability to restrict packet drop" to enhance the network lifetime. This metric provides the status of nodes with respect to energy and memory. Calculation of residual status of an intermediate node is done by knapsack algorithm. Performance of proposed work is analyzed by NS2, and the results show that our work outperforms in comparison with existing protocols.

Keywords Energy efficiency · Cluster head · Wireless sensor network Routing

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1 Introduction

Wireless sensor networks are emerging as a powerful requirement in wireless technology [1]. These sensor networks expected to acquire thousands of nodes with sufficient sensing capabilities and limited communicating and computational energy allowing utilizing a sensor network in large scale. WSNs consist of smaller elements to monitor natural and physical states like temperature, humidity, pressure, motion, pollutants. Such networks can be deployed widely in various environments for civil, commercial, and military applications such as vehicle tracking, medical, surveillance, acoustic data gathering, climate, and habitat monitoring. Power, processing, and storage are the key drawbacks of WSN technology. Due to these limitations and specific sensor node architecture, there is an increasing necessity in secure and energy efficient communication protocols. An advanced technology like MEMS combined with low-cost, low-power DSPs and RF devices accelerates its viability of these inexpensive sensor networks. These sensors are comprised of radio transceivers, actual sensors, microcontrollers, and power supply. The sensing circuits collectively compute the ambient states associated with the environment surrounding the sensor and alter them into an electrical signal. Managing such a signal exhibits some properties about objects located and/or events happening in the sensor area. A sensor collects such data and transmits either directly or through a gateway toward a central node usually via radio transmitter.

Generally, these nodes are distributed throughout the space which needs to be monitored. They organize themselves in such a manner that they can collaborate easily with each other to complete the usual tasks through wireless communication medium. Wireless sensor networks [2] are provided with essential features such as dynamic network topology, self-organizing capabilities, node mobility, failure of a node, multi-hop/single hop routing, and short-range broadcast communication and large-scale deployment. Wireless sensors are flexible and scalable and hence are powerful to be deployed in many applications. These networks can organize themselves and do not require any fixed infrastructure to communicate, which leads them to be arranged in an ad hoc manner in hazardous locations and remote area without any existing physical shape. Therefore, computational node and communicating protocol operations must be energy efficient. Since the energy consumed during data transmission takes 70% of the total energy required, data transmission protocols are more important among these protocols.

In this work, we provide a comprehensive survey on energy efficient WSN protocols and propose a cluster head selection metric "optimized ability to restrict packet drop." Proposed work minimizes the energy consumption and increases the lifetime of wireless sensor networks by considering optimized ability to restrict packet drop with respect to energy and buffer. The remaining part of the paper is organized as follows. Second section provides the related work which presents survey of several routing protocols, Sect. 3 gives proposed work which explains the novel metric calculation algorithm in WSNs, Sect. 4 gives cluster head selection, Sect. 5 gives performance analysis of WSN routing protocols. Finally, Sect. 6 presents conclusion of this paper.

2 Literature Survey

Various researchers are adopting the methods to reduce energy consumption by studying the cause which effects energy consumption. Hence, till now various papers are being analyzed to minimize the energy requirement of these types of wireless sensor networks. Some of these are specified in this paper to consider both the consumption of energy and security of the protocol too. Since energy and security of nodes are always required in wireless sensor networks, various attacks are the main threat which can steal or alter the confidential information and can be destructive in emergency situations. We considered recent papers familiar to the latest issues in WSN technologies involving energy and security.

A genetic algorithm provides number of optimized cluster heads, due to which there are possibilities of local minimization. It can be improved further by stimulated annealing thereby resulting in global minimization. With the help of genetic algorithm, Roslin S. E. [1] created a hierarchical network for WSN. This network administers the network topology without affecting its characteristics. The network performance impact is studied for networks with various densities. A quantitative analysis of the methodologies proposed on an N-Tier with various densities proves that the two-tier architecture provides reduced consumption of energy in comparison with other architectures. Hence, a two-tier sensor network developed with GA can be utilized in any hazardous regions. Based on AHYMN approach, A. S. Uma Maheshwari [2] utilized a new method and represented a generic algorithm to form a sink node dynamically in sensor networks. Hence, it is more accurate and quicker to recognize the nodes with maximum node energy and to choose the cluster heads. The benefits of heterogeneous nodes are the longer network lifetime, network reliability improvement, and it decreases data transfer delay.

For effective selection of cluster heads and to improve HBO algorithm, Kiranpreet Kaur [3] proposed a cluster head selection protocol known as EDC-HBO. It considers the distance factor and energy as a parameter to enhance sink node selection. This is used to improve the lifetime and to reduce the power consumption as well. Results show that EDC-HBO is more energy efficient as compare to other protocols. As WSN is data redundant, our future work will be over designing and realizing routing protocol with optimal data aggregation. R. Aiyshwariya [4] proposed the hierarchical fizzy integral over the scheme in order to make energy efficiency to be a single entity to decide the cluster heads, which is the key innovation and advancement of classical protocols. Moreover, the new scheme effectively eliminates the unwanted data so that both the energy consumption and traffic are reduced. In terms of cost, this FMPDM is more beneficial than existing protocols. The simulation results show that the energy efficiency and network lifetime of FAHP are superior to the other classical protocols. When compared to FMPDM, it improves decision-making consistency and also increases the parameters of energy, throughput and lifetime efficiently thereby increasing robustness.

For improving LEACH by utilizing equally distributed cluster and reducing unequal cluster topology. Bin Deni Raj [5] introduced a new algorithm based on

clustering for wireless sensor network with maximum lifetime known as EDR-LEACH. The new network protocol can be established upon the shortcoming of LEACH to test and amend them. Result shows it increases lifetime considerably. Nabil Ali Alrajeh [6] studied that our protocol cannot be transferred from wired networks to wireless environments; Because WSNs have special liability that does not obtain in wired networks. Hence, in this paper, some of the protocols are used to describe with some methods to determine where the packets can be checked. This includes new theoretical approach which observes that the author is able to enhance energy through energy saving sufficiently for resource-constrained and large networks.

3 Proposed Work

Selecting suitable cluster head in a WSN is a challenging task due to its characteristics and constrained properties. Cluster head should be effective in terms of energy and memory, as limited battery of node is major considerable issue. Available energy of node should be used to complete communication task as much as possible to prolong the network lifetime. In the literature, number of protocols developed to solve the issue of cluster head selection based on energy. However, these protocols cause the cluster node to drop the packets due to insufficient buffer. This situation causes the tremendous negative impact on network performance with respect to throughput and also causes the congestion in network. We argue that energy and memory both parameters are important to decide the node to become cluster head. In this paper, we design a mechanism to select cluster head based on the two parameters, i.e., energy and memory of node. We name the cluster selection metric as "*optimized ability to restrict packet drop*" with respect to memory and energy. This metric help to predict the node ability to restrict the packet drop from a node, and which interns help to prevent the packet loss, congestion, and also improve network lifetime. Without loss of generality, we are considering following conditions to compute the metric.

Every node in a network equipped with battery of "E" joules of energy to process 'P_E' packets and buffer 'B' capacity to hold the 'P_B' number of packets. During time interval 't', let one packet let 'i' through the node, it consumes finite amount of energy of node and utilizes the buffer size. Then the node parameters, remaining energy of node E_r and residual buffer of node B_r become as follows in Eqs. (1) and (2),

$$E_r = P_E - P_{ei}, P_E > P_{ei} \tag{1}$$

$$B_r = P_B - P_{bi}, P_B > P_{bi} \tag{2}$$

In what extent the node drop the packet is nothing but, the capacity of node to process the packets without dropping in an available energy and memory. With help of knapsack algorithm, we computed it by satisfying below conditions

1. Packets must be process within the given residual energy and memory of node.
2. Maximum packets must be processed by node.
3. Part of packet must not processed by node, and this condition will consider as illegal.

The metric "*optimized ability to restrict packet drop*" is calculated by residual energy and memory of intended node. The notation we are considered in our work shown in Table 1. We assume that the node N_i receives the packets from multiple sources within its residual energy and memory E_r and B_r, respectively. The nodes ability to restrict packet drop are up to P_n number of packets. In order to successful process of n packets from a given node without drop, the node must satisfy the below conditions

1. Packet must process completely from a node.
2. Partial process must not be happen, but packet can drop from an node completely.

We contemplate positive values '*n*' of topples as follows to compute the metric "optimized *ability to restrict packet drop*."

1. Let the ability to restrict the packet drop of a node is up to $\{P_1, P_2, P_3, P_3, P_4, \ldots, P_n\}$, every packet consumes P_{ei} of energy and P_{bi} buffer of node to process.
2. We need to calculate the capacity of node to restrict the packet drop in the manner of energy and memory, and also, we need to compute the maximum capacity of the node to process number of packets without dropping the packets.

Table 1 Notation used in our work

Notations	Description
E	Battery energy in joules
P_E	Number of packets for node
P_B	Number of packets for buffer
T	Time interval
E_r	Remaining/residual energy of node
B_r	Remaining/residual buffer of node
Pei	Individual energy node packet
Pbi	Individual buffer packet
ORmax	Maximum threshold value
ORmin	Minimum threshold value
B	Buffer of sensor node
P_n	Number of packets

For instance, we need to find out the capacity of node to process maximum packet of count $K\epsilon\{P_n\}$ to maximize the packets $\sum P_n$, where $n\,\epsilon\,K$ with respect to $E_r(P_n) \leq E$ and $B_r(P_n) \leq B$.

In order to compute the metric "*optimized ability to restrict packet drop*" with respect to buffer and memory, one expedient method is to attempt all the achievable processes subject to K. We computed this with the help of knapsack algorithm, which give two-dimensional array with following entries in Eqs. (3) and (4)

$$J[0 \ldots n, 0 \ldots E] \forall 1 \leq P_n \leq n \, and \, 0 \leq E_r(P_n) \leq E \tag{3}$$

$$L[0 \ldots n, 0 \ldots B] \forall 1 \leq P_n \leq n \, and \, 0 \leq B_r(P_n) \leq B \tag{4}$$

Such that J[i, E] and L[i, B] are the maximum packet processing capacity of node in a residual energy and memory without packet loss. The entries must not have the following conditions

$$J[0, E] = 0 \, \forall \, 0 \leq E_r(P_n) \leq E \text{ and } L[0, B] = 0 \, \forall \, 0 \leq B_r(P_n) \leq B$$

$$J[0, E] = -\infty \forall E_r(P_n) \leq 0, \text{ not acceptable and}$$

$$L\left[0, T_p\right] = -\infty \forall B_r(P_n) \leq 0, \text{ not acceptable}$$

To compute "*optimized ability to restrict packet drop*" *with respect to energy and memory is as follows*

$$J[\mathrm{i}, E] = \max(\mathrm{J}[\mathrm{i}-1, E_r(P_n)], \mathrm{L_i} + \mathrm{L}[\mathrm{i}-1, E_r(P_n) - E_r(P_{n+1})]) \forall 1 \leq i \leq n \text{ and } 0 \leq E_r(P_n) \leq E \tag{5}$$

$$\mathrm{L}[\mathrm{i}, B] = \max(\mathrm{M}[\mathrm{i}-1, B_r(P_n)], \mathrm{M_i} + \mathrm{L}[\mathrm{i}-1, B_r(P_n) - B_r(P_{n+1})]) \forall 1 \leq i \leq n \text{ and } 0 \leq B_r(P_n) \leq B \tag{6}$$

To find the desirable solution from the subset of knapsack algorithm [7, 8], we have to extend the auxiliary array $Keep[\mathrm{i}, E_r(P_n)]$ and $Keep[\mathrm{i}, B_r(P_n)]$ correspondingly. This Boolean array becomes one if and only if the node processing the *i*th packet does not drop; otherwise, it becomes zero.

4 Cluster Head Selection

Evaluated metric "*optimized ability to restrict packet drop*" with respect to energy and memory is used for cluster head selection. In the network initialization stage, every node present in a network must compute their "*optimized ability to restrict packet drop*" metric and also, it calculates reactively to obtain node status. We keep

one threshold value to decide the cluster head known as OR_{max} in idle condition and OR_{min} in least conditions. Computed *OR* value is greater than the maximum threshold value, and then the node can consider for cluster head. Cluster head selection has done by the conditions given below.

1. Node becomes cluster head if evaluated "*optimized ability to restrict packet drop*" *OR* is higher than OR_{max}.
2. Node becomes as backup cluster head if evaluated value of "*optimized ability to restrict packet drop*" *OR* lies between OR_{max} and OR_{Min}.
3. Node cannot considered for cluster head if evaluated "*optimized ability to restrict packet drop*" *OR* is less than OR_{max}.

5 Performance Evaluation

Performance evaluation of proposed mechanism is carried out by NS-2 [9] with appropriate extension in existing libraries and compared with existing cluster head selection algorithms [2, 4] in identical network environment. In our simulation, we considered the communication distance of each node is about 250 m and single hop transmission delay is 10 ms. All sensor nodes arranged across the 1000 × 1000 square area. All nodes are equipped with battery of 10 J energy, IEEE 802.11 e network interface card, and memory. Send data is transmitted in the form of packets of size 512 bytes with consumption of transmission power is 600 mW, the receiving power is 300 mW of node. Each sensor node should run our cluster head selection mechanism and cluster head broadcast its beacons over two hops every 20 s.

Main intention toward our work is to determine the node's *optimized ability to restrict packet drop* within residual buffer and memory, and rendering to it decides the cluster head. We therefore evaluate the performance of network with respect to throughput, packet loss, and network lifetime and compare it with the existing-1 [2], existing-2 [4]. Figures 1, 2, and 3 clearly shows that our proposed mechanism is enhance the network performance and extend the network lifetime.

6 Conclusion

Clustering in WSNs is greatest widespread mechanism in routing processes. Cluster head selection is done based on only one parameter energy results in packet loss due to insufficient buffer. In this work, we consider two parameters energy and buffer to select the cluster head in network. We introduce the novel metric to select the cluster head called "optimized ability to restrict packet drop," which indicates the status of node regarding its status of buffer and energy. Moreover, our proposed

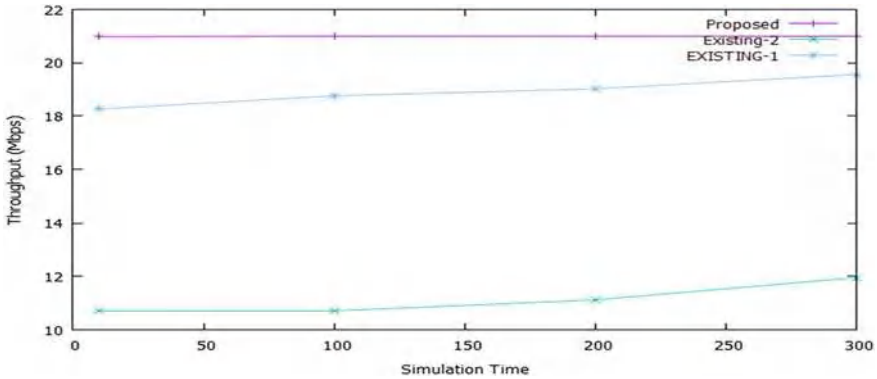

Fig. 1 Throughput versus simulation time comparison of proposed and existing works

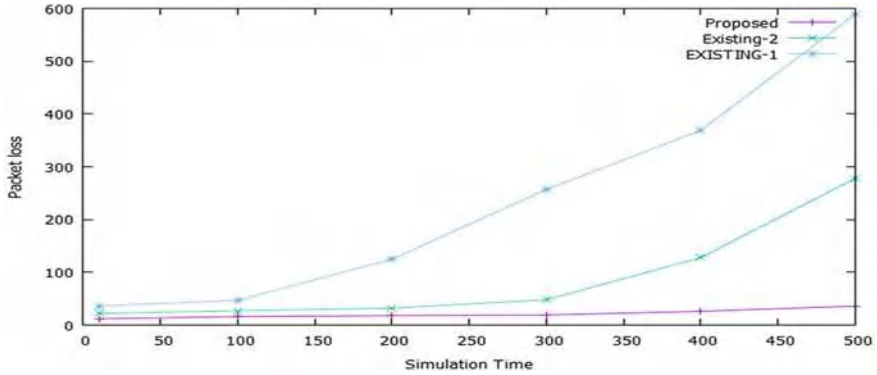

Fig. 2 Packet loss versus simulation time comparison of proposed and existing works

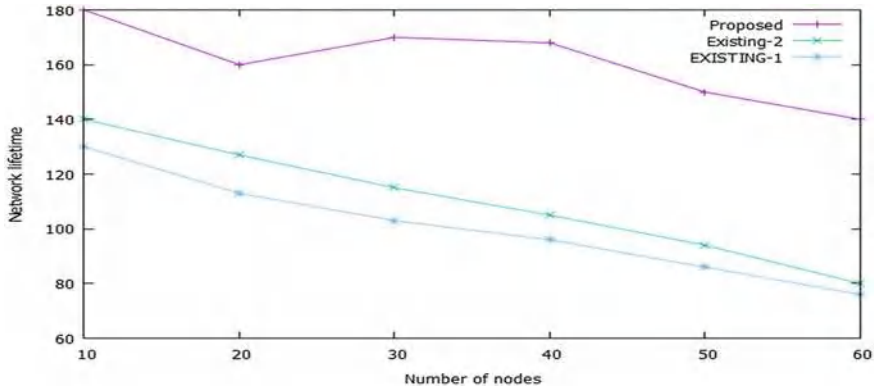

Fig. 3 Network lifetime versus simulation time comparison of proposed and existing works

protocol extended the network lifetime and save the energy of nodes. This metric provides the method to observe the present status of nodes in network, so it could be used as proactive cluster head selection and it is our future work.

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AN UPGRADED VERSION OF DATA PROTECTION COMBINED WITH CRYPTOGRAPHY

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Abstract: Information Security has constantly been an amazingly noteworthy angle with respect to forestalling unapproved access, destruction or examination of ordered data. Today every field on the planet uses sight and sound information. There is need to confirm the arranged information used in these zones. There are different approaches to manage secure information. One of them is Homomorphic Encryption (HE), which is the main hiding the information inside other data with the ultimate objective that there is no perceptible change in spread information. The assistant strategy for confirming information is cryptography, an encryption framework which scrambles the information into a wrote structure which is overall insinuated as figure. Both Homomorphic Encryption and Cryptography have their own one of a kind ideal conditions and limitations. Regardless of the way that the two techniques offer security, to incorporate various layers of security it is constantly a respectable practice to use Cryptography and HE together. So when cryptography and HE are used together, it results in multi-layer security model. The key objective of the proposed work is to give extra layer of security by showing cryptography nearby HE to encode and embed the mystery information to be sent over a non-secure channel.

I. INTRODUCTION

Cryptography, an encryption procedure which disarrange the data into some specific structure with the goal that lone expected client can peruse and process it. Homomorphic Encryption is demonstration of concealing messages so that the main beneficiary can make out the presence of the message [1]. Cryptography and Homomorphic Encryption got little consideration in registering. Numerous figures to be demonstrated powerless against the cryptanalytic assaults and numerous stega-methods are effectively noticeable. Subsequently the need emerges to give better security by joining these two methods. Here, if there should be an occurrence of bombing the Homomorphic Encryption framework, discharge message stay safe as a result of encoding system. Homomorphic Encryption isn't a trade for cryptography but instead to enhance it. The proposed model gives a double layer of security where cryptography and Homomorphic Encryption structure the internal and external layers of security individually. It primarily comprises of four phases to be specific encryption, implanting, extricating and unscrambling. Encryption and Embedding is finished by the sender where the mystery information is first scrambled utilizing a cryptographic calculation to change over the plain content into a figure, after which the figure is inserted into the spread record to conceal its quality as appeared in figure 1. This paper is on the correlation of Homomorphic Encryption calculations LSB and RDH with the execution of cryptography as an external layer.

II. OVERVIEW OF CRYPTOGRAPHY

This area gives various types of cryptography systems like AES, DES, RC4, RSA and Homomorphic Encryption methods like picture, sound, video, system and content Homomorphic Encryption.

- **CRYPTOGRAPHY**

Symmetric Key Algorithms [4]: In this calculation, a similar key is utilized by transmitter and the recipient to scramble and unscramble the message individually.

- **RC4**

RC4 is a symmetric key stream figure created by Ron Rivest. It is notable for its effortlessness and speed in its product. It utilizes variable key length commonly somewhere in the range of 40 and 2048 bits. Here the information stream is XORed with the created key arrangement.

- **AES**

AES otherwise called Rjindael's calculation. AES is a symmetric square figure planned by Vincent Rijmen and Joan Daemen distributed in 1998. The variable key length are 128, 192 and 256 bits. Two sorts of hashing calculations can be utilized in particular: SHA1 (Secure hashing Algorithm 1) Digest Size: 160 bits, Block Sizes: 512 bits, Rounds: 80 and MD5 (Message Digest 5) Digest Size: 128 bits, Block Sizes: 512 bits, Rounds: 4

- **3DES**

The triple data encryption algorithm (TDEA) is a Symmetric key square figure. It applies DES (Data

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Encryption Standard) multiple times to every datum square. It utilizes a Key pack that comprises of 3 keys K1, K2, AND K3 each 0f 56 bits. DES is universal, simple to actualize in both equipment and programming. Deviated Key Algorithm: In this calculation the sender and the client utilize distinctive keys to encode and unscramble. The deviated key we utilized here is RSA.

- **RSA**

RSA is a public-key cryptosystem, asymmetric key algorithm. RSA is developed by Ron Rivest, Adi Shamir,
and Leonard Adleman in 1977. Here sender and receiver use different keys to encrypt and decrypt.

III. METHODOLOGY

In the proposed work, the confidential text will be encrypted with the AES encryption and the key, which will be used for decryption, by using following modules:

- Admin
- Application Owner
- Broker
- User

➢ **Admin**

Administrator is the main module. Administrator login and make the numerous mists as indicated by details. He will make dealer for each cloud. Administrator can compute the nature of administration, security of administration and asset assignment. Discover the hazard examination between various applications.

➢ **Application owner**

Application proprietor is the subsequent module. First he will enroll and login. After login he can demand for numerous mists to the application then he will contact the merchant's of each cloud and send particulars and view principle insights regarding agent. On the off chance that any client demand for the application he can affirm the client. Give administration to the client as indicated by the application.

➢ **Broker**

Specialist is the third module of the venture. Specialist is the middle person among cloud and application proprietor. He can see the application proprietor solicitation and particulars. He will advance the solicitation to administrator and reaction from administrator to application proprietor.

➢ **User**

Client is the fourth module of the venture. First client will enroll with various applications and login. Client can use the administrations of the application and client can store or share the information as per the mists which is accessible to that application. Client subtleties and data is verified dependent on the security levels given by the application.

Sequence Diagram:

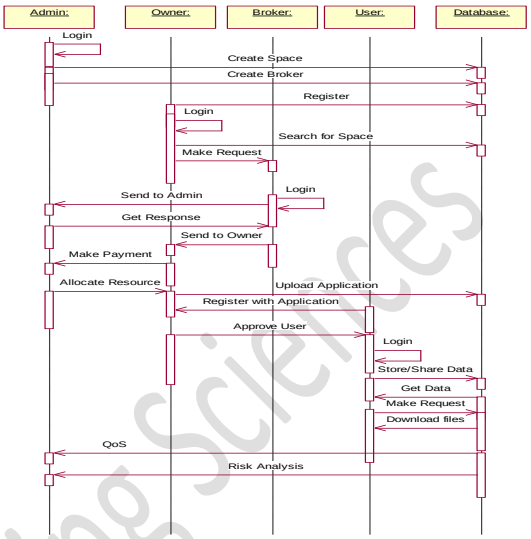

Fig. 1. Sequence Diagram

System Architecture

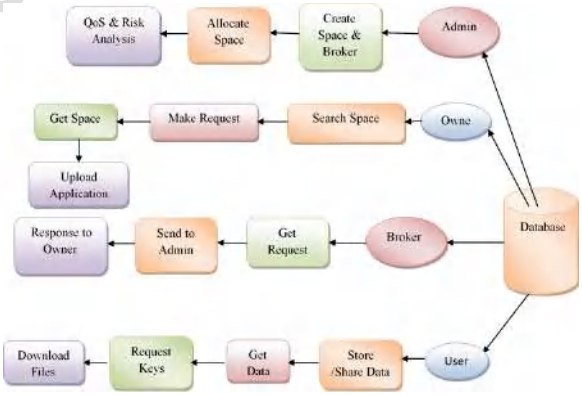

Fig. 2. System Architecture

IV. RESULT

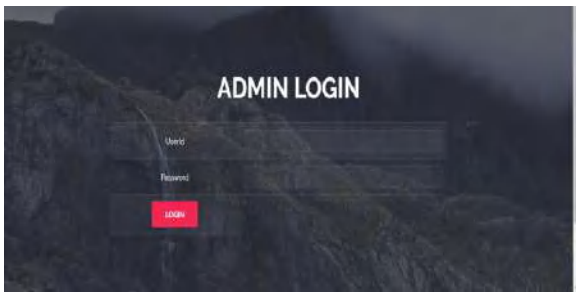

Fig. 3. Admin Login Page

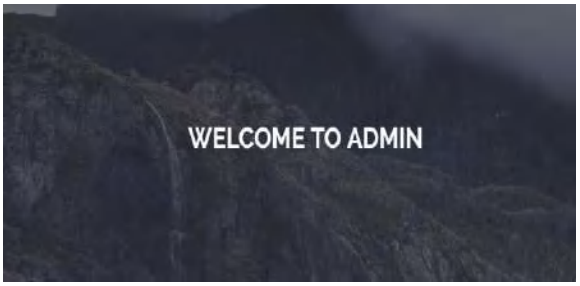

Fig. 4. Admin Welcome Page

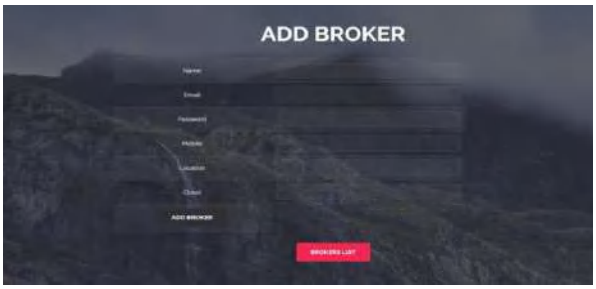

Fig. 5. Add Broker

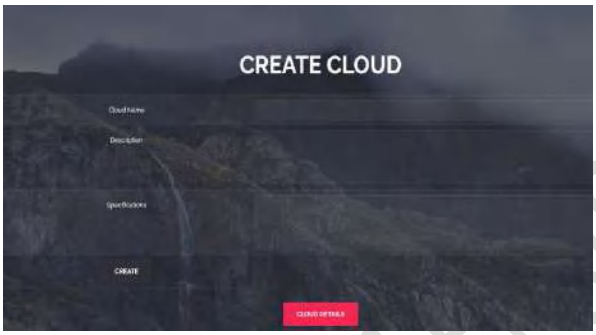

Fig. 6. Create Cloud Page

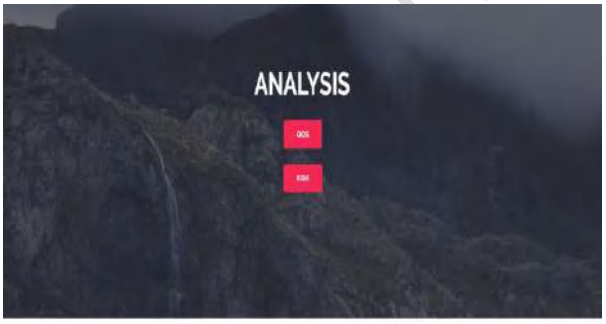

Fig. 7. Admin Analysis Page

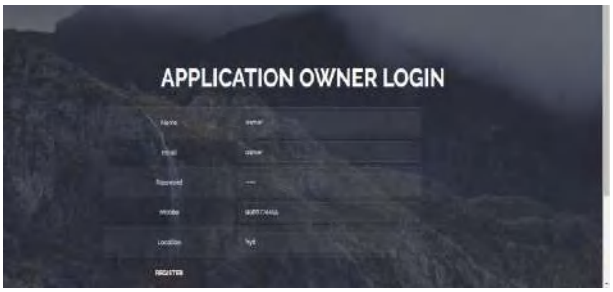

Fig. 8. Application Create Page

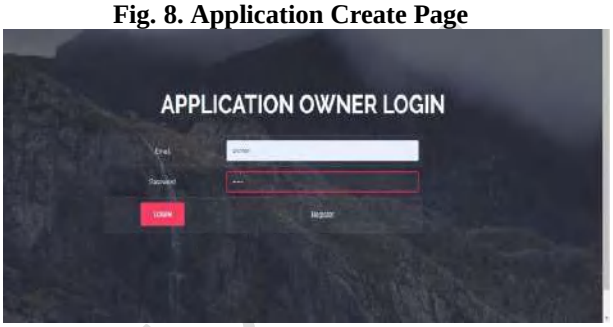

Fig. 9. Application Owner Login Page

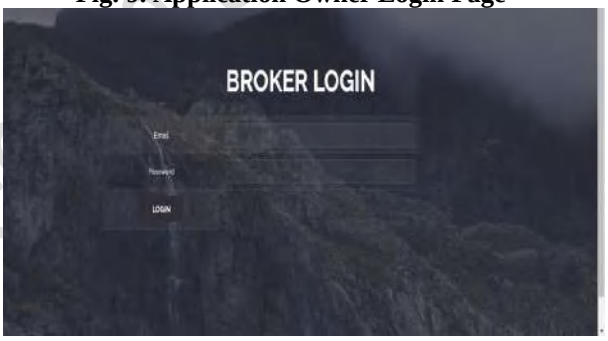

Fig. 10. Broker Login Page

V. CONCLUSION

Today, HE isn't executed in progressively broad ways anyway it might be used as the best security mechanical assembly. The standard issue of the present world is to check their private information; the methodologies used at present are either cryptography or HE, are not capable to confirm this information. Proposed count includes the usage of cryptography with HE by giving stunned security to the mystery data. Assessment of LSB, RDH and Improved RDH counts with twofold security model is viewed. The proposed count gives better results for concealing pictures in double level security.

In spite of the way that the image quality can be secured with high PSNR, visual quality can scarcely be improved. By definitely viewing the visual quality, the technique of RDH can be better improved to achieve the more pleasant results.

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A SURVEY ON ENERGY BALANCE IN WIRELESS SENSOR NETWORK

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Abstract-In Wireless Sensor Networks the sensorsare distributed autonomous to monitor Environmental Surveillance and Health Care, Commission Power, Computation Capacity and Data Storage and Habitat Monitoring. So energy saving should be done to prolong network lifetime. Energy saving hasadvantage in designing routing protocol, clustering algorithms and duty cycle.
The goal of our survey is to present a comprehensive review of the recent literatures since the publications first C. Efthymiou, S. E. Nikoletseas, and J. D. P. Rolim, "Energy balanced data propagation in wireless sensor networks," *Wireless Networks*, 2006 [1], second H. Zhang and H. Shen, "Balancing energy consumption to maximize network lifetime in data-gathering sensor networks," *Parallel and Distributed Systems,IEEE Transactions*, 2009 [2] and third Tong Liu, Tao Gu, Ning Jin, and YanminZhu,"A Mixed Transmission Strategy to Achieve Energy Balancing in Wireless Sensor Networks," Wireless Network, *IEEE Transactions,* 2016 [3]

Keywords-Wireless networks, Energy Balancing, Hop-by-hop, Corona, Slice Based, Network Prolong

I. Introduction

Fig. 1.Application of Wireless Sensor Networks

A Wireless Sensor Network (WSN) is constituted of sensing devices called sensors, which communicate wirelessly (see [4] for excellent surveys). These sensors are small with inadequate processing and computing resources and they are inexpensive compared to traditional sensors. A sensor node can sense, measure, and gather information from the environment based on some local decision process. Later, it transmits the sensed data to the user. Fig .1 shows different applications of wireless sensor network. In the initial stages, the research in WSN was taken forward by the surveillance applications in military and on the battlefield. Later on, WSNs were found to have use in interesting applications like moisture control in agriculture area, forest fire detection, building automation and security applications. For thispurpose it is to required to save energy and prolong the network approaches including hop-by-hop transmission technique, clustering technique and slice based model for altering power saving mode. In this technique energy aware data gathering has also been introduced. Sensors near the sink die out early compared to the other sensors. The reason is due to overuse. The energy balance problem in wireless sensor networks was first introduced in [5]. Inspired by this work, several works extend to study the energy balance problem in data propagation.

In this paper, we opt to categorize energy balancing algorithms proposed in the literature for WSNs. We report on the state of the research and summarize a collection of published schemes stating their features and shortcomings. We also compare the different approaches and analyze their applicability. The rest of the paper is organized as follows: Section II presents the various system models for WSN. In Section III, we discuss different energy balancing techniques. Section IV deals with the discussion and present classification of the various approaches pursued. Finally, Section V concludes the paper.

II. System Model

The arrangement of sensor nodes is placed in a medium such that they can interact with each other and also share their sensed information [4]. These sensor nodes usually follow the broadcast type of communication. These sensor nodes are characterized by restricted energy, low computational capabilities and limited amount of memory. The micro-sensors are deployed in an area of interest, in order to monitor crucial events and propagate the collected results to a base station or SINK.The sensor is made up of microelectromechanical system (MEMS) which are already small sized, low power and inexpensive.

III. Energy Balancing Goal For Wireless Sensor

A. Hop-by-Hop

Efthymiou, Nikoletseas, and J. D. P. Rolim (see[1]) proposed hop-by-hop algorithm. Decision taken by algorithm in each step will decide to propagate data from sensor to sensor. Algorithm helps to decide to choose

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between one-hop (indirectly) or to send data directly to the sink. One-hop is cheap compared to direct transmission. Direct transmissions are expensive but bypass the sensor present near the sink. Direct transmissions are used in rare cases. This isbecause the sensors which are present near the sink tend to die early due to overuse. This algorithm achieved energy balancing following the process by detail analyzing the probabilityof each propagation.

Hop-by-hop algorithm contributes in analyzing energy efficient and energy balance among sensors for data propagation. Probabilities are based on network size and distancefrom the sink at time.This Algorithm is energy efficient along with energy balancing. The model of the sensor network is random along with uniform events 'N' considered as total number in a certain period.'S'. The location of sink is fixed and it is powerful control center. Wireless sensor can be adjusted by broadcasting message from the sink. Transmission range are of two types here R (for network operator) and i.R (I = d/R d=distance between sensor and sink). This model overcomes energy balance problem in former algorithm

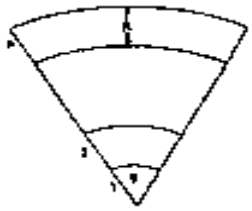

Fig 2 Sensor Network with n ring sectors, angle φ and ring "width" R

As you can see in the fig. 2 Virtual area is considered with an angle φ and the rings are divided into 'n' sectors or slices. The radius of first slice is 'R' and radius of the slice i is defined two waysi.e, i.R and (i-1)R. The energy spent on transmitting is directly proportional to the transmission distance. Based on the above details, network model is setup. Next is distributed data prorogation. Here it considers only one sensor for sensing the event in the presence of other sensor. A number of events occur in each ring and later the message is delivered to the sink. The sensors are placed uniformly and randomization should be done to achieve load balancing by evenly spreading the load.

Events are propagated from ring sector Ti (Pi probability) to Ti-1 (Next sector) and then directly to sink S. If Pi is increased then data is passed directly to sink. If Pi is decreased due to energy consumption then data is bypass through nearby sensor and it will reach sink. So therefore calculation of Pi is done in each Ti. This will be helpful for energy balancing. Data message is fixed throughout data propagation. So in finding Pi, i is distance between sensor and sink which can be found at the time of setup phase. After obtaining recurrency, energy balancing is achieved. Later calculation of P_i is quite straightforward.

The energy balancing property is achieved if any ring sector propagates each message which it handles with probability Pi to the next sector and later directly to the sink. Here P is not dependent on N events. The energy is average and similar in all network sensors, where each message will finally get to the sink. If Pi is small, then data transmission will be direct transmission and if Pi is large, then data transmission it will be hop-transmission. This theory is energy efficient and energy balanced. As the value of Pi decreases due to energy consumption they should spend more energy in sending message i.e., transmit directly to the sink (if it is close to the sink). Whereas for large network direct transmission to the sink occur after some hops which leads to energy balance. But if the fading factor increases then direct transmission to the sink are even less potential. So, this is why Pi increases when fading factor increases. Later recovering from fading the probabilities Pi is done. So with this theory energy balance and energy efficiency is achieved.

B. Corona

Haibo and Hong [2] proposed Energy Balanced data gathering (EBDG) protocol for energy balancing and data gathering in the sensor, later extended EBDG is introduced. It implies that sensors to sink direct transmission are not energy efficient. To overcome drawback multi-hop is preferred than direct to sink for long transmissions, but multi-hop tends to use close by sink sensors which will die at early stage and energy holes is created. This leads to unbalance energy across the nodes. In this network, Mixed routing scheme alternates between hop-by-hop and direct transmissions. In long distance transmissions hop-by-hop is used and for short distance direct transmission is used. Now energy balancing can be easily obtain. It shows that mixed routing scheme beats other routing strategies in term of Network Lifetime Minimization (NLM).

Energy balance and maximization network lifetime problems are investigated. Sensors are deployed in random uniform around the area. Here the probability is same in the entire corona. The sensor network is divided into corona. And the same probability is used by direct and hop-by-hop transmission.

The energy consumption problem is further divided into two sub-problems

a. Intra-corona energy consumption balancing (Intra CECB)

b. Inter-corona energy consumption balancing (inter CECB)

Intra CECB solves the problem by dividing the corona based on data received. Inter CECB solves the problem by

allocating the received data between direct and hop-by-hop transmissions. NLM problem can be solved by calculating the number of coronas divided in the network. So to balance energy among one corona and different corona, EBDG is designed.

Network model is same as the *Efthymiou, Nikoletseas, and J. D. P. Rolim* protocol. Sensors distributed in circular Area A, radius R and node distribution densityρ. Sink located at center and maximum transmission range Rmax . Here Rmax≥ R which means each node can communicate directly with the sink. Data gathering operation is divided into rounds and later data is propagated towards sink. If the operation is taking place between the adjacent rounds then rest of nodes will be turn off, as this will save energy. Here the data generated by each round is 'l'.

Data Aggregation model proposed is

$\varphi(x) = mx+c$ Where φ = data output, m& c values are dependent

m = 0	c > 0	Data aggregation
0 < m < 1	c = 0	Data aggregation
m = 1	c = 1	NoData aggregation

TABLE I.Data Aggregation values

Here we consider energy on the transmitting side and circle Area A is divided in concentric coronas C1 ,C2…..Cn with same radius r=R/n. Data is forwarded to neighbor round i.e., C to Ci-1. T be the number of round, F(u) amounts of data forward in hop-by-hop, D(u) amounts of data transmitted in Direct transmission.

It is assumed that same data distribution among nodes in same corona. For direct transmission radius is r and for hop-by -hop transmission radius is r′. (r'>r to balance energy among nodes in the same corona)

Problem	Solution
Intra corona	Balance energy between nodes in corona
Inter corona	Optimal data distribution
NLM	Divide optimal number of coronas.

TABLE II.Slice model

Inter-corona Energy consumption solves the problem if the amount of data is balanced in the corona. Then only energy will be balanced in the corona. To observe that, a localized based on routing scheme is designed to balance energy consumption among nodes in each corona.

The sufficient and necessary condition for Intra CECB

$E(u) = F(u).\varepsilon_t(r') + D(u).\ \varepsilon_t(i.r) + S(u).\varepsilon_r$

E(u)= Total amount of energy

S(u) = Total amount if data received

$F(u).\varepsilon_t(r')$ = energy spent through hop-by-hop transmission

$D(u).\ \varepsilon_t(i.r)$ = energy spent through direct transmission

$S(u).\varepsilon_r$ = energy consumption for receiving data

By calculating data distribution ratio allocation of the data distribution problem will be solved by Inter CECB. The network lifetime Maximization can be achieved by balancing energy consumption among all the nodes in the network. As the energy consumption gets balanced, all nodes have the same energy in the network. Data Distribution Ratio Computation (DDRC) algorithm is used to compute n coronas, Pi and di. As we know that r' should be longer than r for hop-by-hop. r' depends on the number of sub coronas i.e r'>

If w is small, then r' is large. If w is too long, then the width of sub corona will be small.Then each zone will become thin and large result is larger r. In hop-by-hop transmission energy sufficient is better compared to single hop. Later network is divided into few coronas, further divided into sub corona. Additional energy is spent in hop-by-hop transmission for recurring data is compare to Direct Transmission. The object of NLM problem is solved by calculating optimal number of coronas in terms of maximizing the network lifetime. While calculating NLM, it is reported as nonlinear integer programming problem. By using heuristic algorithm it can be solved.

The EBDG protocol is divided into two phases:

Network set-up phase and data gathering by using the message broadcast message signal from the sink to the portion of coronas, sub-corona parameter is placed. Data Gathering stage is based on EBDG, which are in two States i.e active and sleep. In active stage data is transmitted, received and data aggression, whereas in sleep state nodes turn off its radio to save energy.

Scheduling is done in all nodes in a network to finish repeating of data to the sink in an order from the outermost sub corona to the innermost sub corona. This scheduling scheme provides the opportunity to data aggregation to each node. This will help to reduce data collision. In EDBG, each node alternates between direct transmission and hop-by-hop transmission to balance energy consumption.

At any time slot, there are only two sub-corona whose nodes are in active state. The nodes in corona only transmit the data, and the node in another corona receives the data. This is done so as to avoid data collision. Extension to large-scale data gathering sensor network is done by

employing the advantages of clustering techniques. Because clustering techniques will divide the larger portion into cluster and each small node will contact the cluster head through single or multi hop routing.Here author have shown the solution to maximize network lifetime through balancing energy consumption from uniform deployed data gathering sensor network.

C. Slice Based

Liu, Gu, Jin and Zhu [3] proposed that energy balanced data is done then potentially can save the energy consumption and prolong network lifetime. Traditional hop-by-hop transmission propagates the data but result in poor energy balance. This problem can be addressed by applying slice–based model, further divided into inter-slice and intra–slice energy balancing. Probability based strategy is proposed for this problem named inter-slice Mixed Transmission protocol and intra -slice forwarding technique. By combining these two techniques Energy-balance Transmission protocol is proposed to achieve total energy balancing. This technique can overcome the drawbacks of hop-by-hop transmission and cluster based routing protocol.

Energy balancing problem is that nodes lying near the sink will die early compare to other nodes and in other case if node sends data directly to the sink than it will consume energy. So there will be energy imbalance in the network. To overcome this problem slice based network model is proposed. The area of the network is partitioned into slice with same width R and sensors are divided uniformly. The transmission range is R. To balance energy across is called inter slice and to balance energy. Energy across nodes in the slice is called Intra-slice energy balancing.

Inter-slice Mixed Transmission (IMT) [3] strategy is proposed to achieve Inter-slice energy balancing which will allow each sensor node to make opportunistic choice off its transmission range for sending packet. Linear programming is done for optional transmission probabilities. By using this, sensors near the sink use low power energy and sensors away from the sink use high power to send data to the sink. Hence energy balancing consumption is achieved between the slices.

When compared to traditional hop-by-hop data collection MT has two main advantages

a. Longer distance transmission with less delay.

b. Nodes have choice to select transmission power.

Intra-slice forwarding technique helps to Inter-slice energy balancing by allowing nodes with lower energy to forward their packets to the nodes with higher energy in the same slice and then the data can be propagated to the next slice through inter-slice transmission.

ETP is design by combining Inter slice mixed transmission strategy and the intra-slice forwarding technique to achieve total energy balancing during data collection and hence prolong network lifetime. This proposed protocol performs better than hop-by-hop and clustering based routing. Sensors are placed randomly uniform within the range of the network events occur periodically and probability space distribution in space is uniform. Data aggregation problem is not considered here. The energy spent on delivering which is believed the most important factor affecting network lifespan. Energy consumed by receiving side is also taken into consideration, unlike some existing work; typically ignore receiving side energy consumption denoted by Cr.

All the batteries of the sensor will drain out at the same time. So relay nodes should be chose wisely to make network to make network lifetime as long as possible. Here events are denoted by Z and lifetime is denoted by T. Events are proportional to T. The more number of events get supports, the longer the network survives. The area is divided into n sector or slices. The slice area can corner area network by taking a proper large angle. The slice is shaped by two successive disk sector with Radius equal to iR and (i-l) R respectively the difference between two sectors is R which is the radius of the slice. By using slice model, the maximum transmission ‘m’ distance of a sensor into the multiple of slice Radius R. When m is greater than n then packets send directly to the sink node, when m =1 the process will be hop-by-hop transmission.

Inter-slice energy balancing problem, nodes in the slice consider as a whole. All slice drain energy at the same rate. The energy consumed by slice Si in the lifetime is decided by data sent to upper slice and data received from lower slices. Fi, j denoted as the total number of data events transmitted from Si to Sj in the lifetime T. With the help of flow count energy can be calculated.

The above equation is the energy balance equation, to ensure that the network will finally achieve inter-slice energy balancing. It will eliminate unnecessary transmission overhead in the network. Intra-slice Mixed Transmission (IMT) will decide based on probability distribution. The transmission probability between two slices will be decided.

Based on this probability, end node in the network determines its next slice to propagate its data towards the sink. It will consider only the next slice, but not the next node in the slice. There is no difference in choosing in next nodes as we consider the energy received by the slice. To choose battery larger than Cr with maximum remaining battery in the relay, maximum life of a node is difficult to obtain in real life due to some of the reasons like energy in the slice drain out at same time, no data packet is dropped and part of energy consumed by Intra-slice transmission. A feedback mechanism is used so as to know about the next

node relay energy so that no unbalanced energy left in the network. The results are same as hop-by-hop transmission. The problem in Intra-slice energy balancing is as one node dies the other node die more quickly in the same slice, it should make all the nodes die at the same rate. To overcome this problem Intra-slice forwarding algorithm is designed. It will decide which node should be selected as relay and when Intra-slice transmission is needed. The main idea of this protocol is the node with less energy receives the data it should transfer the data to the other node in the same slice with maximum energy.

Two main factors affecting the design of Intra–slice forwarding algorithm, first sending node should select intra-slice transmission than inter-slice transmission and the second factor is if two much Intra-slice transmission takes place in the slice than there will be energy imbalance in the Intra-slice and reduce network lifetime. A node in a slice will receive a packet and it will decide to send it to adjacent slice. It will compare the node energy with the adjacent slice energy (using threshold Energy). By using Inter- slice mixed Transmission approach the node will deliver the packet.

IV. Discussion

Drawback of a hop-by-hop transmission model [1] is it hardly achieves energy balancing since the sensors nodes lying closer to the sink are always transmit more packets than those lying farther away from the sink. In Slice model[3], the result will be the same as the hop-by-hop model when the maximum transmission range m is restricted by one hop. Thus, there exists a relation between transmission range m and network size n. This relation assists for practical implications for network development and management. In reality it's difficult to achieve energy balancing through Inter-Slice. Reasons for not achieving maximum lifetime, it cannot be ensured that the energy in each slice drain out at the same time, it is difficult to guarantee that no packet is dropped and all packets are delivered to the sink exactly when the lifespan ends, such that equality constraint [4] fails and part of energy in b_i will be consumed by intra-slice transmission. Some slice will exhaust first, which becomes the bottleneck of prolonging network lifetime. A second chance is given to select next hop without considering enough energy to send and receive. To maintain the information of a slice a feedback is mechanism is set up.

V. Conclusion

Thus, we have presented here the survey of different energy balancing based routing algorithms for hop-by-hop transmission, Corona based and Slice based algorithm to identify energy unbalancing or reducing energy data redundancy and cluster based fault detection techniques to identify faulty nodes in time and eliminate it from the network. We have also presented the analysis of surveyed algorithms based on parameters like energy consumption, network lifetime, detection and recovery time etc. Using this analysis, our future work is the simulation of an algorithm that can be used to prolong network lifetime with less energy consumption.

