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International Journal of Computational Intelligence Research

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I N D E X

REVIEW ON ADAPTIVE SPATIAL MODULATION USING HUFFMAN CODING

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Abstract—Adaptive Spatial Modulation(ASM) using Huffman coding explore both Spatial modulation (SM) and transmit antenna selection. Using huffman coding, transmit antennas can be activated with variation in probabilities. In ASM, block of information bits are divided into two units and the first unit is mapped into the antenna index whereas the second unit is mapped into a symbol in the constellation diagram. The proposed system increases the capacity of the MIMO systems. The data rate in SM can be much more increased by using antenna subset spatial modulation. In this, transmitting antennas are grouped into subsets. Antenna selection divides a block of information bits to two units. The first unit is mapped into the antenna index and the second unit for constellation mapping. Optimum activation probability is obtained from optimizing capacity (channel gain). At the receiver, Maximum Likelihood Detector(MLD) is used in order to minimize probability of error

Index Terms—Adapive Spatial Modulation, Spatial Modulation

I. INTRODUCTION

Impressive improvements in the world of communication demands an uninterrupted access to the information with high quality, higher data rate, reduction in cost, etc. Adding more antennas at the transmitter and receiver improves the quality and reliability of transmission. This concept lead to the evolution of MIMO technology. The introduction of Multiple input multiple output (MIMO) transmission system has given wireless communication a new dimension, it has improved data rate and diversity. However, regardless of the use as spatial multiplexing, diversity, or smart antenna system, the main drawback of any MIMO scheme is an increase in complexity and cost. This is mainly due to multiple Radio Frequency (RF) chains, which are needed to transmit all the signals simultaneously and are, in general, expensive. In order to solve this problem transmission schemes that utilizes single RF frond end can be adopted.

II. SPATIAL MODULATION AND TRANSMIT ANTENNA SELECTION

Spatial Modulation (SM) is a recently developed transmission scheme that utilizes single RF front end. The basic idea in SM is to divide block of information bits into two units, that is the first unit is mapped into the antenna index whereas

the second unit is mapped into a symbol in the constellation diagram. Compared to the conventional MIMO system, SM uses only one active antenna at a time to avoid Inter Channel Interference (ICI). Let N_t be the number of transmit antennas and N_r be the number of receive antennas. In SM N_t transmit antennas are equally probable for transmission. Let M be the size of Signal Constellations. The length n of information block will be:

$$n = \log_2 N_T + \log_2 M$$

The channel qualities of possible links between transmitter and receiver are different. Information sending via a weak link is worst than sending a signal over strong link. These effects the performance of spatial modulation.

Another dominant transmission scheme that utilizes single RF front end MIMO is transmit antenna selection. Here, strongest transmit antenna is chosen for transmission and all other antennas are kept silent. Different from spatial modulation, the information is fully carried by signal symbol and no information is conveyed via antenna index. Antenna selection mainly relays on the feedback path from the receiver in order to choose the specific antenna, along with that transmit diversity can be obtained.Limitations in design flexibility restricts the enhancement in system performance.

Performance of spatial modulation depends on channel qualities of each link, which makes it inferior when weak link exist. On the other hand, antenna selection depends only on the strongest link and it is not affected by weak link.S aims to maximize the spatial information but signal information is not fully optimized. Transmit antenna selection intended to maximize the signal information and no spatial information is conveyed via antenna index. So the main objective is to design flexibile transmission scheme that generalize both SM and antenna selection. Huffman mapping helps to adjust activation probability of each transmit antenna with the use of feedback path from the receiver section. Channel capacity(channel gain) can be optimized for good approximation.

III. ADAPTIVE SPATIAL MODULATION

Consider a MIMO system with Nt transmit and Nr receive antennas as shown in Figure. At transmitter side, there is merely a single RF chain connected with Nt transmit antennas
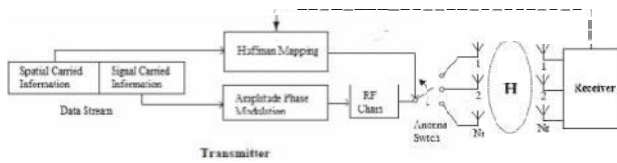
Fig. 1: Structure of adaptive spatial modulation using huffman coding [1]

through an antenna switch. At receiver side, each receive antenna has its corresponding RF chain. The received signals can be represented as

$$y = \sqrt{p} \, H_x + n \qquad (1)$$

Where $H = [h1,h2,...h_{Nt}]$ denotes the flat fading MIMO channel, and n is the additive white Gaussian noise (AWGN) following circularly symmetric complex Gaussian distribution, is SNR and the transmitted signal x is

$$x = (0 \; 0 \; ::: \; 0 \; s \; ::: \; 0 \; 0)^T \qquad (2)$$

Where s is the transmitted signal. Above equation can be rewritten as

$$x = r:s \qquad (3)$$

Where r is choosen from finite set $Cr = $ e1; e2; ::::eN t and ei is an Nt 1 vector with the ith element being 1 and all other elements 0. When ei is chosen, it means the ith transmit antenna is activated to transmit the signal s, and all other transmit antennas are deactivated. The data stream is split into two independent streams, referred to as signal information and antenna information. Signal information is conveyed via the signal s, and antenna information is mapped to the spatial symbol r (antenna index). In each time slot, the signal s is conveyed by the active transmit antenna that is selected according to the antenna information.

$$P \, rob(r = ei) = pi; \; i = 1; 2; ; N \, t \qquad (4)$$

The probability of selecting the ith transmit antenna is represented as p(r=ei), where pi satisfies $\sum_{i=1}^{Nt} pi = 1$. In conventional spatial modulation, the probability vector $p = [p1; p2; ; pN t]$ is

$$p = [\frac{1}{Nt} ; \frac{1}{Nt} ; ; \frac{1}{Nt}]) \qquad (5)$$

That is, all transmit antennas have the equal probability to be activated, regardless of the channel quality. In this case, up to $\log_2 Nt$ bits extra information can be conveyed by antenna index [6], [7]. In transmit antenna selection [13], the probability vector p is

$$pj = 1; \; j = argmax_{i \neq j} h_{i} j; \; pi = 0; \; i = j \qquad (6)$$

in which only the strongest transmit antenna j is selected to convey the signal information and no spatial information is conveyed via antenna index. Spatial modulation and transmit antenna selection are two special transmission schemes for single RF chain MIMO. Spatial modulation aims to maximize the antenna information, but its signal information is not optimized. Transmit antenna selection intends to maximize the signal information, but no spatial information is conveyed via antenna index. Neither of them is necessarily optimal in terms of channel capacity/SER.

Main idea of Huffman coding for adaptive spatial modulation is to assign binary codes to spatial information that is the antenna index that take into account the frequency of occurrence of each symbol. The antenna information bits are mapped to its corresponding transmit antenna according to the constructed Huffman code. The longer codeword means its corresponding antenna has less chance to be activated and vice versa. In addition, no codeword in the generated codebook should be a prefix of any other codeword.

Bit Sequence	Spatial Symbol	Probability%
0	Tx1	50
10	Tx2	25
110	Tx3	12.5
111	Tx4	12.5

TABLE I: Huffman Mapping for $p = [\frac{1}{2} ; \frac{1}{4} ; \frac{1}{8} ; \frac{1}{8}]$

Example 1: When the probability vector $p = [\frac{1}{2} ; \frac{1}{4} ; \frac{1}{8} ; \frac{1}{8}]$ the corresponding Huffman mapping is shown in Table I. The incoming antenna information bits are sequentially detected and then mapped into different transmit antenna indices. If the first bit 0 is detected, then antenna Tx1 is selected. Otherwise, the first bit is 1, go to detect the second bit. If the second bit 0 is detected, then antenna Tx2 is selected. Otherwise, the second bit is 1, go to detect the third bit. If the third bit 0 is detected, then antenna Tx3 is selected. Otherwise, the third bit 1 is detected, then antenna Tx4 is selected. On the average, the activation probabilities of antennas Tx1, Tx2, Tx3, and Tx4 are 50, 25, 12.5 and 12.5 percent , respectively. Hence, the transmitted antenna information is up to $\frac{1}{2} 1 + \frac{1}{4} 2 + \frac{1}{8} 3 + \frac{1}{8} 3 = 1:75$ bits.

The objective of adaptive spatial modulation is to find probability that optimizes the system performance. The design problem can be generalized as follows

$$P \, 1 = \substack{max=min \\ s:tp \, 2 \, P} (p) \qquad (7)$$

Where f(p) is performance matric it can be capacity or SER. Due to binary nature of proposed coding scheme, domain of probability is a discrete set.