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A KEY LEVEL SELECTION WITHIN HASH CHAINS FOR THE EFFICIENT ENERGY CONSUMPTION IN WSNS

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ABTRACT

A wireless sensor network is comprised of a base station (BS) and numerous sensor nodes. The sensor nodes lack security because they function in an open environment, such as the military. In particular, a false statement injection attack seizures and compromises sensor nodes. The attack then causes the compromised nodes to create forward false reports. Due to the false report injection attack, not only does the sensor network have a false alarm, but its limited energy is also emptied. In order to preserve the false report injection attack, over the past few years, several studies have been made looking for a resolution to the attack. Ye et al. studied statistical en-route filtering (SEF). SEF is a method of randomly verifying event reports in the en-route filtering phase. SEF can filter many false reports early using proof of intermediate nodes. However, because the number of keys in a sensor node is fixed by the system, the sensor network cannot control the event report proof probability depending on the conditions of the network. Therefore, it is tough to proficiently consume energy of the sensor network. In order to resolve the problem, we suggest a technique which controls the event report verification probability by using a key sequence level of an event report. In the suggested method, when an intermediate node obtains an event report, the node authenticates the event report by relating a key sequence level of the report and its key

sequence level. Elements defining the key sequence level comprise the concentration of neighbor nodes in the sensing range of a center of stimulus (CoS), the number of stages from the CoS to the BS, and the average of the key sequence level of intermediate nodes in each track. We imitated the projected technique and the SEF technique to assess the performance in terms of energy efficiency and security. In the recreation results, the projected technique disbursed an average of 7.9% less energy of the sensor nodes compared to SEF method. The number of untrue reports inward at the BS of the proposed technique was also fewer, by an average of 6.4, compared to the SEF technique. Concluded the results, we can understand that when the number of false report is huge in the sensor network, the proposed technique is more energy-efficient and protected than the SEF technique.

Keywords: Wireless sensor network, False report injection attack, Statistical en-route filtering, Energy Efficiency, Security.

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1. INTRODUCTION

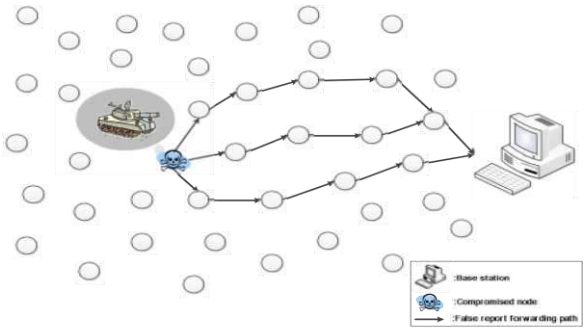


Fig. 1. The operation of a false report injection attack

Wireless sensor networks comprise of a huge amount of sensor nodes, which comprise sensing, computation, and wireless communication capabilities [1, 2]. The sensor nodes are assigned in a specific sensor field and operate each other collaboratively [1]. When an event arises in the sensor field, the nodes sense and calculate data of the event. The nodes also headfirst the data of the event to a BS [2]. The BS forward the data to a user through the prevailing communication infrastructure. Because the sensor networks function in exposed situations such as a military atmosphere, the scopes of the nodes are minor and unmanned [3, 4]. Therefore, the nodes are seized and conceded effortlessly by an invader from the external [2]. A false report injection attack particularly grounds a conceded node to create a false report. Fig. 1 shows the action of a false report injection attack. In Fig. 1, because of the false report generation of the conceded node in the sensor networks, the outbreaks lead to not only to false alarms, but also to the diminution of the limited energy of the sensor nodes, thus reducing the lifespan of the networks [4]. In order to protect the false report injection attack, a lot of resolutions have been projected by many scientists [4-14]. Ye et al. projected a resolution which is called SEF [4]. In SEF, each intermediate node confirms an event report using verification keys stochastically. The nodes headfirst the event report to the following node or drop it conditional on the verification outcomes. When the event report is untrue, the report is released. Thus, the false report is speckled initially by SEF. Though, the number of authentication keys comprised in a node has

to be big for advanced verification of false report possibility. If the numeral of keys of the node is additional, then the energy consumption of the node is higher. The quantity of keys is not attuned depending on the condition of the networks because it is static by the system. This means that it is problematic for the networks to be functioned proficiently. In order to resolve the problem, we projected a technique which regulates the confirmation chance of the node using a scheme of a key sequence level. The key sequence level is an index in a hash chain of a key, which types a message authentication code (MAC) in the event report. In the projected technique, the BS selects the key sequence level of an event report. Intermediate nodes getting the event report confirm it by equating the key sequence level of the node's key with the level of a MAC in the event report. The key sequence level is established by a fuzzy system in the BS. The fuzzy inputs defining the level are the regular of the level of nodes in each path furthering an event report, the compactness of neighbor nodes of a CoS, and the amount of hop from the CoS to the BS. The projected technique comprises security and competent energy consumption of sensor nodes by defining the suitable key sequence level. The rest of this paper is ordered as follows. Section 2 defines the SEF. Section 3 describes the problem statements. Section 4 presents a system model of the projected technique and the operation process of the proposed method. Section 5 shows the simulation results to estimate the performance of the projected technique. Finally section 6 accomplishes this paper.

2. BACKGROUND

2.1. Statistical en-route filtering

SEF is a countermine technique which can filter false reports early on that are made by a compromised node in a wireless sensor network using statistical verification during the en-route filtering phase. SEF consists of three phases: key assignment and report generation, en-route filtering, and sink verification. In the key assignment phase, before the sensor nodes are organized in a sensor field, each node obtains some keys where the amount is fixed by the system casually from a particular partition at random in the global key pool. In the report generation phase, after the nodes are organized, sensing nodes detecting the event elect a CoS when an event occurs in the sensor network. They frontward a partition index and a MAC to the BS which was created by a key that each node comprises to a BS. The CoS creates an event report with the event information and the received MACs and forward the event report to the BS. In the en-route filtering phase, when an intermediate node obtains the event report, it approves the report stochastically. The node checks whether there are key indices of distinct partitions and MACs in the report. If there is also more than one key index or less than the one in the same partition or the amount of them in the report does not resemble with the amount of fixed MACs, the node favors the report as a false report and drops it. The node then inspects whether there is a key index in the report consistent with the key index of the node. If there is not a key index, the node forward the report to the next node. If not, the node generates a MAC using its key. It then equates the MAC with the MAC in the report. If the MAC of the node is dissimilar from the MAC in the report, the report is viewed as a untrue report and is dropped. Else, the report is observed as a valid report and is promoted to the next node. In the sink verification phase, all of the event reports received at the sink are substantiated, because the sink comprises all keys in the global key pool. Thus, it can filter untrue reports out the false reports that are not filtered in the enroute filtering phase.

3. PROBLEM STATEMENT

If a false report injection attack arises in a wireless sensor network, a compromised node will unceasingly produce numerous false reports, furthering them to a BS. When the amount of compromised nodes becomes higher, the amount of untrue reports becomes greater. The sensor

network which connects many false reports may easily breakdown because of the energy reduction of the sensor nodes in the network. In SEF, a illustrative countermine technique, in order to preserve the network against the attack, intermediate nodes authenticate event reports using their allocated key before they are arranged in a sensor field. The key number is a very vital element defining the verification possibility of the report. The number of key that a node comprises becomes bigger, the possibility becomes higher. However, the node has to consume a lot of verification energy. Also, when an attacker compromises a node, the number of keys that the attacker can get becomes greater. On the other hand, as the number of keys becomes lesser, the probability becomes smaller. However, the energy consumption used in the verification becomes lower. Subsequently, the number of keys that the attacker can get becomes smaller. Therefore, in order to proficiently operate the sensor network, it is vital to trade energy consumption for security. Increasing the number of keys that the node includes is difficult in SEF because the energy of the sensor nodes is limited. To solve the problem, we use a key sequence level scheme. The scheme helps decrease the energy consumption and make up for security. Section 4 describes the proposed method using the key sequence level.

4. PROPOSED METHOD

4.1. System model and assumption

A wireless sensor network contains of a BS and numerous sensor nodes. The BS contains a global key pool. In the global key pool, there are all the keys which are used in the sensor network. The BS also includes a fuzzy system that calculates a key sequence level. The BS knows the average of the key sequence level of the intermediate nodes which forward event reports in each path, the density of neighbour nodes of the CoS, and the number of stages from the CoS to the BS. The concentration of sensor nodes in the network is very high, and each node is small and each node contains simple computing capability and limited energy.

4.2. Operation

4.2.1. Key assignment and report generation

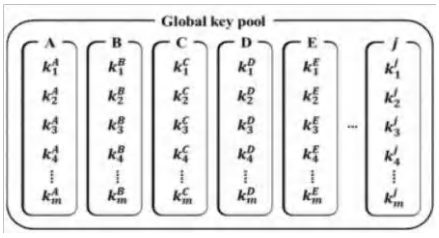


Figure 2 A global key pool which consists of j hash chains

In Figure 2, a hash chain is made up of m keys. The last sequence key in each hash chain k_m^j is a seed key of each hash chain. The next sequence key is consequent using a hash function with the seed key.

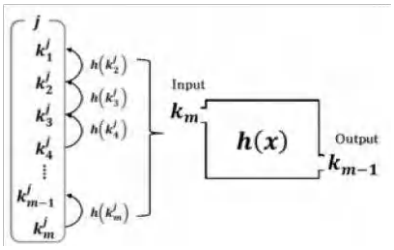
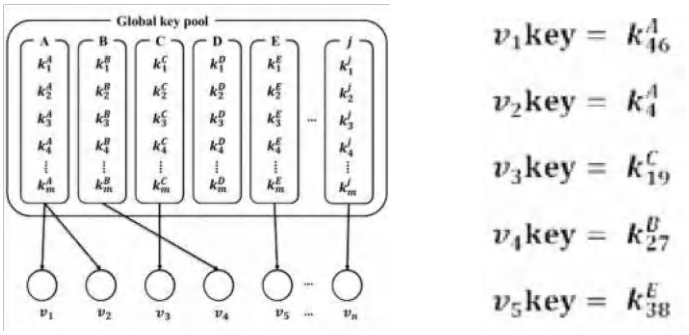


Figure 3 Derivation of keys using the hash function

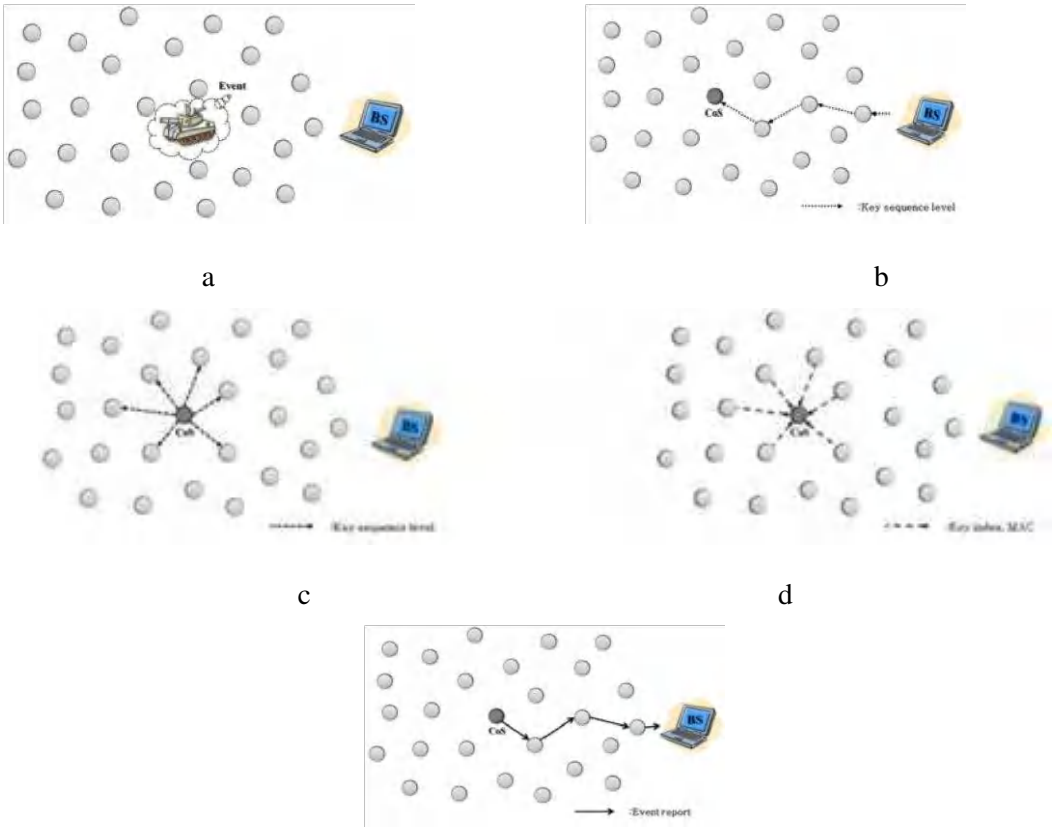
In Figure 3, if the hash function receives a seed key as an input, the hash function outputs the derived key k_{m-1}. If the hash function receives k_{m-1} as an input, then it outputs a derived key k_{m-2}. This process is repeated until the function outputs the key k_1. The derived keys are allotted to sensor nodes before the sensor nodes are organized in the sensor network.



(a) (b)

Figure 4 Example of an operation of key assignment in a global key pool (Fraction of m = 50)

Figure 4 (a) shows that just one key is casually allotted to each sensor node v_1~v_n. Figure 4 describes an example of the keys which are assigned to the sensor nodes. The sensor nodes originate other keys from the allocated key and a hash table. For example, In Fig. 4, a node v_3 receives a key $k_{19}{}^C$ in the C hash chain of the global key pool and then v_3 can get the keys from $k_{18}{}^C$ to $k_1{}^C$ using the hash function.



a b

c d

e

Figure 5 The operation of a report generation

When an event arises in the sensor field, numerous sensing nodes distinguish the event, as seen in Fig. 5 (a). The sensing nodes elect a CoS, which is a node that strongly notices the event. After the election of the CoS, the BS forward the key sequence level, which is determined by a fuzzy system, to the CoS, as seen in Fig. 5 (b). The CoS forward the key sequence level to its neighbor nodes in Fig. 5 (c). The neighbor nodes then create MACs using the equivalent keys with material of the key sequence level from the CoS forwarding the MACs. A node which does not include the corresponding key with the key sequence level does not forward the MAC to the CoS, as seen in Fig. 5 (d). The CoS creates an event report using its information of the event and acknowledged MACs from the neighbor nodes. It then forwards the event report to the following node in Fig. 5 (e, f).

4.2.2. The scheme of key sequence level

The key sequence level is a generation index of a key, which makes a MAC in the event report in a hash chain. The key sequence levels of MACs in the event report are the same.

4.2.2.1. Elements determining a key sequence level

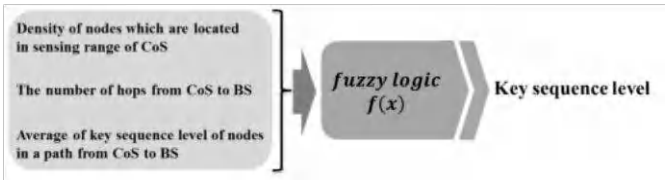


Figure 6 Elements determining a key sequence level

In Fig. 6, the fuzzy system calculates three input values in order to get the key sequence level as an output value. The three input values are the concentration of neighbor nodes, which are situated within the sensing range of a CoS, the amount of hops from the CoS to a BS, and the average of the key sequence levels of intermediate nodes in a path.

4.2.2.1.1. Density of neighbour nodes which are located in sensing range of a CoS

The higher the concentration of neighbor nodes in the CoS, the more the CoS collects MACs equivalent with the key sequence level. For instance, let's suppose the key sequence level is 6 and the number of neighbor nodes in the sensing range of the CoS is 20 or 30. In the case of 30, the CoS gathers more MACs corresponding to key sequence level 6 than in the case of 20. If the possibility of the collection of MACs is higher, although the key sequence level is high, the CoS will assemble enough MACs corresponding to the fixed number of MACs in the event report. Thus, the higher the density, the higher the key sequence level. On the other hand, the lower the concentration is, the lower the key sequence level is.

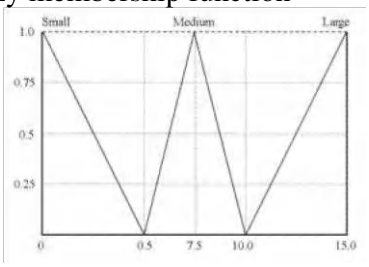
4.2.2.1.2. The number of hops from a CoS to a BS

In order to reduce the energy consumption of the sensor nodes, false reports have to be eliminated early. The more hops there are from the CoS to the BS, the more sensor nodes forward the event report, and a great amount of energy of the sensor nodes is consumed. Therefore, when the number of hops is big, the key sequence level has to be lower, and the report verification probability has to be high. On the contrary, when the number of hops is minor, the key sequence level has to be high and the probability has to be lower.

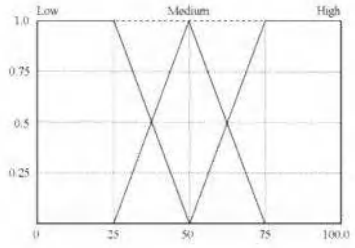
4.2.2.1.3. The average number of key sequence levels of intermediate nodes in a path

The average number of key sequence levels of the forwarding node in each path is a very significant element defining the key sequence level of the event report, because when the average of the key sequence level is high, the report verification possibility becomes high, and when the average is lower, the probability becomes lower. Thus, the higher the average is, the

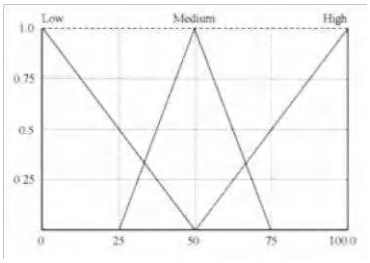
higher the probability is. On the other hand, the lower the average is, the lower the probability is. Fuzzy membership function



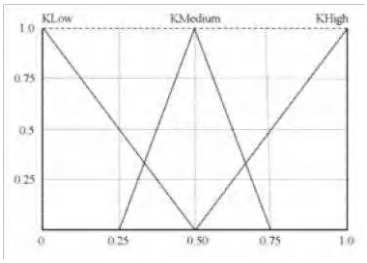
(a) The number of hops from the CoS to the BS



(b) Density of neighbor nodes in a sensing range of the CoS



(c) The average of the key sequence level of intermediate nodes in each path



(d) Key sequence level of an event report

Figure 7 Membership functions of input and output elements

In Fig. 7, (a) is a membership function of the number of hops from a CoS to the BS, (b) is the membership function of the concentration of neighbor nodes in the sensing range of the CoS, and (c) is a membership function of the average of the key sequence level of intermediate nodes in each path. In the membership function (a), fuzzy values are comprised in the fuzzy set which contains of three levels. The three levels are Low, Medium, and Large. In the membership functions (b) and (c), the fuzzy values are comprised in the fuzzy set. The fuzzy set contains of Low, Medium, and High. The membership function (d) is a membership function of a key sequence level of an event report. Its fuzzy values are comprised in a fuzzy set. The fuzzy set is composed of KLow, KMedium, and KHigh. In all fuzzy membership functions, the fuzzy values are in the range from 0-1.

4.2.2.2. Fuzzy rules

Table 1 Fuzzy rules of the proposed method

No.		**INPUT**		**OUTPUT**
0	NUM_HOP	NEIGHBOR_DENSITY	AVERAGE_KEYLEVEL	KEY_LEVEL
	Small	High	High	KHigh
4	Small	Medium	Medium	KHigh
8	Small	Low	Low	KHigh
9	Medium	High	High	KMedium
12	Medium	Medium	High	KMedium
15	Medium	Low	High	KMedium
20	Large	High	Low	KLow
22	Large	Medium	Medium	KLow
26	Large	Low	Low	KLow

In Table1, NUM_HOP, NEIGHBORRR_DENSITY, and AVERAGE_KEYLEVEL are fuzzy inputs. NUM_HOP is the amount of hops that an event report has to pass from a CoS to a BS. NEIGHBOR_DENSITY is concentration of neighbor nodes in a sensing range of the CoS. AVERAGE_KEYLEVEL is the average of the key sequence levels for the sensor nodes in each path. KEY_LEVEL is a fuzzy output and the key sequence level of the event report.

4.2.3. En-route filtering

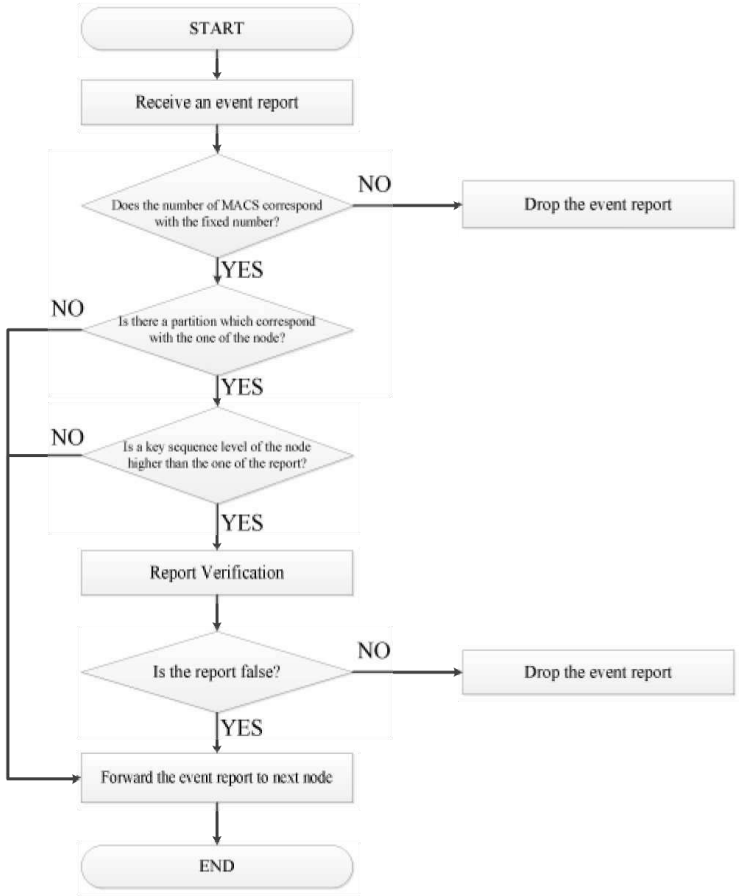


Fig. 8. A flow chart of an event report verification

Once the node obtains the event report, it checks whether the number of MACs in the event report matches with the fixed number of MACs in the system (a). If the two number are dissimilar, the node regards the event report as a false report and drops the it (b). Otherwise, the node inspects whether there is a corresponding partition in the event report with its partition of MACs (c). If there is not a partition, it forwards the event report to the next node (d). If there is a corresponding partition, the node equates the key sequence level of its key with the key sequence level of the MACs in the equivalent partition (e). When the key sequence level is lower than the one in the event report, it forwards the report to the next node (f). Instead, when the key sequence level is the same or higher than the one in the event report, it creates a MAC using its key and equates the MAC with the MAC of the event report (g, f). If the two MACs are the same, it regards the event report as a authentic node and forwards the report to the next node (i). Else, it regards the report as a false report and drops it (j).

4.2.4. Base station verification

When event reports arrive at a BS, the BS will verify all the MACs in the event reports because it includes a global key pool. If the BS receives an event report, it finds a key that matches to the key sequence level of a MAC in the event report. If there is a key, the BS generates a MAC

using the key. It then compares the MAC with the MAC in the event report. If the two MACs are not the same, the BS drops the event report. Thus, although there are false reports which are not filtered in the en-route filtering phase, the BS verifies all false reports during this phase.

5. SIMULATION

In section 5, we equate the energy efficiency and security of our projected technique with that of the SEF in order to evaluate the performance of the proposed method. We evaluate the energy consumption of the sensor nodes versus the rate of false reports based on the number of compromised nodes among the sensing nodes, which generate MACs included in an event report, so as to equate the energy efficiency of the proposed method to that of the SEF. The number of false reports means arrivals at the BS which are not filtered in the en-route filtering phase. We also equated the number of false reports versus the rate of false reports in the proposed method to that of the SEF, so as to estimate security.

Section 5.1 describes our simulation environment. Section 5.2 presents the simulation results.

5.1. Simulation environment

Table 2 A simulation environment

Content	Values
The number of the whole sensor nodes in a sensor network	600
The area of a sensor field	100m X 100m
A sensing range of a sensor node	10.0m
Energy consumption per 1byte when a sensor node sends an event report	16.25 μJ
Energy consumption per 1byte when a sensor node receives an event report	12.5 μJ
Energy consumption of an event report verification of a sensor node	75 μJ
The number of hash chains in a global key pool	10
The number of MACs in an event report	5
The number of occurring event reports in a sensor network	100
The number of keys in a hash chain	50
The number of keys included in a sensor node.	25
The packet size of an event report	24bytes

5.2. Simulation results

In the simulation results, the rate of false reports is the entire number of event reports in the sensor field versus the number of false reports. The energy consumption is the sum total of the energy consumption of all of the sensor nodes in the sensor field.

Fig. 9 is a graph of energy consumption versus the rate of false reports in the projected technique and the SEF method when a sensing node which creates a MAC included in the event report is conceded.

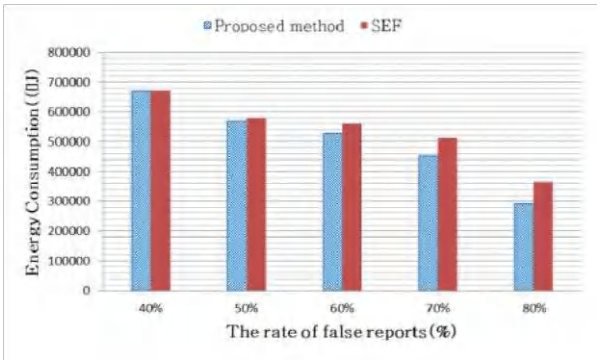


Figure 9 Energy consumption versus the rate of false reports (Fraction of compromised node = 1)

In Fig. 9, we found that the projected technique consumes less energy of the sensor nodes than the SEF method. We also found that the higher the rate of false reports, the larger the gap between the energy consumption of the proposed method and SEF method. In the simulation result, the proposed method consumed an average of 7.89% less energy than the SEF.

Fig. 10 is a graph of the number of false reports arriving at the BS in the proposed method and the SEF method when a sensing node which creates a MAC included in the event report is compromised.

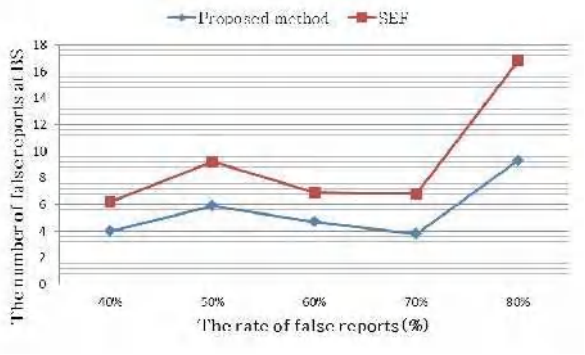


Figure 10 The number of false reports versus the rate of false reports (Fraction of compromised node = 1)

In Fig. 10, we found that the amount false reports arriving at the BS in the proposed method is less than in the SEF method. In the simulation result, the number of false reports of the projected technique is an average of 3.64 less than in the SEF method.

Fig. 11 is a graph of energy consumption versus the rate of false reports in the projected technique and in the SEF method when the two sensing nodes which create MACs included in the event report are compromised.

Figure 11 Energy consumption versus the rate of false reports (Fraction of compromised nodes = 2)

In Fig. 11, the higher the rate of false reports is, the larger the gap between the energy consumption of the projected technique and that of the SEF method. We also know that the proposed method consumes less energy than the SEF. In the simulation result, the proposed method consumed an average of 9.09% less energy than the SEF.

Fig. 12 is a graph of the number of false reports arriving at the BS in the projected technique and that of the SEF method when two sensing node which generate MACs included in the event report are compromised.

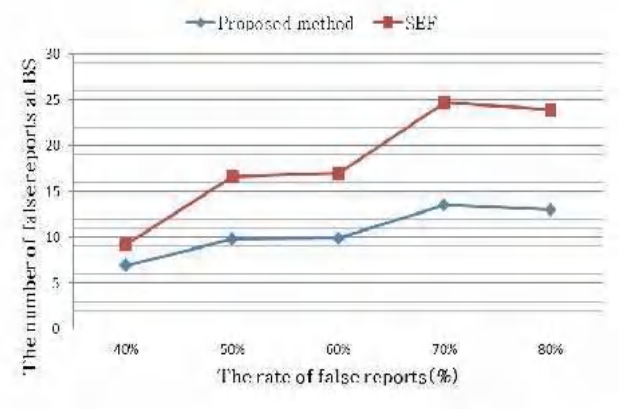


Figure 12 The number of false reports versus the rate of false reports (Fraction of compromised nodes = 2)

In Fig. 12, we found that the amount of false reports arriving at the BS in the projected technique is less than that of the SEF method when the two nodes are compromised. In the simulation results, the number of false reports is 7.66 less than that of the SEF method.

Fig. 13 is a graph of the energy consumption versus the rate of false reports in the proposed method and that of the SEF method when three sensing nodes which generate MACs included in the three event reports are compromised.

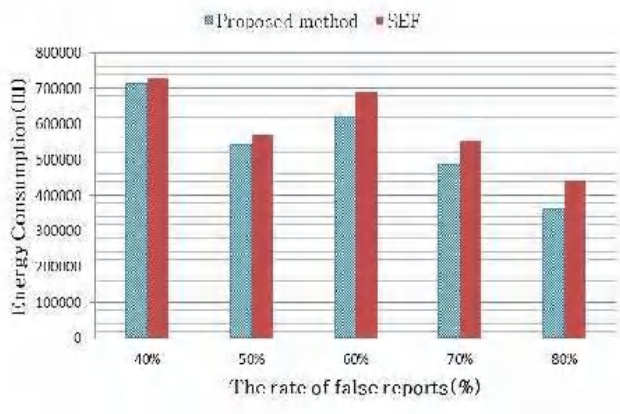


Figure 13 Energy consumption versus the rate of false reports (Fraction of compromised nodes = 3)

In Fig. 13, the projected technique spent less energy than the SEF. The higher the rate of false reports, the larger the gap of energy consumption is between the projected technique and the SEF method. In the simulation result, the proposed method consumed an average of 9.26% less energy than the SEF.

Fig. 14 is a graph of the number of false reports incoming at the BS in the proposed method and that of the SEF method when three nodes which create MACs included in an event report are compromised.

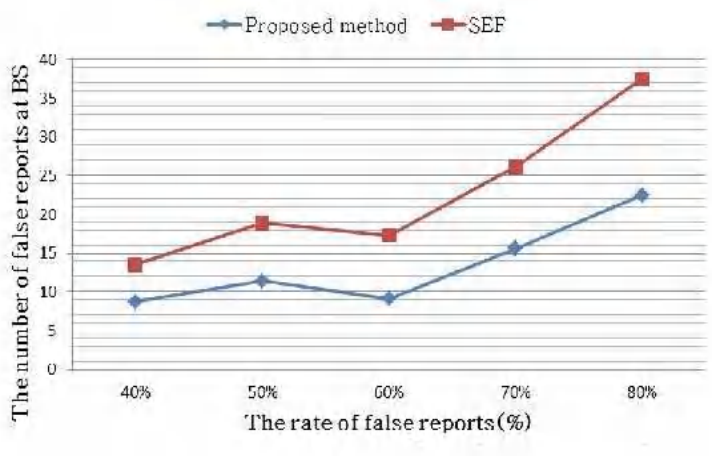


Figure 14 The number of false reports versus the rate of false reports (Fraction of compromised nodes = 3)

In Fig. 14, we found that the number of false report incoming at the BS in the projected technique is less than that of the SEF method. In the simulation result, the number of false reports was 9.22 less than in the SEF.

Fig. 15 is a graph of the energy consumption versus the rate of false reports in the proposed technique and in the SEF when four sensing nodes which create MACs included in the three event reports are compromised.

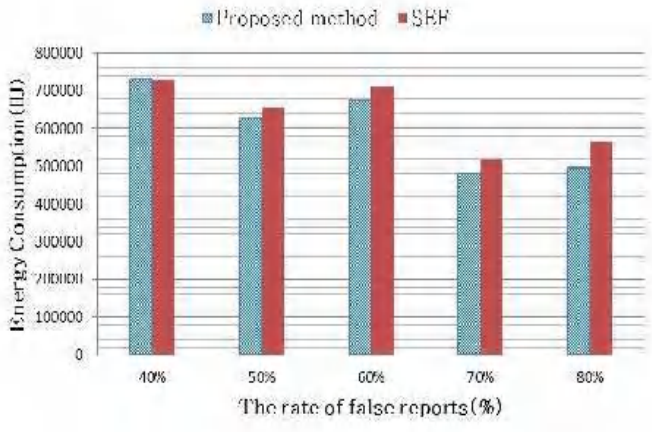


Figure 15 Energy consumption versus the rate of false reports (Fraction of compromised nodes =4)

In Fig. 15, when the rate of false reports is above 50%, the proposed method had better energy efficiency than the SEF. In the simulation result, the proposed method consumed an average 5.63% less energy than the SEF.

Fig. 16 is a graph of the number of false reports arriving at the BS in the proposed method and in the SEF when four nodes which create MACs included in the event report are compromised.

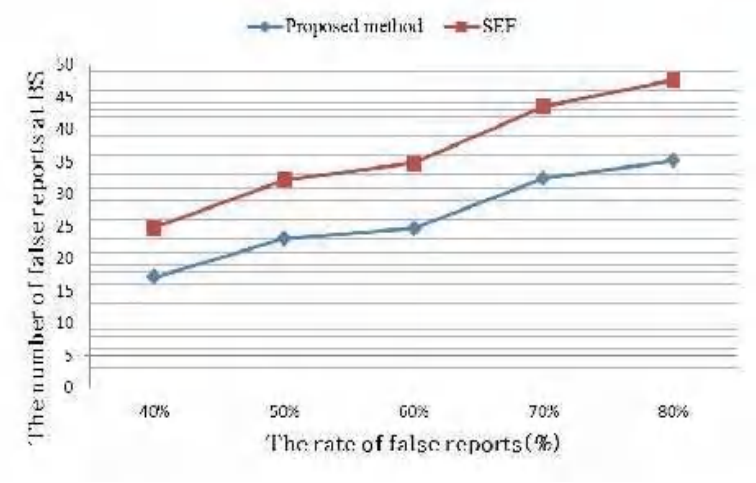


Figure 16 The number of false reports versus the rate of false reports (Fraction of compromised nodes = 4)

In Fig. 16, we found that the number of false report incoming at the BS in the proposed method is less than in the SEF for all of the false reports rates. In the simulation result, the number of false reports was 10.14 less than that of the SEF method.

In the simulation results, the proposed method was an average of 7.9% better than the SEF with respect to energy efficiency. The amount of false reports arriving at the BS in the proposed method was an average of 6.43 less than in the SEF method. We tested that the higher the rate of false reports in the sensor network, the better energy efficiency and security there was in the proposed method compared to the SEF method.

6. CONCLUSION

In this paper, we proposed a resolution which regulates the key sequence level of MACs included in an event report and verifies them by comparing the key sequence level of the MACs in the event report with the key sequence level of a node which receives the event report. This is done in order to preserve energy efficiency so when the possibility of a false report in the event report is high, the event report verification probability is low, and the energy consumption of the sensor nodes is low. On the other hand, when the key sequence level is low, the event report verification probability is high, and energy consumption is high. Thus, it is important to determine an appropriate key sequence level. In order to determine the appropriate key sequence level, it is computed by a fuzzy system in a BS. Elements determining the key sequence level are the density of neighbor nodes in a sensing range of the CoS, the number of hops from the CoS to the BS, and an average of the key sequence level of intermediate nodes in each path.

We estimated the energy efficiency and security of the proposed method by equating it to the SEF method, which is a representative countermeasure method against the false report injection attack. We measured the energy consumption of the sensor nodes versus the rate of false reports in the sensor network to evaluate the energy efficiency of either the proposed method or the SEF. Additionally, we also measured the number of false report received in the BS versus the rate of false reports to evaluate the security of either the proposed method or the SEF. In the simulation results, the proposed method consumed an average of 7.9% less energy of the sensor network. Moreover the number of false reports arriving at the BS in the proposed method was an average 6.4 less than in the SEF method. It was found from the result that the projected technique has better energy efficiency and security than the SEF when the rate of false reports is high.

ACKNOWLEDGEMENTS

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Efficient Energy Routing Protocol based on Energy & Buffer Residual Status (EBRS) for Wireless Sensor Networks

Amairullah Khan Lodhi, M.S.S Rukmini, Syed Abdulsattar

Abstract- ***Wireless networks consist of nodes, having the ability that, they can sense and collect the information from the nearby surroundings. It has the responsibility of designed protocol to send this collected information by data gathering and forward it to the outside network via a sink node. Furthermore, WSNs doesn't need any predetermined network structure; all the nodes used in WSN can operate as a router as well as the host. It uses multiple hops to send information to the node outside the communication range through different neighbor nodes. All the sensor nodes in WSN have their range of communication and can send and collect messages straight to each other until they were in the communication range. Moreover, the Self-organizing property of nodes in the network made WSN outstanding amongst the major applications. Nevertheless, the wireless nodes there in the network have a battery with restricted energy and can't be recharge or change once deployed. Hence, the node energy must be utilized efficiently for various functions as sensing the information, processing the sensed information, and transmitting the processed information to another node. With the enhancements of the innovation and cost-effective hardware, our visualization presents a tremendous life enhancement of WSN into several new applications. To modify following such background, the energy-efficient routing protocol is extremely desirable and can be achieved by clustering in WSN. In the literature survey, various energy-efficient routing techniques based on cluster have been given to attain the energy-efficiency and enhance the lifetime of the network. However, these protocols were suffering from the bottleneck node issue. It is the situation in the network where the router node subjected to heavy traffic due to its presence in energy-efficient routing path or high remaining energy. This paper aims to moderate the possibility of the node to become a bottleneck node throughout the application. Thus, we attain the objective by design and develop the cluster-based efficient-routing protocol by selecting the head nodes of the cluster based on their residual energy and buffer status. Performance outcome shows that the projected work out-performs in contrast with present cluster-based routing protocols.***

Keyword: - Wireless Sensor Network; Sink Node, Cluster Head, Energy efficiency, Buffer, Routing, Network Lifetime, Mobile Sink Node, and Control Packets.

I. INTRODUCTION

The wireless sensor networks (WSNs) are built up of "nodes" commencing a small amount to numerous hundreds or sometimes thousands. Moreover, all nodes are associated with one or numerous sensor nodes.

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These wireless nodes have different parts: like an energy source, an electronic circuit for interfacing, a microcontroller, a radio transceiver, and usually a battery or nowadays a power harvesting module in the embedded form [1].

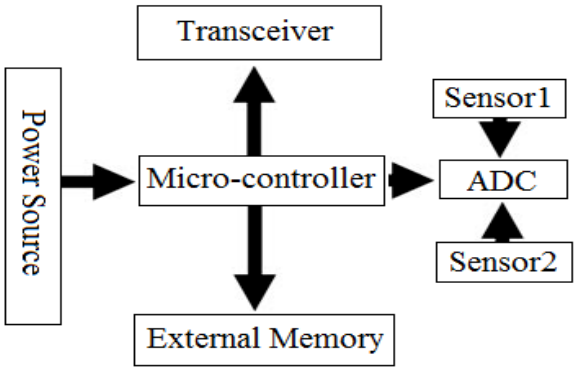

Fig. 1: Basic Structure of Sensors

The three main functions performed by all the wireless nodes are sensing the nature, preprocessing & storage of data information with transmission along with the nodes and with the destination (sink). The WSNs is an isolated system with different sensor nodes to gather and forward the data from surrounding sensor nodes or environment after processing them [2]. The figure below shows various SNs which collects the information from the nearby atmosphere and transfer the collected information to the target node (sink) through gateway [3].

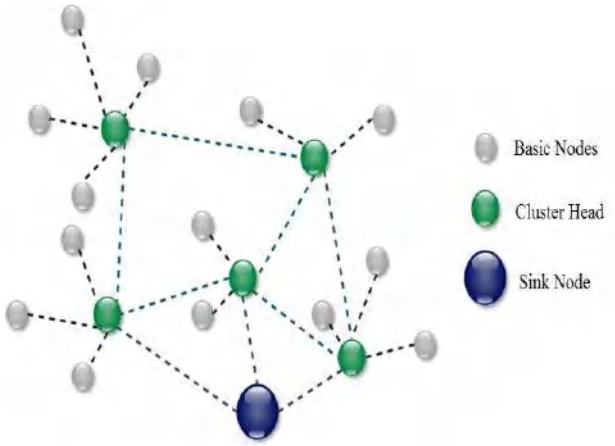

Fig.2. the basic structure of WSN

Characteristics of a good wireless network includes the minimization in consumption of energy for nodes with battery as a source, scalability to a large scale of distribution, node failure handling capacity

(responsiveness), simple in usage, designed in cross-layered, should have the capability to ensure severe surrounding conditions, reliability and mobility [4]. In several applications, energy-efficient data forwarding is supposed to be a critical challenge, due to inadequate energy sources & constrained and low-powered battery issues [5]. Hence, it is insisted that the consumption of energy should be managed (Minimized) so that the network lifetime will be enhanced significantly. Routing in any network is nothing but selecting an efficient (Energy) path to process and transport the data in the network, or over several networks. This action normally maintains information of the path to several network base and forwarding based on the routing tables [6]. Furthermore, the consumption of energy and the lifetime of the network will be affected by the reduced packet delivery ratio. Especially in the case of WSN, the routing mechanism should be handled carefully because it is a very important task [7].

The residual part of the work is prearranged as the IInd part will talk about the survey of several routing techniques and their related protocols. Section IIIrd gives our projected workout which explains the new metric for different calculation outputs with an algorithm in WSNs. Moreover, Section IVth deals with performance analysis of the projected routing protocol. As a final point, the conclusion is made in the Vth section.

II. LITERATURE SURVEY

Most of the traditional systems are more expensive as well as inappropriate for limited-resourced wireless networks. Therefore, it is extremely difficult to design an efficient energy WSN, because the wireless nodes have very low computational time, as well as less storage capacity to store data information packets [8]. Modern technological advancements in wireless technology have been approved to fabricate minimum cost, tiny, battery-operated multifunctional sensor nodes. For gathering or dissemination of data, each wireless node communicates with other nearby nodes as well as with the base station node [9]. Hence, different efficient-energy, as well as balanced- energy protocols for routing technique have been proposed for WSNs. These protocols try to minimize the consumption of energy in each SN, in account; increases the complete network lifetime.

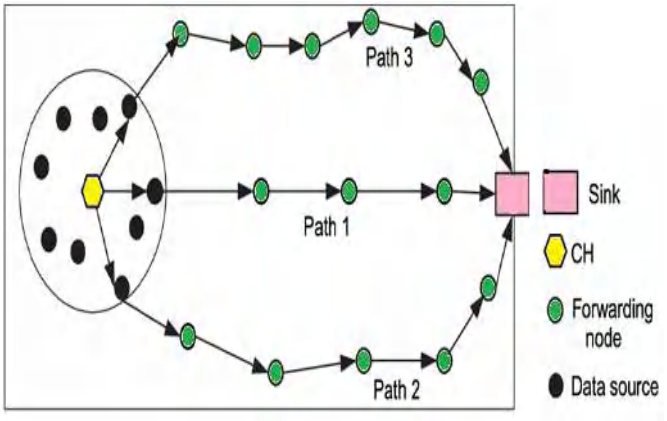

Fig.5 Different paths in WSN

The term "network lifetime" is a basic assessment metric for the particular network. It can be defined as the utmost time in which the system is efficient to measure a physical significance or occurrence. After every network data transmission around, the measurement of the nodes lifetime is done by its level of remaining energy. This remaining node energy is referred to as the residual energy of the wireless node [10].

In the earlier period, remote locations and restricted or hazardous areas, rotating machinery, and mobile resources are unreachable but now are reaching with the help of I/O devices in wireless networks. In water industries, these I/O devices and sensors can be powered by solar panels or battery packs [11]. The transmission capability of the node is restricted due to its communication range and hence the information data is transmitted several times through transitional nodes (Hop) via which fallout in flooding of packets which can cause the conflict between the packets, information idleness, and energy dissipation [12]. On the other hand, the queuing and delay issues are mainly universal features for the technical surroundings, such as in networking and telecommunications [13]. "Queuing premise provides the assessor with a powerful implement for designing and evaluating the performance of the queuing systems".

Except for the routing protocols, some additional techniques are there which are helpful in the transmission of data such as packet scheduling. A typical scheduler model is shown in Fig. below, in which the data packet is placed into the well-organized queue and waiting for being processed when received by the wireless node. In-network patterns like *"many-to-one"* and *"mostly-off"*, all wireless nodes through the multi-hop transmissions technique generate and transmit the packets to the base node or sink.

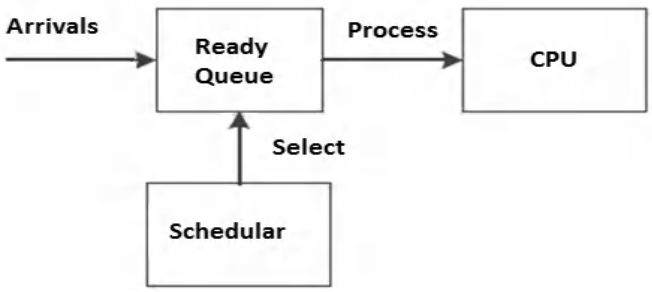

Fig.6. Basic Scheduling Scheme for maintaining queue in WSN

For that purpose, the goal is to make the wireless nodes to deplete their energy approximately at the same time, which can be done by tackling the problem on both levels i.e. on the region and at node level [14]. Hence, in the queuing model, the sensor node is blocked when the waiting queue length reaches the maximum value [15].

Some of the important metrics which are very useful for getting energy efficiency with NL elaboration are Packet delivery performance, which indicates the lifetime of the network. Throughput talks about the successful delivery of the packet to the destination per unit of time over a particular channel. The energy-efficiency metric helps in preserving the energy of the node and is considered as a sensitive parameter and for making it efficient the nodes when they are not in use for long are set to a sleep mode [16].

III. PROJECTED WORKOUT

It is mentioned in three sections

1. Cluster Head (CH) Selection based on nodes present energy & buffer rank
2. Detection of bottleneck Cluster Head (CH) Node by the systematic Approach Model
3. Routing based on CH rank of the Mobile sink

1. Cluster Head (CH) Selection based on nodes present energy & Buffer rank

As all the sensing information of the network is forwarded through the CH to sink node, hence CH selection in WSN is a considerable work. If elected CH is unable to hold the traffic in that case involuntarily the packets drop from it either due to lack of nodes buffer overflow or energy. Thus CH selection should be done precisely, as every node in a network having limited energy and buffer capacity and recharging or replacing the battery during the mission is not possible. For that purpose, a mechanism is developed for selecting the CH based on the status of energy as well as buffer status. It is named as "Energy & Buffer Residual Status (EBRS)", which will help to control the packet drop from CH due to buffer overflow or lack of energy. Thus the projected metric extends the network performance by reducing the packet drop, which justified as follows;

The assumptions made that, every node have the energy of *'E'* joules and can forward *'N'* number of packets with buffer *'B'* and can store *'n'* number of packets in the time interval.

Consider the packet *'P'* is going to forward from one of the nodes during the *'t'* interval of time, this packet consume the *'Ep'* energy and occupies the buffer space of *'Bp'* then the residual status of node in respect with buffer *'Br'* and energy *'Er'* can be computed by following equations.

$$Er = N - Ep,\ N > Ep \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ (1)$$

$$Br = n - Bp,\ n > Bp \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ (2)$$

The ability of a node to hold the packet in its concerning buffer and energy is computed by the knapsack algorithm by applying the following considerations

Table 1: Alphabets used and their Abbreviation

Alphabets	Description
E	Battery Energy in Joules
N	Number of Packets forwarding
PE	Node Packets
P_B	Buffer Packets
T	Period
E_r	Node Residual energy
B_r	Node Residual Buffer
Pei	The individual energy used for node packet
Pbi	The individual buffer used for node packet
ORmax	The upper limit threshold value
ORmin	Lowest threshold value
B	Total Available Buffer space of a node
P_n	Total Available Number of packets

1. In available energy and buffer space, the nodes are free to process the packets through node buffer
2. In respect to energy and buffer, the node should process the maximum number of packets
3. Partial processing of packets is not possible.