In order to derive optimum probability, consider the case of capacity where both upper bound and lower bound of capacity is analyzed. This is done by maximizing the capacity. Consider

the case where ith antenna is chosen for transmission, such that received signal will be

$$y_j (r = e_i) = \sqrt{p}\, sh_i + n$$

Assume that y follows a normal distribution and using prob-ability density function derive capacity in order to optimize probability[1]. At receiver end detectors like maximum like-lihood detector(MLD) can be utilized. MLD searches for the symbol xbfrom the codebook { to minimize euclidean distance metric

$$xb = argmin_{xi2\{}\; k\, y\, \sqrt{p}\, Hx_i k^2\; A.$$

Performance Comparison

Figure 2 shows the capacity performance comparison of adaptive spatial modulation over i.i.d Rayleigh fading channel realization with $N_t = 4$ transmit antennas. Some propositions are given to derive the capacity bounds[1]. The capacity lower bound in Proposition 2[1] is used as the approximation of channel capacity in the mode selection. In Figure2(a), when $N_r = 1$, it can be seen that transmit antenna selection has the same performance as the adaptive transmission. This is because in each channel realization only the strongest transmit antenna is activated to transmit information, which verifies the conclusion in Theorem 1[1]. In addition, the performance gap between conventional spatial modulation and transmit antenna selection is significant, which implies that conventional spatial modulation is not favorable when Nr = 1. In Fig. 2(b), when Nr = 2, the performance of the adaptive spatial modulation is slightly better than the transmit antenna selection in low SNR regime.

With the increase of SNR, the adaptive spatial modulation becomes significantly better than both conventional spatial modulation and transmit antenna selection schemes. This result validates the effectiveness of the adaptive spatial modulation and indicates that transmission schemes other than the conven-tional spatial modulation and the transmit antenna selection may be the optimal transmission strategy in general cases. However, when Nr increases, the performance enhancement of adaptive transmission over conventional spatial modulation becomes slight.It implies that conventional spatial modulation gradually becomes favorable with the increase of the receive antenna number N_r.
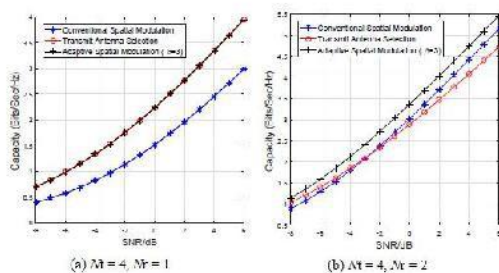
Fig. 2: Capacity comparison over Rayleigh fading channel[1]

IV. CONCLUSION

ASM using huffman coding scheme proposes a system that utilizes spatial modulation and transmit antenna selection. Priority is given to the antenna index for the purpose of index mapping. Antenna selection helps to find out which link is strongest for transmission using gain or capacity. Based on highest value of gain/capacity receiver feedback the information to antenna index and whatever the priority will be, antenna having highest gain is chosen for transmission. Here , using spatial modulation index mapping is first prioritized and then according to antenna selection channel gain transmit antenna adjust the activation probability. After comparing the performance of conventional spatial modulation and transmit antenna selection proposed adaptive spatial modulation using huffman mapping offers better system performance.

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Detection and Correction of SNM Using BTI Sensor for SRAM Using 15nm Technology

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Abstract: The continuous scaling of CMOS technology exponentially increases the power density per unit area (means temperature) and other effect such as lifetime reliability. Bias temperature instability (BTI) is the serious effect which originates due to scaling of MOS , the effect of BTI on the design of SRAM; it decreases the SNM of the SRAM. In this paper a prototype BIT sensor is proposed which used for correction of SNM of SRAM .It is designed on 15nm technology and simulated in Hspice in Cadence 6.15 the precision found after simulation is under 1.15mv(+-3% approx) for 1v supply.