For processing 'n' number of packets successfully from a specified node exclusive of dropping it, the node must satisfy the below conditions, because the ability of the node to mitigate packet drop is 'Pn' number of packets.

1. The packet should be processed by a node completely
2. The packet should be dropped from the node, except incomplete progression should not happen

2. Detection of bottleneck Cluster Head (CH) Node by the Systematic Approach Model

To extend the network performance in respect with lifetime as well as packet delivery the buffer space of the node should be enough to process the packet, otherwise, a lot of packet forwarding chances gets wasted, and it will affect the network performance. Alternatively, at this time also if the node provides the space for upcoming packets, then it must drop any packet from its buffer. In both the situations, node cases as congestion that is a negative impact on the delivery of packets.

Existing protocols relating to WSN can be categorized based on;

1. Congestion control Routing
2. Congestion Non-control Routing

The majority of the obtainable protocols designed for WSN are congestion non-control. Unlike well-established networks, a dynamic and constrained network in WSN is very expensive in terms of overhead as well as time and is only possible to remove blockage but not prevent altogether. To eliminate network congestion, IETF recommended using the average queue size monitoring and computing process. Thus, we compute the average queue and average waiting time of the packet inside the node buffer to control the congestion, and thereby packet loss. Thus this section aims to compute the average packet number queued in nodes buffer, if this queue size is above the buffer threshold size then this node is going to lose the packets.

Without the loss of generality, we can calculate the average numbers of packets arriving at a particular time interval by using the exponential weighted moving average method.

$$A = \alpha\, Ac + \beta\, Ap \quad \ldots\ldots\ldots (1)$$

Similarly, calculation of the average amount of packets departing in an exact time interval by using the exponential weighted moving average method is given by,

$$D = \alpha\, Dc + \beta\, Dp \quad \ldots\ldots\ldots (2)$$

Where, Ac and Dc is an average number of arrivals and departure rate of the packets in a current time interval. Conversely, Ap and Dp is an average number of arrival and departure rate of the packets in the previous time interval. The α and β are the weighted constants, their values vary

from (0, 1). If the condition (A>D) occurs then the packet will drop from the node buffer, and If the condition (A<D) occurs then packets will drop if the queue is greater than the buffer size.

Finally, the queue size is computed by

Np = (A (D−A)/)…….(3)

Queue size (QS) = Qp ∗ Packet size…….(4)

Furthermore, if the size of the queue is greater than the size of the buffer (threshold value i.e. buffer size/4), then the node becomes a bottleneck and it will start dropping the packet.

3. Routing based on CH rank of Mobile sink

The mobile node (sink) maintains the distance table of CH node in its memory table. The network creates a cluster-based network model with the help of existing "LEACH" protocol initially. Then, the mobile sink node moves randomly by Random Way Point Mobility (RWPM) Model to collect the location of CH's. After that those CH's computes the average distance between the CH's by the following equation;

$$D_{avg} = \frac{\sum_{i=0}^{m-1} \sqrt{(X_i - X_c)^2 + (Y_i - Y_c)^2}}{m-1} \quad i \neq c$$

Where,

$(X_c, Y_c) = Location\ of\ the\ current\ cluster\ head$

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1. Based on LEACH routing protocol divide the network into different clusters and elect the CH.
2. Now based on the previous section the CHs will compute their current status of energy and load.
3. The MSN, by moving nearer to CHs, will collect the information about distance as well as CHs present status, and maintain it in the vector table.
4. Now according to the vector table, decide the lifetime of CH and assume it as a period 'T' (This is the time for which sink node will collect the information from the current CH, and create the communication sessions with the CH).
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Performance assessment of projected system is done by NS-2 (NS-2.34) with suitable expansion inaccessible libraries and compare through present protocols in the same network environment. We assumed the communication space of each node is 250m and single-hop broadcast delay is 10ms, in our model.

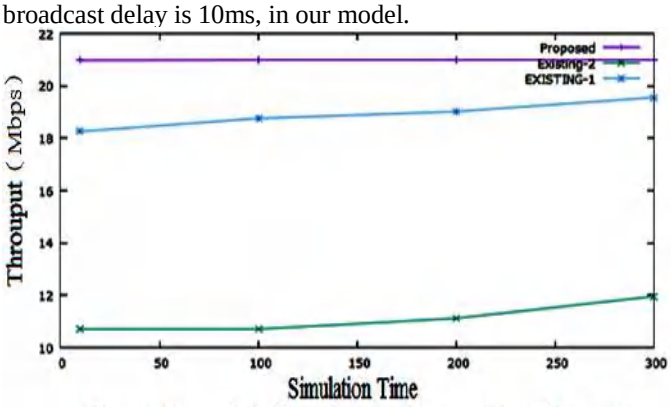

Figure 1: Throuput Vs Simulation Time, Proposed & Existing work

All wireless nodes are set crosswise 1000 × 1000 square area. Nodes are outfitted through 10j battery, data packets are of size 512 bytes with the power consumption of 600mW for transmission, and 300mW is receiving the power of the node. Every node must run our cluster head selection system and the cluster head transmit its beacons more than two hops every 20 sec.

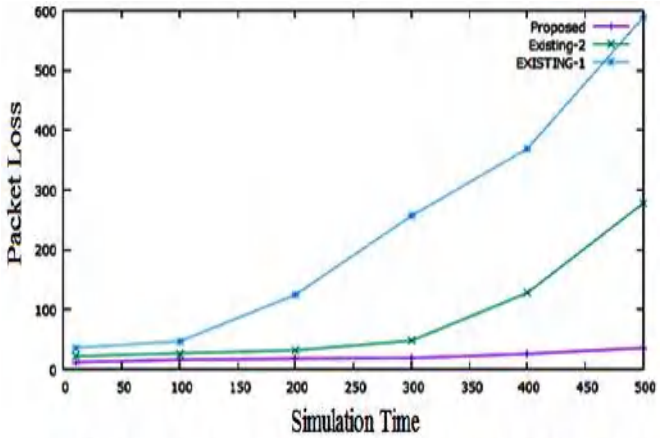

Figure 2:- Packet Loss Vs Simulation Time, Proposed & Existing Work

For that reason, we evaluate the network performance concerning the loss of packet and network lifetime and evaluate it with the present protocols.

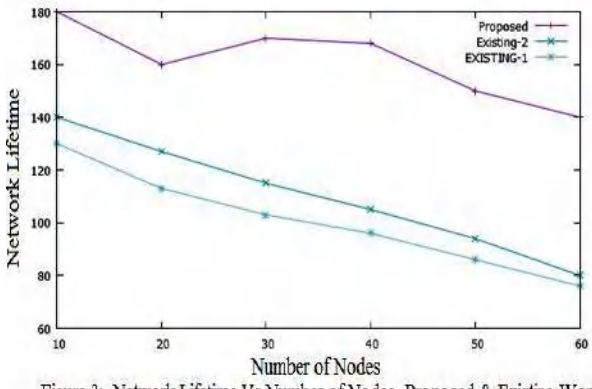

Figure 3:- Network Lifetime Vs Number of Nodes, Proposed & Existing Work

Figures 1, 2 and 3 noticeably show that projected system improve the system performance and elaborate the lifetime of the network.

V. CONCLUSION

To mitigate the bottleneck issue in WSN the suitable approach is cluster-based routing due to its less overhead in energy-efficiency and buffer. However, if merely one parameter i.e., energy efficiency, is considered for the selection of cluster heads then it may results in packet loss due to inadequate buffer. Hence, it is very essential that both parameters i.e., energy and buffer should be considered to select the cluster head in wireless networks. Furthermore, the degradation in network lifetime, depletion in network resources, and overhead are caused by the negligence of bottleneck node which is also a considerable issue to mitigate packet drop in WSNs. Hence, a novel metric "Energy & Buffer Residual Status (EBRS)" is put in place to select the cluster head which gives the status of the wireless node regarding its residual position of the energy of the node as well as its buffer. Moreover, this proposed metric will elaborate the lifetime of the network and accumulate the node energy. Additionally, it also monitors the current status of the wireless nodes and hence may be used like proactive routing protocol for cluster head selection which is our upcoming task.

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Efficient Energy Routing Protocol based on Energy & Buffer Residual Status (EBRS) for Wireless Sensor Networks

Amairullah Khan Lodhi, M.S.S Rukmini, Syed Abdulsattar

Abstract- ***Wireless networks consist of nodes, having the ability that, they can sense and collect the information from the nearby surroundings. It has the responsibility of designed protocol to send this collected information by data gathering and forward it to the outside network via a sink node. Furthermore, WSNs doesn't need any predetermined network structure; all the nodes used in WSN can operate as a router as well as the host. It uses multiple hops to send information to the node outside the communication range through different neighbor nodes. All the sensor nodes in WSN have their range of communication and can send and collect messages straight to each other until they were in the communication range. Moreover, the Self-organizing property of nodes in the network made WSN outstanding amongst the major applications. Nevertheless, the wireless nodes there in the network have a battery with restricted energy and can't be recharge or change once deployed. Hence, the node energy must be utilized efficiently for various functions as sensing the information, processing the sensed information, and transmitting the processed information to another node. With the enhancements of the innovation and cost-effective hardware, our visualization presents a tremendous life enhancement of WSN into several new applications. To modify following such background, the energy-efficient routing protocol is extremely desirable and can be achieved by clustering in WSN. In the literature survey, various energy-efficient routing techniques based on cluster have been given to attain the energy-efficiency and enhance the lifetime of the network. However, these protocols were suffering from the bottleneck node issue. It is the situation in the network where the router node subjected to heavy traffic due to its presence in energy-efficient routing path or high remaining energy. This paper aims to moderate the possibility of the node to become a bottleneck node throughout the application. Thus, we attain the objective by design and develop the cluster-based efficient-routing protocol by selecting the head nodes of the cluster based on their residual energy and buffer status. Performance outcome shows that the projected work out-performs in contrast with present cluster-based routing protocols.***

Keyword: - Wireless Sensor Network; Sink Node, Cluster Head, Energy efficiency, Buffer, Routing, Network Lifetime, Mobile Sink Node, and Control Packets.

I. INTRODUCTION

The wireless sensor networks (WSNs) are built up of "nodes" commencing a small amount to numerous hundreds or sometimes thousands. Moreover, all nodes are associated with one or numerous sensor nodes.

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These wireless nodes have different parts: like an energy source, an electronic circuit for interfacing, a microcontroller, a radio transceiver, and usually a battery or nowadays a power harvesting module in the embedded form [1].

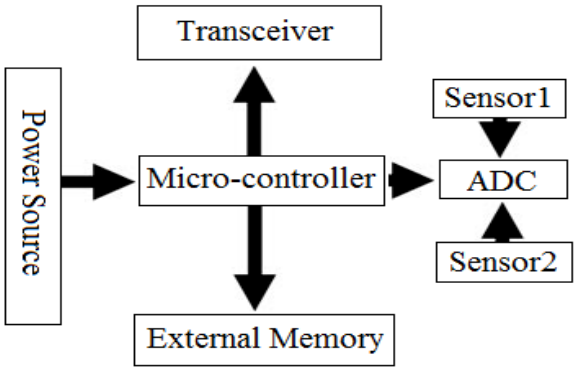

Fig. 1: Basic Structure of Sensors

The three main functions performed by all the wireless nodes are sensing the nature, preprocessing & storage of data information with transmission along with the nodes and with the destination (sink). The WSNs is an isolated system with different sensor nodes to gather and forward the data from surrounding sensor nodes or environment after processing them [2]. The figure below shows various SNs which collects the information from the nearby atmosphere and transfer the collected information to the target node (sink) through gateway [3].

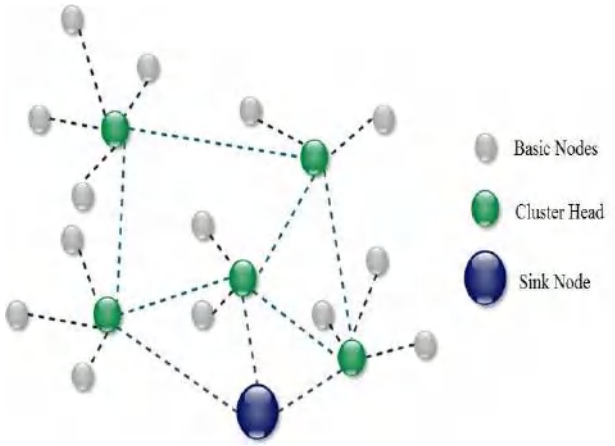

Fig.2. the basic structure of WSN

Characteristics of a good wireless network includes the minimization in consumption of energy for nodes with battery as a source, scalability to a large scale of distribution, node failure handling capacity

(responsiveness), simple in usage, designed in cross-layered, should have the capability to ensure severe surrounding conditions, reliability and mobility [4]. In several applications, energy-efficient data forwarding is supposed to be a critical challenge, due to inadequate energy sources & constrained and low-powered battery issues [5]. Hence, it is insisted that the consumption of energy should be managed (Minimized) so that the network lifetime will be enhanced significantly. Routing in any network is nothing but selecting an efficient (Energy) path to process and transport the data in the network, or over several networks. This action normally maintains information of the path to several network base and forwarding based on the routing tables [6]. Furthermore, the consumption of energy and the lifetime of the network will be affected by the reduced packet delivery ratio. Especially in the case of WSN, the routing mechanism should be handled carefully because it is a very important task [7].

The residual part of the work is prearranged as the IInd part will talk about the survey of several routing techniques and their related protocols. Section IIIrd gives our projected workout which explains the new metric for different calculation outputs with an algorithm in WSNs. Moreover, Section IVth deals with performance analysis of the projected routing protocol. As a final point, the conclusion is made in the Vth section.

II. LITERATURE SURVEY

Most of the traditional systems are more expensive as well as inappropriate for limited-resourced wireless networks. Therefore, it is extremely difficult to design an efficient energy WSN, because the wireless nodes have very low computational time, as well as less storage capacity to store data information packets [8]. Modern technological advancements in wireless technology have been approved to fabricate minimum cost, tiny, battery-operated multifunctional sensor nodes. For gathering or dissemination of data, each wireless node communicates with other nearby nodes as well as with the base station node [9]. Hence, different efficient-energy, as well as balanced- energy protocols for routing technique have been proposed for WSNs. These protocols try to minimize the consumption of energy in each SN, in account; increases the complete network lifetime.

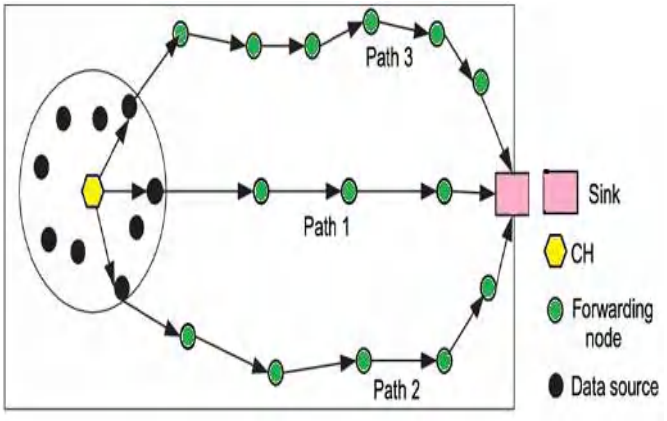

Fig.5 Different paths in WSN

The term "network lifetime" is a basic assessment metric for the particular network. It can be defined as the utmost time in which the system is efficient to measure a physical significance or occurrence. After every network data transmission around, the measurement of the nodes lifetime is done by its level of remaining energy. This remaining node energy is referred to as the residual energy of the wireless node [10].

In the earlier period, remote locations and restricted or hazardous areas, rotating machinery, and mobile resources are unreachable but now are reaching with the help of I/O devices in wireless networks. In water industries, these I/O devices and sensors can be powered by solar panels or battery packs [11]. The transmission capability of the node is restricted due to its communication range and hence the information data is transmitted several times through transitional nodes (Hop) via which fallout in flooding of packets which can cause the conflict between the packets, information idleness, and energy dissipation [12]. On the other hand, the queuing and delay issues are mainly universal features for the technical surroundings, such as in networking and telecommunications [13]. "Queuing premise provides the assessor with a powerful implement for designing and evaluating the performance of the queuing systems".

Except for the routing protocols, some additional techniques are there which are helpful in the transmission of data such as packet scheduling. A typical scheduler model is shown in Fig. below, in which the data packet is placed into the well-organized queue and waiting for being processed when received by the wireless node. In-network patterns like *"many-to-one"* and *"mostly-off"*, all wireless nodes through the multi-hop transmissions technique generate and transmit the packets to the base node or sink.

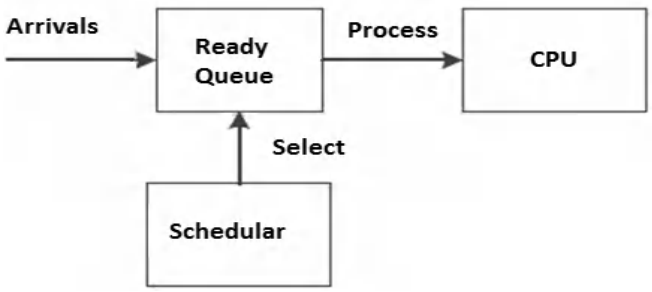

Fig.6. Basic Scheduling Scheme for maintaining queue in WSN

For that purpose, the goal is to make the wireless nodes to deplete their energy approximately at the same time, which can be done by tackling the problem on both levels i.e. on the region and at node level [14]. Hence, in the queuing model, the sensor node is blocked when the waiting queue length reaches the maximum value [15].

Some of the important metrics which are very useful for getting energy efficiency with NL elaboration are Packet delivery performance, which indicates the lifetime of the network. Throughput talks about the successful delivery of the packet to the destination per unit of time over a particular channel. The energy-efficiency metric helps in preserving the energy of the node and is considered as a sensitive parameter and for making it efficient the nodes when they are not in use for long are set to a sleep mode [16].

III. PROJECTED WORKOUT

It is mentioned in three sections

1. Cluster Head (CH) Selection based on nodes present energy & buffer rank
2. Detection of bottleneck Cluster Head (CH) Node by the systematic Approach Model
3. Routing based on CH rank of the Mobile sink

1. Cluster Head (CH) Selection based on nodes present energy & Buffer rank

As all the sensing information of the network is forwarded through the CH to sink node, hence CH selection in WSN is a considerable work. If elected CH is unable to hold the traffic in that case involuntarily the packets drop from it either due to lack of nodes buffer overflow or energy. Thus CH selection should be done precisely, as every node in a network having limited energy and buffer capacity and recharging or replacing the battery during the mission is not possible. For that purpose, a mechanism is developed for selecting the CH based on the status of energy as well as buffer status. It is named as "Energy & Buffer Residual Status (EBRS)", which will help to control the packet drop from CH due to buffer overflow or lack of energy. Thus the projected metric extends the network performance by reducing the packet drop, which justified as follows;

The assumptions made that, every node have the energy of *'E'* joules and can forward *'N'* number of packets with buffer *'B'* and can store *'n'* number of packets in the time interval.

Consider the packet *'P'* is going to forward from one of the nodes during the *'t'* interval of time, this packet consume the *'Ep'* energy and occupies the buffer space of *'Bp'* then the residual status of node in respect with buffer *'Br'* and energy *'Er'* can be computed by following equations.

$$Er = N - Ep,\ N > Ep \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ (1)$$

$$Br = n - Bp,\ n > Bp \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ (2)$$

The ability of a node to hold the packet in its concerning buffer and energy is computed by the knapsack algorithm by applying the following considerations

Table 1: Alphabets used and their Abbreviation

Alphabets	Description
E	Battery Energy in Joules
N	Number of Packets forwarding
PE	Node Packets
P_B	Buffer Packets
T	Period
E_r	Node Residual energy
B_r	Node Residual Buffer
Pei	The individual energy used for node packet
Pbi	The individual buffer used for node packet
ORmax	The upper limit threshold value
ORmin	Lowest threshold value
B	Total Available Buffer space of a node
P_n	Total Available Number of packets

1. In available energy and buffer space, the nodes are free to process the packets through node buffer
2. In respect to energy and buffer, the node should process the maximum number of packets
3. Partial processing of packets is not possible.

For processing 'n' number of packets successfully from a specified node exclusive of dropping it, the node must satisfy the below conditions, because the ability of the node to mitigate packet drop is 'Pn' number of packets.

1. The packet should be processed by a node completely
2. The packet should be dropped from the node, except incomplete progression should not happen

2. Detection of bottleneck Cluster Head (CH) Node by the Systematic Approach Model

To extend the network performance in respect with lifetime as well as packet delivery the buffer space of the node should be enough to process the packet, otherwise, a lot of packet forwarding chances gets wasted, and it will affect the network performance. Alternatively, at this time also if the node provides the space for upcoming packets, then it must drop any packet from its buffer. In both the situations, node cases as congestion that is a negative impact on the delivery of packets.

Existing protocols relating to WSN can be categorized based on;

1. Congestion control Routing
2. Congestion Non-control Routing

The majority of the obtainable protocols designed for WSN are congestion non-control. Unlike well-established networks, a dynamic and constrained network in WSN is very expensive in terms of overhead as well as time and is only possible to remove blockage but not prevent altogether. To eliminate network congestion, IETF recommended using the average queue size monitoring and computing process. Thus, we compute the average queue and average waiting time of the packet inside the node buffer to control the congestion, and thereby packet loss. Thus this section aims to compute the average packet number queued in nodes buffer, if this queue size is above the buffer threshold size then this node is going to lose the packets.

Without the loss of generality, we can calculate the average numbers of packets arriving at a particular time interval by using the exponential weighted moving average method.

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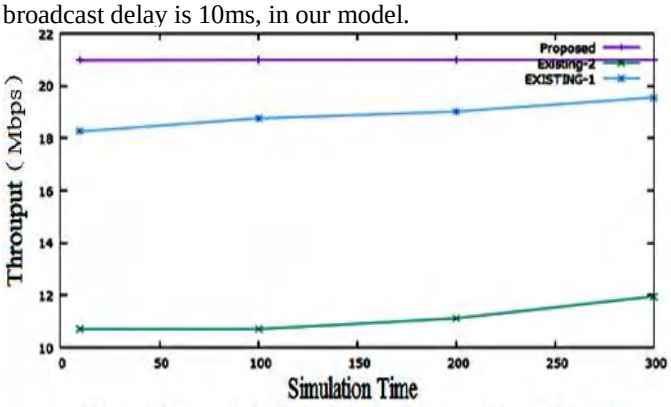

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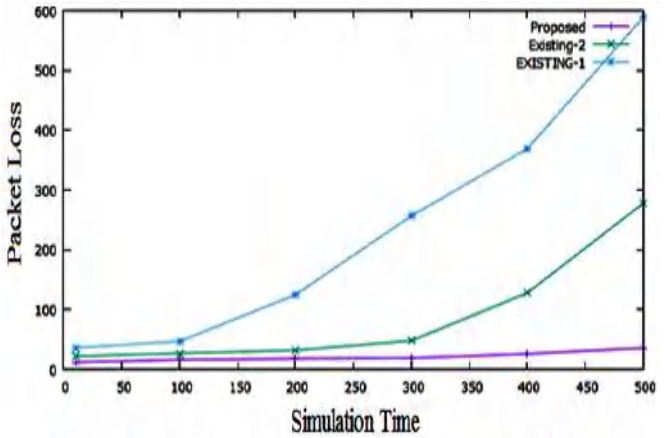

Figure 2:- Packet Loss Vs Simulation Time, Proposed & Existing Work

For that reason, we evaluate the network performance concerning the loss of packet and network lifetime and evaluate it with the present protocols.

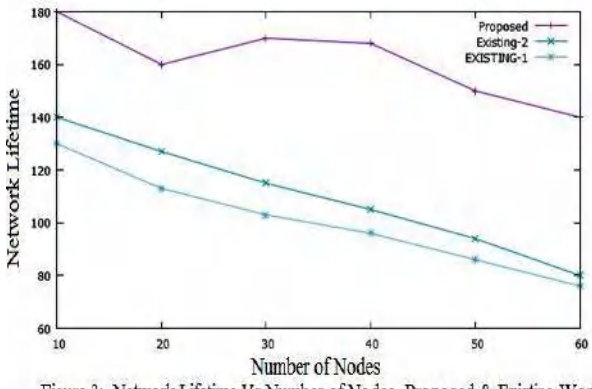

Figure 3:- Network Lifetime Vs Number of Nodes, Proposed & Existing Work

Figures 1, 2 and 3 noticeably show that projected system improve the system performance and elaborate the lifetime of the network.

V. CONCLUSION

To mitigate the bottleneck issue in WSN the suitable approach is cluster-based routing due to its less overhead in energy-efficiency and buffer. However, if merely one parameter i.e., energy efficiency, is considered for the selection of cluster heads then it may results in packet loss due to inadequate buffer. Hence, it is very essential that both parameters i.e., energy and buffer should be considered to select the cluster head in wireless networks. Furthermore, the degradation in network lifetime, depletion in network resources, and overhead are caused by the negligence of bottleneck node which is also a considerable issue to mitigate packet drop in WSNs. Hence, a novel metric "Energy & Buffer Residual Status (EBRS)" is put in place to select the cluster head which gives the status of the wireless node regarding its residual position of the energy of the node as well as its buffer. Moreover, this proposed metric will elaborate the lifetime of the network and accumulate the node energy. Additionally, it also monitors the current status of the wireless nodes and hence may be used like proactive routing protocol for cluster head selection which is our upcoming task.

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A Lossless Data Hiding Scheme in the Predicted Frames

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Abstract: ***The intrest in data hiding in compressed video frames, for digital multimedia distribution applications. Data hiding has been one of most researched issues in information security. In a video, neighboring frames have similar pattern where a secrete message can be embedded. A loss less data hiding scheme in the predicted frames during the motion estimation algorithm is proposed in this paper. This embedding technique produces the distortion videos than the classical-techniques. This data hiding algorithm supports user-defined levels of accessibility and security.***

Keywords: Data hiding, compressed video, motion vectors, predicted p-frames

1. Introduction

The traditional data-hiding schemes of compressed videos would incur a great deal of degradation enduring of signal distortion in the marked bit-stream [1]. In this regard authentication of video is of great interest since they are very susceptible for alterations and manipulations. It is of great importance when the video is used as verification in criminal offenses. Authentication techniques are needed in order to maintain authenticity, integrity, and security of digital video content. As a result, digital watermarking (WM), a data hiding technique has been considered as one of the key authentication methods [2] [3]. Digital watermarking is the techniques of embedded any digital content into the ownership logo content in order to provide authenticity. This digital content may be a random data, text, and image.

Recently, two methods are proposed to finding the moving area [4]. One of these methods is calculated magnitude of the motion vector. The magnitude of motion vectors in moving areas compared to stationary areas moving areas are more. So by determining both the horizontal and vertical motion vectors components and gaining their magnitude, a simple comparison can be achieved in high-motion areas. The other method is object tracking [5].

Now a day's many video watermarking or data hiding schemes are widely used in many of the applications. Over the years researchers has investigated many invisible based data hiding schemes for video authentication in both compressed and uncompressed domain. The level of robustness of the watermark can be categorized into three main divisions: fragile, semi-fragile, and robust. A watermark is called fragile if it fails to be able to detect after the slightest modification. A watermark is called robust if it resists a designated class of transformations. A semi-fragile watermark is the one that is able to withstand certain legitimate modifications, but cannot resist malicious transformations [6]. The main objective of this work is to propose lossless, robust data hiding scheme. This paper is organized as follows.

2. Related Work

In [7] Strycker et al. proposed a well known video watermarking scheme, The implementation of a real-time digital watermark embedding and detector for television broadcast monitoring is addressed it is also called another watermarking system (JAWS), for TV broadcast monitoring.

In [8] Liu et al. proposed a data hiding in inter- and intra-prediction modes of H.264/AVC. It uses these prediction modes to embed the watermark data. Before embedding, Whose function has been defined previously watermark area. The block types in the inter- and intra-predictions are adequately partitioned to represent watermark bits and based on the association of block types.

In [9] and also in [10] authors explained hide the data into a video frames using the phase angle between two successive CMV. These CMV are taken in to account based on the magnitude of the motion vectors as in [11]. So the message bit which is going to hide is encoded as phase angle difference in regions between CMV. The block matching scheme is selected to look among the chosen sector for which the magnitude to be larger than the predefined threshold value.

In [11] Jordan et. al proposed owner information hiding in video using inter frame. The select the inter frames in MPEG video sequences and regularize the motion vectors into a modified data succession. This method uses the predicted frames using motion estimation and the loss less data embedding is applied on the predicted frames.

3. Proposed Method

Algorithm-1: Embedding

1) Read input video
2) Initialize the starting frame for embedding (STF) and the number of frames(NF) for embedding
3) Read the message or bit stream to be embedded

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4) Consider the general video format IBBPBBI of frames and select only frames for embedding
5) Inter-frame MB in the P-frame is represented by forward MVs and quantized.
6) Coefficients of the prediction residual after motion compensation.
7) Consider N – pixel grayscale predicted image which here considered as host image. Assume that the pixel value x_i denotes the grayscale value of the i[th] pixel $0 \le i \le N-1$.
8) Calculate the difference between x_{i-1} and x_i in reverse S-scan order
9) Seek the peak point 'P from the vector differences
10) Shift the vector values by 1 unit

$$y_i = \begin{cases} x_i & if\ i = 1\ and\ d_i < P \\ x_i + 1 & if\ d_i > P\ and\ x_i \ge x_{i-1} \\ x_i - 1 & if\ d_i > and\ x_i < x_{i-1} \end{cases}$$

11) Insert the message bits according to the same above equation

$$y_i = \begin{cases} x_i & if\ i = 1\ and\ d_i < P \\ x_i + M & if\ d_i > P\ and\ x_i \ge x_{i-1} \\ x_i - M & if\ d_i > and\ x_i < x_{i-1} \end{cases}$$

here the $M \in \{0,1\}$. A high capacity of embedding can be obtained by inserting different data bits into different predicted vectors.

Algorithm-II: Extraction Process

1) The predicted values are first normalized and brought into the interval of [0 255]
2) Scan the predicted values in the same reverse S- order
3) Set $x_0 = y_o$ where x_0 denotes the restored value and the message is extracted using the below equation

$$M = \begin{cases} 0 & if\ |y_i - x_{i-1}| = P \\ 1 & if\ |y_i - x_{i-1}| = P+1 \end{cases}$$

where x_{i-1} denotes the restored value of y_{i-1}
4) Restore the original value of predicted vector by following equation

$$x_i = y_i + (|y_i - x_{i-1}| - P) \quad if\ P < |y_i - x_{i-1}| < P+1\ and\ y_i < x_{-1}$$
$$y_i + (|y_i - x_{i-1}| - P) \quad if\ P < |y_i - x_{i-1}| < P+1\ and\ y_i < x_{i-1}$$

5) Repeat the above 3 & 4 steps until the message is extracted

Algorithm example as fallows

Motion estimation (ME) and compensation is an integral procedure to reduce temporal redundancy between adjacent P-frames and spatial redundancy within I-frame. Each inter-frame MB in the P-frame is represented by forward MVs and quantized DCT (Discrete Cosine Transform) coefficients of the prediction residual after motion compensation. In this research these predicted residual vectors are used for data hiding. The data hiding scheme proposed in this work is presented below.

Consider N – pixel grayscale predicted image which here considered as host image. Assume that the pixel value x_i denotes the grayscale value of the i[th] pixel $0 \le i \le N-1$. One important point to be noted that the predicted vectors have the values in the below form

Predicted frame= [0 13 0 -1 1; 0 14 2 1 1 ; -1 12 -6 -10 -8]

The values are in the range of [-255 to 255]. But the spatial content will fall in the region [0 - 255], so the values are normalized and corrected to fall in the region of [0 - 255].

Corrected values: =[0 16 0 1 1; 0 17 2 2 1; 1 15 9 13 11];

After the corrected vector of values are obtained. The embedding process is as follows

(i) Calculate the difference between x_{i-1} and x_i in reverse S-scan order

(ii) Seek the peak point 'P from the vector differences

(iii) Shift the vector values by 1 unit

$$y_i = \begin{cases} x_i & if\ i = 1\ and\ d_i < P \\ x_i + 1 & if\ d_i > P\ and\ x_i \ge x_{i-1} \\ x_i - 1 & if\ d_i > and\ x_i < x_{i-1} \end{cases}$$

(iv) Insert the message bits according to the same above equation

$$y_i = \begin{cases} x_i & if\ i = 1\ and\ d_i < P \\ x_i + M & if\ d_i > P\ and\ x_i \ge x_{i-1} \\ x_i - M & if\ d_i > and\ x_i < x_{i-1} \end{cases}$$

here the $M \in \{0,1\}$. A high capacity of embedding can be obtained by inserting different data bits into different predicted vectors.

After embedding the data, the predicted vectors are decoded along with motion estimation vectors to form a watermarked frame.

At the receiver end the receipt first separate the motion vectors and predicted vectors using motion estimation process and later the extraction process is applied on the predicted vectors. The extraction process is as follows

1) The predicted values are first normalized and brought into the interval of [0 255]
2) Scan the predicted values in the same reverse S- order
3) Set $x_0 = y_o$ where x_0 denotes the restored value and the message is extracted using the below equation

$$M = \begin{cases} 0 & if\ |y_i - x_{i-1}| = P \\ 1 & if\ |y_i - x_{i-1}| = P+1 \end{cases}$$

where x_{i-1} denotes the restored value of y_{i-1}
4) Restore the original value of predicted vector by following equation

$$x_i = y_i + (|y_i - x_{i-1}| - P) \quad if\ P < |y_i - x_{i-1}| < P+1\ and\ y_i < x_{-1}$$
$$y_i + (|y_i - x_{i-1}| - P) \quad if\ P < |y_i - x_{i-1}| < P+1\ and\ y_i < x_{i-1}$$

5) Repeat the above 3 & 4 steps until the message is extracted

4. Experimental Results

In this work the video sequences are taken from [11]. The videos are in YUV format in which the Y component is utilized for the experimental analysis. The results are shown below

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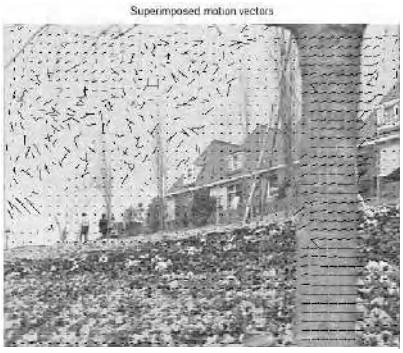

Figure 1: Motion Vectors in a frame

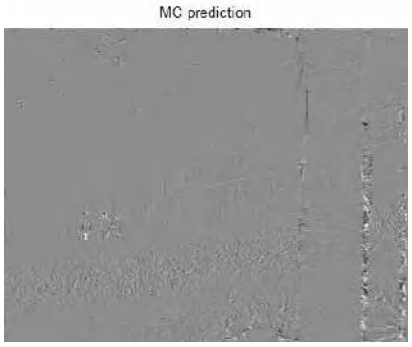

Figure 2: Motion Compensated predicted frame

Figure 3: Original Frame

Figure 4: Frame after embedding data

Txt=' Hi This is nayansrivaan';
Extracted Message is: Hi This is nayansrivaan
The proposed method is lossless data hiding process whose capacity is given as $\left(\frac{MxN}{8}\right) * n$ where M & N are the resolution of the frame along horizontal and vertical axis and 'n' is the number of frames.

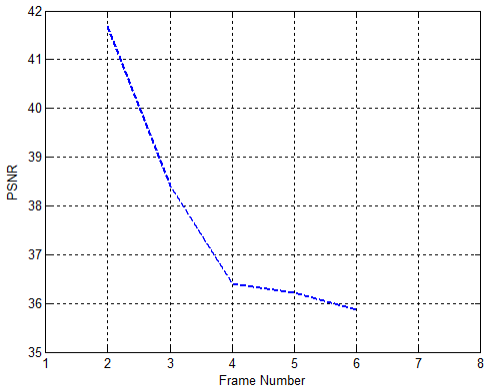

Figure 5: PSNR analysis for different frames

The proposed approach can provide high perceptual quality of the video sequence while embedding higher amount of data into it. Figure 5

Shows the PSNR analysis of the approach for different frames .

5. Conclusion

An improved data hiding scheme based on the modification of motion vectors is proposed in this paper, the algorithm is tested on several video streams and found that this method is leading a considerable improvement both perceptually and capacity wise. The algorithm suffers from a limitation that this approach is consuming more processing time than earlier .The deployment tool or language can be changed in order to improvise this. This algorithm can also be extended in future with changing of transformation domain and also decreasing the processing time.

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Rumour Detection Models & Tools for Social Networking Sites

Mohammed Mahmood Ali, Mohammad S. Qaseem, Ateeq ur Rahman

Abstract*: *Efficient utilization of social networking sites (SNS) had reduced communication delays, at the same time increased rumour messages. Subsequently, mischievous people started sharing of rumours via social networking sites for gaining personal benefits. This falsified information (i.e., rumour) creates misconception among the people of society influencing socio-economic losses by disrupting the routine businesses of private and government sectors. Communication of rumour information requires rigorous surveillance, before they become viral through social media platforms. Detecting these rumour words in an early stage from messaging applications needs to be predicted using robust Rumour Detection Models (RDM) and succinct tools. RDM are effectively used in detecting the rumours from social media platforms (Twitter, Linkedln, Instagram, WhatsApp, Weibo sena and others) with the help of bag of words and machine learning approaches to a limited extent. RDM fails in detecting the emerging rumours that contains linguistic words of a specific language during the chatting session. This survey compares the various RDM strategies and Tools that were proposed earlier for identifying the rumour words in social media platforms. It is found that many of earlier RDM make use of Deep learning approaches, Machine learning, Artificial Intelligence, Fuzzy logic technique, Graph theory and Data mining techniques. Finally, an improved RDM model is proposed in Figure 2, efficiency of this proposed RDM models is improved by embedding of Pre-defined rumour rules, WordNet Ontology and NLP/machine learning approach giving the precision rate of 83.33% when compared with other state-of-art systems.

Keywords* : *Social Networking Sites (SNS), Rumour Detection models (RDM), Pre-defined rules, WordNet Ontology.

I. INTRODUCTION

With the use of Social media platforms there is a tremendous increase in spreading of rumours on various topics and domains. Now-a-days, these social messaging applications are excessively used in promoting of events, Advertisements, New's channels, sharing of market data and business transactions. Sometimes, these microblogs communicate the false information which leads to misunderstanding among the group of people creating mental tensions in the society. Surveillance of falsified information (i.e., rumour) needs to be strictly monitored by e-crime cell. The e-crime cell is authorized to take stringent action against those culprits for sending rumours through SNS. Sending of deceitful and false information named as "rumour", which is one of the serious cybercrimes as per the FISA Act [4]. Spreading of rumours through Websites and Social media platforms, mobile phones, laptops and vice versa may encounter various problems in the society that hinders the development by creating mental tensions among the people [5]. Specifically, many of the electronic rumours spread through mobile messaging applications is very difficult to catch at the initial stages unless it is notified by the users, and these short posts exists for short life span at the server. Similarly, microblogs communicated or shared via various interchangeable social media platform to other social mediums (i.e., WhatsApp to Facebook, Google+ to Instagram, Instagram to WhatsApp, youtube to WhatsApp, Facebook to WhatsApp and vice versa) differs in their messaging architecture and privacy restrictions of storing and retrieving policies that makes it difficult to identify the rumour words when they are encountered in microblogs [6]. Radio agencies and News channels also plays a vital role in sending of rumours through audio, video or conference communication, which becomes impossible to analyze and stop their transmissions at run-time, such contents once viewed in mobile phones are automatically auto-saved in the memory and hence, are transmitted to others at later point of time. Spying of such rumour voice communications and video recordings is still a research issue that requires rigorous surveillance at various instance of timestamps. Every post may not be a rumour, identifying factual microblogs from set of cluster of posts that are sent through social media is predicted using ranking algorithm from various enquiry patterns [7]. Twitter messaging application which is widely used by millions of people for posting, giving reply to specific tweets, forwarding of tweet to other users adversely influence on Health domains by creating mental tension in the society. To overcome, health domain problems from Twitter, few parameters are picked for evaluation such as statistics of users, sentiments of specific tweets, followers of root of tweet along with URLs and fed to classifiers for finding the rumours [3]. A new classification algorithm was proposed using statistical metrics for segregation of rumour and non-rumour twitter posts based on users frequency of interaction, structure & network establishment, temporary connectivity and linguistic features. It is concluded that linguistic features evolved to be on top-priority with good accuracy rate in classification of rumours and non-rumours for tweets that vary for long duration [10].

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Another study, suggest that rumours are detected by supervised (well-labelled datasets), unsupervised (unknown labels), and hybrid based (known and unknown keywords) approaches [5]. In this Section we illustrated the importance and its necessity to detect rumours from Social networking sites and its impact towards maintaining of Harmony and peace by avoiding unfaithful tensions in the society. In Section II, we defined the Rumour definition based on earlier studies and the various types of rumour categories, We identified the problems that are faced, if rumours are not detected in the initial stages from microblogs. The Section III, describes the thorough comparative analysis of various rumour detection models by highlighting the Features, Technique utilized, Drawbacks, and giving an assertive suggestion for improving these rumour detection models, whereas Section IV, depicts the overview of Datasets that are used in prediction of rumours from social media platforms and the currently existing tools available to predict and stop rumours from various SNS is discussed. To overcome, the necessary enhancements needed to be embedded by removing the flaws that exists in RDM with the use of Ontology and pre-defined rumour rules are elaborately discussed in Section V. The Section VI, discusses the experimental results obtained by *TraceMiner*, *CED*, and Proposed *RDM* approach. Section VII, concludes with the literature survey reviewed in this paper by considering the seriousness required in detection of rumours from various electronic communication channels, especially social media platforms. Further, in future the RDM can be improvised by embedding of multilingual language along with pre-defined patterns and Ontology.

II. PROBLEM STATEMENT AND RELATED WORK

A. Rumour Definition

"A rumour is defined as *falsify message*, intentionally created by an individual or group of individuals to gain personal benefits and it is forwarded to other individual or groups. Later, this *falsify message* is again forwarded by innocent individuals believing it's a truthful *message*". The spreading of rumour words through various messaging applications and creating misconceptions among the users of SNS resulted in social disaster is depicted in figure 1.

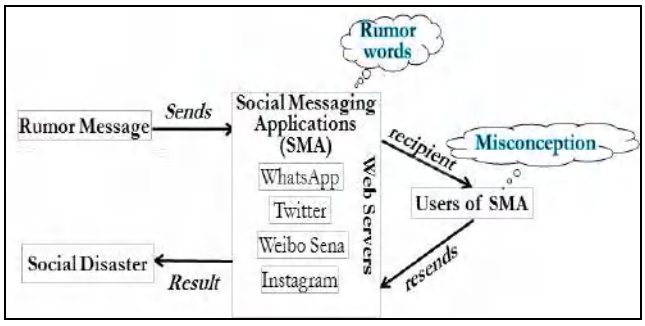

Fig. 1. Depicts the communication of Rumour through Social Messaging Applications (SMA)

B. Rumour Types

Many of rumour detection methods are categorized into three paradigms namely hand-crafted features based classification approaches, the propagation-based approaches and the neural networks approaches.

In 1944, Robert H. Knapp analysed the various categories of rumour types in his reports "A Psychology of Rumor". He broadly categorised these rumours into three types [20]:

- Pipe dream rumors: Reflects public desires and wished for outcomes. (*E.g. Japan's oil reserves were low and thus World War II would soon end*.)
- Bogie or fear rumours reflects feared outcomes. (*E.g. An enemy surprise attack is imminent*).
- Wedge-driving rumours intend to undermine group loyalty for interpersonal relationship (*E.g. German-Americans, Italian-Americans, Japanese-Americans were not loyal to the American side*).

C. Problems faced due to rumours in SNS

RDM approaches that are discussed in Section I, are mediocre to detect multilingual rumour words. Further, these methodologies are deficient to predict emerging rumours that has abbreviated terms (i.e. short-forms). When the words from microblogs of social media are mapped and checked with rumour datasets the efficacy of detection rate is poor, this is due to emerging rumour words in which linguistics words are used for this reason they are not detected by RDM, and hence neglected.

The dataset needs to be updated frequently as the new trending rumour words arrive from SNS. Hence, the old rumour words (i.e., dataset) are obsolete when compared with emerging rumour words. These dataset are again categorized based on domains, obtaining dataset in specific domain and judging rumour and non-rumour posts is limited to certain extent, but collectively testing with multiple domains and comparing with each of the respective domain resulted in ambiguity outputs [3]. Many of architectures make use of Machine learning technique which is a time-consuming process that can be improvised with the use of pre-defined knowledge based rules guided with semantic ontology.

Another major drawback of rumour datasets is processing time taken to generate an alert and report to servers is delayed. In many of the rumour detection strategies it is found that machine learning approaches requires frequent training of system using the labelled dataset in case of supervised strategy. Studies suggest that, instead of machine learning or ranking algorithmic approach, the pre-defined knowledge based rules sum-up with deep learning approaches (CNN/RNN) and Natural Language processing embedded with Semantic Ontology are found to be efficient when compared to earlier approaches [16] [8]. After keen observation of various datasets of different domain it is suggested that domain specific rumour words need to be used in a particular context for better precision rate. If the Hybrid Ontology is used for finding multiple synonyms of rumours using WordNet it becomes easy in logical annotating of rumour words of a particular domain [9].

In this section we thoroughly briefed the problems that are faced in detection of rumour words from microblogs. Further, how these approaches can be improvised with the use of Knowledge-based pre-defined rumour rules, Machine learning technique and Semantic Ontology is discussed.

III. COMPARATIVE ANALYSIS OF RUMOUR DETECTION MODELS

Spreading of rumours through various means such as websites, social media, or electronic messaging systems is considered as one of the serious cybercrime [11]. To mitigate the rumours that are spread widely needs to be detected and stopped using cyber surveillance tools at the servers before it is forwarded through various means of communication channels. The technique of asserting the rumours from microblogs sent via social media is identified using Hidden Markov model and supervised classifier by deriving parameters from annotated dataset [12]. Similarly, many approaches to predict and prevent rumours from different communication channels were proposed, most of them make use of machine learning classification technique, Text mining, deep learning or SVM techniques as shown in Table I. .

Table- I: Comparative analysis of Rumour Detection Methods of SNS

Sl. No.	Title	Objective	Strategy/ technique	Remarks
1	CED: Credible Early Detection of Social Media Rumors [16]	Predicts the rumours from the reposts made via Social media	Deep neural network (i.e., CNN) is used to train the sequence of posts, for every single microblog a unique "credible detection point" is generated for better accuracy	This strategy could able to obtain an accuracy of 85% when tested on twitter, facebook & weibo datasets
2.	Automatic Rumor Detection on Microblogs: A Survey [17]	Mine the available microblogs sent through communication channels over the network.	Machine learning technique efficiently used for rumour detection from posts	Fails to detect long text and multimodal messages sent among the various social media platforms
3.	Early Rumour Detection [1]	Timely detection of Rumour before it spreads	Max pooling method extracts features then deep Q-learning model applied to check real rumour event, then successively train, & finally minute-to-hour posts grouped and compared for real rumour	Dependent on Data sets for comparing, Reinforcement recurrent neural networks used to learn, ERD model predicts rumours from Twitter and Weibo at an average time of 3.4 & 7.5 hours respectively. Fail to detect Emerging & new rumours
4.	Rumor detection over varying time windows [10]	Cumulative dispersal of rumour patterns over time & tracking the continuous changes in predictive powers of rumour features	Removal of irrelevant features using permutation, then selecting relevant features through interpretation, Next removal of redundancy from selected features. During this process Machine learning (Classifier used to learn)	Duration of 2-3 days (minimum) & 28 days (maximum) for continuous monitoring of rumours from features (user, network, temporal, structural & linguistic), jointly user & linguistic features fed to NLP tool (rule-based) will improve rumour detection,
5.	Exploiting Context for Rumor Detection in Social Media [13]	Depending upon the type of tweets sent the selection of classifier is chosen to predict the rumour and non-rumours	Rumours predicted based on context using various classifiers namely Conditional Random Fields, Maximum Entropy, Enquiry-based	Filters by removing unnecessary prepositions, ?, !, word-vector, . (period), POS, before selection of precise classifier, Lack to predict veracity for emerging rumours.
6.	Identifying Influential Rumor Spreader in Social Network [14]	Spying of rumour spreaders and controlling along the social networking sites is the objective	Monte Carlo is used to simulate rumour propaganda. The high degree and low degree at the network nodes is identified by intuitive ranking and K-Shell decomposition method using Degree centrality.	Monte carlo conclude that rumours explode exponentially at higher layer in less amount of time by propagation nodes with respect to comparison of informed nodes, Four real datasets are picked from SNS, but in real time it is not possible to predict trending rumours
7.	Detection and Resolution of Rumours in Social Media: A Survey [18]	Detects long lasting and newly emerging rumours spawned across the network	Machine Learning approaches and NLP techniques used for Rumour Classification by rumour tracking, stance & Veracity classification	Applicability to other domains need to be carried out, such as hoaxes and fake news.
8.	Enquiring Minds: Early Detection of Rumors in Social Media from Enquiry Posts [19]	Proposed a technique to identify trending rumours, which are defined as a topic that includes disputed factual claims.	Performs four major tasks: i) identify tweets that has Questions, ii) perform clusters of those questions, iii) annotate by detecting the rumour in the tweet, iv) Rank clusters using statistical features	The questions raised to be checked and if correction exists need to be corrected instead of depending on manually selected regular expressions. Updation of patterns in real time scenario to be induced to prevent from spamming in detection process.

IV. RUMOUR DATASETS AND DETECTION TOOLS

A. Rumour Datasets

Collection of datasets by considering historical belongings is trivial as discussed on websites snopes.com and urbanlegends.about.com where the events that were occurred in 1876 were suddenly re-appeared in 1974 showing old collective materials which were never existed earlier, but at the same time few contents such as Address and the shops used to exist till date, which becomes extremely difficult to believe. For, such events, tweets were widely discussed by different people with respect to current situation which will inadvertently gives rise to propaganda of rumours.

Detecting of short rumour tweets such as "Obama is a muslim guy", this does not require excessive learning for this authenticated books to be checked and a conclusion can be derived within seconds using a pre-defined rule based classifier [13]. In literature, most of the researchers had picked datasets of their own considering a particular scenario and few have taken from previously existed rumour datasets [3] [13] [16]. Many of the researchers had picked rumour dataset of microblogs from Twitter, Facebook, Weibo and Instagram to predict the category of rumours [1] [18].

B. Rumour Detection Tools

Many tools for detecting of Fake rumours was proposed earlier, one among them is *TraceMiner* that detects the Fake news or rumors generated using the social media linkages in various social networking communities which is a static approach [15]. Rumour detection projects aimed at developing of specialized tools namely *Emergent, PHEME, RumorLens, TwitterTrails, RumourFlow, COSMIC, SUPER, Hoaxy, REVEAL, InVID, CrossCeck, Decodex, Check, ClaimBuster, Una Hakika, Seriously Rapid Source Review, TweetCred* were successfully deployed for detection of rumours from microblogs [18].

V. PROPOSED RUMOUR DETECTION MODEL

After analyzing, various Rumour detection tools and problems faced by RDM in Section 3. These RDM can be improvised by embedding of features namely Linguistics, Pre-defined rumour rules and Machine learning approach. The proposed approach of Rumour detection model after embedding the above features is shown in Figure 2.

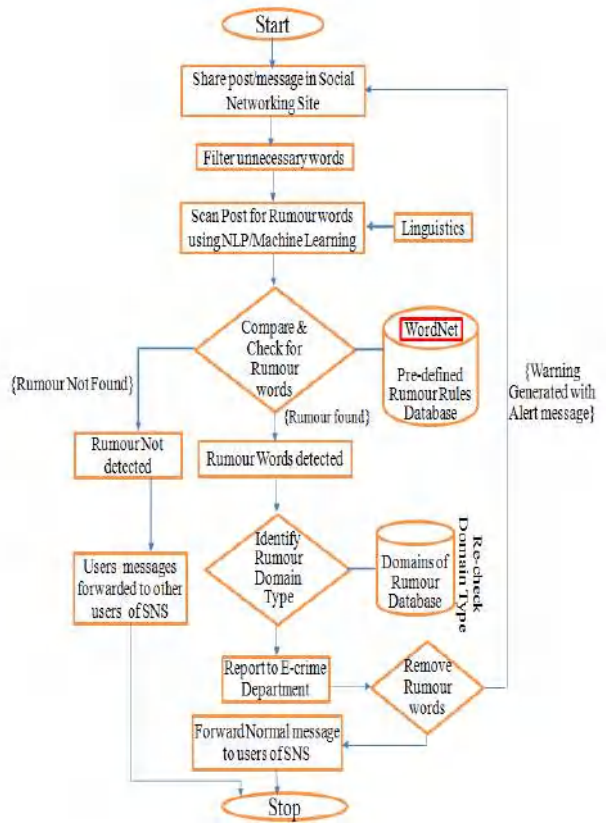

Fig. 2. Flowchart-cum-Algorithmic approach for Rumour Detection from messages of SNS

The WordNet, logically establishes the links with set of synonym words from the posts that are sent by the users via SNS [2] [22]. This WordNet lexical database comprises of 155,327 words forming a synsets word-pairs of 207,016.

In this proposed Rumour detection approach, the messages that are sent via SNS are picked and then unnecessary words are filtered. After this, filtered message along with linguistic words is fed to NLP or Machine learning Tool, which then tries to detect the Rumour words by computing with pre-defined rumour rules which is assisted with WordNet Ontology. On detection of rumour words the domain of Rumour type is identified and reported to E-crime department cell. This e-crime cell will remove the rumour words and then forwards the filtered message without rumour words to other users of SNS. Subsequently, a warning message and an alert is generated and forwarded to the concerned user of SNS.

VI. EXPERIMENTAL RESULTS & ANALYSIS

Based on stance and veracity these rumour messages communicated through Social Networking sites are classified into Four (4) types:

i) Rumour messages persist for long durations and continue to exist forming an infinite linked-chain.

ii) Rumour messages that exist temporarily for short-duration and then disappear after certain period.

iii) Emerging rumour messages are those that changes with respect to time, context, necessity and situation.

iv) Use of diverse and versatile language style in chatting session that constitute of rumour words.

First and Second type of rumour messages are detected using rumour detection methodologies which are discussed in Section IV, they are dependent on historical datasets for categorizing posts as rumour or non-rumour using machine learning approaches which is a time-consuming process. Whereas Third and Fourth types efficiently predicts rumours from SNS using NLP guided with pre-defined rules shown in Table II instead of historical datasets as discussed in Section V.

Table- II: Set of domain specific pre-defined rumour rules

Type of rumors (Domain)	Rumour words
Wish rumors →	Imagining, day mare, illusion, mirage, hallucination, pipe dream, gossip, vision, fantasy, fiction, dream, visualization....
Dread rumors →	Bone chilling, startling, threatening, weird, horrid, alarming, ghastly, fearsome, terror, panic....
Wedge Driving rumors →	Hateful, loathsome, distasteful, bold, determined, insolent, dominating, fierce, vicious, savage, fighting....
Accident →	Crash, disaster, tragedy, collision, survive, deathblow

A. Rumour Scenario in Social Networking Sites

In this section, an example is chosen that illustrates, how the rumour words are propogated through online-chatting session by group of users in SNS, which is shown in Table III.

Table- III: Depicts the domain of *'Accident'* rumour words communicated between the users

Domain of Rumour	User 1	User 2
Accident	"Did u hear the latest news of a car crash? It turned out to be a disaster." "the collision took place at the intersection when the driver fell asleep" "no, it was a deathblow"	"what a tragedy, how did it happen" "Did anyone survive?"
Rumour words to be detected:	Crash, disaster, tragedy, collision, survive, deathblow	

In Table III, the '*user 1*' propagates the fake information of rumour words pertaining to '*Accident*' domain to another '*user 2*'. In this chatting session the rumour words like *crash*, *disaster*, *tragedy*, *collision*, *survive* and *deathblow* are used which needs to be detected. The above chatting session is tested with Rumour Detection strategies *TraceMiner*[15], *CED*[16] and the proposed RDM. The precision rate that are obtained are shown in Table IV.

Table- IV: Rumour words detected from chatting session by *TraceMiner, CED, & Proposed RDM strategy*

	TraceMiner	CED	Proposed RDM
Word Detected	Crash, Disaster	Collision, Tragedy, Disaster	Crash, disaster, tragedy, collision, deathblow
Count of Words	2	3	5
Precision rate	33.33%	50.0 %	83.33%

B. Analysis of RDM model

TraceMiner has detected only Two (2) rumour words namely 'Crash' and 'Disaster' with a precision of 33.33%, *TraceMiner* initially forms a cluster of messages from the users of Social media with the aid of Gaussian distribution and segregates the collected messages into two sets one is training and another is validation, then these sets are fed to RNN for training purpose for a certain period of time. Thus this training for *TraceMiner* using reinforcement learning resulting in poor detection of rumour [15]. Another rumour detection approach named as *CED* succeeded in detecting of rumours with a precision rate of 50%. The words 'Collision', 'Tragedy' and 'Disaster' are words identified from Table II. The *CED* uses checkpoint for every single post sent by the user, these posts are fed to CNN and RNN for training of *CED*, during this process the weights changes as the post increases. This *CED* approach is better when compared to *TraceMiner*, because it uses checkpoints for every post.

In our proposed RDM approach, the precision rate is 83.33%. This approach initially, filters unnecessary words from messages, parses the text using NLP approach, identifies the Entity relationships between the words. After finding the entities, it starts mapping with the pre-defined rumour rules which is shown in Table II. During this process, WordNet ontology is efficiently used that logically finds the exact word by mapping with the words from various posts sent by users. On detection of matched words the domain '*Accident'* along with set of rumour words is predicted by our proposed RDM model.

VII. CONCLUSION AND FUTURE WORK

This paper reviews different ways by which rumours are propagated by criminals through various means of social media platforms. Further, how these falsified rumours are picked and communicated to other social users or groups that resulted into a serious cybercrime and disturbing of mental peace in the society. Interestingly, the various rumour detection models developed till date are discussed in this paper in section III, it is found that, many of these approaches of rumour detection methodologies could able to predict and prevent rumours from different communication channels (i.e. social media platforms) most of these RDM make use of Classifiers, machine learning, Text mining, deep learning, SVM techniques, and statistical approaches. Whereas, in section IV, we discussed the various datasets that are used for analysis for rumour detection, which are chosen from various sources of SNS sites namely, Facebook, Twitter, Linkedin, WhatsApp, Seina weibo and Instagram. Subsequently, we have listed the rumour detection tools that are available for detection of rumours.

Lastly, we conclude that most of these detection models fail to predict emerging long-term twitter posts and multilingual rumours. To improve the efficacy of rumour detection rate the trending use of NLP/machine learning technique along with semantic ontology guided with pre-defined knowledge based rumour rules shown in Table II, is integrated into the existing rumour detection approach as discussed in Section V. Ultimately, we propose RDM approach that aid in prediction of rumours from microblogs and generating a report that will be submitted to e-crime department to take appropriate action as per the law. Apart from this RDM will pop-up an alert with a warning message for sending falsify information to the users of SNS [21].

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Composite and Hybrid Routing Protocol for Wireless Sensor Networks with Mobility Consideration

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Abstract:- Due to the rapid advancement in Wireless Sensor Network, it is very essential to focus on efficiency in performance of the sensor networks. We design a hybrid routing protocol for wireless sensor network with mobility consideration. The protocol selects the route by three factors; cluster formation, cluster head selection and determining the sink node position based on its load. Cluster head selection is based on the residual status of node regarding load and energy. This protocol improves the network performance and reduces the packet loss by removing the congested and constrained nodes from routing path. Moreover, it improves the network lifetime by dynamically changing the sink node position based on the status of its neighbor node load status. Thus this paper deals with the design and development of hybrid routing protocol for WSN with mobility of sink node in multi hop communication environment.

Keywords: Hybrid Routing Protocol; Mobility; Cluster; Sink Node; Congestion;

I. INTRODUCTION

Wireless Sensor Networks (WSN) is an emerging area of research and development as it is being implemented in large number of applications. WSN has interconnected devices operated by battery with low power signal processing and wireless transceiver. Basically WSNs are comprised more than one sink and large number of sensor nodes [1]. A sensor node collects data and transmits the information either in compressed or aggregated form to neighboring nodes. Thus each node acquires a view of monitored space which can be accessed by devices connected externally through some gateway nodes in WSN.

A network consists of mobile devices that communicate via radio transceiver along a multi hop path. Ad-hoc network is used where wired setup is not feasible [2]. Two or more devices exchange information by using radio signal and are called nodes. The development of WSN was initiated for military purpose but nowadays WSNs have become pervasive.

In literature lot of routing protocols [3] have been proposed to extend the lifetime of network. One such routing protocol is energy aware routing protocol. This protocol selects routing based on higher energy nodes routing path. Source sends the information to destination by sending the data to higher energy neighbor nodes. However these types of routing protocols reserve a particular node for communication purpose. If a node is receiving packets from multiple sources due to its higher energy and insufficient buffer space, the packets get drop. Thus these routing protocols creating a load balancing issue, which interns causes the packets drop. This type of situation in network is known as bottleneck [4]. From above discussion we needs a routing protocol which address the three issues

- Energy efficiency
- Load balancing
- Mobility

While selecting the neighbor node of sender it needs to check the two factors namely energy and load. Thus in this paper, we develop a routing protocol which selects a routing path by considering the energy and load of the neighbor nodes. In order to achieve our goal, we first calculate the reactive status of node regarding buffer and then we calculate proactive status of node regarding energy. Thus our proposed routing protocol is hybrid routing protocol as it is a combination of reactive and proactive status of energy and buffer of an intermediate nodes.

In order to overcome the problem of bottleneck intermediate node, the appropriate solution is to change the sink node position based on the status of sink node intermediate node with respect to energy and load. Thus we design a routing protocol to extend the energy efficiency and network lifetime by mobile sink named as Composite and Hybrid Routing Protocol for WSN with Mobility consideration (CHRPM), which performs better in terms of lifetime, energy consumption and mobility.

Remaining paper is organized as follows. Next section discuss about the LEACH routing protocol designed for WSN and random mobile sink routing protocols along with mentioning literature of other related

protocols. Section III discuss about proposed routing protocol i.e., CHRPM. The paper ends with Simulation Results followed by Conclusion.

II. RELATED WORK

LEACH is Energy efficient hierarchical clustering protocol. It is design for minimizing power utilization. It is designed for prolonging life of the network. It randomly selects the cluster head from a set of clusters. Routing information is forwarded from cluster heads. Cluster heads are responsible for reducing energy utilized by the nodes present in the cluster. With the help of local coordination that restricts the amount of data forwarded to sink. It also makes the routing strong and scalable. Leach uses fusion technique. This technique aggregates the data and communicates only useful information to all nodes. Cluster heads responsibilities are changes among nodes inside the cluster to avoid energy depletion. LEACH works in two phases.

Phase 1: First phase deals with forming clusters, selecting cluster head and preparation of transmission schedule.

Phase 2: Second phase deals with data fusion, data compression and transmission of data to the sink.

LEACH is distributed protocol which requires no prerequisite knowledge of the network. It uses single hop routing from source node to cluster head, and from cluster head to the sink. Cluster head needs to spent more energy, in case of the source is far away from sink. It happens because of dynamic clustering.

LEACH routing protocol [5] is based on time division multiple access based routing protocol. The principle point of this routing protocol is to enhance the network lifetime by reducing the energy consumption. The protocol comprises of two stages i.e., set up phase and steady phase. Protocol operation consists of several stages with two rounds in each stage, and it is hierarchical structure. This protocol is self-organized and adaptive.

LEACH protocol is cluster based routing protocol for WSN. The aim is to randomly select the sensor nodes as cluster head and uses them to router to sink node. Cluster head selection is changed based on remaining energy consumption of node in particular time period. The threshold value for selecting the cluster head is based on the following formula, i.e., $T(n)$.

$$T(n) = \begin{cases} \frac{p}{1-p\times[r \bmod(1/p)]}, n \in G \\ 0, others \end{cases} \quad (1)$$

Where,

$p = desired\ percentage\ to\ be\ a\ CH$

$r = current\ round$

$G =$ set of nodes that have not been cluster-heads in the last $\frac{1}{p}\ rounds$

Random mobile sink routing protocols

The random waypoint model is a model for the mobile users and about their locations. Mobility model is used for simulation purpose for new protocol being evaluated. Random waypoint model is famous mobility model to evaluate networks and protocols. It is simple and easily available. In this model mobile nodes move randomly. Here destination, speed and direction are selected randomly.

The work by Chatzigiannakis [6] explores the possibility of using the coordinated motion of a small part of users in the network to achieve efficient communication between two other mobile nodes. Basically, a part of the network nodes act as forwarding agents carrying packets for other nodes. The packet is exchanged when the source node and the agent are neighbors and it is then delivered to the intended destination when the agent passes by it. This basic idea has been introduced to WSNs by Shah in his work on *data mules* [7]. Mobile nodes in the sensor field, called mules, are used as forwarding agents. The idea here is to save energy by having single-hop communication (from a sensor to the mule that is passing by) instead of the more expensive multi-hop routing (from the sensor to the sink): It is the mule that will eventually take the sensed data to the sink. This approach has been further investigated by Kimet, which proposes a dissemination protocols in which a tree-like communication structure is built and maintained and mobile sinks access the tree from specified sensor nodes in the tree.

Energy consumption optimization is needed for synchronization of life of network. Load balancing is crucial for life of WSN and node having heavy load will consume energy quickly. Energy efficient consumption scheme and high lifetime of network by load balancing by applying the technique of sub network is proposed in reference [8]. This scheme proposes load balancing of individual node is to maximize system life. It manages sub network.

In [9], the authors proposed a hybrid routing algorithm for wireless sensor networks. They proposed mobility aware multi objective hybrid routing algorithm for WSN. This algorithm selects the best route and forwards the data packet from source to sink using multiple metrics such as average consumption of energy, control overhead reaction time, LQI and hop count. This algorithm proposed a novel two-tier cluster based algorithm in order to make MWSN more efficient in terms of amount of consumption of energy, packet delivery ratio and jitter. It evaluates regularly for different route and picks the best in two phases.

i. Setup phase: Routing tables are setup at each sensor node.

ii. Data Communication phase: Data sent from source to sink. This is when paths are chosen with respect to weighted average of many metrics.

The authors of [10] proposed a hybrid routing protocol for WSN with mobile sink. It is a combination of reactive and proactive approaches and hence called hybrid. It enhances the existing protocol efficiently by taking care of multiple sinks random movements. There are multiple mobile sinks in networks that change their positions randomly. It enable node to start a demand discovery for nearest sink in the zone. It also predicts future location by estimating speed and previous position of moving sink. It helps in reducing traffic, reducing load of network and hence result in less congestion.

The protocol, termed SEAD (Scalable Energy-Efficient Asynchronous Dissemination) demonstrates the effectiveness of deploying mobile sinks for energy saving with respect to the static case via simulation. SEAD is shown to be more effective for energy conservation than directed diffusion [11], TTDD [12] and ADMR [13].

In all these works, the mobility of the sink is unpredictable, for instance, sinks move according to the random way point model. A first attempt on how to determine specific sink movements for energy minimization is presented in [14]. The authors present an ILP (Integer Linear Programming) model to determine the locations of multiple sinks in the case multi-hop routing to the sink is allowed. The model aims at minimizing the energy consumption per node and the total energy consumption during a given time. The authors argue that minimizing the energy consumption yields to improved network longevity. In order to obtain stronger energy saving results, the authors consider the presence of multiple sinks in the network. The ILP model is used to determine feasible locations.

In this paper, we are concerned with the joint problems of determining the movements of the sink and the times the sink rests at certain network nodes so that network lifetime is maximized. Moreover, proposed method uses the cluster based approach to implement the CHRPM, where sink changes its position based on the node status with respect to load and energy.

III. PROPOSED MODEL

Proposed protocol is an extension of the existing energy efficient routing protocol LEACH designed for WSN.

A network consists of many clusters of sensors in hierarchical routing. Every cluster has a cluster head. Cluster head is responsible for overall activities of sensors in the particular cluster. Hierarchical routing protocols provide scalability, less energy, less load and more robustness.

TEEN is also a hierarchical clustering protocol. It combines sensors into clusters with each group headed by a cluster head. The sensors inside a cluster exchange their sensed data to their cluster head. After getting the data from sensors, the cluster head sends aggregated data to a head in the higher level until the data reaches to sink. Thus the architecture of network in this protocol is based on hierarchical grouping. Here, sensor nodes form clusters and the process continues till sink gone to the second level. This protocol is useful for application where users manage efficiency of energy, accuracy of data and response time effectively.

Hybrid Energy Effective Distributed Clustering protocols extends the basic idea of LEACH by using residual energy for cluster selection to maintain power balancing [15]. HEED operates in multi hop network by using transmission power in the inter-clustering communication. HEED is proposed with four goals.

i. Extending network lifetime by dividing energy consumption.
ii. Terminate the process of clustering within a constant number of iterations.
iii. Reducing control overhead.
iv. By producing distributed cluster heads.

APTEEN is hybrid clustering based routing protocol which allows the sensor to forward sensed data over a particular amount of time, as well as react to any sudden changes in sensed attributes. This will be reported to their cluster heads [16]. TEEN and APTEEN architectures area same. They use the concept of hierarchical clustering for efficient energy communication between source sender and sink. APTEEN guarantees a large number of sensors alive by lowering energy consumption. Here cluster heads calculates data aggregation to save energy.

After the clusters are formatted, the cluster-head node creates a TDMA [17] schedule noticing each node when it can transmit data to the cluster-head [6]. The cluster-head also aggregates the data before transmitting these data to the sink.

We consider the random way point mobility model for sink mobility to communicate with intermediate node. Thus mobile node stay at particular place for some interval of time for communication then change its location by random way point mobility model. After this interval of time node change the position to other intermediate node based on node status. Initially sink select the node randomly for its first time and move nearer towards it and communicate through it. Then sink node selects the new intermediate node for communication and moves towards it by random way point mobility model.

Most of the existing routing protocols deal with sensor nodes that do not move and are un-replaceable, where the sensed data have to be delivered to the sinks that are static as well. A trend of the research on data dissemination in WSNs has recently started where the mobility of some of the nodes is exploited to facilitate the delivery of the sensed data to the sinks. The primary objective of these works is to deliver messages in disconnected ad hoc networks and to improve network throughput.

Energy and Load awareness

The aim of proposed routing protocol selects the neighbor node of mobile sink node based on its buffer and energy status so that intermediate node must not drop the packets and also should not exhaust. Here we consider the two considerable parameters in a single process to calculate the routing path between communication entities. Cluster head must compute the status regarding energy and buffer or load. In this work we computed it proactively as, maximum number of packets it can process (receive, proceed and transmit) within its available energy. Every node in a network needs to calculate its load status. In this work we computed it reactively as, the queue present in a node is less than or greater than predefined threshold value. Two factors are used to remove node to become bottleneck intermediate node there by reducing packet loss.

Proactive status of node regarding energy

Reducing the packet drop by an intermediate node due to its constraint energy is overcome by the multi objective optimization process. That is capacity optimized maximum packets can be processed by an intermediate node in its current battery of energy. Let us consider that an intermediate node equipped with a battery capacity (E) joules, and it can be processed maximum of $'n'$ number of packets in its current battery of energy.

Multi objective optimization

1. Energy of node
2. Energy is required to process the packet

Energy consumed by an intermediate node for processing one packet let $'P_1'$ is computed by, equation 1.

$$E(P_1) = E_r(P_1) + E_p(P_1) + E_t(P_1) \ldots\ldots\ldots (1)$$

Where,

$E_r(P_1) = energy\ require\ to\ recive\ the\ packet\ 'P_1'$

$E_p(P_1) = energy\ require\ to\ process\ the\ packet\ 'P_1'$

$E_t(P_1)$

$= energy\ require\ to\ transmit\ the\ packet\ 'P_1'$

Now remaining energy of node after processing $'P_1'$ packet is given by equation 2.

$$E(residual) = E - E(P_1) \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

In order to compute the capacity optimized maximum packets can be processed by an intermediate node in its current battery of energy is achieved by two dimensional array with entries, as given below.

$$K\ [P_i\ , E(residual)\ ] \ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where $i = 1,2, \ldots . number\ of\ packets$

$E(residual)$

$= energy\ required\ to\ process\ the\ packet$

Computation of capacity of optimized maximum packets can be processed by an intermediate node in its current battery of energy is given by equation 4

$$K\ [P_i\ , E(residual)\ ] = \max(K\ [P_i - 1\ , E(residual)]\ ,\ K_i + K\ [P_i - 1\ , E(residual)]) \ldots\ldots\ldots\ldots\ldots (4)$$

$$\forall\ 1 \leq P_i \leq n$$
$$and$$
$$0 \leq E(residual)\ \leq E$$

Here $K\ [P_i\ , E(residual)\ ]$, provides the capacity of optimized maximum packets can be processed by an intermediate node in its current battery of energy.

Reactive status of node regarding Load

Reducing the packet drop by an intermediate node due to its buffer overflow is overcome by the queuing mechanism. An intermediate node reactively calculates its buffer status by number of packets arrived in current interval of time as well as number of packets departure from node. If packet arriving rate is greater than its departure rate then packets will get drop from an intermediate node. If the arrival rate is less than departure rate then queue is created at node buffer based on difference between arrival and departure rate. Node compute arrival and departure rate using exponential moving average method.

Packet arrivals or departures at time zero or no packet arrival or departure in previous time interval as event zero. Weighted constant values are decided based on time constant of receiving circuit. Number packets queued at an intermediate node is computed by queuing theory by equation 5.

$$\text{queue size} = \text{Average Packet Departure}/ (\text{Average Packet Departure rate} - \text{Average Packet Arrival rate}) * \text{bytes} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

If queue size is greater than the buffer packet holding capacity then packet drop from node. Thus while selecting an intermediate node, source node must consider the two factors such as buffer and energy so as

to reduce the packet loss in network there by enhance the network performance and efficiency.

Mobile sink node maintains the distance table of the cluster head location nodes in its memory table. Initially network creates a cluster based network model with the help of existing LEACH protocol. Then mobile sink node moves randomly using random way point mobility model to collect the location of cluster head. Then cluster head computes the average distance between cluster heads by following equation 5.

$$D_{avg} = \frac{\sum_{i=0}^{m-1} \sqrt{(X_i - X_c)^2 + (Y_i - Y_c)^2}}{m-1} \; i \neq c$$

Where, $(X_i, Y_i) = Location\ of\ the\ cluster\ head$
$(X_c, Y_c) = Location\ of\ the\ current\ CH$
$m = Total\ number\ of\ cluster\ heads$

After particular time interval the memory table of mobile sink node is updated or it also updated whenever new cluster head is selected. Mobile sink selection about intermediate node/cluster head is made by two factor energy and load, which is calculated above in the section, and moves towards it for communication. The control packets are used to inform the cluster head that the mobile sink is visited to it. Every cluster head in LEACH protocol acts for particular amount of time. If new cluster head is elected for the cluster then mobile sink compare its residual status with remaining cluster heads residual status, if it find the another node has better status than current cluster head status. Then cluster head moves towards new cluster head and this process is go on.

The proposed algorithm is explained as follows

1. Divide the network into clusters and select the cluster head based on LEACH routing protocol
2. Cluster heads compute their current status of load and energy.
3. Mobile sink calculates the cluster head distance and their current status information and the same is maintain in vector table by moving nearer to them.
4. Decide the life time of cluster head according to the vector table and decide it as the time period "T". This is the time for which sink node will collect the information from the current cluster head, and create the communication session between it and cluster head
5. Now cluster head collect the sensing information from cluster members and transmit it to sink node
6. After this communication session, cluster head reselection process will begin and now it is based on their load and energy status. If cluster head is selected then the sink node computes the distance as well as status and updates the vector table and compare the status value with other cluster head values. If it found greater than sink then set the communication session time interval and start the communication. Otherwise sink node moves to that cluster head which is having higher status regarding energy and buffer and start communication with it.
7. This process continues.

IV. SIMULATION RESULTS

We used the NS2.34 [18] simulator to evaluate the performance of our model and compare it with existing algorithms with respect to throughput, delay and routing overhead. In our simulation we consider the variable number of nodes with random way point mobility model with 20 m/s pause time. Every node equipped with battery of 10j energy initially and fixed radio transmission range of 250m and IEEE 802.11 MAC card with data rates of 2 Mbps. The receiving power is 300mW and transmission power is 600mW. Finally, source nodes generate CBR traffic with a packet size of 512 bytes. Simulation duration is 1000s, we took the average of 3 scenario performances. In order to measure the performance, we considered the following performance metrics.

- Throughput: It is a network performance metric to calculate how much data packets transmitted from source to destination in a particular amount of time.
- Delay : Delay is calculated as the average time take to reach the packet from source to destination
- Overhead: It is the ratio of amount of control packets are transmitted for routing (including routing path finding, maintaining the route) to actual data transmission in the network.

Simulation parameters are shown in table1.

Table1. Simulation parameters

Network Parameters	Values
Simulation Time	1000 s
Number of Nodes	10-100
Link Layer (LL)Type	Logical Link (LL)
MAC	802.11
Radio Communication	Two-Ray Ground
Queue Type	priority Drop-Tail
Routing	Proposed
Traffic	CBR
Area of Network	1500m x1 500m
Mobility Type	Random Way point

Packet Delivery Fraction (PDF) is a ratio of packets forwarded by sender and number of packets received at the destination node. As per the simulated results, there is higher PDF in proposed protocol as

shown in figure 1. Results studied that in proposed protocol, PDF averaging at 95 in comparison with Protocol where no bottleneck consideration was taken, is averaging nearly 100 and existing-1 is averaging 4 and existing-2 is averaging 57 in terms of packet delivery fraction.

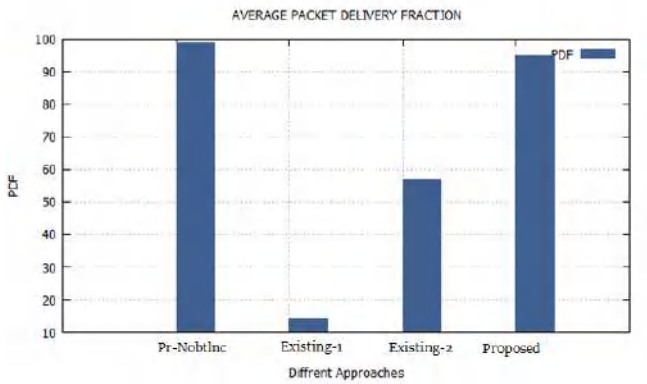

Figure 1: Performance comparison of average PDF in different approaches.

Throughput is the rate of at which messages are delivered successfully during the communication. As per the simulated results, there is highest throughput in proposed protocol as shown in figure 2. Results studied that the proposed protocol has average throughput nearly 100 in comparison with Protocol where no bottleneck consideration was taken, is averaging 88 and existing-1 is averaging 72 and existing-2 is averaging 55 in terms of throughput.

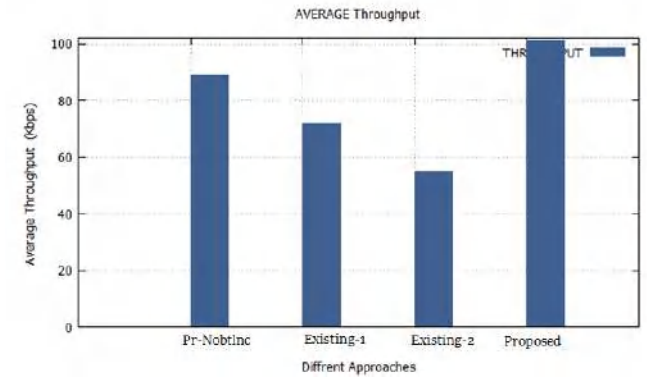

Figure 2: Performance comparison of throughput in different approaches.

It is observed from the following figure 3 that the proposed protocol saves energy in comparison with the existing protocols. As the number of nodes increases in the network the remaining energy is also decreasing but comparatively better results shown in terms of saving energy by the proposed work.

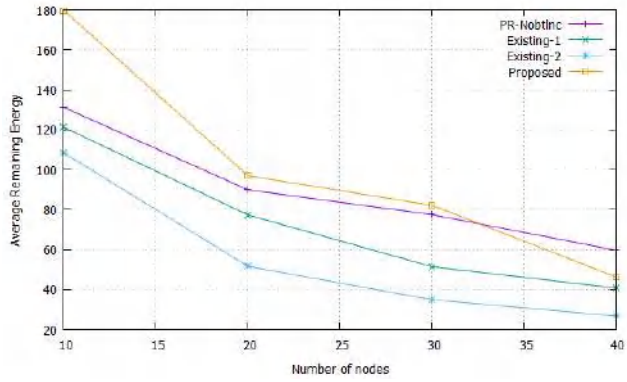

Figure 3: Performance Comparison of average Remaining Energy with varying number of nodes.

In the figure 4, throughput is compared with average remaining energy for proposed model and existing protocol for observations. Collectively in both characteristics the proposed model has shown better results.

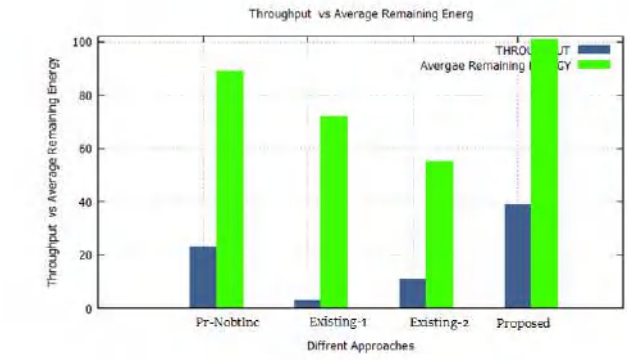

Figure 4: Performance comparison of throughput vs. Remaining Energy in different models.

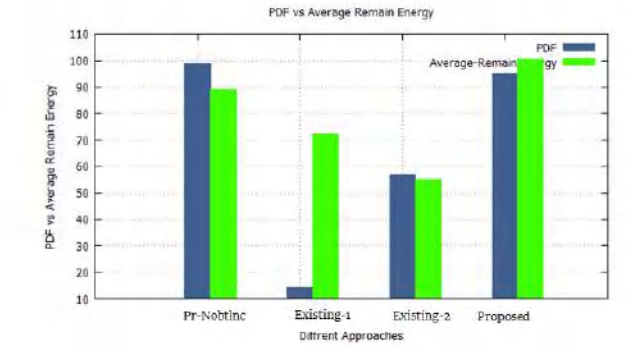

Figure 5: Performance comparison of PDF vs. Average Remaining Energy in different models.

In Figure 5, the performance comparison of network lifetime is shown. The results clearly depicts the proposed model maximizes the network life time ratio in comparison with existing schemes because we contribute to select best congestion less node.

V. CONCLUSION

In this work, a hybrid routing protocol for wireless sensor network with mobility consideration is designed. It improves the network performance and reduces the packet loss by removing the congested and constrained nodes from routing path. Moreover, it improves the network lifetime by making sink node mobile based on its neighbor node load status. The nodes deployed in WSN are static and fixed to particular location and we cannot change the position of sensing nodes. One possible solution is to make the sink node to mobile and its location can be changed according to neighbor node properties with respect to energy and load. This protocol selects the path between communication entities. The routing path is selected based on the reactive status of node regarding load and energy. Proposed hybrid routing protocol performance validated through simulation and compared with energy aware routing protocols in terms packet delivery and throughput. Thus the aim is to change the position of sink to achieve the energy efficiency and extend the network lifetime. Experimental values show that providing mobility to sink node results in achieving the network lifetime and energy efficiency by removing the problem of neighbor node of sink to become bottleneck node.

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Trusted and Secured Clustered Protocol in MANET

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ABSTRACT
Mobile Ad hoc Networks (MANETs) are subject to various kinds of attacks. Deploying security mechanisms is difficult due to inherent properties of ad hoc networks, such as the high dynamics of their topology, restricted bandwidth, and limited resources in end device. With such dynamicity in connectivity and limited resources it is not possible to deploy centralized security solution. Like many distributed systems, security in ad hoc networks widely relies on the use of key management mechanisms. However, traditional key management systems are not appropriate for them. This work aims at providing a secure and distributed authentication service in ad hoc networks. A trusted and secured clustered protocol in MANET, where clusters are formed based on **highly-trusted nodes having sufficient energy is proposed. Secured communication** with public key authentication service based on trust model and network model to prevent nodes from obtaining false public keys of the others when there are malicious nodes in the network is organised. Efforts to present energy efficient, secure and trusted clustering to enhance the security assurance and significant adaptation of trustworthy communication is presented. Simulation results demonstrate that proposed routing protocols can improve the energy efficiency, packet delivery ratio and route stability.

Keywords
MANET, Trust, Key management, Cluster

1. INTRODUCTION
A mobile ad hoc network is a collection of nodes with no infrastructure while its nodes are connected with wireless links. Nodes in the network are able to sense and discover nearby nodes. They communicate with each other by forwarding packets hop by hop in the network. Also, the topology of the ad hoc network is dynamically changing and the nodes of the ad hoc network are often mobile. A major challenge in the design of the mobile ad hoc network is to protect its vulnerability from security attacks. As in many distributed systems, security in ad hoc networks is based on the use of a key management system for authentication. Specific key management systems have to be developed to suit the characteristics of mobile ad hoc networks.

Cluster-based data transmission in MANETs has been investigated by researchers to achieve the network scalability and management, which maximizes node lifetime and reduce bandwidth consumption by using local collaboration among mobile nodes [1]. Clustering schemes [2] organized the network into one hop disjoint clusters then elect the most qualified and trustworthy nodes which play the role of cluster heads. Cluster heads are responsible for monitoring all the routing activities within the cluster itself. Thus need for secure clustering solutions which are resilient to the various security problems of MANET and provide secure and reliable clustering even in the presence of malicious nodes and attackers. Some cryptography-based clustering schemes such as [3- 6] have been designed for MANETs which are able to operate in hostile environment and use PKI or symmetric encryption techniques, but they do not offer sufficient protection against insider attackers and compromised nodes.

2. BACKGROUND AND MOTIVATION
Several trust models [8–11] have been proposed for self organizing networks in distributed paradigm. Jiang and Baras [12] examined the efficiency of trust based reactive routing protocols in the presence of attacks in the networks. This method is considered first-hand information to evaluate other node's trust values to make trustworthiness. Yan et al. [13] proposed a secure AODV based routing protocol for an ad hoc network which is established a secure end-to-end route. The trust values are calculated based on direct observation which is transitive.

Pirzada and McDonald [14] enhanced the trust management by considering the confidence level of trust of each node. They have used confidence level as a weight to compute trust value. Ghosh et al. [15] developed a trust model to strengthen the security of MANETs and they dealt with the issues associated with recommendations. Their model was utilized only trusted routes for making effective communication and isolates the malicious nodes based on the evidence obtained from direct interactions and recommendations. Ghosh et al. [16] proposed a mechanism for distinguishing selfish peers from cooperative nodes that is based on local monitoring. In order to distinguish between selfish and cooperative peers, a series of well-known statistical tests are applied for obtaining features from the observed AODV actions. The objective of mechanism design [10] is to address problem of designing incentives for nodes to provide truthful information and computing optimal system wide solution for finding the optimal cost efficient leaders. Vickrey, Clarke, and Groves (VCG) model is applied for node incentives to ensure truth telling to be the dominant strategy for any node. They have proposed local election algorithms, namely, cluster-dependent leader election and cluster independent leader election which provided globally optimal election solutions with a low cost. The Nodes with the most remaining energy are elected as the cluster head. This approach makes storage overhead because the cluster head kept an extra service table and each node maintains a reputation table and neighboring nodes list.

Milan et al. proposed a scheme [17], where a game theoretic model is applied to study the impact of collisions on a hop-by-hop reputation based mechanism for regular networks with uniform random traffic. The nodes in MANETs are equipped with different resources and provide discrete services. It did not deal with irregular topologies and non-uniform routing. It also discussed the perception and interaction asymmetries that could impair cooperation between nodes. Safa et al. presented a cluster based trust aware routing protocol (CBTRP) [18] to ensure secure routing path and established the trust based environment. This mechanism is used to distinguish the trusted nodes from malicious nodes. CBTRP makes use of the weighted clustering algorithm (WCA) [19] to elect cluster heads.

The weighted degrees are taken into consideration such as battery power, number of neighbors, transmission power, and mobility of the nodes to form optimal cluster head. CBTRP has also taken security into account to form trusted clusters. It organized the network into 1-hop clusters in which every node is able to elect the most qualified and trustworthy node to be its cluster head. Cluster members forward the packets through the trusted cluster heads. Malicious nodes do not forward the packets to them. In CBTRP model, the trust value is computed based on the information that one node can gather about the other node's vital information including analyzing the received, forwarded, and overheard packets. Analyzing the node's behaviour, the node is selfish, acting like a black hole, and carrying out a modification attack, fabrication attack and latency delays. This approach provides improved connectivity in MANETs in the presence of malicious nodes and also it ensured the passage of packets through trusted routes only by behavior of each node. Once a malicious node is discovered, it is isolated from the network such that no packet is forwarded from it.

Chatterjee et al. [20] proposed a secure trusted auction oriented clustering based routing protocol (STACRP) to provide trusted structured framework for MANETs. Two auction mechanisms, namely, Procurement and Dutch, determine the forward cost of one hop. STACRP organized the network as one hop clusters and elects the trusted nodes as cluster head (CH) by using a secret voting scheme. Each node maintains information of itself and its neighboring nodes for cluster maintenance. The trust model is analyzed using Markov chain which guarantees to selfish node to revoke its status from warned status to normal status by proper forwarding of others packets. This achieved a secure reliable routing solution. STACRP detected selfish nodes and enforces cooperation between nodes to achieve better throughput and packet delivery ratio with less routing overhead

Main contribution of the proposed approach is to obtain a practicable degree of tradeoffs between trust and security. Network trust metric parameters intimacy, integrity, mobility, and reliability identified and combined to evaluate the cumulative trust to provide ground level of security for human centric application with human notions. Unlike discussed trust management systems in order to growing years wise advanced technology [2, 12, 16], efforts are put forward to combine best of existing trust management models for soft security concerns while dynamically observing the impetus behavior of a node in open and dynamic pervasive environment. Exiting models are based on one or more trust or security parameters for WSN or MANETS, while our trust metric consists of five crucial trust parameters for direct and indirect communication in pervasive environment. To reduce the overheads and dependency, clustering is used for group based communication.

3. MODEL OF THE SECURE CLUSTER BASED SCHEME

The contribution of the proposed trusted secure clustering based routing protocol, TSCP are organized in two different phases such as trust management and clustering phase. In trust management phase, the protocol evaluates the node trust level in trust table with different trust factors. The trust factors present the node trust level in different states to determine trust calculation. The cluster management phase evaluates the clustering phase based on trust values and organize secure cluster communication with secured key sharing. The below sections present the detailed description of proposed protocol.

3.1 Trust Computation

We assume that each node maintains a trust table to keep trust factors with respective of communication as per node dynamic behaviour its social and QoS trust factors. Dynamic behaviour between two communicating nodes as X and Y over time t will autonomously update when it interacts with other node on demand or expiry to save resources.

Trust calculation consists of two processes, first evaluate the communicating node table credentials about trust factors and second calculates the mean of trust value based on each parameter as per predefined threshold. Consider following trust parameters for evaluating the node information.

Intimacy ($\mathrm{Tr}_{xy}^{\mathrm{intimacy}}$ (t)): it measures the interaction experiences following the maturity model [21]. It is computed by finding the ratio of positive number of interactions between nodes x and y over the maximum number of interactions over the time period [0, t] as

$$Tr_{xy}^{intimacy}\ (t) = It_x = (\frac{Pve_x}{T_x}) \quad (1)$$

Where It_x is the interaction ratio considering only positive Interaction Pve_x over total no of Interaction T_x through node x.

Integrity: this refers to the confidence of node x that node y is truthful based on node x's direct observations toward node y. Node x calculate approximately (t) by observing a count of suspicious untruthful experiences of node y that node x has observed. If the count exceeds a system-defined threshold, node y is considered totally dishonestat time t, i.e., (t) = 0. Otherwise, (t) is computed by 1 minus the ratio of the count to the threshold. It can be measured as

$$Tr_{xy}^{intigrity}\ (t) = n \times \alpha \times S \quad (2)$$

where n is normalized interaction value, α is over time t experience and S is security level of recommending Service Interface.

Mobility: Node mobility is a significant parameter to estimate the battery life where average distance between nodes required with limited energy provided. Thus average movement can measured by two factors, first the mobility incidences of the mobile nodes in a given time (t) bounded by a battery life threshold where high mobility with limited battery life will be punished that makes it highly unaffordable to achieve cooperative and second Uncertainty measures misbehaviour of nodes during failure to stabilize themselves in competitive forces where nodes are penalized for irregular haziness. Thus the node mobility misbehaviour impact can be measured for given time t as.

$$\mathrm{Tr}_{xy}^{\mathrm{mobility}}\ (\mathrm{t}) = ((1 - \mathrm{Mo_x(E, D)} + (1 - \mathrm{Pen_x(t)}))/2 \quad (3)$$

Where $\mathrm{Pen_x(t)}$ is the x mobile node's penalty measure for visit the similar position for t times ($0 \leq \mathrm{Pen_x(t)} \leq 1$), and $\mathrm{Mo_x}$ () is the node x punishment credentials with $0 \leq \mathrm{Mo_x(E, D)} \leq 1$.

Reliability: the reliability of nodes may be evaluated in different ways, but, in general, it may be defined as the capability of nodes to respect a service agreement. This is a particular procedure that lies behind the identity certification or the encryption process. In the remaining part of this section, the word trust is used to identify the reliability of nodes also

that may be evaluated in different ways, but, in general, it can be considered as the capability of nodes to respect a service agreement. Trust based reliability over a time t can be computed as probability of packets being lost, inserted and multiplied as

$$\mathrm{Tr}_{xy}^{\text{reliability}}(t) = (|S_{pkt} - R_{pkt}|)/S_{pkt} \quad (4)$$

where S_{pkt} = Total no. of packets sent by Y to X and R_{pkt} = Total no. of packets received by Y sent from X.

3.1.1 Trust Calculation

The trust calculation is conducted, particularly between two neighbor nodes in a cluster. When a node X evaluates trust on another node Y at time t. We assume five trust components as described above like intimacy, integrity, energy, selfishness and reliability. The trust value that node X evaluates towards node Y at time t, $\mathrm{Tr}_{xy}(t)$, is represented as a real number in the range of [0, 1] where 0 indicates distrust and 1 complete trust.

$$Tr_{xy}(t) = TC1 \times Tr_{xy}^{intimacy} + TC2 \times Tr_{xy}^{integrity} + TC3 \times Tr_{xy}^{mobility} + TC4 \times Tr_{xy}^{reliability} \quad (5)$$

Where $TC1, TC2, TC3,$ and $TC4$ are total costs associated with these four trust factors with equal threshold of 0.25 for each trust factor and computation of all these four factors gives as a results as $TC1 + TC2 + TC3 + TC4 = 1$. Based on the higher probobability values of $TC1, TC2, TC3,$ and $TC4$ the best trust formation value will consider for formation of node trust.

Algorithm 1: Trust Evaluation

Step1 To calculate node trust based on node interaction and analyze node X and Y data.

Step 2 Calculate trust value for all four parameters

$(\mathrm{Tr}_{xy}^{\text{intimacy}}, \mathrm{Tr}_{xy}^{\text{integrity}}, \mathrm{Tr}_{xy}^{\text{mobility}}, \mathrm{Tr}_{xy}^{\text{reliability}})$

Step 3 Identify each trust parameter with corresponding trust value as per pre-defined threshold [0.0–0.2]

Step 4 Estimate the overall trust value Tr_{xy} over a specified time t

$$Tr_{xy}(t) = TC1 \times Tr_{xy}^{intimacy} + TC2 \times Tr_{xy}^{integrity} + TC3 \times Tr_{xy}^{mobility} + TC4 \times Tr_{xy}^{reliability}$$

Step 5 Finally aggregate the trust value according to weighted cost.