Index Terms— Bias temperature instability (BTI), reliability, SRAM, static noise margin (SNM) degradation, Cadence, Hspice

1. INTRODUCTION

Advancement of CMOS technology increases the performance aggression of digital circuits but the adverse effect is the long time hardware failure or reliability of the system. Continuous scaling of CMOS technology adversely affect the electron migration (EM), stress migration (SM), time dependent dielectric breakdown (gate oxide breakdown) and thermal cycle (TC) all the affect arise due to the power density increment (due to temperature increment) as this is due to non linear scaling in between supply voltage, threshold voltage vs channel length of MOSFET (scaling of MOSFET). [1]–[4]. Among different reliability issues, bias temperature instability (BTI) is the most serious concern [2]–[4]. The BTI gradually increases the absolute value of transistors threshold voltage (Vth) and decreases the mobility (μ) of the charge carriers

as well [2], [4]. High electric field on the gate insulator, at the elevated temperature, accelerates BTI phenomenon [5]. When a transistor is in linear or saturation state, electric field on gate insulator that reaches to the millions of volts per meter breaks the Si–H bonds, which had been established at the fabrication time to passivate incomplete bonds between Si and SiO2. Interface traps that are generated due to this dissociation slow-down the movement of charge carriers. On the other hand, the generated Si ions, due to Si–H bonds break, push the transistor channel away and increase the absolute value of Vth, forming the stress phase of BTI [5], [6]. On the contrary, when the electric field is removed, some of the broken Si–H bonds will be formed again and put the transistor in the recovery phase. In this way, the previous Vth degradation is partially compensated in the recovery phase. The total effect of BTI is a gradual increase of Vth over time. The amount of Vth degradation is strongly proportional to the duty cycle (the ratio of stress to recovery time), the supply voltage, and the operating temperature [5], [6]. The effect of BTI on p-type and n-type transistors is called NBTI and PBTI, respectively. In the previous fabrication technology sizes, the NBTI has been far more severe than PBTI; however, nowadays by the development of high-k materials, the PBTI has become a major concern as well [7], [8]. The main effect of BTI on combinational circuits can be observed as propagation delay increase [9], [10] and the delay variation can be accurately monitored using timing violation sensors [11]–[13]. But, BTI effect on SRAM cells, which occupy up to 90% of processors die area [14], leads to static noise margin (SNM) degradation. The SNM is the minimum noise voltage that can flip the state of the SRAM cell. However, tiny shift in SNM can hardly be monitored using built-in sensors and the sensor

precision steps down due to process variation and other environmental parameters change. To assess the amount of SRAM SNM change due to NBTI, Liu and Chen [15] proposed error-correcting code (ECC) double checking technique, which distinguishes between soft errors and aging-caused errors. This technique can only detect the permanent failures due to NBTI effect. Qi et al. [8] suggested an asymmetric SRAM cell with tracking and polling phases as a BTI sensor. The most challenging issue for sub threshold SRAM is increasing reliability during read/write. A good metric for read/write margin is critically important to all kinds of SRAM designs. Moreover, the stability of the SRAM cell is seriously affected by the increase in variability and by the decrease in supply voltage. Furthermore, new SRAM cell circuit designs have been developed to maximize the cell stability for future technology nodes.It estimates aging state of the entire SRAM block by putting multiple numbers of redundant cells as sensors (within original SRAM cells) under constant stress to achieve reasonable accuracy. However, this paper cannot guarantee the occurrence/nonoccurrence of aging in SRAM cells. Ahmed and Milor [16] proposed a method to drive the p-type transistors currents into the bit lines and to make NBTI degradation observable. This is done by storing zero on both internal nodes (Q and Q) of SRAM cells by force. This design needs some essential modification of SRAM block row decoder and read/write circuitry, which are not easily applicable to the SRAM block and imposes area and performance overhead. Furthermore, such a sensor is required for each bit line with considerable area overhead. Kang et al. [17] suggested an NBTI sensor to monitor SRAM leakage current to specify aging state of memory block. However, in nanoscale technology sizes, leakage current is related to many causes, like gate oxide breakdown and gate leakage currents, rather than only Vth shifts [18]

2. STATIC NOISE MARGIN (SNM)

SNM is the measure of strength of the SRAM cell to hold its information against noise .SNM of SRAM is defined as minimum amount of noise voltage present on the storing nodes of SRAM required to flip the state of cell. There are two strategies to find the SNM of SRAM cell. Initially technique is a graphical approach in which SNM can be acquired by drawing and reflecting the inverter qualities and afterward finding the extreme conceivable square between them. Another approach includes the utilization of noise source voltages at the node as appeared in

figure 4 (a). SNM Dependences [19] incorporates cell ratio (CR), supply voltage and furthermore pull up ratio .Cell ratio [20] is the proportion between sizes of the driver transistor to the load transistor in the read activity. Pull up proportion [20] is the proportion between sizes of the load transistor to the access transistor in the write operation.