3.2 Cluster Formation

Clustering is a standard energy efficient technique used in mobile networks to provide locality of communication through organizing the several nodes in different virtual groups known as clusters that saves energy and reduces network contention. Here several nodes are physically neighbouring and helps to organize the pervasive ad hoc networks hierarchically. An essential operation with clustering technique is to select cluster head shown in Fig. 1. The base station or mobile base stations are satellite based setups or machines capable of analyzing the data collected from the cluster heads and displaying a global view of actions being monitored.

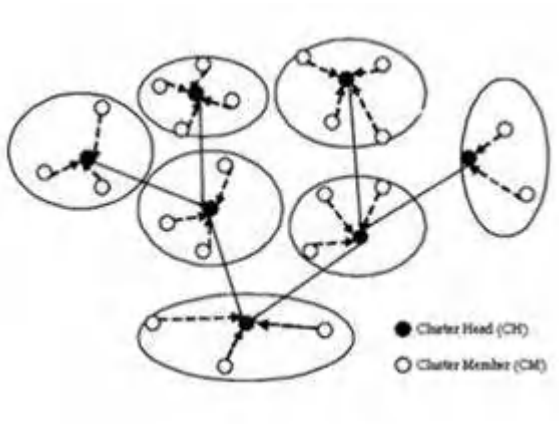

Fig 1: MANET Clustering

Inspired by Multi-objective optimization [22, 23], where multiple optimal solutions using multiple fitness functions used at same time to find optimal solution. Here fitness function is a function used to measure the optimality of a solution in evolutionary algorithm. In multi-objective optimization multiple optimal solutions using more than one objective function is used at same time.

Thus inspired by a multi-objective optimization, we use two objective functions $1(), and f2()$. The cluster head selection algorithm is based on proposed trust calculation metric as defined in Eq. (5). The algorithm initially assumes that each mobile node in the network may become a cluster head with probability 1 or 0 where nodes make autonomous decisions without any centralized control to measure the trustworthiness of the node, life time and extended security.

The fitness function in the proposed work, the fitness is evaluated based on two objective functions $f1(), and f2()$ where $f1()$ computes the trustworthiness Tr_{xy} Eq. (5) of the node, $f2()$ is used to estimate the remaining lifetime or residual energy for to elect the cluster head with a probability p which is proportional to the residual energy of the node. Thus a mobile node with higher remaining lifetime has higher possibility to become head.

Let assume NL_t is the predicted life time of the node before set up the nodes and TC_c be the time consumed to set up of the n mobile nodes as cluster, then total residual energy RE_n of all mobile nodes can be estimated as

$$RE_n = \frac{nE_{ini}(NL_t - TC_c)}{NL_t}$$

where E_{ini} is the initial energy of each node and n is the total number of nodes.

Further the probability p proportional to the residual energy can be defined to the as if NL_t number of candidates is c % of the total number of nodes with leftout energy E_l then

$$P = n \times \frac{E_l}{RE_n} \times \frac{c}{100}$$

3.2.1 Secure Cluster Communication

Assume that a MANET consist of set of clusters C where $C = \{C_1, C_2, C_3 \ldots . C_n\}$each cluster contains n number of nodes, and the public parameters in the clusters are $(H_1, H_2, H_3, P_1, P_2, \varphi, P_{pub}, n, g, h, p, \alpha, q, G_1, G_2)$. Where H_1, H_2, H_3 are cyclic groups whose orders are all q, where q

is large primer number. φ represents an isomorphic function which maps from H_2 to H_1, where α is an asymmetric function where it maps from $H_1 \times H_2 \rightarrow H_3$, non-zero generators $P_2 \in H_2^*, P_1 = \varphi(P_2) \in H_1^*$. The messages between different clusters will be forwarded by the cluster heads, due to the existence of the session keys between the cluster heads, the cluster head chooses a random number s which is belongs to Z_q, and then calculate the public key as $P_{pub} = s\,P_1$, and p and q are large primary numbers, g is a generator with q order which belongs to Z_q. Hash functions are G_1, G_2 where the messages can transmitted in the common channel. The generation of public keys across clusters and secure communication describe in next section.

3.3 Nodes Secret Shares and Key Generation

In a cluster T, the cluster head defines polynomial of degree function as

$$k-1 : f(x) = a_0 + a_1 x + a_2 x^2 + \cdots . + a_{k-1} x^{k-1} \bmod q$$

To compute the authentication key by deriving the authentication parameter as

$$\varepsilon_j = g^{a_j} \bmod p, (j = 0 \ldots . k-1)$$

This authentication key is generated at the same time to validate the authentication of node

The cluster head calculates secrete shares for the normal nodes as

$$U_i^T = f(ID_i) \bmod q$$

Then the cluster head generate the authentication parameter as a node verification where $Ver_{node} = \frac{1}{s + H_1(U_i^T || T || ID)} P_2$

The verification key is encrypted and the encrypted verification key is transferred to node

$$Enc_i\{U_i^T, \varepsilon_j, Ver_{node}\}$$

3.3.1 Key Generation

Step 1: The cluster head chooses two large primer numbers as p1 and p2 and $N = p1\ p2$

Step 2: Define a cluster key as $K = \{(N, p1, p2, c, d) : cd = 1 (\bmod \Phi(N))\}$

Step 3: Compute cluster encryption key and decryption key as follows

$$enc_k(x) = x^d \ mod\ N$$

And

$$dec_k(y) = y^c \ mod\ N$$

N and d forms a cluster public key and p1 , p2 and c forms a cluster private key

Step 4: Encrypt the message with cluster public key so that the key computation processing is reduced with the help of this and as well as reduces traffic overhead with the help of cluster key formation.

4. PERIODIC UPDATES

In this section, the key updates on different cycles to ensure the keys efficiency by updating the keys on different cycles are presented. This section describes the updates of secrete shares, node keys and cluster keys. According to the security limitations in MANET, the networks needs to get regulate key updates to ensure of security.

There are deadlines for all the circles, if this circle is over, then, the cluster will reselect the cluster head, a new service group will be formed consequently. After all the work has been done, the new cluster head will broadcast the update news to the cluster members, if the node receives the news, it needs to send its authentication parameter to the cluster head, and its qualification of update will be checked by the service group. When receive the authentication parameter from the node, the service group will judge whether $\hat{e}(H_1(U_i^T || T || ID)P_1 + P_{pub}, V_{er})$, if this statement presents true results, the service group will update the keys to the nodes.

If the authentication details failure $\hat{e}(H_1(U_i^T || T || ID)P_1 + Ppub, Ver \neq e(P1, P2)$, the node will get refused for update.

Step1 : Secret Share update : Reselection of clusterhead is based on trust value and energy level, After selection of new cluster head the new cluster head will choose a polynomial expression such as

$$S(x) = a_0 + a_1 x + a_2 x^2 + \cdots . + a_{k-1} x^{k-1} \bmod q$$

The cluster head will generate new ID's to cluster members

Step 2: Update of nodes keys : After successful node data transaction, when a node needs to send new transaction the system need to update new nodes new public key by computing the public key P_n as

$$P_n = \frac{H_1(U_i^T || T || ID)P_1 + P_{pub}}{x'}$$

Step 3: Update cluster keys: Two new large prime numbers P_1, P_2' should be chosen after the cluster head has been selected, the new cluster key will be generated as the method mentioned above, the new cluster key will be sent to all the nodes in the cluster, the broadcast will be encrypted by the new cluster key in the circle T+1.

5. SECURITY ANALYSIS

According to the MANET characteristics and security limitations there are some possibilities of potential attacks exist in the MANET. A trusted and secured clustered protocol is designed by analyzing the characteristic of the Mobile Ad Hoc Network and the potential attacks exist in the MANET, we propose a security protocol with perfect forward secrecy and backward secrecy. Even though the malicious nodes eavesdrop the traffic which is broadcasted in the network, it is impossible for them to get any useful information due to all the broadcasts are encrypted by the cluster key, only the nodes which know the key can decrypt the message. By this way, all the broadcasts can be protected well, at same time as a result of introduction of cluster key can greatly save the network resources such as bandwidth, node computational power and so on. The communications between the nodes are greatly protected as well because all of them are encrypted before transmitted by the nodes' private keys. The node without the key will never know them. In maintaining the privacy of the information, it is impossible for the node to deny the message which had been sent from it. The periodic update of keys

which is brought up in the end of protocol can resolve the problem of key leakage or loss. According to the protocol, the group network can work in a secure and more efficient manner.

6. PERFORMANCE ANALYSIS

Firstly, this section provides the computation cost and network scenario parameters for the implementation of the TSCP protocol. Then analyze the routing performance and effectiveness of the TSCP protocol in providing complete anonymity with the existing schemes through simulation results.

6.1 Simulation Setup

The proposed TSCP protocol is for MANET is implemented on ns2 simulator version 2.35. The network scenario parameters used for simulation are listed in Table II.

Table 1: Simulation Parameters

No. of Nodes	50,100,150 and 200.
Area Size	1000 X 1000
Mac	802.11
Radio Range	250m
Simulation Time	10 sec
Traffic Source	CBR
Packet Size	512
Receiving Power	0.395
Sending power	0.660
Idle Power	0.035
Initial Energy	10.0 J
Rate	5,10,15,20 and 25Kbps

In the simulation scenario an ad hoc network of size 1000m × 1000m consists of 50,100,150 and 200 mobile nodes. The mobile nodes are moving in the field according to the random waypoint model, and their average speeds range from 2 to 7 m/s. The bidirectional Constant Bit Rate (CBR) traffic is generated and the radio range of mobile node is 250m.

The proposed protocol maintains the each node trust in different trust factors, for validating each node authentication. The protocol configures trust factors to maintain node trust update parameters. During the process the TSCP protocol computes the trust based on different trust factors and determine trust evolution based on different trust parameters. The networks are organized into multiple clusters by considering each node trust value, based on the trust value and node energy level the proposed model elects a cluster head. The TSCP organizes key generation algorithms for ensuring node authentication and secured data distortion. We determine the performance by considering different key size and different network size.

6.2 Simulation Results

The performance of TSCP protocol is analyzed and the observations are made with respect to the parameters of packet delivery ratio, end to end delay, throughput and energy consumption represented in Fig 6. Fig 6 demonstrated the comparison performance of TSCP, and STACRP by varying node speeds

According to Fig. 6 (a), TSCP has the better packet delivery ratio than STACRP [20] under different mobile speed such as 5, 10, 15, 20 and 25 m/s. The packet delivery ratio of TSCP protocol is around 93.5% and for STACRP is about 92% when there is a node mobility of 2m/s. In case of STACRP, as the mobility increases the packet delivery ratio is decreased significantly about 87% to 85% when the mobile speed is 7 m/s. On the other hand, under the same scenario and mobile speed the packet delivery ratio of TSCP protocol is about 89.5%. The difference between TSCP protocol and STACRP on packet delivery ratio is less than 5%.

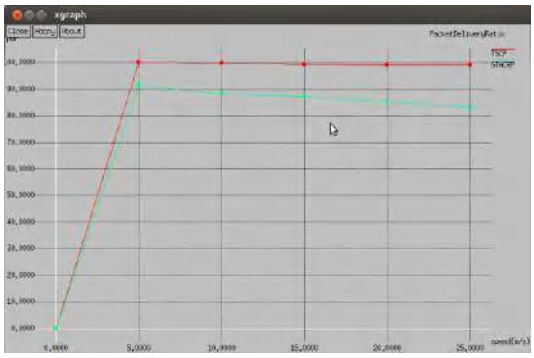

Fig 6(a) Packet Delivery Ratio vs Speed

Fig. 6 (b) shows that the comparison of TSCP, and STACRP end to end delay performance where the STACRP protocol end to end delay is increased, while mobile speed increases. TSCP performance is far better while compare to STACRP, it has less end-to-end delay.

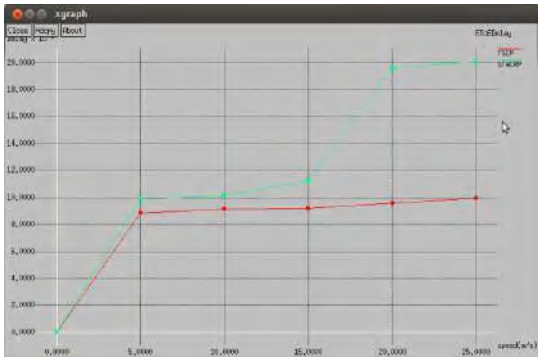

Fig 6(b) End to End delay vs Speed

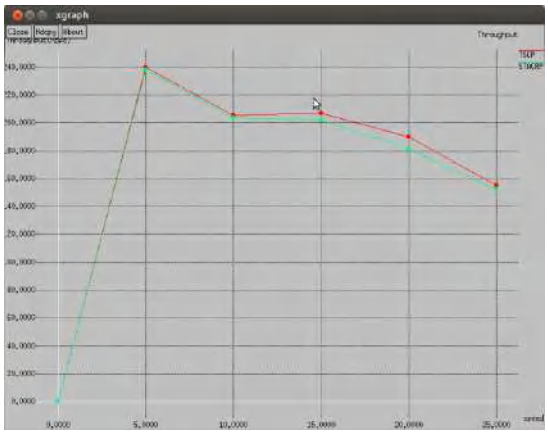

Fig 6(c) Throughput vs Speed

Fig. 6 (c), TSCP performs slightly better throughput than STACRP. The throughput of STACRP decreases as the node speed increases.

Fig. 6 (d), shows the Energy consumption, energy consumption of TSCP slightly increased while node speed increased but while compare to STACRP the energy

consumption ratio is less than STACRP. TSCP protocol energy consumption rate is almost 8 % less than STACRP.

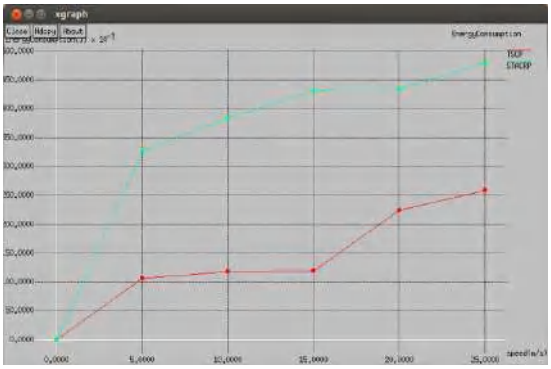

Fig 6(d) Energy Consumption vs Nodes

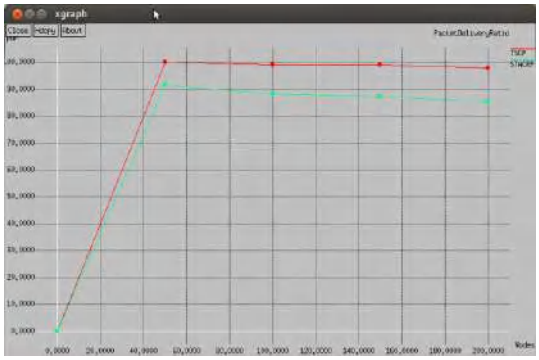

Fig 6(e) PDR vs Nodes

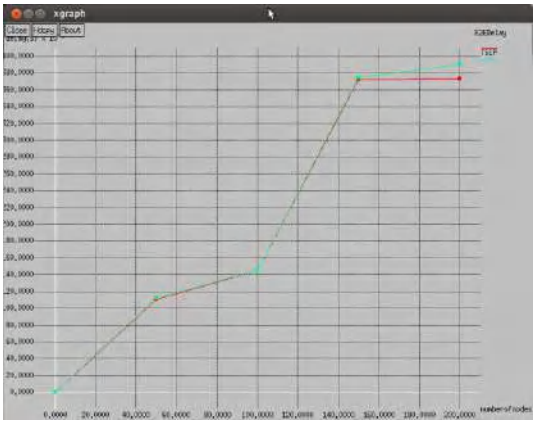

Fig 6(f) Delay vs Nodes

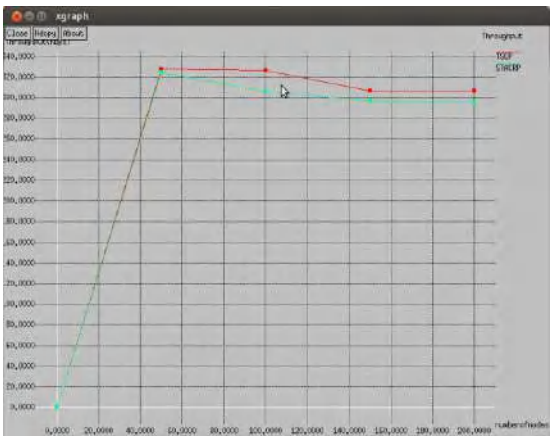

Fig 6(g) Throughput vs Nodes

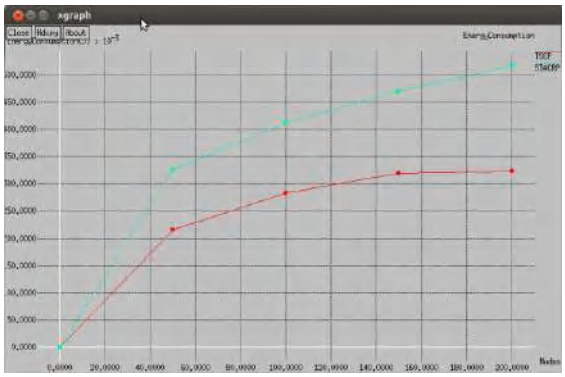

Fig 6(h) energy consumption vs Nodes

7 CONCLUSION

In this project a trusted and secured clustered protocol in MANET to organize secured and trusted communication in mobile pervasive environment is proposed. The proposed protocol organize individual node trust and reliability based on different node characteristics. Fitness functions to find out multi- dimension clustering with extended security consideration to improve energy efficient trusted clustering is formulated. A lightweight key management techniques for node authentication and secured communication with low resource computations. Based on the simulation results the proposed model perform energy efficient and robust.

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Energy-Efficient Routing Protocol Based on Mobile Sink Node in Wireless Sensor Networks

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Abstract— Wireless networks be comprise of spatially spread independent sensor node linked with each other for maintaining and detecting the environmental as well as physical states of the given application. The batteries of these sensor nodes are outfitted with limited energy to work as a source of energy. Hence, efficient energy utilization is a significant challenge in these types of networks, which are equipped with batteries having limited power storage capacities. Thus, routing techniques with energy efficiency are needed in corporate operations of WSN to provide the connectivity and data transmission in a network with minimum energy consumption. So, routing protocols are one of the key considerable factors to minimize the consumption of energy and lifetime elaboration of the network. Thus, this work gives the development of routing protocol with efficient energy to elaborate systems lifetime by selecting a proper route with the consideration of "reactively the status of an intermediate node". Proposed protocol "reactively the status of an intermediate node" computes the route finding metric based on current energy condition of an intermediate node. To offer a complete understanding of energy-aware routing, protocols are developed for WSN and superimpose the path for forthcoming investigation; in this paper, the feat of "energy-aware routing protocol based on residual status" is analyzed in detail. Based on performance parameters analyzed such as delivery of the packet, the lifetime of the network, and delay (end to end); through NS2 simulator, the result shows proposed system performs better than the present protocols in terms of systems lifetime as well as other metrics considered.

Keywords: Efficient Energy, WSN, Route Discovery Time, Delay, Packet Loss.

I. INTRODUCTION

Nowadays different waste delivered from several Industries is an improbable issue. These materials will lead to pollution of the environment; this industrial waste contains a vast number of non-biodegradable substances. As of late, utilization of this industrial waste has been considered in pavement construction with incredible enthusiasm for creating communities. The usage depended on specialized, financial, and living criteria. The absence of conventional pavement materials and the protection of nature make it essential to examine the credible utilization of these materials. Many researchers has carried out their research to control fatigue cracking in flexible pavements by using modified bitumen at binder course but still more research has to be carried. Base course of a pavement have low resistance towards the tensile stresses and dynamic loads which leads to the failure of pavements and maintenance of roads,

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The major failure in flexible pavements is fatigue cracking This fatigue leads to formation of cracks, pot holes and undulations on the pavements. In flexible pavements load will be distributed into lower layers in decreasing order. EPDM rubber consists of properties like tensile strength, abrasion, resistance to temperature. Wireless communication technology in WSN contains two types of communication methodologies i.e., Wireless transportation based communication model and wireless transportation-less network communication model [1]. Wireless transportation based communication model contains wireless movable nodes and permanent nodes. The wireless movable nodes exchange the information data with fixed nodes through pre-established transportation [2]. The wireless transportation-less system communication model is nothing but wireless MANETs which contains movable wireless nodes spread in the radio communication region and they communicate with each other through relying on in-between node i.e., with lacking transportation and thus WSN has to perform as a peer to peer network. However, contact among communicating nodes is very challenging due to the features of WSN. Moreover, wireless movable node working in a network has restricted with power batteries and it is not probable to recharge the energy of the batteries during the given task. Applications of WSN mainly include military, healthcare, natural, household & commercial areas as well as disaster recovery. Due to its variety of features, WSN is paying attention by the majority of the researchers and hence the group of routing protocols has been intended based on considering diverse parameters. One of those routing protocols is "energy aware routing protocol based on the reactive status of movable nodes" [3]. This work present the state of art performance analysis of "energy aware routing protocol based on the reactive status of mobile nodes" designed for wireless networks. However, it is a lot demanding to justice the current position of routing protocol for the particular network state. In future, the motivation is to split the network state into different categories and after that evaluates the different routine metrics. Based on present investigation parameters such as delivery of packets, the lifetime of the network, and end-to-end delay our work performance is analyzed with the help of network simulator-2 (NS-2) [4]. Furthermore, the performance grades of our work can be used by researchers for their future research. Even though a lot of research efforts carried out within literature in the direction to calculate the performance of dissimilar routing protocols for WSN based on different network circumstances, this work contains performance investigation metric as the lifetime of the network, delivery of packet, overhead and delay (end-to-end). Furthermore, these metrics extremely suitable to calculate the execution of energy-aware routing protocols used for WSN.

The paper's remaining part is prearranged as, the 2nd Section will discuss regarding Efficient-Energy Based different routing protocols in WSN. Furthermore, the part 3 provides the performance assessment of the proposed work. Finally the work is concluded in fourth and final part of the work.

I. EFFICIENT-ENERGY BASED ROUTING IN WSN

Routing is the methodology to discover the path/route among communicating nodes, in addition, to transmit the information data throughout the selected path in the form of packets. The main feature of routing is to select the path between the communicating nodes and to keep up the path up to the successful transmission of the information packets. In WSN, routing protocol appearances an additional overhead in contrast by means of wireless transportation based sets of connections, due to its features such like mobility, heterogeneity within the movable nodes, the lack of an intermediate controller and peer to peer system. Furthermore, several routing protocols developed in WSN based on various frameworks, attributes, and features of the network. Utmost of the available routing protocols in WSN considered based on a variety of patterns consequently as to manage with network features of WSN [5]. One of the major challenges in WSNs is efficient-energy routing, since its applications are built-in disaster assistance, military, and health care. Throughout the assignment application, it is not at all possible to recharge or put back the battery. Various routing protocols designed are discussed in literature survey taking into consideration that the energy of the wireless nodes in WSN. Out of that one such routing protocol is "energy aware routing protocol based on the reactive status of mobile nodes". The intention of the development of this routing protocol is to expand lifetime as well as to achieve energy-efficiency of the network in the system [6]. The routing protocols, which are designed based on energy awareness i.e., selecting the routing path, connecting transmission nodes through the nodes which have utmost left over power or greatest residual energy, are reserving the several of the wireless nodes intended for transmission of the data information due to their higher remaining energy [7]. This condition in the network known as blockage transitional node and bottleneck intermediary node drops the packet due to two reasons such as each of the wireless nodes does not have enough buffer to hold the traffic or its processor does not support the incoming packets in a transitory approach. Figure 1 show the bottleneck intermediate node's situation, in this node 4 becomes a bottleneck node [8].

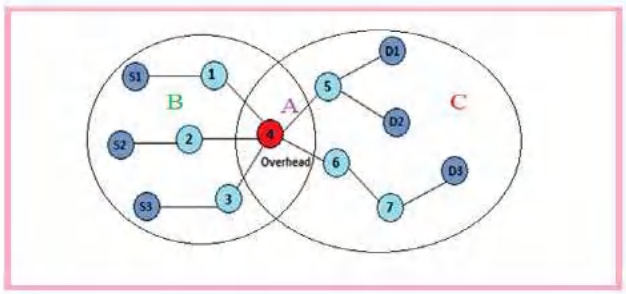

Fig.1 Scenario of node becoming bottleneck (node-4 is a bottleneck node)

In this work, focus is given on energy efficient protocols developed for WSNs and classified them to obtain an ideal solution. The substitute to above energy-aware routing protocols is "energy aware routing protocol based on the reactive status of mobile nodes". This protocol is designed based on the existing position of a transitional node concerning its energy as well as the buffer. Furthermore, while choosing a routing path, this protocol checks the position of each transitional node reactively concerning nodes energy as well as the buffer [9]. Therefore, due to the blockage or bottleneck transitional node it drops the packet. To overcome the scenario of a bottleneck intermediate node, it defined a new route scheme metric which is called as "residual status of intermediate node regarding energy and buffer". This metric is calculated by a multi-objective optimization technique.The two main objectives are remaining power and energy to transmit the information packets [10]. It calculates the metric by the knapsack algorithm in equation-1 i.e. "residual status of transitional node is concerning energy as well as a buffer".

Each node in a system outfitted by means of a battery with energy $'E'$ joules for processing the packet $'P_E'$, a buffer with a capability of $'B'$ to hold the packets $'P_B\ '$. Throughout the time period $'t'$, let anyone 'i' packet throughout the sensor node, which consumes a limited amount of energy as well as utilize properly the buffer size as well. Subsequently parameters of the nodes, like "E_r" the remaining energy and nodes residual buffer "B_r" become as follows,

$$E_r = PE - P_{ei}, \quad P_E > P_{ei} \qquad \ldots\ldots\ldots 1$$

$$B_r = P_B - P_{bi}, \quad P_B > P_{bi} \qquad \ldots\ldots\ldots 2$$

The point at which the node will drop the packet is the packet processing capability of the node without dropping it, in available energy and buffer [11]. It can be computed by satisfying the below situation through the assistance of knapsack algorithm,

1. Processing of packets should be done within the remaining energy and buffer
2. The utmost packet should be processed through the node
3. Fraction or part of the packet must not be processed, it will believe as an illegal condition

"Optimized ability to restrict packet drop" metric designed by remained energy as well as a leftover buffer of the target node. Annotation considers in this work is specified inside the table1. Assumptions are made that the node gets information packets from numerous sources contained by the limits of leftover energy 'E_r' as well as buffer 'B_r' correspondingly. The nodes capability to control the packet drop is 'P_n' packets. The processing of the packets 'n' successfully from exclusive of a drop, the conditions below should assure

1. Complete processing of packet should be done from the node
2. A Packet can drop as of a node completely; it means incomplete processing should not happen,

Hence, to calculate the "optimized ability to restrict packet drop" metric, consider optimistic values for $'n'$ as follows

The capability to control the packet drop is P_1, P_2, P_3, P_4, ……, P_n, all packets use energy 'Pei' and buffer 'Pbi' of the node to process.

It requires estimating the nodes capability to control packet drop in both cases like buffer and energy; in addition, it needs to calculate the utmost processing capability of a node to process number of packets without drop [12].

For example, it's needed to discover out the capability to process the utmost packets of count $K\epsilon$ { }, to gather packets with $\sum P_n$, where 'n' & '$K\epsilon$' with respect to E_r, $P_n \leq E$ and B_r, $P_n \leq B$

Notations	Description
E	Battery Energy in joules
P_E	Number of packets for node
P_B	Number of packets for buffer
t	Time interval
E_r	Remaining/Residual energy of node
B_r	Remaining/Residual Buffer of node
Pei	Individual energy node packet
Pbi	Individual buffer packet
ORmax	Maximum threshold value
ORmin	Minimum threshold value
B	Buffer of sensor node
P_n	Number of packets

Table.1: Notation used

To calculate the "optimized ability to restrict packet drop" metric by means of both buffer and energy, the convenient technique is to try every attainable process related to 'K'. It can be computed through the assistant of Knapsack Algorithm, it gives two-dimensional arrays through the entries [13],

$J\ 0 \ldots n, 0 \ldots E\ \forall 1 \leq P_n \leq n\ and\ 0 \leq E_r \quad P_n \leq E$

$L\ 0 \ldots n, 0 \ldots B\ \forall 1 \leq P_n \leq n\ and\ 0 \leq B_r \quad P_n \leq$

Such that Ji, E, and Li, B is the highest processing capability with leftover energy and buffer without loss of a packet. The main thing is the following conditions should not entertain,

$L\ 0, E = 0 \forall 0 \leq E_r \quad P_n \leq E$ and $L\ 0, B = 0 \forall 0 \leq B_r\ P_n \leq B$

$J\ 0, E = -\infty \forall E_r \quad P_n \leq 0$, not acceptable and $L\ 0, T_p = -\infty \forall B_r\ P_n \leq 0$, not acceptable

Calculation of the "optimized ability to restrict packet drop" through energy as well as a buffer is given below

$J_i, E = \max J_i - 1, L_i + Li - 1, E_r \quad P_n - E_r\ P_{n+1}\ \forall 1 \leq i \leq n$ and $0 \leq E_r\ P_n \leq E$,

Li, $B = \max Mi-1, M_i+Li - 1, B_r \quad P_n - B_r\ P_{n+1}\ \forall 1 \leq i \leq n$ and $0 \leq \leq B$,

For getting the advantageous result from Knapsack Algorithm subset, it is needed to expand supporting Boolean arrays Ki, E_r, P_n, and ei, B_n, in the same way. It becomes one (1) for the node while processing the i^{th} packet does not drop if not becomes zero (0).

II. PERFORMANCE ANALYSIS

A. PERFORMANCE CALCULATION METRICS

The execution stage of the particular system is helpful to have an effect on the approval of its users. Moreover, the specified system is appropriate whenever its propositions accept transmission services [14]. The Performance investigation attributes are combining noticeable and additional system framework such as the ability to transmit information data at very higher delivery speed and a lesser amount of delay with controllable overhead. Performance analysis attributes measured in this work are delivery of the packet, network lifetime, delay and overhead.

Sr. No.	Network Parameter	Values Used
1	Simulation Time	10, 20 and 30 Sec
2	Nodes in numbers	20 - 100
3	Type of Link Layer	(LL) Logical Link
4	Type of MAC	802.11MAC
5	Propagation Model of Radio	Two-Ray Ground
6	Type of Queue	Drop-Tail
7	Antenna	Omni Antenna
8	Routing	Energy-aware routing
9	Traffic	Constant bit rate
10	Network Area	750m x 750m
11	Mobility Model	Random Way Propagation

Table.2 Simulation parameters used

Among the above metrics, the information packet delivery speed is considered as, the percentage of the amount of arriving packets by sink node or destination, by the number of packets transmitted by the source node. Network lifetime considered as the time taken to die individual node in a system due to consumption of energy [15]. The metric delay can be defined as, the time taken to transmit the information packet by a source node to reach the sink or destination node [16].

B. ENVIRONMENT OF SIMULATION

Network Simulator of version NS 2.34 is used to calculate the performance of the system "energy aware routing protocol based on the reactive status of mobile nodes". The main purpose of our performance assessment is towards study the ability of "energy aware routing protocol based on the reactive status of mobile nodes" to act in response to the various traffic situation in WSN, such as variable packet size, radio transmission region, and mobility. Furthermore, the objective which plays a key role is the comparison of the measured results with the evaluated results. Finally, the main objective is to assess the in-depth performance assessment of "energy aware routing protocol based on the reactive status of mobile nodes". Simulation parameters are exposed to table 2.

C. EVALUATION OF PERFORMANCE

In order to work out the performance of "energy aware routing protocol based on the reactive status of mobile nodes" on the basis of inconsistent hop count, mobility and radio transmission region. In all the run of the simulation, the input folder was taken, which explains the complete node as well as data packet information within the system throughout the transmission process. In this work, two simulation scenarios are considered to assess the results in terms of the metrics such as network lifetime, packet delivery, delay, and the overhead.

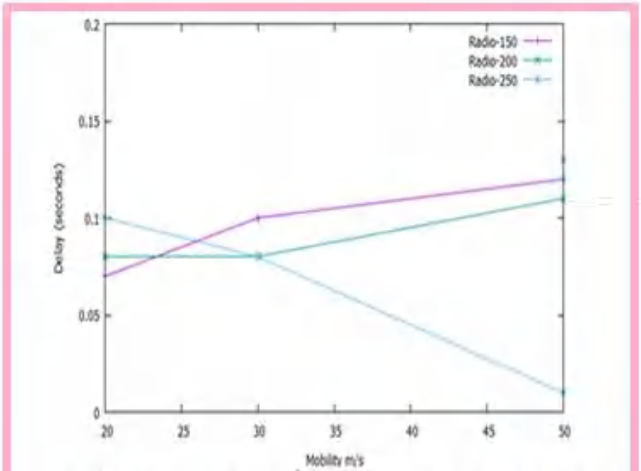

Fig. 2: - Delay of network with Variable Mobility and Radio Transmission Region

Variable radio transmission ranges for each node (150m, 200m, and 250m) by means of mobility.

The variable hops counts up among transmission nodes with mobility.

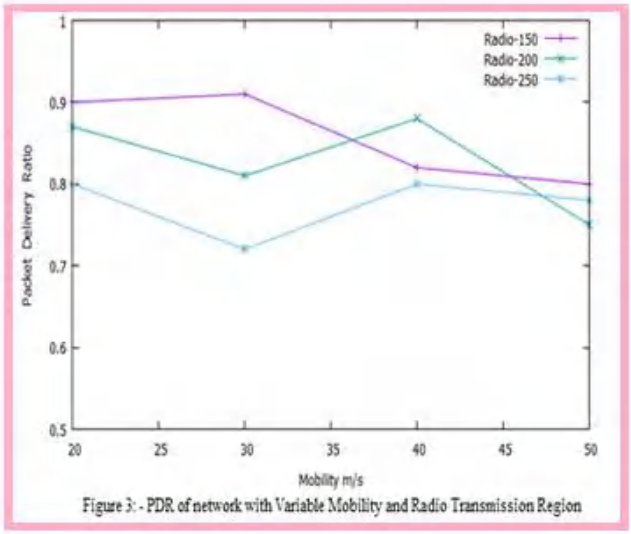

Figure 3: - PDR of network with Variable Mobility and Radio Transmission Region

Performance assessment of projected method is approved by NS-2 through suitable expansion in accessible libraries and also compared by existing algorithms for selection of cluster head with the same network surroundings. Results show that the proposed protocol "energy-aware protocol based on the reactive status of mobile nodes" outperforms as compare to the available protocols.

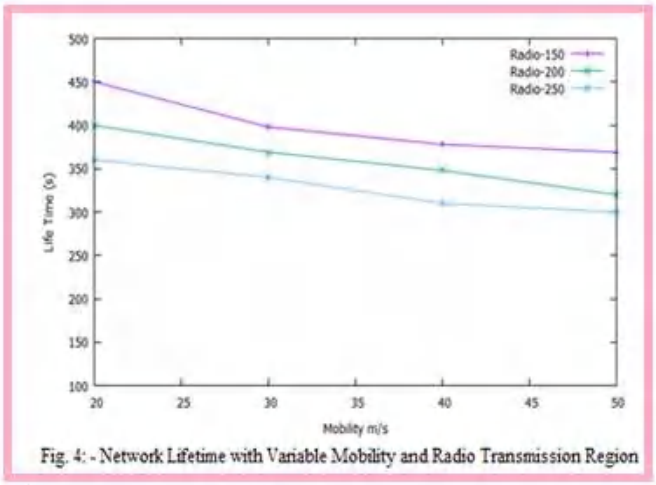

Fig. 4: - Network Lifetime with Variable Mobility and Radio Transmission Region

Figure 2, 3, and 4 show that the performance of delay, packet delivery ratio and network lifetime. Performance of "Energy-aware routing protocol based on the reactive status of mobile nodes" is good in changing mobility and the different radio transmission region. As, the proposed routing protocol detach the node to turn out to be a bottleneck node, which interns enlarge the networks lifetime and minimize the loss of information packets in that way improves the delivery of packets with less delay. From our simulation results, it is considered that the proposed routing protocol is well suitable for WSN applications.

III. CONCLUSION & FUTURE WORK

In WSN, routing is an active research area and a variety of routing protocols are designed by taking into consideration various features and system circumstances. Therefore, by considering various circumstances this work analyses the performance of "energy aware routing protocol based on the reactive status of mobile nodes". Hence, through the results of the simulation, it concludes that the proposed routing protocol is well suited for the various applications of WSNs. Moreover, it elaborates the lifetime of the system as well as accumulates energy of the node. Furthermore, this work gives the technique to scrutinize the current condition of the node in the system, so it is used as a selection of cluster head in a proactive manner in the future approach.

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HVAC Design and Heat Recovery Options in an Office Building

Syed Abdul Gaffar, Raza Ahmed Khan, Md Sadiq Mohiuddin, Dr. Mohammed Yousuf Ali

Abstract— Heating, Ventilation, and Air Conditioning (HVAC) is the technology of indoor and automotive environmental comfort. HVAC system design is based on the principles of thermodynamics, fluid mechanics, and heat transfer. It is very important in the design of medium to large industrial and office buildings such as skyscrapers and in marine environments for safe and healthy building conditions are regulated with respect to temperature and humidity, using fresh air from outdoors. The basic purpose of an HVAC system is to provide interior thermal conditions that a majority of occupants will find acceptable. The heat and moisture control functions of HVAC systems provide the foundation for key system components. In specific building situations, supplemental functions, such as controlling smoke from fires or providing background noise for acoustic privacy, may be imposed on an HVAC system.

The primary purpose of this project is to design an HVAC System for a corporate office building to achieve human comfort conditions as per ASHRAE Standards. The project involves load calculations on a sample office building plan at New Delhi using Hourly Analysis Program (HAP). It further deals with routing each sub-system in coordination with other building services to prevent any collisions at site. The equipment machinery is selected based on the requirements and the designed load (tonnage) of the building. Efforts have been made to conserve energy by employing the Heat Recovery Wheel (HRW) in Air Handling Units.

Keywords—Central Plant System, HVAC Systems, Building Design, Heat Recovery, Design Software, Hourly Analysis Programme

1 INTRODUCTION

Heating, ventilation and air conditioning (HVAC) systems control the temperature, humidity and quality of air in buildings to a set of chosen conditions. To achieve this, the systems need to transfer heat and moisture into and out of the air as well as control the level of air pollutants, either by directly removing them or by diluting them to acceptable levels.

Heating systems increase the temperature in a space to compensate for heat losses between the internal space and outside. Ventilation systems supply air to the space and extract polluted air from it. Cooling is needed to bring the temperature down in spaces where heat gains have arisen from people, equipment or the sun and are causing discomfort. Heating, ventilation and air conditioning systems vary widely in terms of size and the functions they perform. Some systems are large and central to the building services – these were probably designed when the building was originally commissioned and use ventilation to deliver heating and cooling. Other systems may provide heating through boilers and radiators, with some limited ventilation to provide fresh air or cooling to certain parts of the building such as meeting rooms. In some cases, individual comfort cooling units have been added to a building to overcome a specific overheating problem that had not been thought of at the time of the original design.

So if heating, ventilation and air conditioning can be separate systems, why consider them holistically? The answer lies in the interaction of these services with each other and with the building. By considering HVAC systems as individual elements rather than as an interacting system, it would be easy to overlook a major area of energy wastage – that one component might impact on another. For example, it would be wasteful to increase heating inside a building while the cooling system is fighting to reduce temperatures. It is therefore useful to look at how the elements of an HVAC system interact with each other and fine tune each part to save energy and money.

The true definition of an air conditioning system is one which has the ability to control temperature, humidity and air quality within precise limits, yet the term is often applied to systems which simply cool the space. These cool air systems are more correctly referred to as 'comfort cooling'.

2 RESEARCH METHODOLOGY

Modern air conditioning is critical to almost every facet of advancing human activity. The Project report mainly intends to deliver the requirements and Procedures to implement HVAC Systems in a Commercial Building in terms of Heat Load Calculation, Air Distribution System and Chilled Water System. Understanding the building requirements and applying standards in designing a HVAC System using Tools like HAP (Hourly Analysis Program), etc. to define the capacity and routing of the system is the Scope of the Project.

The project also introduces the concept of Heat Recovery System in the HVAC segment to extract the energy being lost to the atmosphere through the exhaust air. Exhaust Air is the unwanted air being removed from the indoor space from

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areas like washrooms, toilets to maintain the indoor air quality. Such air will also contain the treated air of the indoors space, whose cooling is wasted to the atmosphere. By recirculating the building exhaust air and transferring its cooling to the fresh ambient air is a great alternative of Heat Recovery.

HVAC system provides adequate indoor air quality by: conditioning the air in the occupied space of a building in order to provide for the comfort of its occupants; diluting and removing contaminants from indoor air through ventilation; and providing proper building pressurization.

In many buildings, the air distribution system also includes a return air system so that conditioned supply air is returned to the AHU (return air) where it is mixed with supply air, re-filtered, re-conditioned, and re-circulated throughout the building.

This is usually accomplished by drawing air from the occupied space and returning it to the AHU by: (1) ducted returns, wherein air is collected from each room or zone using return air devices in the ceiling or walls that are directly connected by ductwork to the air-handling unit or (2) plenum returns, wherein air is collected from several rooms or zones through return air devices that empty into the negatively pressurized ceiling plenum (the space between the drop ceiling and the real ceiling). The air is then returned to the air-handling unit by ductwork or structural conduits. Finally, some portion of the air within is exhausted from the building. The air exhaust system might be directly connected to the AHU and/or may stand-alone.

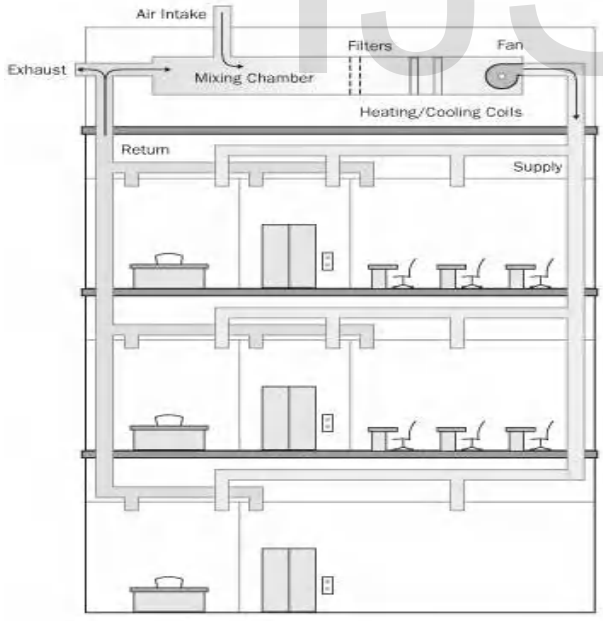

Fig. 1. Central HVAC System
(*Courtesy: York Air-Conditioning)*

The Calculation and selection of the Heat Recovery Wheel depends on the temperature conditions of the return air and the supply air through the heat exchanger. A rotary air-to-air heat exchanger has a revolving wheel filled with an air-permeable medium having a large internal surface area is selected. The wheel is mounted in a supporting structure, and the motor driven at up to approximately 20 revolutions per minute. Adjacent supply and exhaust air streams each flow through half of the wheel in a counter-flow pattern. The selection is done using an application software ECOFRESH for the desiccant wheel.

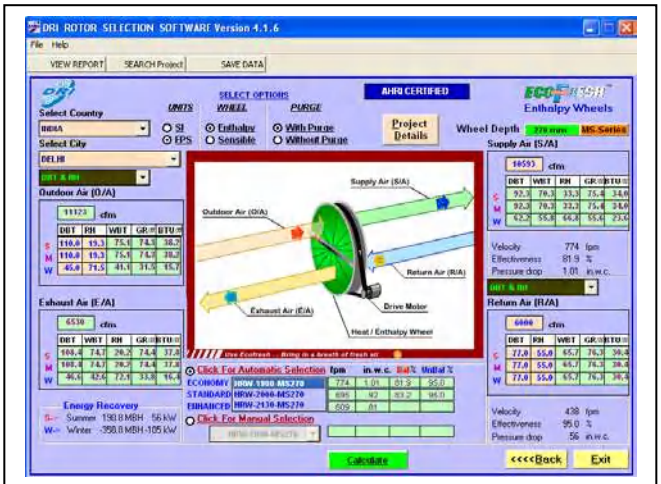

Fig. 2. Selection of Desiccant Wheel by Eco-Fresh Software

The actual use of the words "air conditioning" varies considerably, so it is always advisable to check what is really meant. Consider, for example, "window air conditioners." The vast majority provide cooling, some dehumidification, some filtering, and some ventilation when the outside temperature is well above freezing. They have no ability to heat or to humidify the conditioned space and do not cool if it is cold outside. In colder climates, heating is often provided by a separate, perimeter heating system that is located within the outside walls. The other functions: cooling, humidification, dehumidification, cleaning, ventilating and air movement, are all provided by a separate air system, often referred to as the "air-conditioning system." It is important to remember that both the heating and the air system together form the "air-conditioning" system for the space.

Finally, by keeping the Heat Recovery Wheel in the Air Handling Unit tried to make heat transfer from the exhaust air to the fresh air. Heat Recovery Wheel plays a vital role to save the energy consumption and recommendations are made at the end to save the energy consumption.

3 Designing Software

Computer-aided design and sizing programs are widely used for more precise calculation and optimum sizing of large and more complicated systems.

Heat Load Calculation – Hourly Analysis Program (HAP)
Duct Designing – McQuay Software
Heat Recovery – Eco Fresh Software

4 Building Survey

The Civil Construction details for the Commercial Corporate Project (G+3F) are as per the specifications provided from the civil consultant. The Civil specifications form the consultants

include the complete civil plan with a given North direction and all the material specifications of all those kinds of materials to be used in the project.

The material specifications were inserted into the HAP software and are as given below.

U 8" wall = 0.222 BTU/hr/ft²/F
U 6" roof = 0.091 BTU/hr/ft²/F
U glass = 0.590 BTU/hr/ft²/F

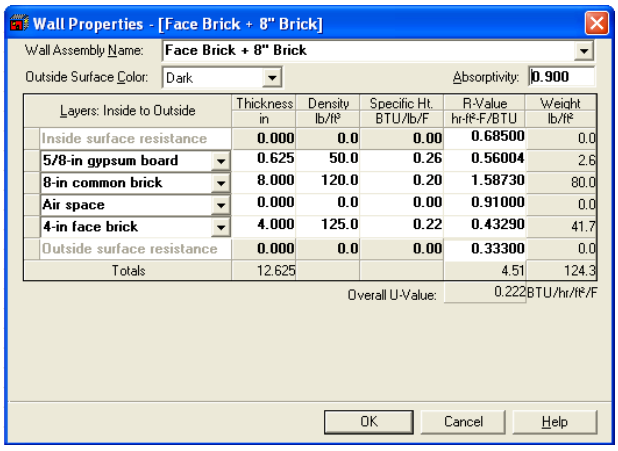

Fig. 3. External Wall Properties

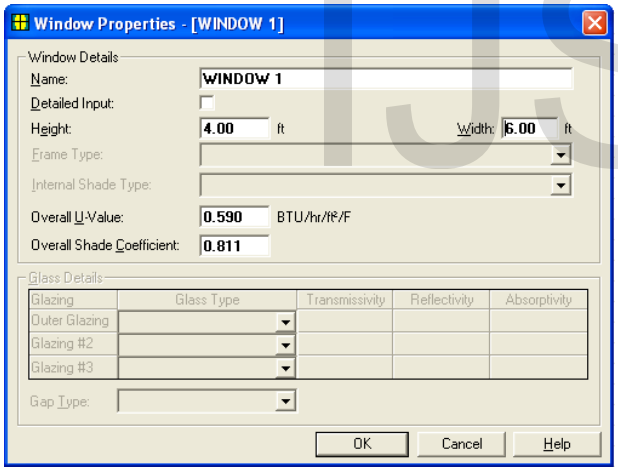

Fig. 4. Glass Properties

5 Discussion of Design

While there are many different HVAC system designs and operational approaches to achieving proper system functionality, and every building is unique in its design and operation, HVAC systems generally share a few basic design elements like outside air intake, air handling unit, air distribution system, and air exhaust system.