With reference to figure 1

$$CR = \frac{\left(\frac{W}{L}\right)_{M1}}{\left(\frac{W}{L}\right)_{M5}} \quad \text{(During Read operation)}$$

$$PR = \frac{\left(\frac{W}{L}\right)_{M4}}{\left(\frac{W}{L}\right)_{M6}} \quad \text{(During Write operation)}$$

If the cell ratio increases, size of the driver transistor also increases, consequently increasing the current. As current increases, the speed of the SRAM cell also increases.

2.1 The SRAM cell read stability

Information maintenance of the SRAM cell, both in standby mode and read mode is an imperative practical limitation in cutting edge innovation hubs. The cell turns out to be less steady with bring down supply voltage expanding spillage streams and expanding changeability, subsequent from innovation scaling. The stability is generally calculated by the SNM [21] as the greatest estimation of DC noise voltage that can be handled by the SRAM cell without changing the stored bit.
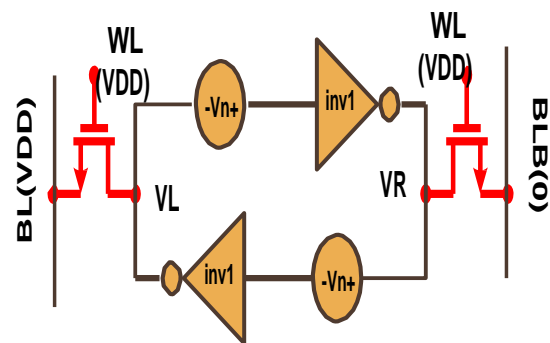
Fig :1 Equivalent Circuit for SNM

In Fig.1, the proportional circuit for the SN definition [21] is appeared. The two DC noise voltage sources are set in arrangement of series with the cross-coupled Inverters. The least value of noise voltage (Vn) which is important to flip the condition of the

cell is recorded as SNM. The graphical strategy to decide the SNM utilizes the static voltage exchange qualities of the SRAM cell inverters.
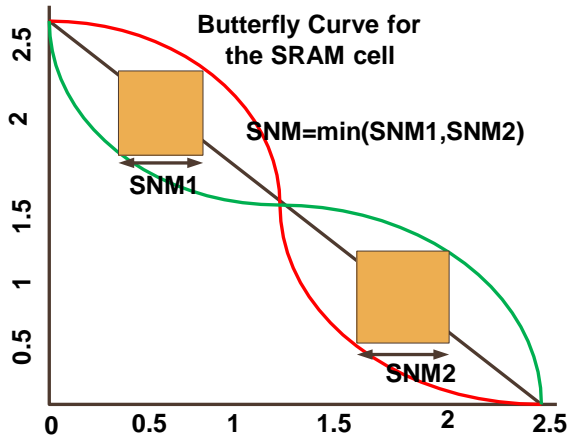
Fig 2 Butterfly graph for calculation of SRAM SNM

Superposes the voltage transfer characteristic (VTC) of one cell inverter to the inverse VTC of the other cell inverter. The subsequent two-lobed chart is known as a "butterfly" curve and is utilized to decide the SNM. Its esteem is characterized as the side length of the biggest square that can be fitted inside the lobes of the "butterfly" curve. Progressively the estimation of SNM, higher the read stability of the SRAM cell. A cell with less RSNM has poorer read stability.

2.2   Write ability of the SRAM cell
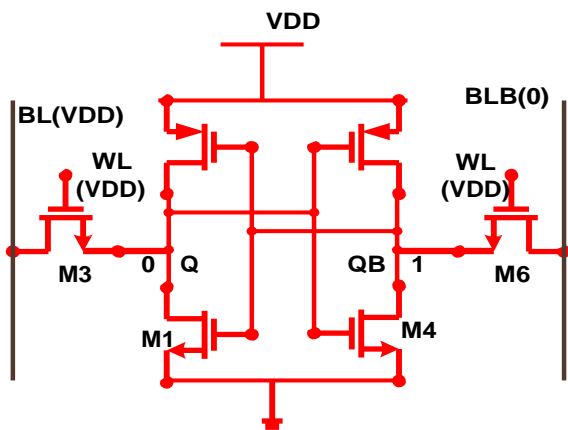
Fig: 3 Circuit for WSNM [22] of writing "1"