In general, outside (supply) air is drawn into a building's HVAC system through the air intake by the air handling unit (AHU). Once in the system, supply air is filtered to remove particulate matter (mold, allergens, and dust), heated or cooled, and then circulated throughout the building via the air distribution system, which is typically a system of supply ducts and registers.

Hourly Analysis Program (HAP):

The Heat Load Calculation for the project was performed with the industry oriented software called as HAP, Hourly Analysis Program. The Heat Load Calculation sheets for the project building as per each room/space are as given below. The values required herein for further calculations are the Tonnage and CFM flow of air of each room/space. These values are formulated through HAP Software and printed in form of word formats as Project reports.

HAP is designed for consulting engineers, design/build contractors, HVAC contractors, facility engineers and other professionals involved in the design and analysis of commercial building HVAC systems. The program is a powerful tool for designing systems and sizing system components.

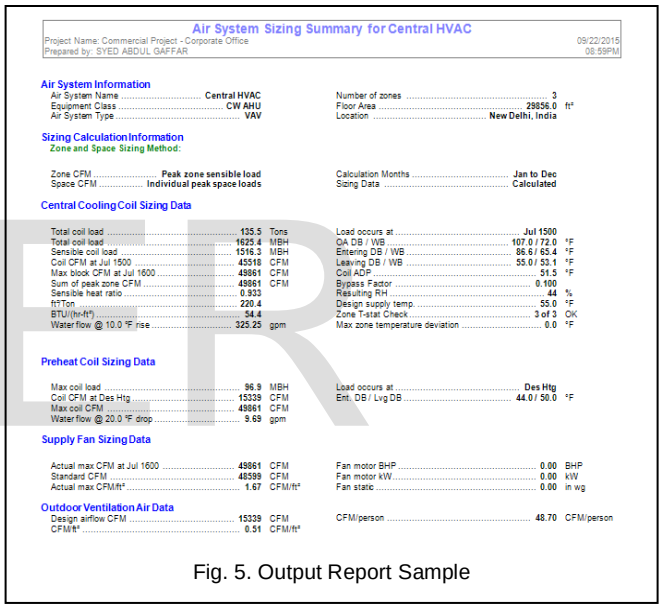

Fig. 5. Output Report Sample

6 Discussion of Results

The centralized Air Conditioning System for the Commercial Corporate project were designed for New Delhi region under the specification of the civil part to achieve the indoor conditions of the project with considerable options of efficient design such as heat recovery. The design and drafting of the project is as submitted, below are the results and their discussion which can be further carried out to evaluate the outcomes of the project.

The design of the complete project was done as per the requirements to maintain the given human comfort conditions for all the occupants with the climatic condition at New Delhi.

The design load calculations for the project were performed on Hourly Analysis Program Software which estimates the heat transfer as per hourly basis to provide efficient way of selecting the machines. The complete shop drawings for the project were prepared along with the

schedules of all equipment for further procurement an installation at site. The air calculations were performed to determine the air inflow and outflow requirement for the heat recovery option of desiccant wheel.

The implementation of the FAHUs along with Heat Recovery option as per the requirement will provide its savings in the life of project. The desiccant wheel selected for the FAHU to extract cooling from the exhaust air to pass it to the fresh air as supplied to the building as per human comfort requirement.

Usually these Heat Recovery systems do provide and reduction on 1-2˚F which in turn provide significant savings in the lifetime of project. The building's energy performance will be continuously monitored with further fine tuning and improvements to control strategies.

There is a need to conducting site-wide energy efficiency assessments to identify the opportunities to reduce energy intensity and identify waste heat recovery and reuse opportunities. The Savings for the same will be more in terms of energy consumption like Electricity and also the cooling thus given can be more appropriately reused for further saving requirement. In addition to the energy savings, building reliability has increased together with an improvement in occupant comfort due to enhanced zoning arrangements and better control.

The results thus discussed are the outcomes of the project Central HVAC for Commercial Corporate Building, will be further developed and to be utilized for a proper implementation for the future scenario of the MEP Industry requirements.

S.No.	DESCRIPTION OF RESULT	RESULT
1	Total Tonnage TR	135.5 TR
2	Total Air Supply CFM	49861 CFM
3	Fresh Air CFM	10500 CFM
4	Exhaust Air CFM	6000 CFM

Result Analysis:

By the design analysis it has been identified that, by using Heat Recovery Wheel there was power consumption of 10-15% on the total load.

In general, the comfort levels as per the ASHRAE standards are:

Temperature range: 22oC - 26oC

Relative Humidity range: 30% - 60%

CO2 level: <1000ppm

The abnormal distribution of cool air in the space by the HVAC system, hence it needs proper rotation and distribution of air in the space.

More over from the Research Questionnaire analysis, it seems that the quality of air is better. Further to improve the air quality levels in the space and healthy environment of the occupants, it is necessary to allow the fresh air continually in the floors which is rectified to be done in the office in walk through inspection. Maintenance and Operation person of the HVAC system need to monitor the proper working of the system from time to time. Cleaning of the carpets is to be done to remove dust formation and accumulation of the pollutants. Also noted that the locations are free from wet or moist with which there are chances of growing fungi which also lowers the quality of air.

7 Conclusion

HVAC systems are the mostly required in now-a-day corporate offices for maintaining the Human Comfort at international & large scale level. The report describes the importance of proper design of a Centralized Air-Conditioning System for the Corporate Office building as per the standards of ASHRAE & SMACNA, will be submitted for approval from the sponsored authority.

The Heat Load Estimated provides the requirement of Cooling for the project, provides a guideline for the Selection of Machines.

HAP is designed for consulting engineers, design/build contractors, HVAC contractors, facility engineers and other professionals involved in the design and analysis of commercial building HVAC systems. The program is a powerful tool for designing systems and sizing system components.

All the Equipment are installed as per the manufacturer's recommendations to achieve its best efficient performance. The Duct designing is done as per SMACNA Standards, providing the most economical and effective routing to deliver the cool air with least losses. There is a need to conducting more such site-wide energy efficiency assessments to identify the opportunities to reduce energy intensity and identify waste heat recovery and reuse opportunities, thus the Project Report clearly identifies the requirements of the project and provides an effective way of Air-Conditioning to achieve Human comfort for the occupants. The design and drawings as approved will be sent to the site installation process. Therefore, the project defines the requirement and process of achieving the Human Comfort and Environment.

Acknowledgment:

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A Survey on Deceptive Phishing attacks in Social Networking Environments

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Abstract. Social Phishers continuously adapt the novel trapping techniques of prying usernames and passwords by establishing a friendly relationship through microblog messages using various Social Networking Environments (SNEs) for Financial benefits. APWG report of 2018 shows the successive rise in phishing attacks via URLS, fake websites, spoofed e-mail links, domain name usage and Social media content [1]. Innumerable defending techniques had been proposed earlier, but are still vulnerable due to exchange of compromised microblogs in SNEs resulting in leaking of confidential information and falling prey to phishers attack. To mitigate the latent fraudulent phishing mechanisms there is a scope and an immense need to get rid from phishing attacks in SNEs. This paper surveys and analyzes the various Social Phishing detection and prevention mechanisms that are developed for SNEs.

Keywords: Social phishing, phishing attacks, APWG report, mitigate, Social Network Environments (SNEs).

1 Introduction

The Social Phishing is defined as the technique(s) used to trace out the privacy information without users knowledge by sending social messages to gain the victims trustworthiness and confidentially [3]. Many of research studies were made to detect phishing from emails, URLs, websites and Domain name usages. But, very little concentration paid towards the research for surveillance of social phishing in Social Netwoking Environments (SNEs) such as Facebook, Twitter, Linkedin, Instagram, chatbots, WhatsApp, Teenchat and many more messaging applications. In SNEs to open an account, the confidential data is supposed to be uploaded willingly by the users if they want to access and share information. Its Well-known that Facebook stores the users profile data such as Account name, Place, Residential address, Contact numbers, Current Job address, Educational details, Job description and its experience, personal preferences, hobbies, likes, dislikes, interests, Profile photo and Videos (optional), now-a-days to secure the accounts a Two-step-verification strategy

of linking Mobile numbers to accounts is embedded. Further, email accounts are also merged with Facebook and other Social Networking accounts opening a hidden channel for social phishing attacks. In Mid of 2016, Google thought of linking unique mobile number with the gmail accounts for restricting the users to limit the opening of multiple accounts upto Ten (10), by appending a Three-Step verification of sending an OTP (One-Time Password) in the name of high level secure security. At one end by using OTP the Google can trace the users location, latitudes, longitudes through google maps and can locate the person very easily which is hidden from the users[5].

Ultimately, these Social Networks traps out the personal and confidential information without the users knowledge unknowingly. Currently, the accumulated users information is extensively used by various marketing and other agencies [9]. Simultaneously, the confidential information is known to unauthorized persons such as phishers then they make illegal use of data for phishing attacks [18].

This Section motivates the social users to carefully make use of personal information while chatting with others on various SNEs for security reasons. Further, alerts the users for the difficulties faced due to negligently sharing of information in SNEs. The remainder of this paper is organized as follows: Section 2, highlight the consequences of sharing personal information in SNEs that leads to deceptive phishng attacks and its impact on blocking of online banking transactions. The Section 3 elaborates the different phishing strategies developed earlier for overcoming deceptive phishing attacks exclusively in Social Networking Sites (SNS) is discussed, where as Section 4 explores the features chosen in generalized architecture of phishing detection system (PDS) to detect deceptive phishing from microblogs which guides in prediction of latent phishing attacks. In Section 5, thorough and in-depth comparative analysis among the phishing detection approaches is explained. Section 6 concludes this survey with an outlook to future research challenge for detecting and understanding the psychological intent of phishers in SNSs that needs to be exposed.

2 Problems with sharing data in Social Networking Environments

In this section we explore the problems faced due to carelessly sharing of personal profiles and their data in various SNEs, that makes them falling prey to phishers. Intelligently, phishers may adopt various SNEs to trap social users for leaking out confidential information. These phishers keep track of users for certain period of time may be for weeks or months, not only from SNEs but also by making phone calls pretending themselves as official authorized personal requesting to share information such as birth place, date, job, martial status, credit cards, bank accounts, and PAN details through questionnaires pattern.

The sample scenario of deceptive social message sent by phishers to trace out confidential information is shown in Table 1, that depicts how a phisher plans and forwards spoofed social messages unanimously and then establishes a fraudulent relationship to deceive social users for financial benefits in SNEs.

Table 1. Sample microblogs sent by Phishers to IM user for trapping via social media.

Chatmate -1 ***(phisher)***	*Chatmate -2* ***(IM user)***
I wil ***deposit*** *the* ***amount*** *to ur* ***account****, give ur* ***account details***	*yes, my* ***Account number****: 30527854265,* ***Account name****: Raghu Vamshi,* ***Bank****: HDFC,* ***Branch IFSC code****: 74585*
	Received money, Thanxs a lot…..
Pls., ***pay back*** *(50%)* ***money*** *after 3 weeks to my* ***account*** *as promised by u*	*Ok, sure. Can u pls. send your* ***account details***
Ok. My ***Account number****: 45565221253,* ***Account name****: Praveen,* ***Bank name****: AXIS, Branch* ***IFSC code****: 58747 …… ; whats your phone number and* ***DOB*** *please*	*Hi, 9980423222 is* ***mobile number*** *20/2/1987*

The bold keywords in Table 1, namely *deposit, amount, account, details, account number, account name, bank, branch IFSC code, mobile number, DOB* are the confidential words leaked by IM user to become a social victim due to phishers deceptive microblogs. The above information is enough to block online Bank transactions of customers, One of such worse case of misusing of privacy data by phishers, is locking the online bank accounts temporarily for a period of 24 hours without the bank customers knowledge. The sample deceptive phishing attack performed by phisher is shown in Fig. 1. The bank customers accounts is easily blocked by unknown phisher by a simple trick of entering wrong information three (3) times into the Online banking web page. The elliptical marked messages represents that the account is blocked for a day i.e., 24 hours. Further, the leaked private information such as Account number, Mobile number, and Date of birth of a particular user which is shown in Table 1, is effectively used by a phisher that aids for generation of new password as shown in Fig. 2.

Fig. 1. Strategy for locking bank account by entering wrong information Three (3) times using the Username blocked for 24 hour, to unlock see the elliptical marked

Fig. 2. Phisher clicks the "Forgot Login Password" on banks online web page where Account number, Account names, Country, Mobile and DOB fields are entered

Subsequently, if the intelligent technology that involves Deep learning, Artifical Intelligence and Machine learning techniques are collaboratively used by phishers and hackers on SNEs then it results in harming and destroying online transactions in different fields of domains which is unimaginable. The third parties are selling the hacked users profile information obtained through crawling from social networks and making illegal use of private information for their financial benefits to phishers [4].

3 Survey on Deceptive phishing detection approaches in SNEs

Confidential information is both unanimously and sometimes unintentionally exposed through microblogs in Social Networks Environments (SNEs) by various users, because they are interested in exponential exposure and their willingness for establishing good relationships with different Social Networking groups. Many of these user's of Social groups very rarely understand the privacy policies and accepts it blindly by biasing themselves towards leakage of confidential information that traps them into disastrous privacy risks. To detect many strategies and techniques developed from identifying spim microblogs by using advanced technologies, among them one of machine learning technique is used to detect spam bots in Twitters is explored [6]. Similarly, in another study machine learning approach is effectively used in detecting and identifying the political goons that misuse the social media [7]. In another approach analyzing the tweets that constitutes of malicious keywords using Bayesian approach for predicting phishers is explored [8]. Similarly, to detect polluters from SNEs (Facebook and Twitter) a hybrid supervised classifier is proposed that minimizes the burden for service providers [10]. Serious concern of various attacks and its consequences in online Social Networks (OSN) is briefly discussed, further to reduce OSN attacks the solutions that exists to mitigate is pin-pointed [9] [19].

Many of the machines learning approaches are used to detect phishing only after committing of attacks that comprises of new keywords, new urls, new links and new domain names which must be frequently updated into the historical phishing database to avoid the future attacks. The drawback in machine learning is that it requires excessive training and mostly works on static OSNs messages. But, most of these are unsuccessful to identify and predict the social phishing attacks in OSNs from online chatting sessions dynamically. Instead of that, in a recent study suggested that use of pre-defined rules can dynamically detect words and is bit faster showing accurate result, further no training is required [14].

One of such System had been implemented to surveillance the Social phishing attack in SNEs named as Anti-Phishing detection system (APDs) that solely depends on pre-defined words [12]. Similarly, in another approach an enhanced APD system for detecting the social phishing words at run-time from text and audio is developed [13]. Subsequently, an integrated APD system using data mining and Wordnet Ontology was developed to detect and then predict the deceptive phishing words from SNEs [11].

4 Generalized architecture for Phishing Detection System in SNEs

In most of these phishing detection methodologies make use of data mining technique or probabilistic GSHL algorithm which is assisted with pre-defined logical rules & WordNet Ontology for predicting the phishing words in microblogs from Social Networking Sites (SNS) [11], [12], [13]. The generalized architecture of phishing detection system (PDS) is depicted in Fig. 3.

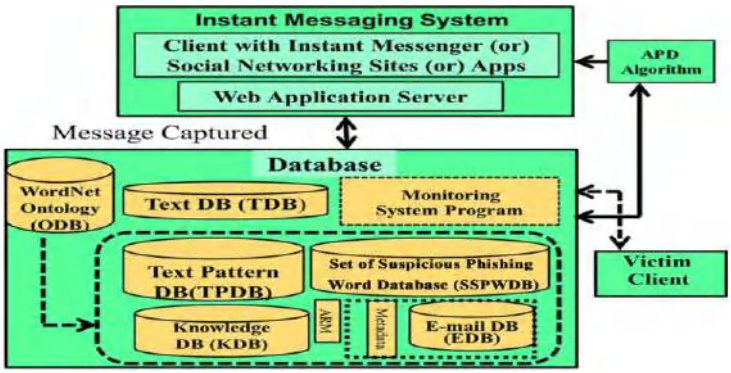

Fig. 3. Architecture of PDS to detect phishing in Social Networking Sites (SNS).

The operational components of Anti-Phishing Detection algorithm (APD) is shown in Fig. 3. This PDS system makes use of databases like TDB (to store user messages), TPDB (stores phishing patterns found), SSPWDB (set of suspicious pre-defined phishing rules) & KDB (stores domain with set of phishing words), ODB (uses OBIE model for predicting phishing words from microblogs using WordNet, which is guided with pre-defined logical rules) [15].

The APD algorithm initiates the steps for capturing the phishing words that are exchanged between the users and then stores them into database for identifying phishing words using pre-defined phishing rules [12]. In PDS, the Monitoring system program (APD algorithm) identifies the culprit details of Phisher and reports to the victim client [15]. The APD algorithmic steps are discussed below.

The working pseudo code of the APD Algorithm for PDS is explained step-by-step process as shown below:

1. In this step, the phishing words are identified by using *GSHL* and *Tree Alignment* Algorithms as discussed in [15]. These messages are stored in Text database (TDB), where unnecessary words are filtered using OBIE technique (stemming, N-gram technique, ignore words).
2. The frequently recurring words are extracted from the TDB dynamically using Association rule mining technique and pre-defined rules guided with Ontology database (ODB), later these words are pushed to TPDB. The *metadata* stores the gist of information related to microblogs sent in SNEs.
3. Once the Phishing words are detected, the message is considered as phishing, as shown in Table 1. The *KDB* maintains the detected stem words along with the domain (i.e. type of Phishing activity).
4. Profile details are traced from *EDB*, which are provided during the creation of an email id, with the aid of Relational Wrapper Algorithm [15].
5. The SNEs user account through which the phishing words are sent is tracked using *metadata*, and the victim is alerted.

In this section we have chosen one of the best architecture out of other approaches for spying of microblogs from SNS that predicts the phishing words dynamically during the chatting session at run-time and then generates an alert pop-up to the users on which this system (APD algorithm) is configured.

5 Flaws in Earlier Phishing detection approaches

In this section, we focus only on the earlier phishing detection approaches that were proposed for identifying the phishing words at run-time when the short messages or posts are shared among the chatmates in SNEs, rather than the static approaches of phishing detection as explored in Section 3.

After keenly observing the APWG reports starting from January 22, 2004 till July 31, 2018 [2], to our knowledge APD system was the first attempt made to detect phishing in Instant Messaging applications from short posts in the year 2011 [16]. In this paper they have designed an "APD: **A**RM Deceptive **P**hishing **D**etector System", that uses an Apriori algorithm, a data mining technique to detect phishing words from messages but the major drawback of this system is initially it needs an enormous training dataset through phishing messages that constitute of phishing words, which is a time consuming process. When the test messages are fed to APD for predicting the phishing words, again the apriori algorithm checks each of the message for phishing words, and checks the threshold value which is tuned by the developer, if it satisfies then phishing words are detected otherwise the messages are ignored.

Table 2. Illustrates different Phishing detection approaches & their deficiencies

Title of Paper	*Textual detection*	*Pre-defined rules*	*WordNet Ontology*	*Text and Audio*	*Approach used*	*Drawback*
APD [16]	Yes	No, but frequent patterns	Not Supported	Not Supported	Apriori Algorithm	Excessive training
APD [12]	Yes	partial, but frequent patterns updated	Not Supported	Not Supported	Apriori Algorithm & Updating of frequent patterns	One level of Frequent patterns is reduced
APD [13]	Yes	Initial stage use of Predefined	Terminological Ontological	Supported	Pre-defined rules mapped and then Integrated with speech, using LPC and FFT technique	Processing time is high, accuracy reduced due to inefficiency of pitch signals of voices
APDS [11]	Yes	Yes	Terminological Ontology used	Not Supported	OBIE Approach used	few phishing words are ignored
CBA [17]	Yes	Context based rules	Terminological Ontological words are used instead of formal Ontology	Not Supported	Classification based Association rules & GSHL Algorithm	Classifying & then applying association rules, excepted tree is not formed, time taken is more
APD[15]	Yes	Yes	Supported	Not supported	Probabilistic GSHL & Treealignment algorithms	Short-form words are ignored

Similarly, in the year 2012, APD system is improvised by updating the detected phishing words and appending these words to training dataset, which has reduced the processing time of apriori algorithm by reducing one level of generation of phishing patterns. In 2014, based on the context of words, a phishing detection & prevention approach for SNS is proposed, that analyzes and predict phishing in Instant Messages (IM) with relevance to domain ontology (OBIE) and utilizes the Classification based on Association (CBA) for generating phishing rules and alerting the victims [17].

With the advancement of Instant messaging application the phishers tried to trace out co[nfidential information of the users through voice chatting as well as Texting of messages simultaneously. To overcome this phishing detection process, APD system is enhanced to detect phishing words from microblogs that constitutes not only text but also Audio (speech) in the year 2012. The Speech recognition system is embedded

to earlier textual APD system using FFT spectrum analysis and LPC coefficients methodologies [13]. Even though, it was time-consuming process as it involves filtering of noise from speech and then converting to voice signals that needs to be checked with wide range of spectrum of voice clips that belongs to phishing words and then subsequently checking the text messages that has phishing words and initiate the integration of phishing words from voice clips and text was bit difficult task.

Later, in the year 2015, the APD system is enhanced and improved a lot with the use of pre-defined logical phishing rules assisted with logical WordNet dictionary using probabilistic GSHL and Treealignment algorithms instead of Data mining technqiue [15]. The results obtained are marvelous giving a good rise in precision rate for the given set of messages. The comparative analysis and the chosen features in each of the strategies are illustrated in Table 2.

6 Conclusion and Future scope

In this paper we have surveyed various earlier approaches that were used to detect phishing from microblogs specifically in SNEs. Totally, Eight (8) survey papers were thoroughly reviewed that were related to deceptive phishing attacks in SNEs. One of the reasons that can be concluded from APWG reports [1] [2], is that this report has neglected the online social phishing attacks that are yet happening from instant messaging applications [9]. In Section 2, we have explored the problems faced with a detailed scenario of tracing out confidential information from SNEs through spoofed social messages by phishers. To overcome, the APD algorithm is discussed in Section 4 that can be effectively integrated into SNEs, so that an alarming alert is given to the users of SNEs if it is configured efficiently [15].

Further, we have identified the future scope for enhancing the APD system are given below as follows:

- Phishing words that are sent using Short-form notations are ignored by APD system.
- Multi-lingual Phishing words are not identified by APD system.
- Understanding the Psychology of phishers is another research area that needs to be explored.
- If deceptive social phishing messages are sent in any other formats such as multimedia (Images, Audio and Video) apart from textual are deferred by APD system.

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Performance Analysis of Robust Data Hiding Scheme for Video Sequences /Streams

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Abstract:

Data hiding schemes in video sequences is hidden either in spatial domain or in compressed domain and these methods are robust for steganalysis. In this paper a data hiding scheme that target the motion vectors and provide high imperceptibility is proposed. By altering the selected motion vectors high payload can be achieved and remains robust for different spatial and geometric attacks. In this paper the data hidden sequences are subjected to several attacks and in most of the cases the method proves to recover the embedded data without much degradation in the spatial quality of the video sequence.

Keywords: Data hiding, Motion vectors, compressed domain, Attacks.

1. INTRODUCTION

The need for digital data hiding schemes to protect the multimedia data is growing rapidly and to meet the requirements of the end user many algorithms have been proposed so far in the literature despite of this there is a huge requirement and demand for high quality video streams that were protected by some hidden digital data. These hiding techniques are prioritized on hiding capacity, imperceptibility and robustness for various attacks. [1] [2] [3]. The distortions that were introduced with the hiding scheme play a vital role in analyzing the performance of the hiding scheme.

Hiding the secret digital data into video sequences can be achieved in two ways, firstly to embed the raw or encoded data directly into the spatial domain of video frames and secondly to hide the data in compressed frames or hiding them in selected motion vectors [4][5]. Most of the works that were proposed to hide the data in motion vectors were sued to alter the motion vector by its attributes such as magnitude, phase, in the similar manner the method proposed in [6] used to consider the magnitude as a criteria for selecting the motion vectors but the limitation of this approach is that its payload it too low to combat against the attacks.

This approach concentrates on providing a robust lossless data hiding scheme for video sequences. The robustness of any method is categorized as fragile, semi fragile and fully robust and a method is said to be more robust if could able to resist and sustain for various spatial, geometric attacks. This paper aims to present a fully robust video data hiding approach for various attacks and the performance of it is evaluated with multiple quality metrics.

2. RELATED WORK

In literature there are several methods and approaches that were proposed for data hiding in video sequences some of them intend to hide the data in spatial domain of the individual frames and some intend to modify the motion vectors of the video. In this section the data hiding schemes in compressed domain are considered as references since it was observed that by modifying the motion vectors high imperceptibility and high payload can be obtained [10].

Wang et.al in [7] proposed a simple way of selecting a region, where the data is intended for hiding. The data initially is been encoded and thereafter that were hidden into motion vectors. Zhang.et.al in [8] tries to embed the data into motion vectors by selecting those vectors which are beyond a predefined threshold for magnitude of the motion vectors. However this method is later modified by He.et.al in [9] by selecting the motion vectors based on the phase angle of consecutive selected motion vectors. It is very often to note that the data hiding introduces some distortions that was assigned as a problem by authors and tried to mitigate this with the algorithms. The method proposed by Qian et.al in [11] embeds data into motion vectors after encrypting, the problem defined by the authors state that with the attributes of the bit-streams the location of the data can be detected. Authors in [12] and [13] proposed a mechanism to search for the key points in the motion vectors for data embedding. In this article the data is hidden into the motion vectors by picking the most relevant motion vectors based on their magnitude and phase angle.

3. PROPOSED APPROACH

The most prevalent motion picture expert group (MPEG-2/4) the video is arranged in group of pictures (GOP) where the frames are encoded in [I,B,B,P,B,B,P,B,B] sequence. The temporal redundancy between the P-frame and (inter-predicted) I-frame is reduced by motion estimation along with compensation. The motion field in the video sequence is translated onto horizontal (d^x) and vertical components (d^y) for motion estimation with block based approach where macro blocks are searched in P and B frames. Every inter frame macro block in P^{th} frame is represented with forward motion vectors and the quantized DCT coefficients of the prediction residual after applying motion compensation. The number of motion vectors for a respective macro block is determined by

prediction mode and the reference frame. So a prediction error has to be incorporated with compensated vectors in order to reconstruct back the "P" frame.

$$P = \overset{\frown}{P} + E \quad (1)$$

Where $\overset{\frown}{P}$ is the motion compensated vector and "E" is the error

The motion vectors are lossless coded and thus become an attractive place to hide a message that can be blindly extracted by a special decoder.

Making the concept more simpler in this theoretical analysis assume the macro block size to be 16x16 and then the embedding process can be modeled as modifying the motion vectors either horizontally or vertically.

$$\begin{cases} SV_{k,l}^{h} = V_{k,l}^{h} + \eta_{k,l}^{h} \\ SV_{k,l}^{v} = V_{k,l}^{v} + \eta_{k,l}^{v} \end{cases} \quad (2)$$

In the above equation e $V_{k,l}^{h}$ *and* $V_{k,l}^{v}$ are the horizontal and vertical components of the motion vectors in the cover video. The video encoder compresses the spatio-temporal redundancies between the frames by motion compensation and prediction. Minimum error is predicted when the difference between the predicted block and the reference is very low and this can be termed as the best motion compensation so there is a provision to replace the original motion vector with slightly different motion vector which can be obtained after embedding the data.

Consider the motion vector $S = \{MV_0, MV_1, \ldots MV_{n-1}\}$ and its phase angle as $\theta_i = \arctan(\frac{MV_v}{MV_h})$ where MV_v and MV_h are the motion vectors along vertical and horizontal components. In this approach the data is hidden in motion vectors based on the properties of magnitude and phase angle

The process followed for embedding the data is presented

- *Mark up the starting frame and the number of frames for processing*
- *Consider the message to be embedded if it is a text then convert it into binary data bits*
- *Apply YUV transformation to all the frames required for processing and consider only 'Y' component.*
- *Select P and B frames from the video sequence*
- *Calculate MV_v & MV_h from the processed video stream*
- *Measure the magnitude and phase angle for the predicted motion vectors of every block*
- *Note the index of the motion vectors that are greater than a threshold (T=0,.5,1,1.5,2)value*
- *Now partition the input message according to the available motion vectors both in horizontal and vertical components*
- *Embed the data according to equation (2) on the basis of phase angle like*

  If the phase angle $\leq 90^0$ and if there is available message for embedding then

  If mod(MV_h,2)=message bit(Horizontal message stream) the MV_h=MV_h else

  MV_h=MV_h+C

  Where 'C' is a embedding bit in [0 1]

  The same criteria is applied for vertical components too.

- *At the extraction the process is blind and reverse*

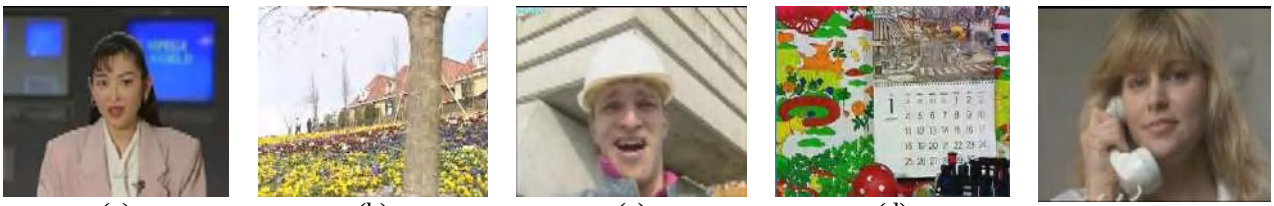
  if the Phase angle $\leq 90^0$ then extract from horizontal components or else extract from vertical components

The propose approach is simple yet effective, the algorithm is tested on several video sequences and evaluated the performance under different constraints, these results are discussed in the next section

4. RESULT ANALYSIS

The approach is evaluated with multiple video sequences taken from [14] which are tabulated below

In order to evaluate the performance of the approach several metrics were calculated like PSNR (Peak signal to noise ratio), MAE (mean absolute error) [15], NC (Normalization coefficient), PSNRHVS (PSNR-human visual system) [17] , SSIM (structural similarity index metric) [18] , VSNR (Visual signal-to-noise ratio for digital)[16] .



(a) (b) (c) (d) (e)

Figure 1: Video Sequences that were used for experimental analysis (a) Akiyo (b) Flower (c) Foreman (d) mobile (e) Suzie

The approach is tested with various attacks like noise, in this analysis sat & pepper noise is considered. Gaussian blur is considered as the blurring attack. Other attacks include, rotation, scaling. The video based attacks like frame dropping, averaging and swapping are considered. The results obtained under different constraints are tabulated below

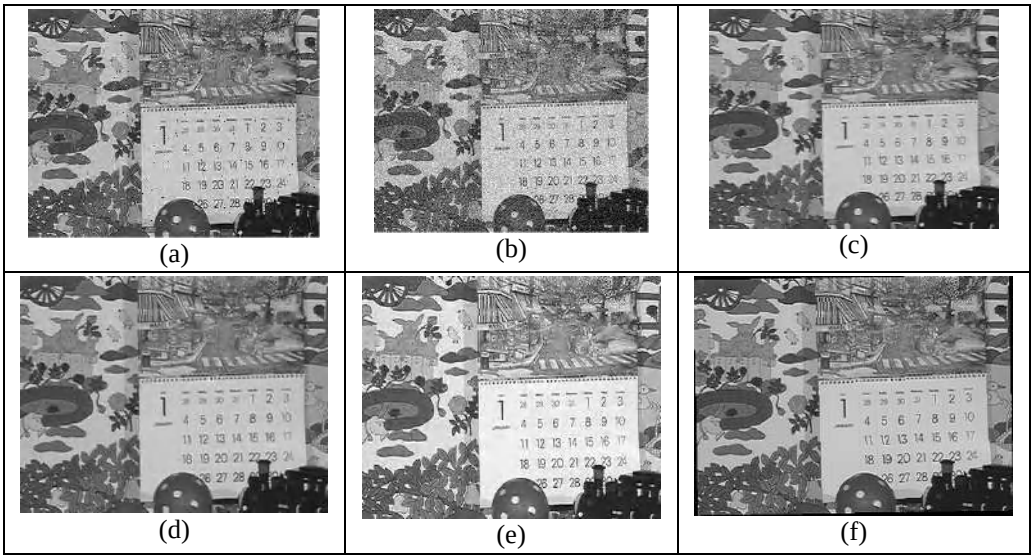
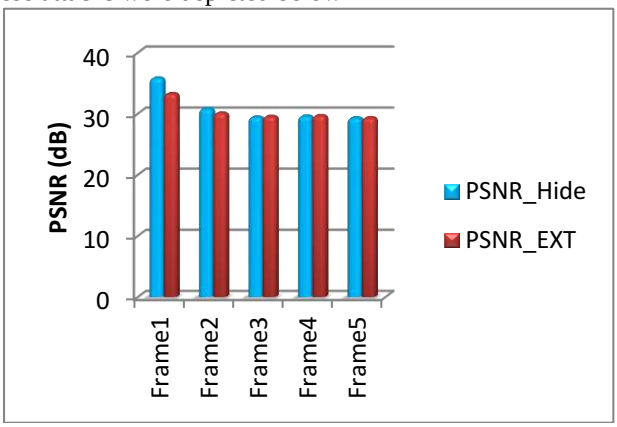
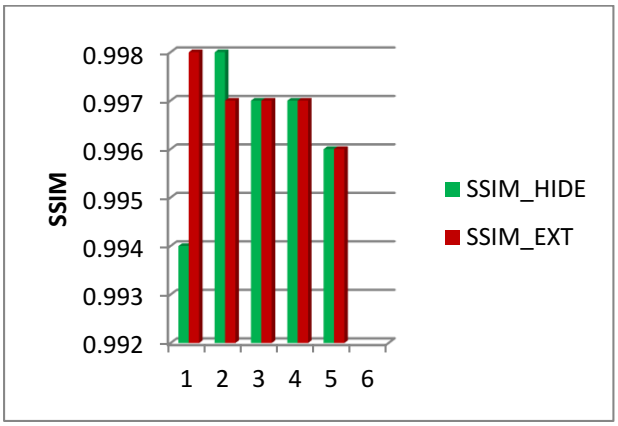


Figure 2: Various attacks (a) Salt & Pepper noise (b) Gaussian noise (c) Blur attack (d) Averaging filter (e) Scaling attack (f) median filtering

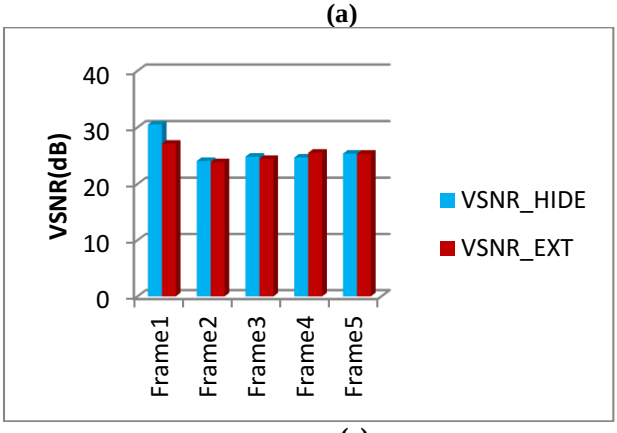
Apart from these spatial attacks frame averaging, frame dropping and frame swapping were applied. The performance analysis for all these attacks were depicted below



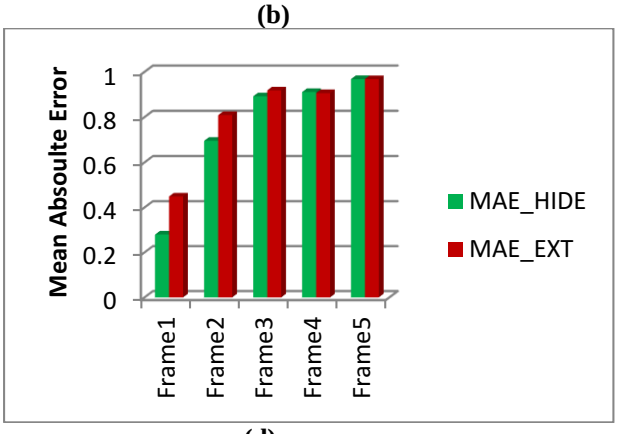
(a)



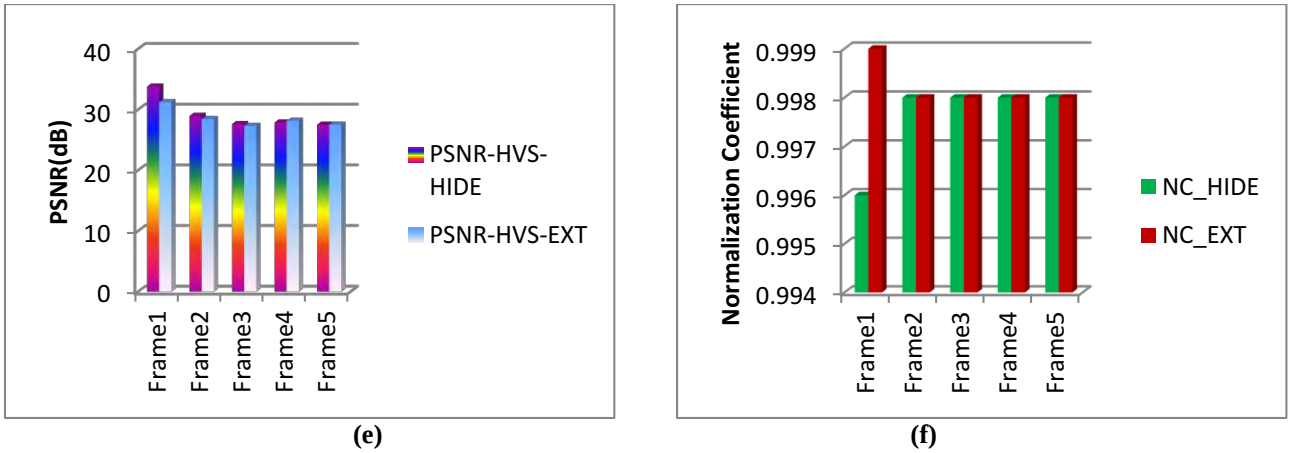
(b)



(c)

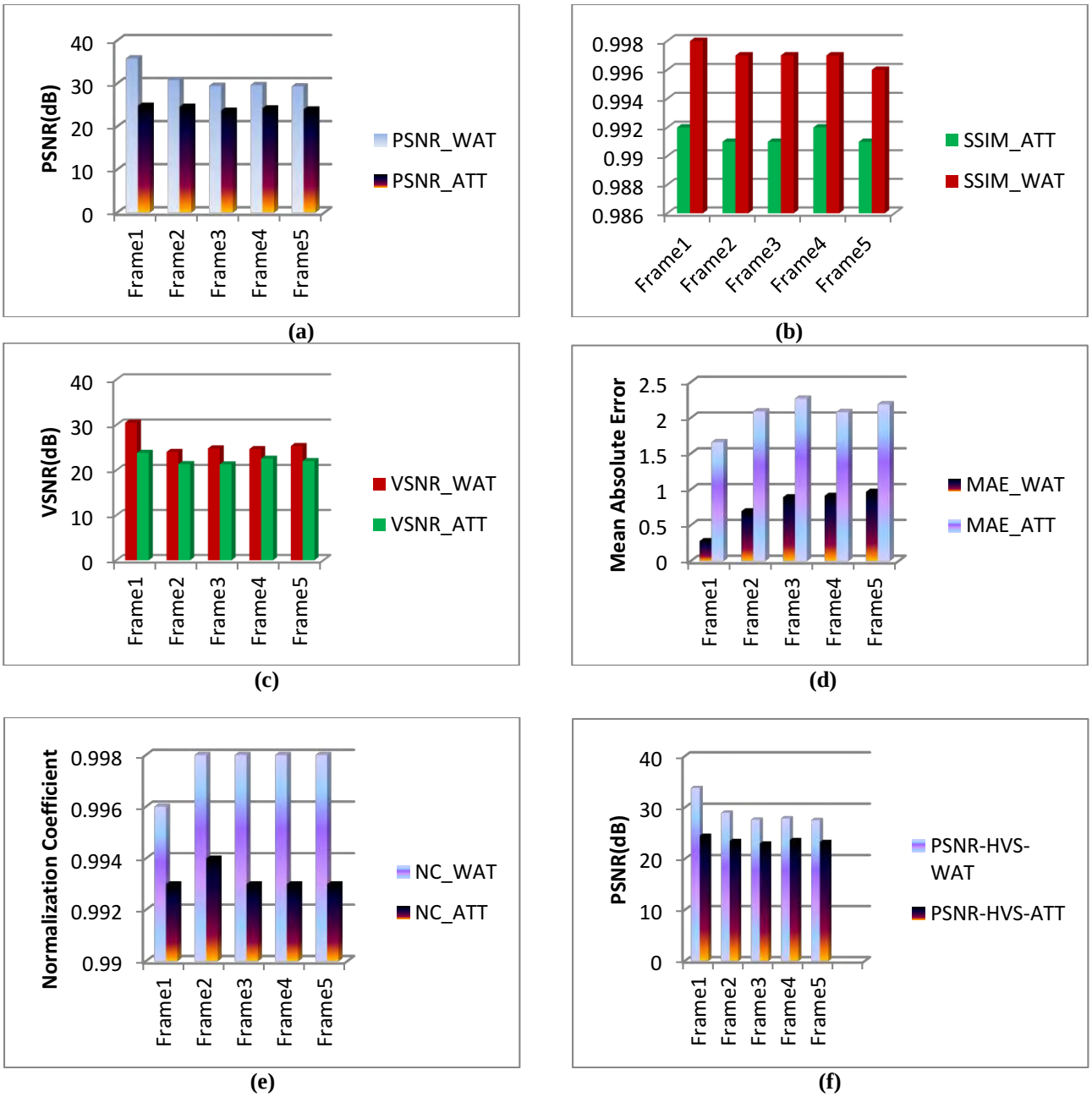


(d)



(e) **(f)**

Figure 3: The performance analysis of the proposed approach for mobile video sequence without attacks for multiple metrics



(a) **(b)**

(c) **(d)**

(e) **(f)**

Figure 4: The performance analysis of the proposed approach for mobile video sequence with salt and pepper attack for multiple metrics

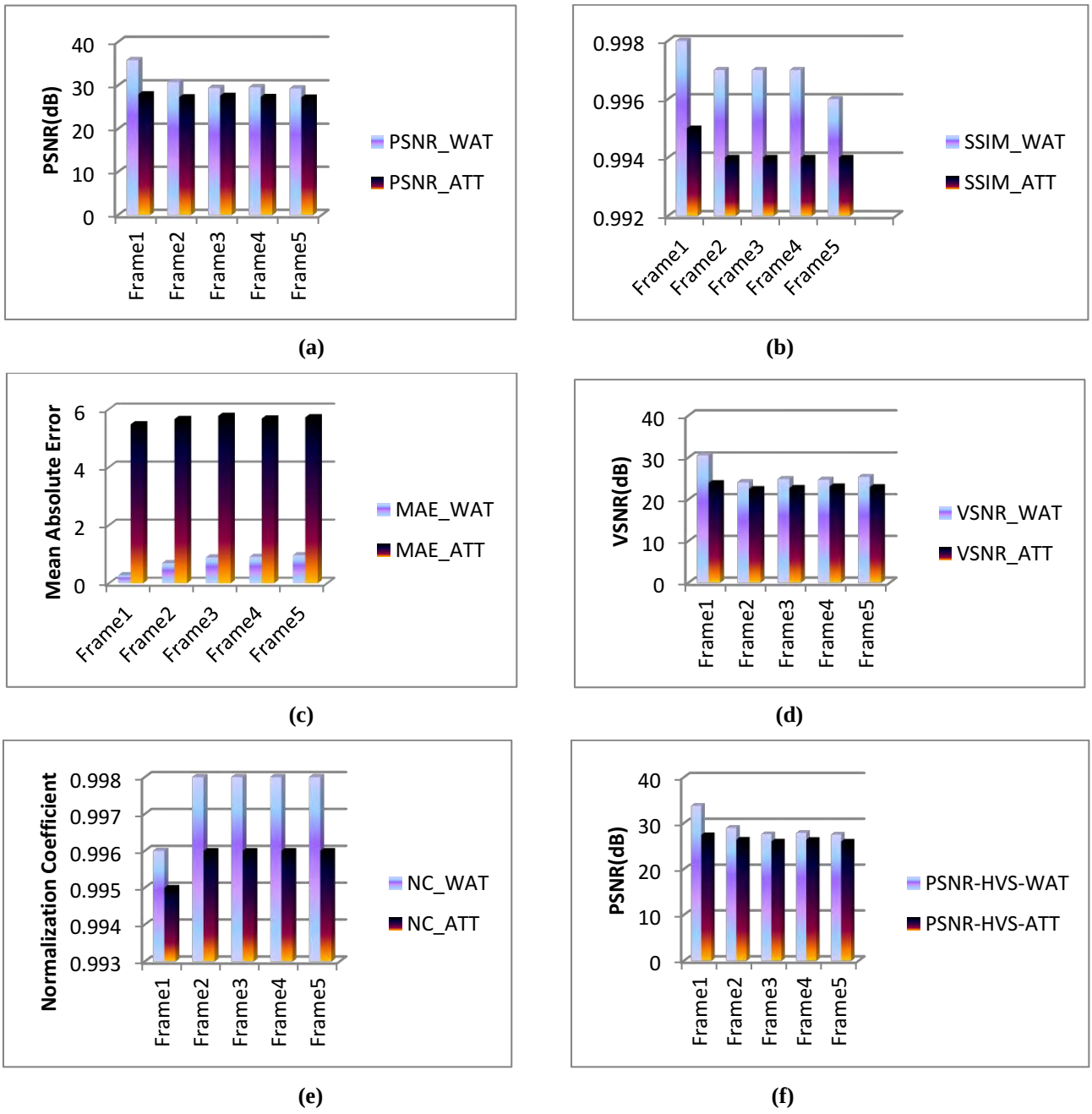


Figure 5: The performance analyses of the proposed approach for mobile video sequence with Gaussian blur attack with length=2 and degrees=4 for multiple metrics

Table 1: Analysis for frame averaging attack on the proposed approach

Frame No	PSNR	MAE	NC	PSNR-HVS
2	22.96	10.67	0.992	20.25
4	22.81	10.81	0.991	20.10
6	22.78	10.85	0.991	20.06
8	22.81	10.80	0.991	20.11
10	22.75	10.86	0.990	20.02

Note: Every two consecutive frames are averaged

Table 2: Analysis for frame dropping attack on the proposed approach

Frame No	PSNR	MAE	NC	PSNR-HVS
1	14.86	28.12	0.942	10.05
3	14.81	28.14	0.941	10.09
5	14.78	28.17	0.946	10.06
7	14.81	28.11	0.949	10.08
9	14.80	28.15	0.940	10.08

Note: For every two consecutive frames a frame is dropped

Table 3: Analysis for frame swapping attack on the proposed approach

Frame No	PSNR	MAE	NC	PSNR-HVS
2	18.86	26.79	0.92	14.73
5	18.68	27.14	0.94	14.64
3	18.67	27.02	0.94	14.59
9	18.68	26.94	0.94	14.08
7	18.58	26.95	0.94	14.08

Note: Every two consecutive a frame is dropped

In this paper the results obtained with the mobile video sequence were presented, it can be observed from the graphical analysis is that the quality of the data hidden image is around 34~36 dB of PSNR whereas after extraction it has dropped by 2~3 dB on average. The approach is tested for multiple attacks and it was observed that it could sustain for all geometric attacks producing a PSNR of 22~~24 dB for salt and pepper noise, around 27~29 dB for Gaussian blur and attains a normalization coefficient of 0.990~0.999 for most of the attacks. The approach is also tested for video based attacks like frame averaging, in this analysis every two consecutive frames are averaged and attained a PSNR about 22~23dB and PSNR-HVS of 20.0~20.9dB. Frame dropping and swapping were applied for every two consecutive frames and it was observed from the experimental results it sustained for all these attacks.