Write margin is the measure of the capacity to write information into the SRAM cell. Write margin voltage is the most extreme noise voltage available at

bit lines amid effective write activity. At the point when noise voltages surpasses the written edge voltage, at that point write failure happens. In this section, we present static approach for estimating write noise margin. The most well-known static approach utilizes SNM as a measure
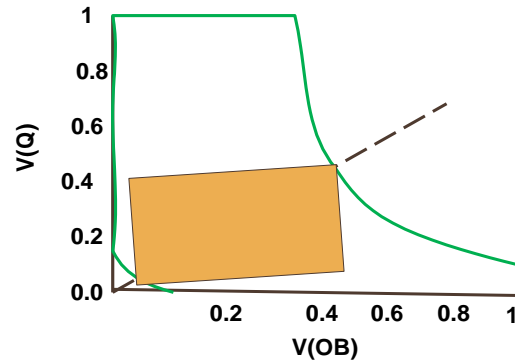
Fig: 4 WSNM [22] of writing „1" is the width of the smallest embedded square at the lower-right side

The cell is set in the write task. Fig 3 demonstrates the circuit for composing a "1" into the cell. Write SNM (WSNM) is find out by utilizing butterfly or VTC [23] curve(Fig 4), which are find out from a dc simulation sweeping the contribution of the inverters (QB and Q"). For a correct write , just a single cross point is to be found on the butterfly curve , showing that the cell is mono-stable. WSNM for writing "1" is the width of the smallest square that can be added between the lower-right half of the curves . WSNM for write „0" can be obtain from a similar situation . The final WSNM for the cell is the minimum of the writing margin for „0" and writing „1" . A cell with less WSNM has poorer writing capacity.

SNM
Strategy used to outline the BTI sensor in light of finding the amount of peak current (Ivdd / Ignd) flowing in PMOS during the write operation (1/0)

PMOS/NMOS and this difference of current is

exceedingly defenceless towards the Vth change. In the write activity a short circuit happens amongst VDD and GND path. At the point when write current is most extreme then the difference between Q and -Q or the output of two cross-coupled inverter vary by more higher than Vth or Vgd of Vth of PMOS. Under similarity condition of PMOS M2 and M5, Imax current is the sum of total current of PMOS saturation

current which can be calculated by

$$I_{max} = \frac{\mu_p}{2}\left(\frac{W}{L}\right)_{2/5} C_{ox}\left[\left(V_{dd} - V_{g2} + V_{th}\right)^2 + \left(V_{dd} - V_{g5} + V_{th}\right)^2\right]$$

Now variation of Imax with respect to Vth is given by derivative of Imax w.r.t Vth

$$\frac{dI_{max}}{dV_{th}} = \mu_p\left(\frac{W}{L}\right)_{2/5} C_{ox}\left[\left(V_{dd} - V_{g2} + V_{th}\right) + \left(V_{dd} - V_{g5} + V_{th}\right)\right]$$

$$\frac{dI_{max}}{dV_{th}} = \mu_p\left(\frac{W}{L}\right)_{2/5} C_{ox}\left[2V_{dd} + 2V_{th} - \left(V_{g2} + -V_{g5}\right)\right]$$

So from above condition this derivative will be most extreme when $\left(V_{g2} + -V_{g5}\right)$ should to be least which indicate greatest vulnerability to the Vth change which will acquired at max peak write current.

4. Sensor Structure:

This method can just find the aging with the granularity of the whole SRAM block, which is a harsh aging estimation. This paper recommends a sensor, which screens the SNM move caused by BTI in SRAM cells, called as BTI sensor for aging with no reason to change the SRAM block structure. By our analysis we find out that the VDD rail current (Ivdd) of the SRAMs is proportional to Vth of the p-type transistors of SRAM .

This is while the GND rail current (Ignd) is relying on the Vth of n-type transistors. The other SRAM memory operations such as (read and hold) current utilization isn't definitively influenced due to the BTI. Due to this reason, the BTI sensor uses the highest current utilization of the total SRAM cells in the block , during the write activity, to find out the the BTI on SRAM cells. A relative voltage to the highest current dissipation of the SRAM block is stored and is utilized as control voltage to drive the exhibited voltage-controlled oscillator (VCO). The output frequency change of the oscillator is a direct pointer of the BTI impact on the SRAM cells, with a decent estimation. The block diagram of BTI sensor is appeared in figure.
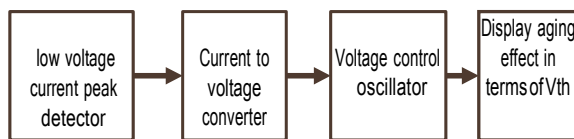
Fig: 5 Block diagram of BTI Sensor