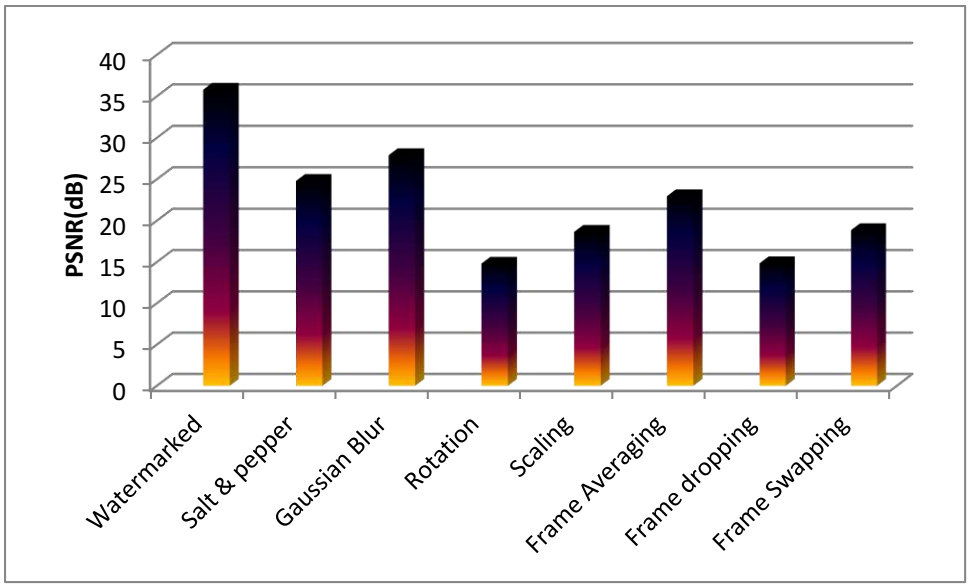


Figure 6: PSNR analysis of the proposed approach with multiple attacks

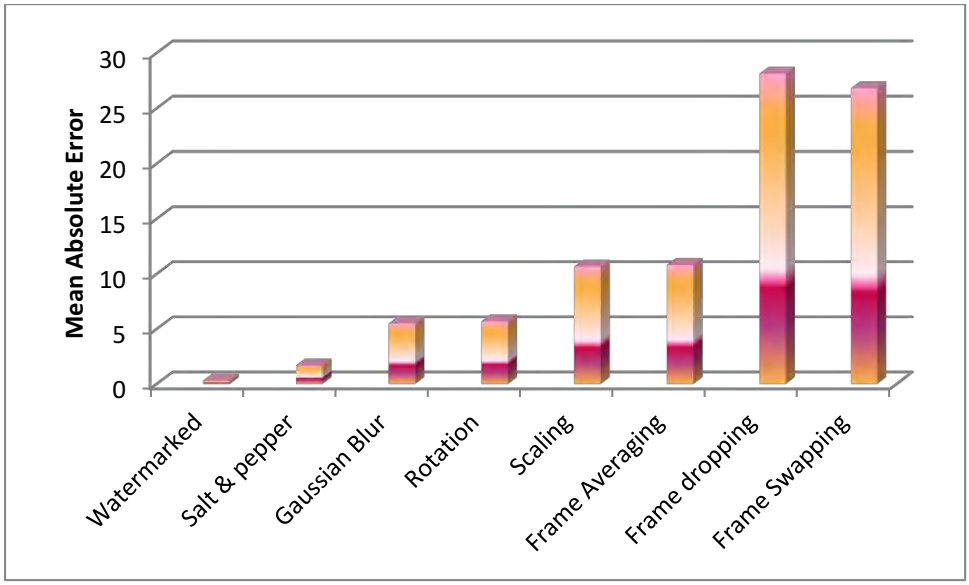


Figure 7: MAE analysis of the proposed approach for multiple attacks

In the above figure 6 & 7 it can be observed that PSNR decreases of about 15~20 dB for video frame based attacks which is comparatively higher than the traditional geometrical attacks, however the method could withstand and sustain for these extreme attacks.

5. CONCLUSIONS

This paper introduces a robust data hiding scheme for video sequences that embeds the data in the compressed domain by altering the motion vectors. The method could achieve a higher payload while preserving the quality of the video and also it sustained for various geometrical and video based attacks. The method is tested for MPEG-2 videos with text as the embedding data however this can be more reliable if the methods employs MP4 and deploys any digital data. No encryption is applied before embedding the data since it causes distortion at retrieval however the data that is embedded is may more secure if it is encrypted with any standard encryption algorithms. Finally from all the observation it can be concluded that this approach is critically robust for any geometrical distortion but the quality may degraded when video attacks were applied.

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HOME AUTOMATION USING ZIGBEE TECHNOLOGY AND IOT

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ABTRACT

Technology is a never ending process. From the past decade has seen significant advancement in the field of consumer electronics. Various devices such as cellular phones, air conditioners, home security devices, home theatres, etc. are lead us to smart home/home automation. They have given rise to a PAN (Personal Area Network) in home environment, where all these appliances can be interrelated and monitored using a single controller. Busy personalities and physical limitation/old aged people require home automation and networking to ease their work. Home automation networks uses many systems like wireless embedded sensors and actuators that allows monitoring and control applications for home user and give an efficient home management.

Keywords: PAN, Controller, Wireless embedded sensors, Actuators.

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1. INTRODUCTION

In recent years, wireless sensor and actuator networks have enlarged momentum, receiving momentous attention from academia, industry, and standards development organizations. One of the chief application domains of this technology is home automation. This system enables us to access monitoring and control applications for the home user and effective home management a WHAN (Wireless Home Automation network) characteristically comprises several types of strictly constrained embedded devices, which may be battery powered and are furnished with low-power Radio Frequency (RF) transceivers. The use of RF communication allows flexible addition or removal of devices to or from the network and reduces installation costs since wired solutions require channels or cable trays. However, the dynamics of radio propagation, resource drawbacks, and the mobility of some devices challenge the design of WHANs. We then present an overview of ZigBee, ZWave, INSTEON, Wavenis, and IP-based approaches. We then discuss these solutions with regard to WHAN requirements plus additional technical and nontechnical criteria.

2. EXISTING SYSTEM ISSUES

- Problems with integration
- Electrical issues
- Physical damage
- Your home network
- System designed for budget rather than performance
- Energy efficiency
- Extensibility

3. PROPOSED SYSTEM

3.1. Light control

A new light can be controlled from any switch, which reduces the need for new wired connections. Lights can also be activated in answer to a command from a remote control. Furthermore, they can be turned on automatically when presence and luminance sensors detect that people are in an off-color illuminated room.

3.2. Remote control

Infrared technology has been used for wireless communication between a remote control and devices such as TVs, HiFi equipment, and heating, ventilating, and air conditioning (HVAC) systems. However, infrared requires line-of-sight (LOS) and short-distance communication. RF technology overcomes these drawbacks. Intercommunication between the appliances inside the home.

3.3. Smart energy

We use Window shades to rotatable according to sunshine, HVAC, central heating, and so on may be controlled subject to the information collected by many types of sensors that are used to monitor parameters around the home such as Motion, light , humidity , thermostat etc.. In addition, smart utility meters can be used to sense usage peaks and alert the household devices that may be causing them. Energy supply firms may also use WHANs to perform energy load management.

3.4. Security and safety

Advanced security systems can be based on several sensors (e.g., smoke detectors, glass-break sensors, and motion sensors) for detecting possible risk situations that trigger appropriate actions in response. For example, smoke detectors may activate fire alarm. The proposed system employs the biometric in the authentication for home entrance which enhances home security as well as lenience of home entering process which can be overruled by OTP sent to mail and phone for giving authorization to relatives and others.

3.5. Voice recognition

The voice recognition system uses a single-chip solution for recognizing the voice. LD3320 is a chip which is used to recognize the voice based on speaker-

4. SYSTEM ARCHITECTURE

Liberated automatic voice recognition technology. LD3320 has an extremely operative speaker-independent voice recognizer. It is designed with hardware optimization and acceleration for speech recognition, without any external supporting devices such as Flash, RAM, etc. It can complete speech recognition at a precision rate of 95%, not even requiring users to do their own voice training to create speech features for the training library. So the cost of voice recognition module is inferior to SUNPLUS SPCE061A. It first examines the spectrum of the voice input by the MIC and then extracts the voice features. After that, it's compared with words in the list of keywords. Finally, the keyword with the highest score is output as the recognition result.

4.1. Remote care

Patients and disabled and elderly citizens can benefit from at home medical attention. Wearable wireless sensors can occasionally report the levels of several body parameters (e.g., temperature, blood pressure, and insulin) for an exact diagnosis. If acceleration sensors recommend that a person has fallen, alarms can be activated instantly and smart air control to maintain the fresh air inside the home by means of a geothermal pump and smart ventilation by allowing mandatory amount of sunlight into the home.

4.2. Features of the proposed system

- Increase the lifespan of each appliance in the home
- Very appliance act as they can receive the commands so therefore it doesn't have to wait for any future permissions

5. SYSTEM DESCRIPTION

An **actuator** is a device which is liable for moving and controlling a system, an actuator requires a control signal which requires very low energy that can be generated by means of hydraulic pressure and current to control the system. When it receives a control signal it retorts to System by converting the signals into mechanical motion.

An **audio power amplifier** an electronic device that is used to generate audio signals and increase its level to strong that is good enough for voice reform and home audio system.

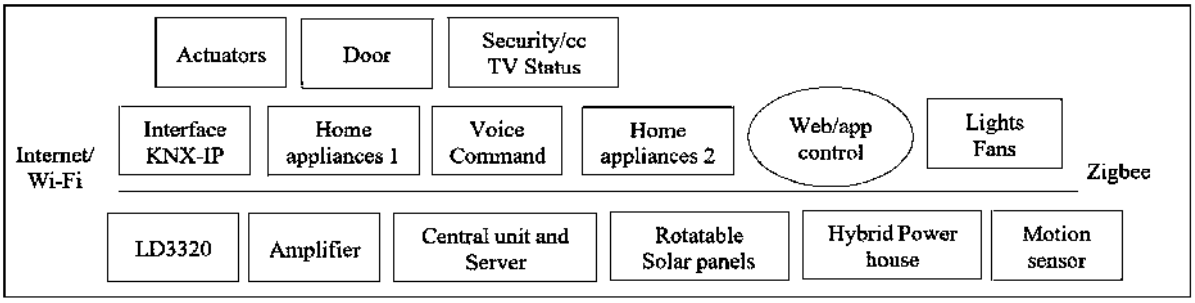

Figure 1 System architecture

A **Central Unit & Server** has the commands information and how to perform the task and to whom the task is allocated sends the signal to particular device and device performs the action consequently it stores the past commands given to it by the user in the cloud.

An **LD3320** is used to receive the commands via voice and transmits the information to the central unit from their process proceeds to action. We can also interconnect with any of the devices that are connected and allocate the task through voice commands.

WEB/APP we can also control the home by the website or by the app. We can allot the task by home. With this help, we can control the home from any part of the world.

Motion Sensor: This Sensor used to detect the motion and turn on/off the device accordingly like lights and fans.

Rotatable Solar Panels: This is new to everyone that this solar panel rotates according to the sunlight to make the maximum angle of inclination with the sun and make maximum energy.

Hybrid Power House: This stores the power that generated by the solar panels and distributes to the devices that are in the home the entire home runs on power generates by solar panels if the powerhouse is having 1000kWh then it switches to EB

Zigbee is an IEEE 802.15.1 based is used for high-level communication protocols used to creates PAN Which requires low-power and these are used in digital radio and used for data collection, and it has low data rate and more cost-effective as it has low power consumption its distance is limited.

6. CONCLUSION

This paper has shown the issues with current system state of home automation systems and a home automation system is projected using the latest communication technology ZigBee.The use of ZigBee communications technology which is less expensive and operative and This leads to the concept of the virtual home which has security and safety efforts in a clear and reliable manner The home gateway in this type of implementation provides interoperability between the local ZigBee, Wi-Fi, and the Internet. The System offers a various type of networks and devices used to access the system. Proposed system architecture has the benefits of low cost, flexible and reliable and secure system the developed system has generous support for the various devices and modes of control, monitoring, and feedback of home.

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DESIGN AND MODELING OF DIFFERENT ELEMENTS ON A DISTINCT TYPE OF MULTICOMPUTER NETWORKS, DUAL-RADIO WIRELESS HYPERMESH BASED ON SYSTEM C METHODOLOGY

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ABSTRACT: *This paper presents an original development methodology for the use of System C to compare two different networks at the system level. A single cluster of a single channel network based on CSMA and multi-channel network cluster based on non-overlapping channels available for each node have been developed. Recently, multi-radio mesh technology in wireless networks has been put under extensive research. This is because of its potential to overcome the inherent wireless multi-hop throughput, scalability and latency problems caused by the half-duplex nature of the IEEE 802.11. This paper also introduces a design and modeling of different elements on a distinct type of multicomputer networks, the dual-radio wireless hypermesh, based on System C methodology.*

Key Words: *dual-radio wireless hypermesh, multicomputer networks, wsn*

I. INTRODUCTION

The goal of the topological design of a computer communication network is to achieve a specified performance at a minimal cost. A reasonable approach is to start with a potential network topology and see if it satisfies the connectivity and delay constraints. If not, the starting network topology is subjected to a small modification yielding a slightly different network, which is now checked to see if it is better. If a better network is found, it is used as the base for more network configurations. If the network resulting from the modification is not better, the original network is modified or reconfigured in some other way. The traditional ways of network designing mainly depend on experience. However, the ways that simply depend on experience to design networks cannot keep up with the development step of new systems. Moreover, traditional design methodologies increasingly fail to handle such reasoning in a cost- and time-effective manner, when product time-to-market is the key to success.

One of the most promising solutions to this problem are system-level modeling and simulation for instance System C methodology which is covered in this work. My methodology reveals that based on the popular System C design methodology fast simulation and an excellent path to implementation with potential reuse for different implementation blocks can be easily done. Another important application of System C modeling techniques is to perform meaningful comparative studies of different protocols, or new implementations to determine which communication scenario performs better and the ability to modify models to test system sensitivity and tune performance. The drawback is that models of well-known protocols have to be completely rewritten in the system description language together with models of nodes outside the design scope.

CHANNEL MODULE REFINEMENT

The channel module developed is initially refined in section to support contention and non-contention based wireless communication. Moreover, it will support different noise and corrupting methods. The initial results conducted in section shows that the packet transfer delay requires additional clock cycles to cross the communication medium. To reduce the number of communication cycles a packet can take to cross the communication medium, the communication medium needs further refinement. This refinement can be done using one of distinct capabilities and features of System C. System C has custom hierarchical channels mechanism. Hierarchical Channels are intended to model quite complex behaviors such as PC WE Express,

Hyper Transport, or Advanced Microcontroller Bus Architecture (AMBA). Hierarchical channels and the interface concept forward a very powerful refinement strategy. It is easy to replace a channel with another one; they only have to share the same interfaces.

Primitive channels, which were used in my initial implementation phase, on the other hand are intended to provide very simple and fast communications. (e.g., sc_signal provide a piece of wire behavior). To build complex system level models, System C defines hierarchical channels as modules that implement one or more interfaces, and serves as a container for communication functionality. An interface provides a declaration of methods for accessing a given channel. No implementations or data are provided in a System C interface. In sc_signal, for example, the interfaces are defined by two classes sc_signal_in_if and sc_signal_out_if, and these define methods (e.g., read () and write ()).

Separating the definition of an interface from its methods implementation, System C has a unique coding style in which communication is separated from behavior, a key feature to facilitate refinement from one level of abstraction to another. Channels in System C create connections between module ports allowing modules to communicate. Figure 1 shows a System C hierarchical channel representation. A port acts as an agent that forwards method calls up to the channel on behalf of the calling module.

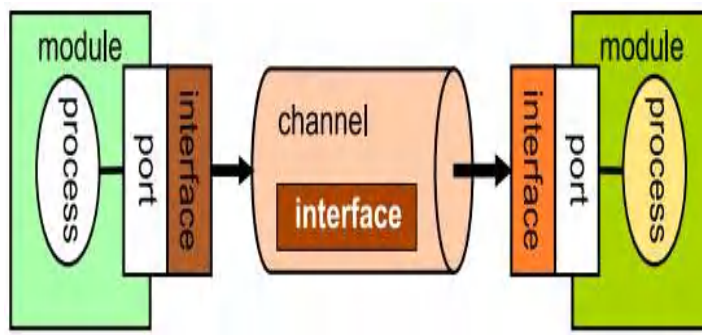

Figure 1: Hierarchical channels representation

Hierarchical channels are implemented as modules in System C: in fact, they are derived from sc_module. Primitive channels have their own base class, sc_prim_channel. This section will show only the implementation of the hierarchical channel model used in this work. Figure 2 shows the communication medium refinement process done in System C.

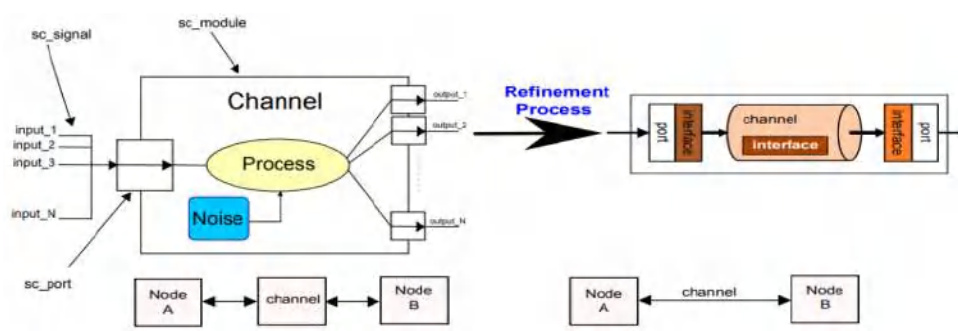

Figure 2: Channel refinement process

II. SHARED CHANNEL NETWORK MODEL ANALYTICAL MODEL

WE consider the shared channel network model developed is to provide an analytical model of the results obtained from the developed System C model. It has been developed and the performance properties are investigated for a number of configurations of the system parameters (e.g., packet sizes, number of nodes). The node structure for this configuration is further shown in figure 3.

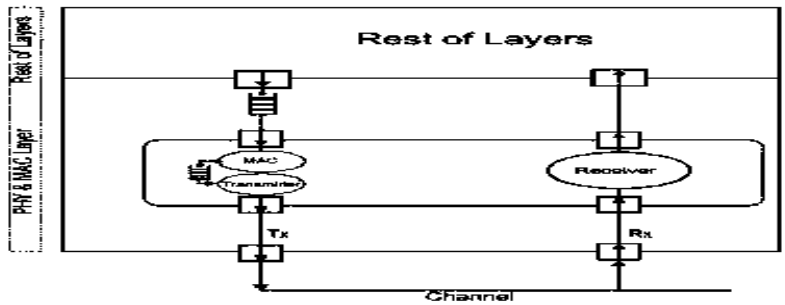

Figure 3: Node structure in a one-dimensional single shared channel cluster

For modeling-based approaches to be effective, it is important to understand how well the analytical models are able to capture the performance as seen in simulation model, which will provide a solid model for a future development. With this in mind, in this section we provide some preliminary results on a comparison of analytical model predictions with System C model performance results on simple shared communication medium network. In my model we do not consider channel errors and packet retransmissions. However, we focused on contention model in single-hop wireless network model.

Delay Analysis for a Noiseless Channel

The latency or the packet delay T using results from M/M/1 queuing theory can be computed. This system has a Poisson input (with an average arrival rate λ) and the average service time is $\bar{T} = 1/\mu$.

The expected number of entries in the queue is given by

$$\bar{N} = \frac{\rho}{1-\rho} = \frac{\lambda}{\mu - \lambda}.$$

With variance

$$\sigma_N^2 = \frac{\rho}{(1-\rho)^2}$$

Using Little's result, which relates the average number in the system to the average arrival rate and the average time spent in the system, namely $\bar{N} = \lambda \bar{T}w$, we can obtain Tw, the expected waiting time as follows:

$$T_w = \frac{\bar{N}}{\lambda}$$

$$T_w = \left(\frac{\rho}{1-\rho}\right)\left(\frac{1}{\lambda}\right)$$

When channels are error free, each nodal delay becomes similar to the system delay of an M/M/1 queuing system. So we have

$$T_w = \frac{1/\mu}{1-\rho}$$

Using $\rho = \lambda/\mu$, we get the latency for a shared communication medium as:

$$L = \frac{T}{1 - n\gamma T}$$

III. Results of shared channel network

The SystemC model has been compared against the M/M/1 queuing model that mimics the behaviour of a shared communication channel as a single queue with multiple inputs at the phit level. The x-axis in the figures represents the rate at which a node injects packets into the network in packets per cycle. The y-axis gives the mean packet latency to cross the network. The statistics gathering was inhibited for the first 3000 packets to avoid distortions due to the initial start-up conditions. The simulation stops when it reaches the accuracy required, which is set to be 0.05 relative half width, i.e., a confidence limit of 95%.

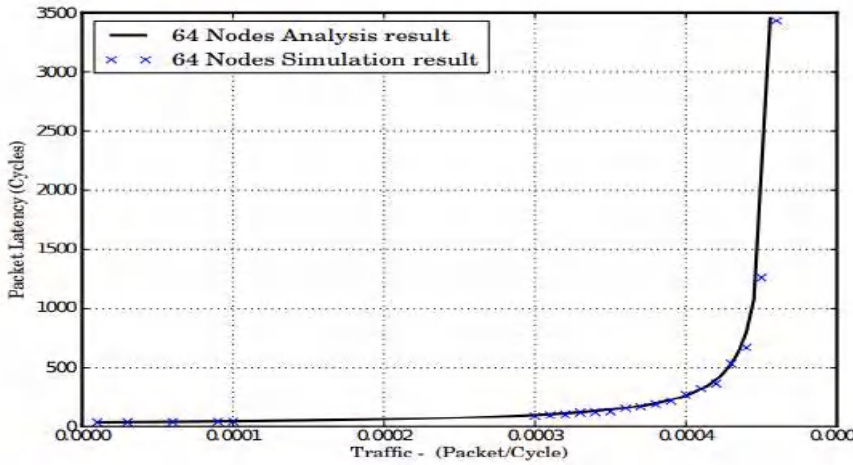

Figure 4: Latency vs. throughput of 64 nodes with packet size of 34 phits

Numerous experiments have been performed for several combinations of network sizes, packet lengths to get a good agreement between the models. However, for the sake of specific illustration Figure 4 and Figure 5 depict latency results for 64 nodes and 144 nodes network model. The figures reveal that in all cases, the analytical model predicts the mean packet latency with a good degree of accuracy in the all network regions, i.e., in the steady state region, heavy traffic region and in the saturation region. In addition, as shown in Figure 6 that the network saturates earlier as the number of nodes increase. This is due to the increase in channel acquisition time due to the contention on accessing the medium.

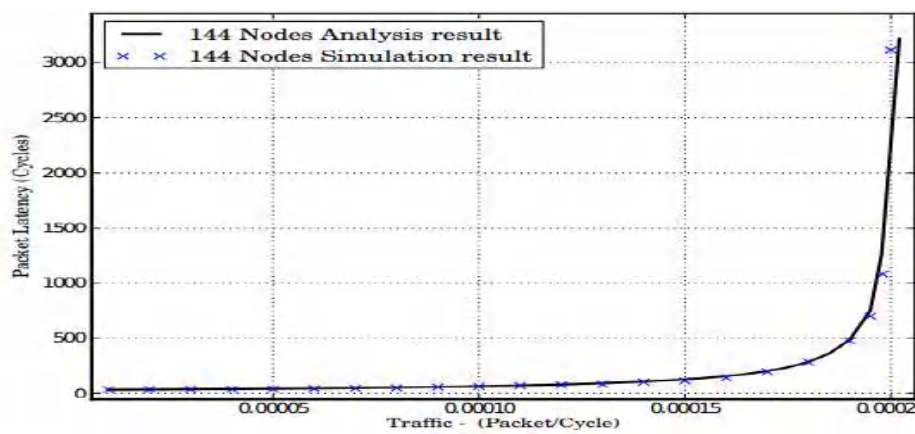

Figure 5 : Latency vs. throughput of 144 nodes with packet size of 34 phits

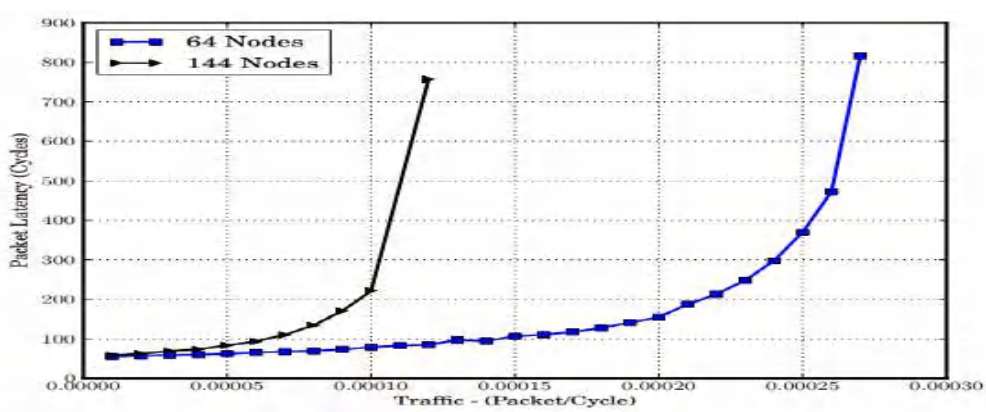

Figure 6: Latency vs. throughput for 64 and 144 nodes with a packet size of 54 phits

IV. ONE-DIMENSIONAL MULTIPLE CHANNELS NETWORK

The shared medium is no more a single channel but a group of channels. Full connection of the nodes to all the channels is performed, both for transmission and for reception. The one-dimensional multiple channels network cluster has been proposed is depicted in Figure 7. Their proposed configuration is known as the Distributed Crossbar Switch Hypermesh (DCSH). This configuration is from the hypergraph type of networks. The basic structure consisting of N nodes connected by unidirectional and not shared channels. Every node has its own channel that connects it to the other (N-1) nodes in the cluster. These multiple channels do not suffer the performance penalties associated with contention based single channel structure. In addition, this structure will contribute to maximise throughput and to minimise latency. According to Old-Khaoua et al. their architecture proposal also offers scalability. More network capacity is easily obtained by increasing the number of channels; however the receiver realisation should be modified to admit more channels.

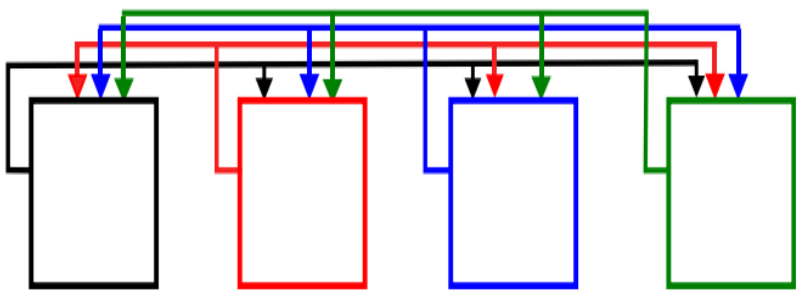

Figure 7: One-dimensional multiple channels network cluster

Figure 8 shows the node structure in a one-dimensional multiple channels cluster. The node structure is also similar to that of the shared communication channel. Except that there are (k-1) inputs in a one-dimensional multiple channels and one output channel. For simplicity only the difference from the shared channel node structure that has been presented, is shown here.

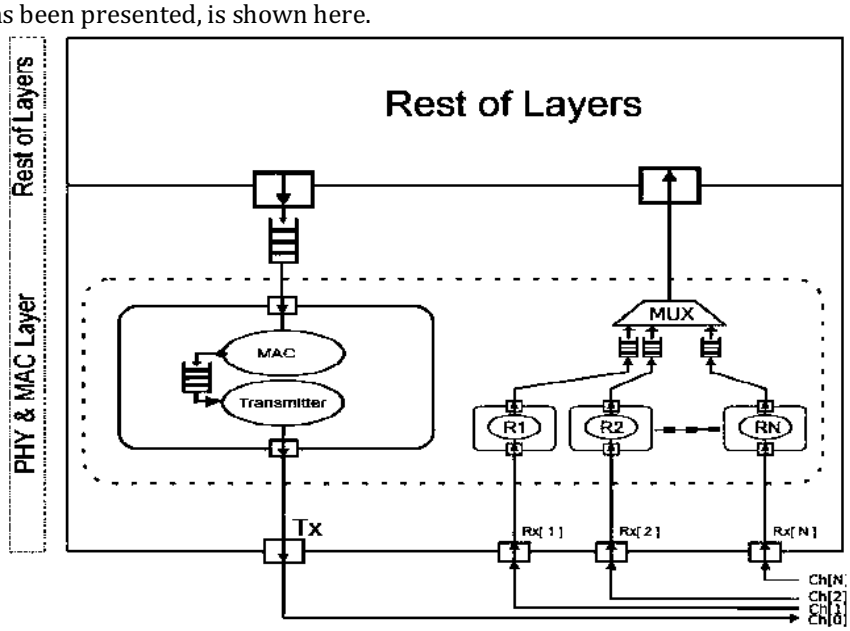

Figure 8: Node structure in a one-dimensional multiple channels cluster

Buffers are provided at both inputs and outputs of the PHY layer. There is one (N-1)-to-1 multiplexer per cluster. An input queue consists of a packet buffer, each of which has enough storage to temporarily hold a few numbers of packets. This multiplexer is to prevent a contention, if multiple packets arrive at the same time to the multiplexer and find it busy

Results of one-dimensional multiple channels network

Figure 9 shows the relationship between the offered traffic load and the latency. The horizontal axis in the figures shows the traffic in Packets/Cycls while the vertical axis shows the mean packet latency to cross the

network from source to destination. Packet length is 34 symbols or phits. This packet sizes were chosen to represent a short size packet, and have been used in similar studies. The network comparisons take in to account the bisection width of the network. As described the bisection width across a cluster in DCSH with is givin by

$$B_{DCSH} = NW_{DCSH}$$

To compare the results of the two networks the bisection width is held constant for both networks, the channel width of the first and second DCSH networks are given by

$$B_{DCSH1} = N_1 W_{DCSH1}$$

$$B_{DCSH2} = N_2 W_{DCSH2}$$

If the bisection width is held constant for both networks then we have

$$W_{DCSH2} = \frac{N_1}{N_2} W_{DCSH1}$$

The figure reveals that in all cases for small and large networks the network saturates at different points. Because the network under test has different network sizes. Moreover, the figure shows that as the network size increase the network latency is becoming higher at low traffic rates. This is due to the small channel widths as the network become large.

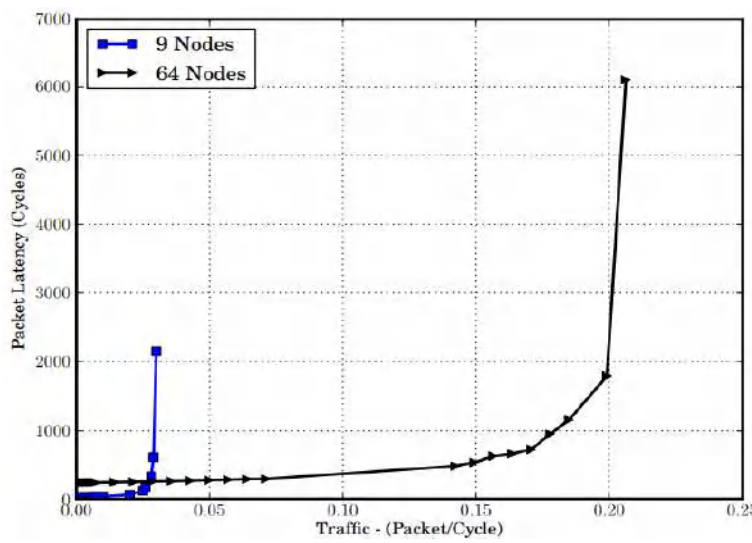

Figure 9: Latency versus Traffic rate for 9and 64 nodes 1D multichannel network model.

V. PERFORMANCE COMPARISON

Performance comparison of any interconnection network should take into account implementation costs to give a meaningful evaluation. Several criteria have been proposed in the literature to make fair comparison between networks of fixed cost including chip pin-out and wiring density. Bisection width as a measure of network cost has been used and other researchers thereafter to account for wiring density. However, we use in my discussions the term channel to refer to a link as a wireless channel. The bisection width of a network is the minimum number of channels cut when the network is divided into two equal halves. One way to approximate the channel density of a network is the calculation of the bisection width. The bisection width across a cluster in Bus and DCSH with a channel width of WBus, WDCSH, respectively, are given by

$$B_{Bus} = W_{Bus}$$

$$B_{DCSH} = NW_{DCSH}$$

If the bisection width is held constant for both networks, the channel width of the DCSH in terms of shared media (Bus) channel is given by

$$W_{DCSH} = \frac{1}{N} W_{Bus}$$

For illustration we will use network sizes of 64 and a packet size of 34 phits, typical figures which has been used but the results shown in figure 10 are applicable across other network sizes and packet lengths.

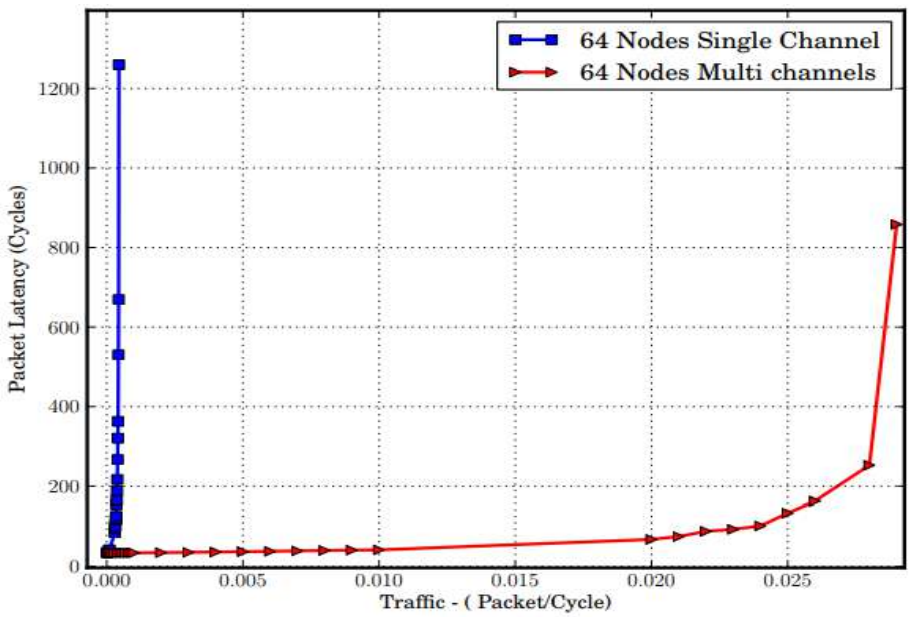

Figure 10: Latency comparison for 64 nodes network model

VI. DUAL-RADIOS HYPERMESH NETWORK BASED ON CSMA PROTOCOL

The hepermesh is a well-known topology that belongs to the hypergraph family of networks. Hypermeshes have been proposed as potential alternatives to the graph networks for the future System Area Networks. In this work, we consider a two dimensional dual-radio wireless hypermesh network, where each router node is equipped with two radio interfaces and two non-overlapping channels are available for each node. We address the problem of assigning channels to communication links in the network with the objective of keeping overall network latency low and provide a relatively high throughput.

The simulations and analysis have shown that my design achieves a significant increase in network throughput with less average network latency for large number of communication nodes, compared with the CSMA shared channel model, which is currently the de facto MAC protocol for most wireless networks. My simulations have been validated analytically to show the accuracy of the developed model. In addition, simulation results have shown that the wireless hypermesh outperforms shared medium wireless networks under the constant total bandwidth argument, especially in large networks.

The increasing demand for high performance computing from the military and research centers in industry and academia for the simulation of complex problems makes SANs a very interesting research area. SANs are Hardware/Software systems designed to perform specific applications in which network communications are essential. For this reason, their processing functionality is strictly connected with communication functionality. Typically, the processing part is implemented through CPU, memory, and application-specific components; the communication part is implemented through HW components (e.g., network interface and wired or wireless links) and SW components (e.g., the protocol stack). The design of SANs is the context of this thesis. It requires the capability of modeling and simulating both their behaviour/architecture and the complex communication environment in which SANs operate.

The success of Large SANs for multicomputer networks is highly dependent on the design and the efficiency of the interconnection network used. Interconnection network is constructed normally from routers, switches and channels. It provides the means by which the information is transferred between nodes. The design and implementation of a communication network for applications such as scientific computing research applications, for instance, fluid dynamics or finite element methods, modeling of nuclear

explosions, climate modeling, and others has a direct impact on the cost and performance of the whole system.

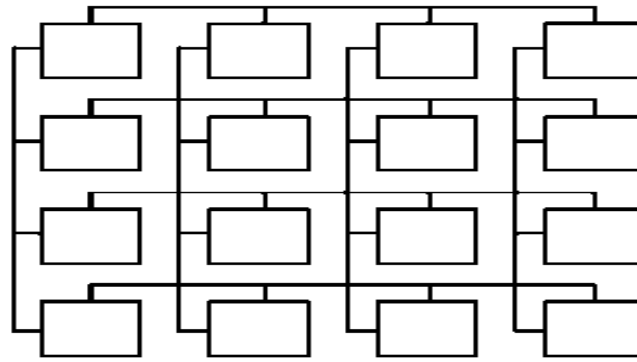

Figure 11: A two-dimensional hypermesh

There are several network architectures and topologies for implementing interconnection networks have been introduced in literature to use an interconnection networks with mixed level of success. Some of the most important networks are: Fully connected or all-to-all, a Circular Ring, a Star, a Binary tree, Mesh (Torus), Hypermeshes, or even Random networks. Most of the above mentioned interconnections are designed to implement wired networks, which can have more applications in a wireless sensors network. Recently hypermeshes have been shown to be a good promising candidate for interconnection networks of parallel systems. Hypermeshes have desirable features over other interconnection networks such as a low diameter, high bandwidth, and low latency network. Those advantages make the hypermeshes to embed naturally a wide range of communication patterns. A number of different hypermesh implementations have been suggested in the literature including shared buses, crossbar switches, and distributed crossbar switch with different implementation technologies, costs and constraints. Figure 11 shows a typical example of a hypermesh implementation, which is the spanning bus hypercube (SBH) proposed. And it has been further studied. In their introduced model nodes in a given dimension are connected together with a shared bus. A bus in the SBH is time multiplexed among the cluster nodes, which is not suitable for a large number of wirelessly communicating nodes.

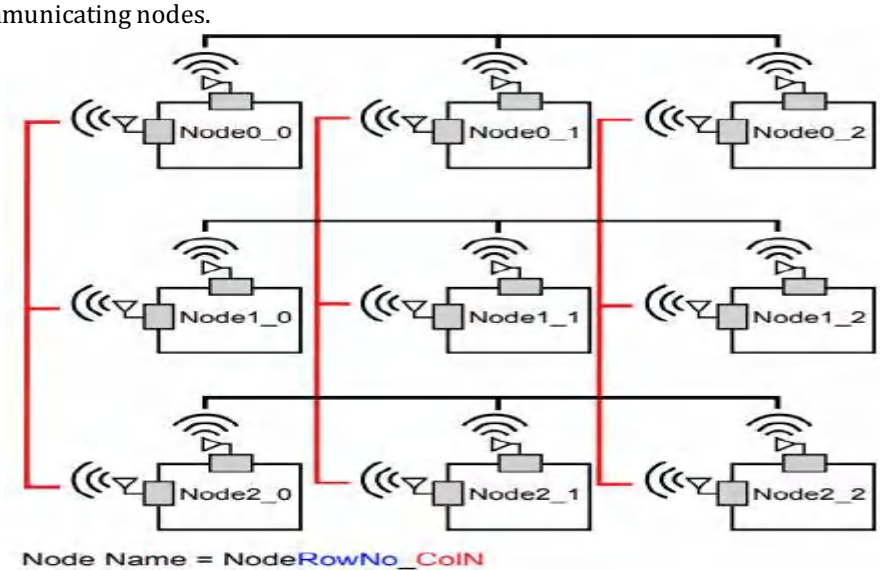

Figure 12: Dual-Radio Hypermesh Topology

VII. DESIGN AND IMPLEMENTATION

When two or more radio interfaces are placed on a node, we are faced with a number of choices as to the way they are interconnected. Two main alternatives are bridging at the link layer and connecting the interfaces at the network layer. While bridging at the link-layer may be acceptable in a wired network, in its wireless counterpart traffic unnecessarily relayed can significantly degrade performance. In this work, we

adopted a more generic solution by connecting the interfaces at the routing level. The individual PHYs act as separate entities with different addresses for routing purposes. In this section, we further expand on this design and describe my implementation of a dual-interface node in System C. The communication nodes are the main construction units of the network system, which will communicate with each other through the underlying interconnection network. The nodes of the network are modeled as modules with different methods, which will reflect the application, network and DLC and PHY of the standard reference model of an OSI/ISO. Each node interacts with the network to send or receive data packets. Each node is assumed to have two baseband transmitters and receivers for communication with other network nodes as shown in Figure 13.

The two-dimensional node structures have been modeled by adding the necessary components to the one-dimensional model. By adding a network layer for routing and switching data packets and another PHY layer for transmission of data packets to the second dimension the hypermesh node has been constructed. Throughout the analysis and simulation, the following assumptions have been made.

Traffic generated by nodes independently of each other, and follows a Poisson process of a mean rate λ (packets/cycle). Furthermore destinations are chosen randomly and independently. This assumption is widely used in the literature as it greatly simplifies the analysis.

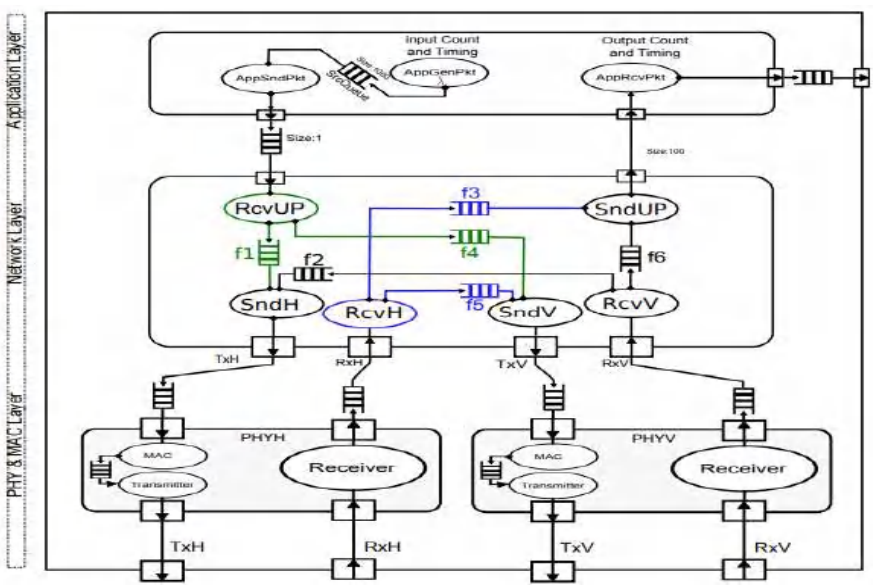

Figure 13: Two-Dimensional model of the communication node

- All packets generated are of equal length, M phits, each of which requires M-cycle transmission time.
- Packet destinations are uniformly distributed across the network unless specified otherwise. Although many network evaluation studies make this simplifying assumption, it is rarely true in practice.
- Routing is restricted; packets are transmitted between routers using packet switching (store-and-forward). Dimension-ordered routing, where packets visit network dimensions in a strict order (it is assumed here that dimensions are visited in a decreasing order), is sufficient to avoid packet deadlock.
- Balanced network to avoid complexity in my analysis and in my proposed topology this assumption is easily realizable. A network is said to be balanced if the utilization factor of all of its channels is the same.
- Packet queues are assumed to have infinite capacity. This assumption has been shown to be realistic under uniform traffic.
- Negligible channel propagation delay

VIII. RESULTS AND PERFORMANCE COMPARISON

A performance comparison has been carried out between the two-dimensional wireless hypermesh to the shared communication medium for a fixed size N and equal implementation cost. Each channel entering a node has a bandwidth of W bits/Cycle. All packets generated are of equal length, M phits, each of which requires one-cycle to be transmitted. A packet length M phits is broken into B = M × W phits, each of which contains W bits. Implementation cost should be taken into account to compare different network

configuration to give a meaningful evaluation of the network performance. There are several measures have been proposed in the literature to make fair comparison between networks of fixed cost including pin-out and wiring density.

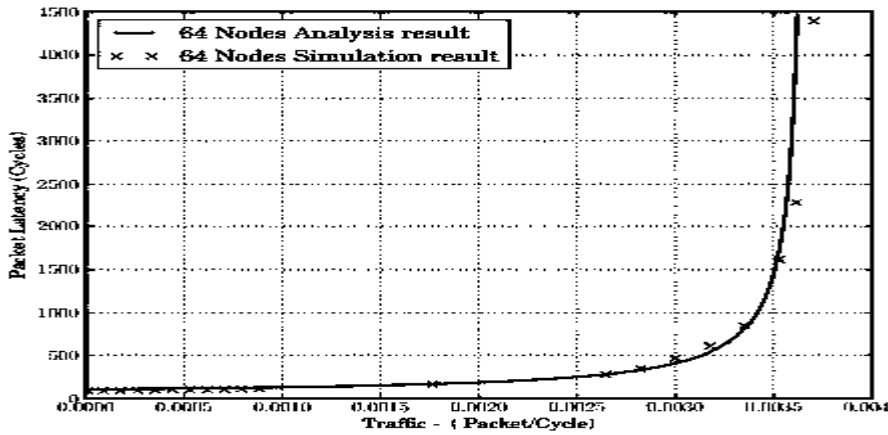

Figure 14: Latency vs traffic for 2D Hypermesh for 64 nodes

Under a constant pin-out argument the total bandwidth entering a node is the same for both networks under comparison. As described in section, to approximate the channels density of a network is the calculation of the bisection width. The bisection width across a cluster in Bus and SBH with a channel width of WBus, WSBH, respectively, are given by

$$B_{Bus} = W_{Bus}$$

$$B_{SBH} = \frac{N}{k} W_{SBH}$$

If the bisection width is held constant for both networks, the channel width of the SBH in terms of shared media (Bus) channel is given by

$$W_{SBH} = \frac{k}{N} W_{Bus}$$

Figure 14 and Figure 15 respectively compare the network latency predicted by our model, and through simulation for 64 and 144 network nodes.

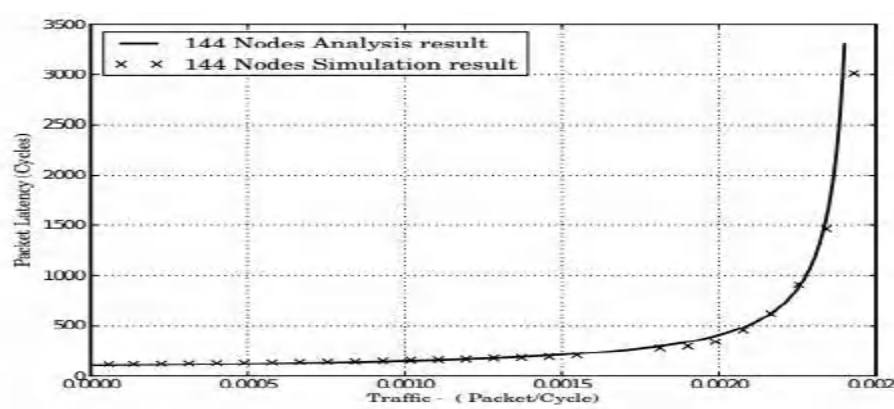

Figure 15: Latency vs traffic for 2D Hypermesh for 144 nodes

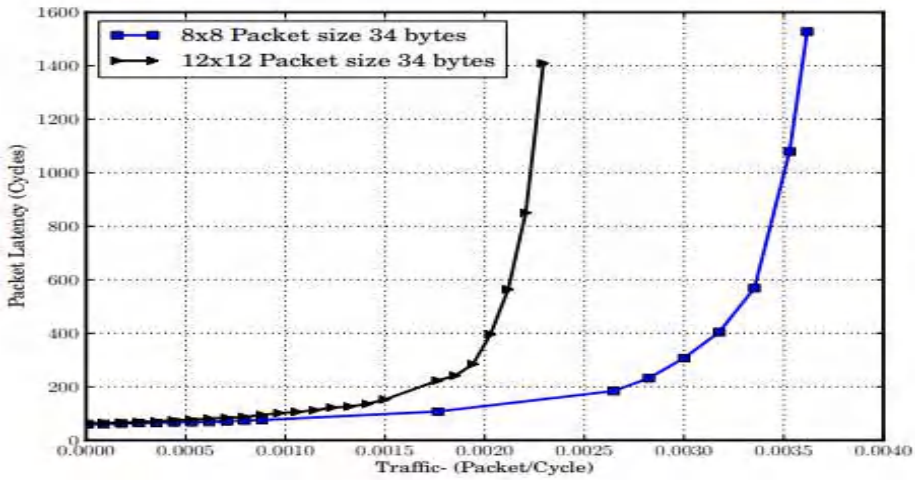

Figure 16: Latency vs traffic for 2D Hypermesh for 64 and 144 nodes

To mimic the Hypermesh and make the comparison with the shared medium network the following simulation sitting have been used:
Number of nodes N = 144 node.
Packet size for both networks is (34 Symbols each of which is 8 bits)
Number of channels in the hypermesh is C = we + j = 12 + 12 = 24 channel, where we and j is the number of channels in each dimension we = j = 12

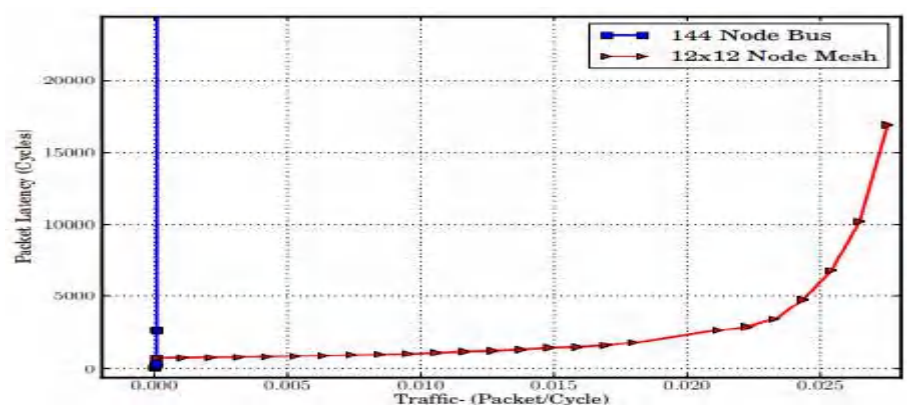

Figure 17: Latency vs traffic for 2D and 1D Hypermesh

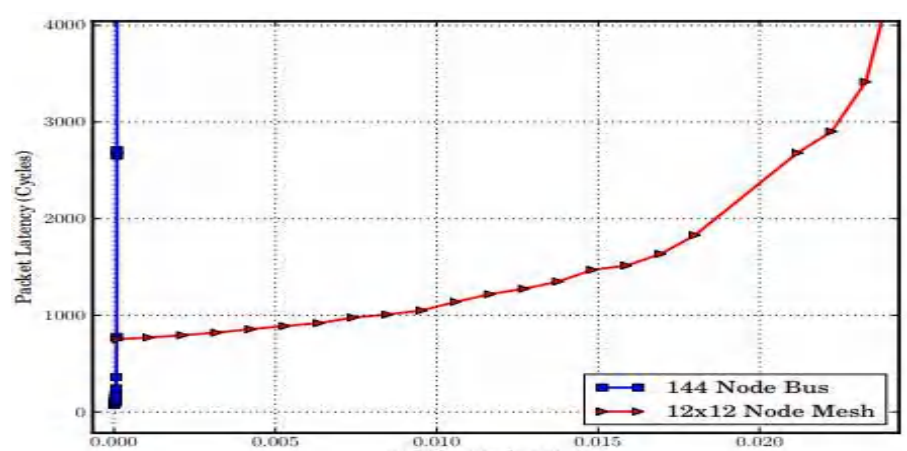

Figure 18: For clarity the same graph but with different scale shows the latency vs traffic for 2D and 1D Hypermesh

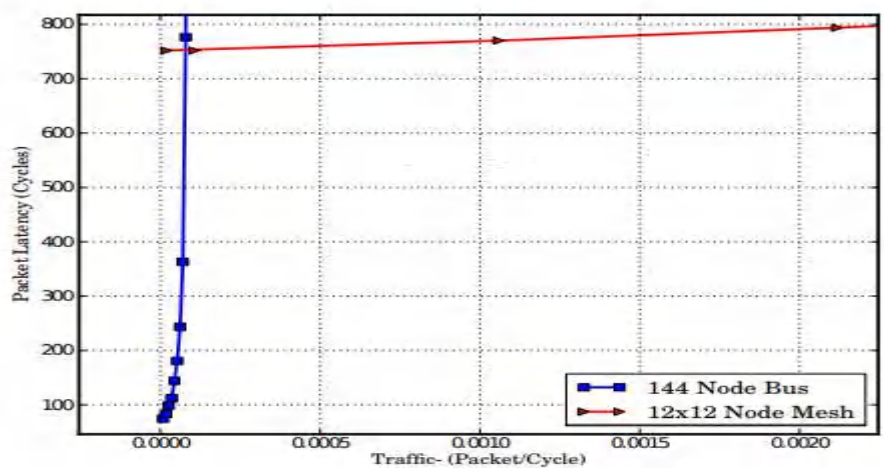

Figure 19: For clarity the same graph but with extra zoom on the crossing point of the curves.

We again note that these results were obtained without introducing noise into the communication channels of the system. Although the SystemC model is designed so that random noise and signal fading can be easily introduced and we showed results of the introduction of such noise provides a detailed noise analysis of multichannel and DRWH systems is outside the scope of this thesis. However it is important to have some indication of the type and magnitude of the effects of noise upon such systems. The prime effect of such noise is to increase both the traffic in a system, and the latency, due to the need for data re-transmission events. The effect of noise due to multipath transmission was estimated at between 20-30dB. As a worked example, considering equations 2.8-2.11, if the communication links were set to a bit error rate of 1/100, signal fading of 20dB in the noisy environment would raise the bit error rate to ¼. Assuming hardware error correction led to an equivalent change in packet loss from 1% to 25% and each packet re-transmission took twice the latency of the original transmission (assuming a message returned to the transmitter, but minimal computational cost) then the overall packet latency would increase by 50%, with a commensurate increase in network congestion. These noise induced increases in latency and network congestion are not trivial, and emphasize the need for networks, like the DRWH, which are robust in the face of high congestion, to be used.

IX. CONCLUSION

In this paper we addressed the performance comparison of contention based wireless networks, and Multi-channel network, using System C design methodology. For this purpose, we developed a conceptual model of the communication node of the multichannel network based on my previous node architecture and the communication channel which was introduced and compared my findings analytically and by appropriate simulations. This paper has investigated the relative performance merit of the two different implementations. The results have revealed that the multi-channel network has superior performance characteristics over the shared communication network.

Simulation results have shown that the wireless hypermesh outperform shared medium wireless networks under the constant total bandwidth argument, especially in large networks. In addition to the simulation results, the performance improvements have been compared against theory.

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Indoor Air Quality Considerations for HVAC Systems Design in India

Raza Ahmed Khan, Dr. Kavita Daryani Rao, Dr. M. Manzoor Hussain, Dr. S. Kumar

Abstract— The performance and design of Heating, Ventilation, and Air-Conditioning (HVAC) Systems decides the soundness of Indoor Air Quality (IAQ) to a large extent. Almost all modern buildings are air-conditioned and a huge number of occupants spend considerable time inside these buildings. Hence, the goodness of indoor air is vital to their health and productivity. In this study, a research questionnaire survey is carried out for the HVAC designers to obtain information regarding their design practices in India. A large number of HVAC designers and offices were contacted and explained about the study. However, 52 HVAC designers / offices participated from across the country. Their responses were recorded and analyzed to build up a picture of the prevalent HVAC design practices in India.

Index Terms— Heating, Ventilation, & Air-Conditioning (HVAC); HVAC Designers; HVAC Systems; Indoor Air Quality (IAQ); Questionnaire Survey; Standards.

1 Introduction

THE economic liberalization policy and subsequent entry of multi-national companies in Indian market resulted in sprouting of many advanced air-tight glazed buildings .throughout major cities of the country. All these modern buildings employ air-conditioners to control their indoor environments.

Now people spend most of their time indoors, where the concentration of pollutants are often much higher than those outside. Hundreds of chemical and biological pollutants are found indoors, many of which are known to have significant health impacts. Many research findings have highlighted the indoor environmental pollution as the greatest risks to human health [1].

The Heating, Ventilation, and Air-Conditioning (HVAC) design offices are the places where decisions on the performance of the buildings are first taken, either good or bad. It is therefore essential to know the design criteria that these designers take into account for Indoor Air Quality (IAQ) issues.

2 Methodology

The research methodology adopted for the investigation of IAQ problems that are related to HVAC systems is through gathering the required information from the feedback of HVAC designers. Self-administered questionnaire surveys (see Appendix) and personal interviews with the designers were carried out which provided useful information.

An extensive literature review was done to acquire the in-depth understanding of the issues related to IAQ and HVAC systems, which was helpful in formulating the questionnaire in particular.

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The questionnaire is developed seeking information regarding the experience and design practices of HVAC design professionals in India. The designers were introduced to the objectives of the study, its scope and the usefulness of its results. Several aspects of design and compliance with guidelines and standards were also discussed during personal meetings. The architectural and engineering plans of some of the sample buildings were reviewed wherever possible, to have an insight into the design practices.

Various manufacturers and suppliers of HVAC systems were contacted, and information obtained about the range of HVAC products in the Indian market. Useful information and product information brochures were downloaded from the manufacturer's website

The information thus gathered from the HVAC designer's feedback, manufacturers and suppliers was useful in identifying the design criteria, standards followed, most common types of HVAC systems and products that are employed in commercial and office buildings.

It was encouraging to observe that many designers appreciated the objectives of the study and actively participated. However, some designers could not respond due to their job engagements. More than 100 designers were contacted personally and over e-mail throughout the country for the questionnaire survey. They were requested to either fill it on-line on "google forms" or on paper sheets [2]. A total of 58 HVAC designers responded by filling the questionnaire both on-line and on papers.

3 Questionnaire Analysis

The questionnaire for HVAC designers was developed and administered with the aim of obtaining information on the following aspects of design practice:

(a) General information like the years of experience, types of HVAC systems designed, their manufacturers, etc.
(b) The criteria for design and selection of HVAC products and their manufacturers
(c) The range of temperature and relative humidity for designing commercial and office buildings in India

(d) The rates of ventilation and fresh air intakes
(e) Common choices of filters, location and types of duct insulation

The response to this questionnaire was used to build up a picture of the prevalent design practices in India. Data analysis and discussion of this questionnaire are discussed in the subsequent sections.

3.1 Background Information

Most of the HVAC designers, who were contacted, were senior professionals having sound experience in designing HVAC systems in different building types. Out of the 58 HVAC designers who responded, around 41% of respondents possess more than 10 years of experience, 19% possess between 5-10 years of experience, another 19% has 2-5 years of experience, and 21% are relatively freshers with less than 2 years of designing experience. It is interesting to note that 60% of respondents have more than 5 years of working experience and about 59% have less than 10 years of field experience. It indicates that the respondents are well experienced and that the HVAC field has emerged in the past 10 years in India.

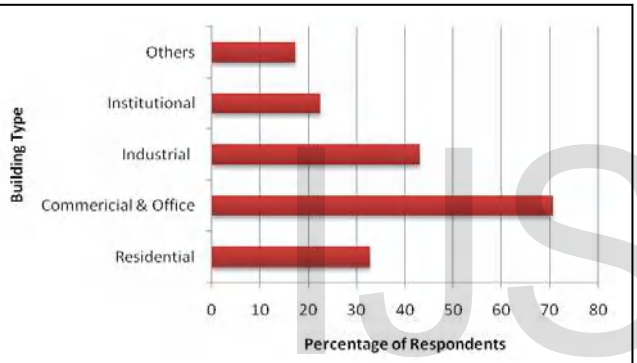

Fig.1. Types of buildings designed by surveyed designers

As per the feedback received from the designers, about 71% of them deal with the design of HVAC systems in commercial and office buildings as shown in Fig.1. Other building types that they design include industrial buildings (about 43%), residential buildings (about 33%) and institutional buildings (about 22%). 17% of the designers also deal with the design of other buildings like hotels and hospitals.

3.2 HVAC Systems Design and Selection

A large variety of HVAC systems are available for commercial and office buildings in India. These systems differ according to the size of the building, occupant activities, building age, climatic conditions, geographic location and so on.

According to the Indian designers, the most frequently used HVAC system for commercial and office buildings is the chilled water system with Air Handling Units (AHUs) as shown in Fig.2. 77% of respondents prefer to use chilled water system with 74% using AHUs and 53% opting for Fan Coil Units (FCUs). It is however, interesting to note that about 60% of HVAC designers are utilizing the Varible Refrigerant Flow (VRF) systems. The split systems are used by 46% of respondents where as 44% employ rooftop packaged units, followed by Variable Air Volume (VAV) systems at 37%. The split systems are available in the variants of ducted and non-ducted.

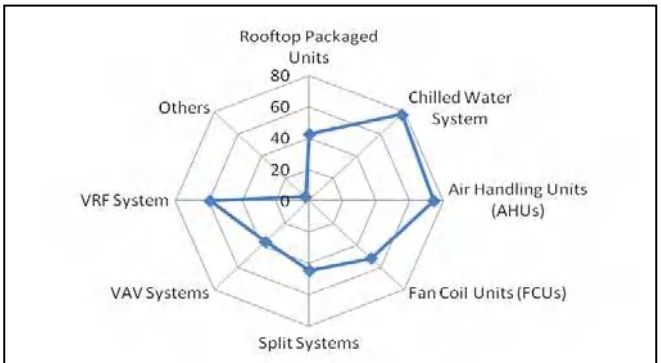

Fig.2. Most common HVAC systems used in commercial and office buildings in India.

There are more than a dozen HVAC system manufacturers available in the Indian market which caters to the commercial and office building sector. The popular manufacturers among the HVAC designers are Carrier (70%), Blue Star (52%), Daikin (44%), Voltas (39%) and Trane (30%) as shown in Fig.3. The other manufacturers like Kirloskar (17%) and LG (15%) are popular in other sectors like industrial and residential buildings. There are few other trade names that are recommended by about 11% of respondents.

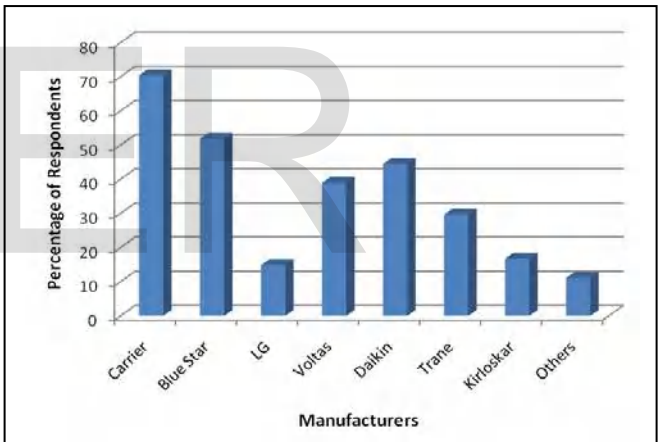

Fig.3. Most common manufacturers of HVAC systems in commercial and office buildings in India.

According to the HVAC designers, the most important criteria for the selection of these manufacturers is their good experience with the product, with about 72% of the respondents indicating this aspect. 40% of the designers have pointed out that the manufacturers are usually specified by the building owners. About 28% respondents have expressed that local weather conditions dictate the choice of manufacturers, where as 19% designers say that availability of product in the market is crucial to this decision.

The main criterion for designing and selecting the HVAC system in commercial and office building is to provide good IAQ to building occupants. This was indicated by about 78% of respondents. 72% designers also expressed that the next important criterion is the energy conservation, and 67% have marked that providing the thermal comfort in office spaces is crucial to productivity.

3.3 Indoor Conditions and Ventilation Design

ASHRAE Standard 55-2013: Thermal Environmental Conditions for Human Occupancy specifies the combinations of indoor thermal environmental factors and personal factors that will produce thermal environmental conditions acceptable to a majority of the occupants within the space [3]. The standard addresses the four primary environmental factors (temperature, thermal radiation, humidity, and air speed) and two personal factors (activity and clothing) that affect thermal comfort.

The HVAC designer anticipates based on owner's feedback, the occupant activity and equipment, which may reject heat into the space prior to calculating the heating loads.

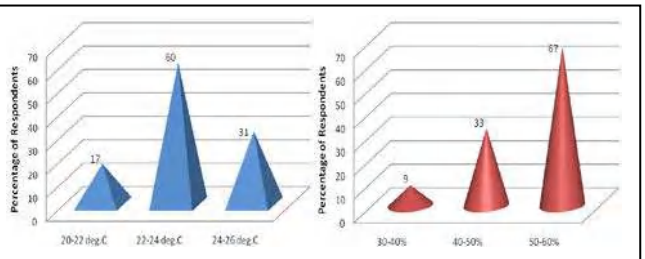

Fig.4. Design range practices for indoor temperature and relative humidity

The most common range of indoor temperature that the HVAC designers normally design for commercial and office buildings in India is 22^{0}C to 24^{0}C as shown in Fig.4. About 60% of designers normally design in this range, whereas 31% design in the range of 24^{0}C to 26^{0}C and 17% in the range of 20^{0}C to 22^{0}C. These values are within the acceptable range as ASHRAE Standard 55 recommends that the temperature in occupied spaces be maintained between 21^{0}C to 26^{0}C (70^{0}F to 78^{0}F).

Most designers (about 67%) specify relative humidity in the range of 50 to 60% as shown in Fig.4. 33% of respondents design in the range of 40 to 50% and only 9% desing between 30 to 40% relative humidity. These values too are within the acceptable range as ASHRAE Standard 55 recommends that the relative humidity in occupied spaces be maintained between 30 to 60 percent.

ASHRAE Standard 62.1-2013: Ventilation for Acceptable Indoor Air Quality specifies that any one of the Ventilation Rate Procedure, the IAQ Procedure, and the Natural Ventilation Procedure can be used to meet the requirements of ventilation [4].

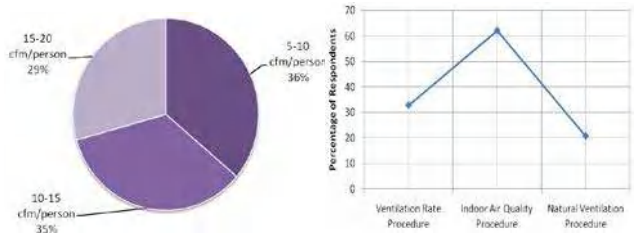

Fig.5. Design ventilation rate practices and the procedures adopted for ventilation

Ventilation air or the fresh outdoor air is a crucial aspect of HVAC designs as it controls the indoor air contamination through dilution [5]. The ventilation rates that are incorporated by different designers are as follows: 5-10 cfm/person by 36%, 10-15 cfm/person by 34%, and 15-20 cfm/person by 29% as shown in Fig.5.

All the three procedures specified by ASHRAE are practised by the Indian designers. IAQ procedure is used by about 62% of respondents, 33% refer to the Ventilation Rate procedure, and about 21% opt for the Natural Ventilation procedure as shown in Fig.5. It has to be noted that the intake airflow determined using each of these approaches may differ significantly because of assumptions about the design, any of these approaches is a valid basis for design.

3.4 HVAC System's Components Design

Proper filter selection plays an important role in the control of IAQ issues. Efficiency, resistance to air flow, and dust holding capacity are the main characteristics that distinguish different types of air filters [6]. As shown in Fig.6, about 53% of designers generally recommend bag filters for commercial and office buildings in India. About 45% specify the High Efficiency Particulate Air (HEPA) filters, 29% respondents recommend rigid aluminum filters, 28% suggest media filters, and only 7% opt for Electrostatic Air Cleaners (EAC).

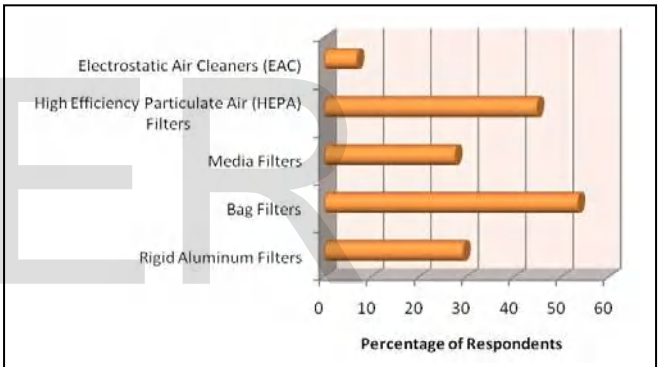

Fig.6. Most common air filters specified by HVAC designers

It is important for the HVAC designers to know the types of contaminants that are or could be present in the building environment so as to prescribe proper filter efficiency. The air filtration efficiency normally specified by designers is as follows: 48% respondents prescribe more than 90% filtration efficiency, 43% specify between 70 to 90% filtration efficiency, 12% designers recommend 60 to 70% filtration efficiency, and only 5% design for 50 to 60% filtration efficiency. It is a healthy trend to recommend high efficiency filters as they provide cleaner air and cleaner HVAC system coils, duct works, and diffusers.

In order to have better control over IAQ issues, HVAC designers must take into account the minimum maintenance requirements, equipment access and servicieability, and overall equipment reliability [7].

In response to the question on the design of coil condensation pan to ensure complete condensate drain and prevent blockage, about 93% designers indicated that they recommend U-trap connections and 17% specify P-trap connections to the condensate drain lines.

The ductwork system is one of the most important compo-

nent of the HVAC system that affects the air quality. It becomes pathway for pollutants and transports it form one place to areas throughout the building [8].

The ductworks made of Galvanized Iron (GI) sheets are popular among surveyed designers with about 93% recommending it. 14% respondents also specify aluminum duct and a minor 3% even recommends PVC ducts.

Regarding the duct insulation, fiberglass is very popular among designers with about 53% recommending it as shown in Fig.7. About 36% respondents specify EPS / styrofoam / thermocol insulation, 19% respondents recommend rockwook insulation, 17% designers specify cellulose fiber insulation, and 17% designers recommend nitrile rubber insulation.

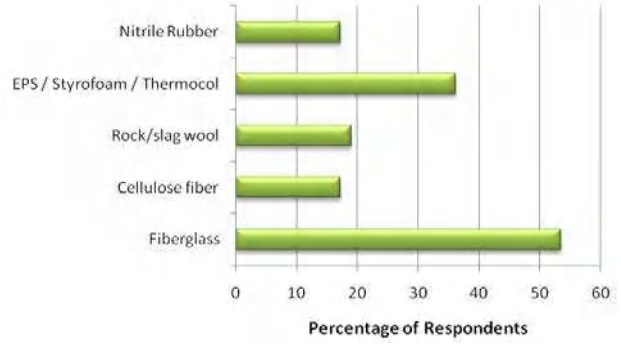

Fig.7. Types of thermal insulation used in HVAC systems

Almost 93% of designers highly recommend external insulation to duct. However, about 24% respondents specify internal insulation as acoustical lining for sound absorption. However care must be exercised for internal insulation as there is a potential for biological and mold growth in it when subjected to humid air [9].

3.5 IAQ Strategies in HVAC Design

In response to a question on separate smoking zones inside commercial and office buildings, about 60% respondents agreed that they provide such tobacco smoking zones in buildings with local exhaust. 29% designers provide such zones as per the requirements, and about 12% designers have never provided such zones in their buildings. ASHRAE recommends that 100% air in smoking lounges should be exhausted [4].

About 78% of the designers allocate local exhaust with localized contaminant generation like toilets, kitchen, labs, printers, etc. Almost 19% indicated that they design it based on the requirements or specifications of the building owners.

To compensate for the exhausted air from the building, fresh outside air is introduced into the building. It also acts as a dilution strategy for the building contaminants [10]. The surveyed HVAC designers emphasized that various considerations have to be taken into account while designing the fresh air intakes. 69% designers feel that the location of air intake is crucial, about 64% respondents are of the opinion that outdoor air quality is important, and 41% specifies proper bird screen and mesh to prevent the unwanted entry.

The HVAC designers were asked about the special components that they normally use in their designs. About 64% designers use energy recovery wheels, 36% use dehumidifiers and electric heater, 33% use humidifiers, and 9% use underfloor ducting as shown in Fig.8.

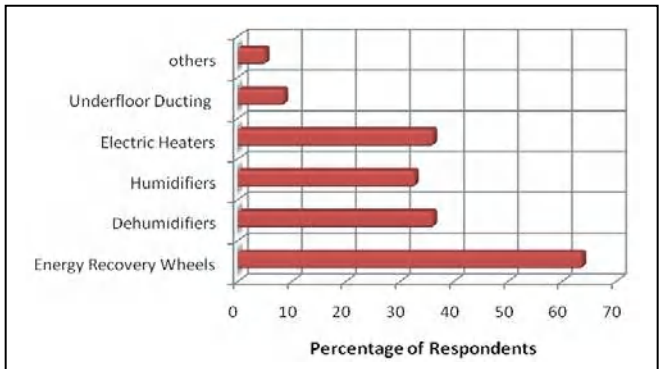

Fig.8. Special components used in HVAC designs

In response to a question on the standards that are referred while designing the HVAC systems, the designers listed out some of them. About 60% refer to the ASHRAE Standard 62 for IAQ and ISHRAE Standards, 53% refer to SMACNA Standards for ductworks, 45% refer to ASHRAE Standard 90 for Energy Conservation, 36% refer to ASHRAE Standard 55 for Thermal Comfort, 40% refer to IGBC / LEED-NC Standards for Green Buildings, and 33% refer the NFPA Standards for Fire Safety.

The HVAC designers were asked about the strategy they employ for better IAQ in commercial and office buildings. 59% designers suggested that fresh air intake is a sound strategy to improve IAQ. About 53% respondents feel that Fresh Air Handling Units (FAHUs) is a better idea for good IAQ. 34% participants opined that using high efficiency filters can enhance IAQ, while 17% believe that providing local exhaust at the source of pollutant generation is the best solution.

4 Conclusion

The responses to questionnaire represent the general HVAC design practice for commercial and office buildings in India. The chilled water system, AHUs and VRFs are the most popular HVAC systems. Providing good IAQ is the main criterion for designing and selecting these systems. All design professionals design the indoor conditions and ventilation rates as per the relevant standards. Bag filters and HEPA filters are most commonly used filters. More than 80% designers recommend use of more than 70% filtration efficiency. 93% of respondents use GI sheets for ductworks with external insulation. Fiberglass and thermocol are popular thermal insulations. 78% participants design local exhaust for local pollution sources. Fresh outside air is introduced to compensate for the exhaust air. Energy recovery wheels are being recommended by many professionals. Standards are being referred by designers, including the green building codes. The HVAC industry is expanding in India, new products are being introduced and young professionals are choosing HVAC as their careers.

APPENDIX – HVAC DESIGNER'S QUESTIONNAIRE

11. What kind of **air filters** do you generally recommend for HVAC systems (C&O Bldgs)?
☐ Rigid Aluminum Filters ☐ High Efficiency Particulate Air Filters (HEPA)
☐ Bag Filters ☐ Electrostatic Air Cleaners (EAC)
☐ Media Filters ☐ Others (specify) _____

12. What is the **air filtration efficiency** that you normally specify?
☐ >90% ☐ 70-80% ☐ 60-70% ☐ 50-60% ☐ Others (specify) _____

13. Do you take any measure during the design of **coil condensation/drain pan** to ensure complete condensate drain and prevent blockage?
☐ P-trap ☐ U-trap ☐ T-trap ☐ Others (specify) _____

14. What is the **ducting material** that you generally prescribe for air distribution system?
☐ PVC Duct ☐ GI Duct ☐ Aluminum Duct ☐ Others (specify) _____

15. What kind of **thermal insulation** you specify for the ducting system?
☐ Fiberglass ☐ EPS / Styrofoam / Thermocol
☐ Cellulose fiber ☐ Others (specify) _____
☐ Rock/slag wool

16. Which type of **insulation** you generally specify for ducts?
☐ Internal to the duct ☐ External to the duct

17. Do you normally allocate **separate areas for smoking** with local exhaust (C&O Bldgs)?
☐ Always ☐ Sometimes ☐ Never

18. Do you provide **local exhaust system** for spaces with localized contaminant generation (like kitchen, laboratories, copy machines, etc.) in C&O Bldgs?
☐ Always ☐ Sometimes ☐ Never

19. What are the considerations you take into account while designing for **fresh air intake**?
☐ Outdoor air quality ☐ Bird screens and mesh
☐ Location of air intake ☐ Others (specify) _____

20. What are the **special components** that you normally use in HVAC designs?
☐ Energy Recovery Wheels ☐ Electric Heaters
☐ Dehumidifiers ☐ Underfloor Ducting
☐ Humidifiers ☐ Others (specify) _____

21. Which **standards** you refer to while designing the HVAC Systems for C&O Bldgs?
☐ ASHRAE Standard 55 version ____ ☐ SMACNA
☐ ASHRAE Standard 62 version ____ ☐ NFPA
☐ ASHRAE Standard 90 version ____ ☐ USGBC / IGBC / LEED-NC
☐ ISHRAE Standards ☐ Others (specify) _____

22. What **strategies** do you employ for **better Indoor Air Quality** (C&O Bldgs)?
☐ Fresh Air Intake ☐ Fresh Air Handling Units (FAHU)
☐ Local Exhaust at Source of Generation ☐ Others (specify) _____
☐ High Efficiency Filters

Additional Comments: _____

Thank you for participating in this study. We appreciate your efforts and time spent to make this research more meaningful. We strongly encourage you to kindly provide the following details (optional):

HVAC Designer's Name: _____ Designation: _____

Design Office (Name & Address): _____

E-mail: _____ Phone (Mobile): _____

Research Questionnaire for HVAC Design Professionals

Dear HVAC Designer,

The following information is required for an academic research project to study the existing Heating, Ventilating and Air-Conditioning (HVAC) design practices in Commercial & Office buildings in India.

We request you to kindly participate in this study by providing valuable information in this questionnaire. We assure you that the confidentiality of your inputs will be maintained and used for research purpose only. Should you have any queries regarding this study, please feel free to contact the undersigned.

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Dr. Kavita Daryani Rao
Research Supervisor
JNAFA University, Hyderabad

1. How long have you been involved in designing the HVAC systems in buildings?
☐ <2 years ☐ 2-5 years ☐ 5-10 years ☐ 10-15 years ☐ _____

2. What **kind of buildings** have you designed the HVAC systems so far?
☐ Residential
☐ Commercial & Office
☐ Industrial
☐ Institutional
☐ Others (specify) _____

The following questions refer to HVAC design in Commercial & Office Buildings (C&O Bldgs).
You may choose more than one options, wherever required. Write your comments in blank spaces.

3. What **type of HVAC system** is mostly used in commercial & office buildings in India?
☐ Rooftop Packaged Units ☐ Split Systems
☐ Chilled Water System ☐ VAV Systems
☐ Air Handling Units (AHUs) ☐ VRF System
☐ Fan Coil Units (FCUs) ☐ Others (specify) _____

4. Which **manufacturer / brand name** of HVAC systems do you normally use in your projects?
☐ Carrier ☐ Daikin
☐ Blue Star ☐ Trane
☐ LG ☐ Kirloskar
☐ Voltas ☐ Others (specify) _____

5. What is the **criteria for selection** of a particular manufacturer?
☐ Specified by the building owner
☐ Suitable for local weather conditions
☐ Availability in the market
☐ Good experience with the product
☐ Others (specify) _____

6. What is your **main criterion** for designing and selecting the HVAC system? (You may give ranking)
☐ Energy conservation
☐ Thermal comfort
☐ Indoor air quality
☐ Others (specify) _____

7. What is the range of **indoor temperature** that you normally design (C&O Bldgs)?
☐ 20°-22°C ☐ 22°-24°C ☐ 24°-26°C ☐ Others (specify) _____

8. What is the range of **indoor relative humidity** that you normally design (C&O Bldgs)?
☐ 30-40% ☐ 40-50% ☐ 50-60% ☐ Others (specify) _____

9. What is the **ventilation rate** (outside fresh air) that you incorporate to design the HVAC system?
☐ 5-10 cfm/person ☐ 10-15 cfm/person ☐ 15-20 cfm/person ☐ Others (specify) _____

10. Which procedure is followed to determine the required **ventilation rate**?
☐ Ventilation Rate Procedure ☐ Natural Ventilation Procedure
☐ Indoor Air Quality Procedure ☐ Others (specify) _____

ACKNOWLEDGMENT

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Performance Analysis of the HVAC System in a Hospital Building in Hyderabad

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Abstract— Indoor air quality (IAQ) is a term which refers to the air quality within a building, especially as it relates to the health and comfort of building occupants. The hospital is a high risk indoor place which has airborne infection from patients. The complex hospital environment requires special attention to ensure healthy IAQ to protect patients and healthcare workers against hospital-acquired infections and occupational diseases. The aim of this study is to recommend effective guidelines for the control and management of hospital IAQ. A one week survey was carried out in the Continental Hospital and Research Centre situated at Gachi Bowli, Hyderabad. It is a massive eighteen storied structure, competently managed by senior professionals. In the experimental analysis for indoor air quality, measurements were recorded on four floors for Temperature, Relative Humidity and Carbon Dioxide. In the observation analysis the operation and maintenance of the HVAC system and the well-being of the occupants were observed.

Index Terms— CO_2, HVAC Systems, Indoor Air Quality, Occupant Comfort, Pollutants, Relative Humidity, Temperature

1 Introduction

Hospital buildings and health care facilities are among the most complex indoor spaces. In particular, the most demanding indoor zones are hospital operating theatres (suites) that comprise operating rooms (ORs) or surgical theatres, their interconnecting hallways and ancillary work areas. The indoor environmental quality (IEQ) in ORs, including thermal, visual and acoustical comfort and indoor air quality, affects the working conditions, well-being, safety and health of patient and the medical personnel who work in these environments. About 50% of the total number of doctors works in the ORs, as surgeons or with other responsibilities (e.g. anesthesiologist), while about 10% of the total medical staff also work in the OR. Heating, Ventilating and Air-Conditioning (HVAC) installations control indoor air quality and aseptic conditions, and secure health, safety and suitable indoor thermal (i.e. temperature, humidity, air quality and airflow) conditions for surgeons and medical staff, and of course, the patients. The air in an OR must be aseptic, at a reasonably constant temperature and humidity and have relatively low air velocity in order to avoid drafts and swirls that promote the recirculation of microbes and may disrupt the procedures during an operation. The ventilation rate is expressed as the volumetric air flow through the space divided by the volume of the space, e.g. number of air changes per hour (ACH). The desirable conditions can be met by proper design, installation, operation and maintenance of the electromechanical equipment, such as the HVAC equipment and lighting systems of the space. Due to their demanding indoor conditions, operating theatres constitute the most expensive sector of the healthcare establishment mandating an efficient management. Indoor air quality (IAQ) can be affected by gases (including carbon monoxide, radon, volatile organic compounds), particulates, microbial contaminants (mold, bacteria), or any mass or energy stressor that can induce adverse health conditions. Source control, filteration are the primary methods for improving indoor air quality in most health care facilities.

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2. HVAC System Investigation

The preliminary HVAC investigation involved the discussions with property owners and building management, walk through investigation of building and surrounding areas, interviewing HVAC operation & maintenance personnel, study of as-built drawings, review of maintenance schedule and preventative maintenance program.

Preliminary observation/review of the HVAC system was carried out. Direct instrument measurements of carbon dioxide, relative humidity, and temperature were recorded to know the status of IAQ and comfort of building occupants.

3. Hospital Occupant Survey

A hospital occupant's questionnaire was developed to get the demographic background and socio-economic status of the respondents such as personal information, health status, symptoms of sickness, and level of comfort inside the hospital. The questionnaire include the occupant's health status and symptoms of Sick building syndrome (SBS) such as chronic cough, cough with phlegm, chest tightness, and shortness of breath. Questionnaires also contain questions on the previous workplace, working history, and location of current workstation (near the entrance door, near to photocopied area, etc), and also working background such as overtime, shift work

schedule, duration of work per day, duration of work per week and the employment years at the office. Zoning of each worker's workstation then categorized accordingly with the reference of floor plan. Reported sick building syndrome (SBS) symptoms were recorded from the respective respondents on each day of IAQ assessment conducted and the score given in the analysis of data as shown in Fig. 1.

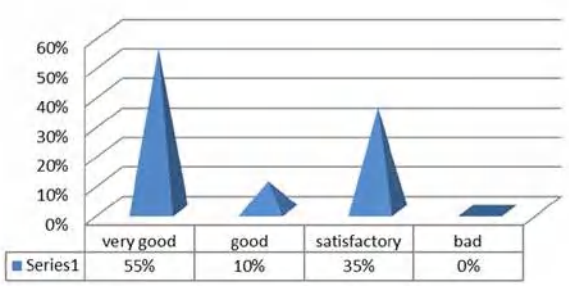


Fig. 1. Hospital occupant's perception of Indoor Air Quality

4. Hospital Building Infrastructure

The questionnaire was done in the Hospital Building in Hyderabad which is fully Air Conditioned controlled by Building Management Sysytem. A continuous data log of carbon dioxide, temperature, and relative humidity for approximately one week. Indoor air quality analysis was carried of the Hospital having buildup area of 1,20,000 sq mtrs with 18 floors of capcity 750 beds controlled and maintained by HVAC system of capacity 4000 Ton.The hospital requires close coordination among Medical staff, Support staff and patients along with the maintenance of diagnostic equipment along with disinfection and sterlization techniques in order to improve health of patients, avoid infections among patients and hazards for hospital occupants.

5. Parametric Measurement

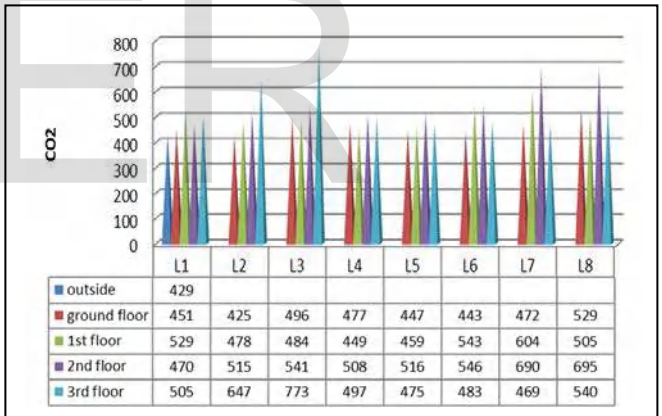
The parametric measurement of carbondioxide, Relative humidity and Temperature are major factors in health care facilities indoor air quality (IAQ). The interiors are deemed to be the most important indicators that the quality of the indoor air is good enough, when people themselves are the main source of emissions. Poor indoor air quality leads to tiredness, lack of concentration and can even bring about illnesses.

5.1 Carbon dioxide

Carbon dioxide (CO_2) level is considered to be an indicator for purpose of evaluation of indoor air quality (IAQ). Hospital occupants asre the main sourse of Carbon dioxise levels variation and air borne infections along with the concentration of body odour. Carbon dioxide is relatively varies with respect to seasons and even within a day, human traffic, occupants living habits. The useful approach is to measure surrogate for indoor pollutants emitted by humans, and correlates with human metabolic activity. Carbon dioxide at levels that are unusually high indoors may cause occupants to grow drowsy, to get headaches, breathing and pulse rate increase, nausea, unconscious, further exposure 100,000 ppm leads to death. Humans are the main indoor source of carbon dioxide in most buildings. Indoor levels are an indicator of the adequacy of outdoor air ventilation relative to indoor occupant density and metabolic activity.

To eliminate most complaints, total indoor carbon dioxide should be reduced to a difference of less than 600 ppm above outdoor levels. NIOSH considers that indoor air concentrations of carbon dioxide that exceed 1,000 ppm are a marker suggesting inadequate ventilation.These higher limits are concerned with avoiding loss of consciousness (fainting), and do not address impaired cognitive performance and energy, which begin to occur at lower concentrations of carbon dioxide.

Carbon dioxide concentrations increase as a result of human occupancy, but lag in time behind cumulative occupancy and intake of fresh air. The lower the air exchange rate, the slower the buildup of carbon dioxide to quasi "steady state" concentrations on which the NIOSH are based. Therefore, measurements of carbon dioxide for purposes of assessing the adequacy of ventilation need to be made after an extended period of steady occupancy as recorded in figure no 2. Portable instruments used to measure carbon dioxide should be calibrated frequently and outdoor measurements used for calculations should be made close in time to indoor measurements.



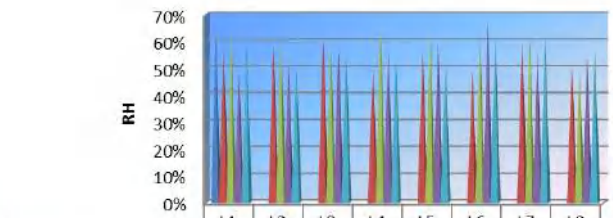
	L1	L2	L3	L4	L5	L6	L7	L8
outside	429							
ground floor	451	425	496	477	447	443	472	529
1st floor	529	478	484	449	459	543	604	505
2nd floor	470	515	541	508	516	546	690	695
3rd floor	505	647	773	497	475	483	469	540

Fig. 2. Carbon Dioxide values recorded at different floors

5. .2 Relative Humidity

Hospital buildings having high humidity levels can cause damage to sensitive hospital equipment and products used during surgery apart from discomfort to occupants. Sources of biological contaminants are major source of risk to patients health. Relative humidity also affects the shelf life and product integrity results unexpected malfunction. Air humidity must be maintained at acceptable levels because it is closely related to the space hygiene and thermal comfort conditions. Humidity control is most often accomplished by treating the ventilated air for lowering (dehumidification) or increasing (humidification) its water content, using proper equipment and controls. HVAC system configurations can achieve humidity targets for delivering the required supply air conditions, without energy wastage. High humidity levels favor the growth and transfer of bacteria that can be easily become airborne on wa-

ter molecules high humidity levels cause thermal discomfort. During low humidity level electro-medical equipment is effected by electrostatic discharge. The ventilation requirements influence humidity control. Depending on climatic conditions, additional ventilation may increase the dehumidification load more than the sensible cooling, imposing a disproportionate demand on the HVAC equipment. Low humidity levels (dry air) favor blood coagulation, which is undesirable during a surgery. In addition, moisture can be absorbed into the duct lining and building materials where it may support microbial growth. With the heavy use of electric equipment, low humidity levels may cause problems associated with static electricity on medical equipment and surfaces. In addition, this may even pose a fire hazard, as there may be flammable gases present in the environment. The recommended levels of indoor relative humidity are 30–60%, according to international regulations and standards. Most regulations establish where the use of in-flammable anaesthetic gases is possible, volatile liquids are used frequently, and in order to prevent the accumulation of static electricity should maintain a humidity of about 60%. Humidification may be necessary to increase low humidity levels, commonly encountered during winter. Special care must be exercised with humidification to assure that there is no potential for transferring bacteria through the ventilation system, since humidifiers may provide favorable environment for bacteria growth. Proper maintenance and cleaning practices will minimize this kind of risks. Humidification is best accomplished by supplying dry steam. Cold-water humidifiers in HVAC systems must be connected to a domestic water source and provided with a drain line to remove the water. Stand-alone, console-type humidifiers that re-circulate water for humidification should not be used because the water in these systems becomes contaminated with microorganisms rapidly and have been linked to outbreaks of Legionnaires' disease. Study recorded as shown in Figure no. 3.



	L1	L2	L3	L4	L5	L6	L7	L8
AT 03:00 outside	63%							
AT 03:00 ground floor	57.50%	68.5%	61.20%	50.80%	67.40%	89.10%	61.20%	61.10%
AT 03:00 1st floor	62.20%	63.40%	58.00%	65.40%	63.00%	62.30%	62.30%	59.00%
AT 03:00 2nd floor	49.60%	61.70%	67.30%	66.60%	60.60%	67.90%	65.90%	65.00%
AT 03:00 3rd floor	59.30%	63.70%	66.40%	63.40%	61.70%	62.10%	62.00%	67.70%

Fig. 3. Relative Humidity values recorded at different floors

5.3 Temperature

The indoor air temperature must be maintained within the recommended ranges to ensure acceptable conditions. The Indoor air temperature must be uniform within the space. Special care must be taken to operation theater account for the different internal loads (e.g. surgical lamp) by proper design of the air conditioned supply and exhaust vents and temperature of the air supply stream. The desirable indoor air temperature is usually 20–24°C, according to international regulations and standards. Use of lower or higher temperature is acceptable when patients' comfort and/or medical conditions require those conditions. For example, for specialized procedures, such as cardiac surgery, the indoor air temperature may be set as low as 17°C, on the other hand paediatric surgeries usually demand a higher indoor air temperature because children are more sensitive to lower temperatures. In any event, a high indoor air temperature may cause discomfort and offers more favorable growing conditions for bacteria or their mitigation from and to the patient. Practically, it is not possible to provide all occupants with 100% acceptable indoor thermal conditions. Similarly, the medical staff working in an Operation Room may have a different perception of prevailing indoor conditions due to different levels of activity and even working positions within the OR. In general, surgeons tend to feel from ''slightly warm'' to ''warm''. Regulatory sweating is also present very often. Anaesthetists and nurses, by Contrast, experience from ''slightly cool to cold'' thermal sensation. This is especially true for temperatures below 21°C. These are in agreement with other studies where preferable thermal comfort conditions were reported for aesthetics (23–24°C), for nurses (22–24.5°C) and for surgeons (18–19°C). For patient's, the recommended air temperature ranges between 24 and 26°C. Medical clothing will have a direct impact on personnel's thermal comfort conditions. Surgical scrub garments are typically worn by OR personnel to control airborne contamination, although there is no scientific data to support this practice as a means for preventing transmission of infection. Heavier gown requirements used by the surgical team for protective reasons during an operation (i.e. because of AIDS) may require an indoor temperature down to 18°C or even lower. The field measurement was conducted at various floors present in figure-4 at various locations.

	L1	L2	L3	L4	L5	L6	L7	L8
AT 03:00 outside	28.6							
AT 03:00 ground floor	24.6	25.1	24	26.2	24.3	29.3	25.6	27.3
AT 03:00 1st floor	26.3	26.2	24.6	26.6	24.3	26.2	26.5	26.1
AT 03:00 2nd floor	25.2	24.6	24.4	27.3	22.9	22.1	23.6	23
AT 03:00 3rd floor	25	26.6	23.3	21.9	25.2	24.9	24.2	24.5

Fig. 4. Temperature values recorded at different floors

Finally, asymmetric thermal radiation from surgical lights on the surgical staff is a potential source of thermal discomfort. Thermal radiation emitted from surgical lights regardless of the indoor air temperature.

6. BUILDING HVAC SYSTEM

The procedures used to calibrate indoor air quality of health

care facilities are as follows:

- Determine the effective volume of the hospital.
- Record the temperature and humidity conditions, the method of distribution of air (ceiling outlets, side wall, floor outlets, etc.) and the operation hours of the system.
- Collect the specifications of the airside system (type, capacity of supply air, fresh air and return air flow rate, control method, etc.) and the accessories such as fresh air damper, type of diffuser, etc.

To calculate the air change rate when the air-conditioning system was operating, the hospital was pressurized and infiltration is reduced.

The Outdoor air requirement is significant important for IAQ. The outdoor air requirement is related with the number of occupants and net available occupancy.

HVAC system should provide sufficient fresh air to avoid concentration of contaminated indoor air pollution. Supply air velocity for each supply air grill was measured by using anemometer. Airflow rate was designed and measured of supply air flow rate for fan coil units and Air Handling Unit.

7. Conclusion

The measurements were carried out to check the values Carbon dioxide (CO_2), Relative Humidity (R.H %) & Temperature (T). It was observed that throughout the week the values of CO_2, relative humidity and temperature were in acceptable range. It indicates that the overall performance of HVAC systems is good in this hospital building.

Since the feedback gathered from the occupants of the building also indicate that a majority of them feel comfortable inside the building and do not report of any severe complaints, it can be concluded that the HVAC systems is providing sufficient amount of fresh air along with maintaining the temperature and relative humidity.

The above measurements were recorded for a period of one week only. However, a long term field measurements have to be recorded to analyze the performance of HVAC systems and IAQ issues on a minute scale.

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