The current peak detector in fig. 6 comprises of a NMOS current mirror (Mn1 and Mn2), a CMOS inverter (Mp3 and Mn3), PMOS switch (Mp1) and one diode-associated PMOS transistor (Mp2). The NMOS current mirror acts as a current-memory which stores the peak current . The CMOS inverter works as a current comparator which compares the approaching current i,, and the drain current of the transistor Mn1
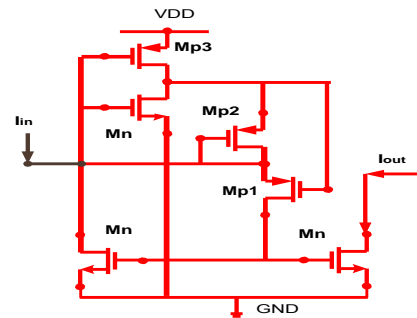
Fig: 6 Schematic of current peak detector

To convert Ivdd to the relating voltage, a low overhead and precise current controlled voltage source (CCVS) are added. Fig. 7 demonstrates the structure of CCVS, which contains a non-inverting operational amplifier . The output voltage (VCCVS) is related with R1, R2, R3, and Ivdd. The following equation gives the relationship between these parameters to the corresponding output voltage:

$$V_{peak} = \frac{R_3}{R_1} \times (R_1 + R_2) \times I_{peak}$$
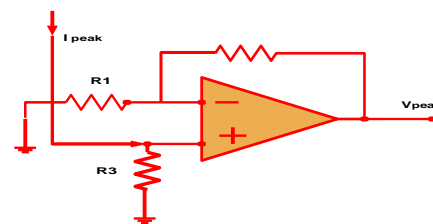
Fig: 7 Schematic of current to voltage converter

The latched voltage, which is related to the maximum of Ivdd, will work as the control voltage for the given VCO. With even number of stages of typical inverters and odd number of stages of current starved inverters. One typical inverter is set after the every current starved inverter; this is because of a rail-to-rail signal oscillation will be created by the ring oscillator. This VCO with two ordinary inverters

and one current starved inverter is given in Fig. 8. The output frequency of the displayed VCO is straightly reliant on the input voltage in the frequency range that runs a sensor
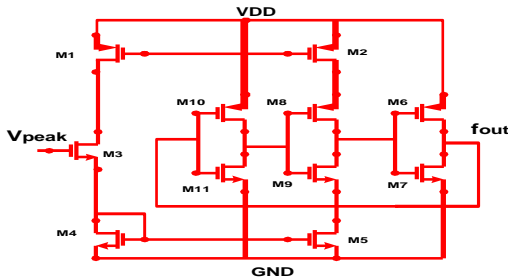
Fig 8 Schematic of VCO

Fig: 9 shows the block diagram for testing of Vth degradation of NMOS & PMOS of cross-coupled inverters used in SRAM for data storage.
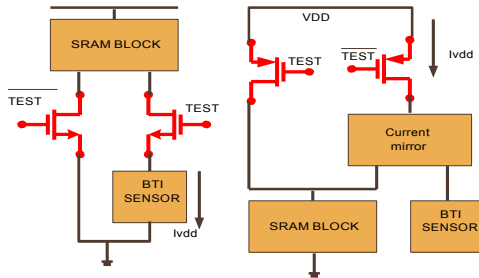
Fig: 9 Testing block for Vth effect using BTS sensor

5. Simulation Result

Simulation is carried out in cadence using 15nm Technology with HSPICE simulator.
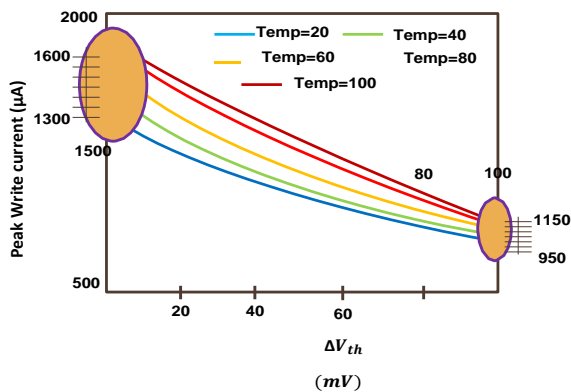
Fig :10 Parametric variation of "Peak Write current vs threshold voltage variation of PMOS" for Different temperature values
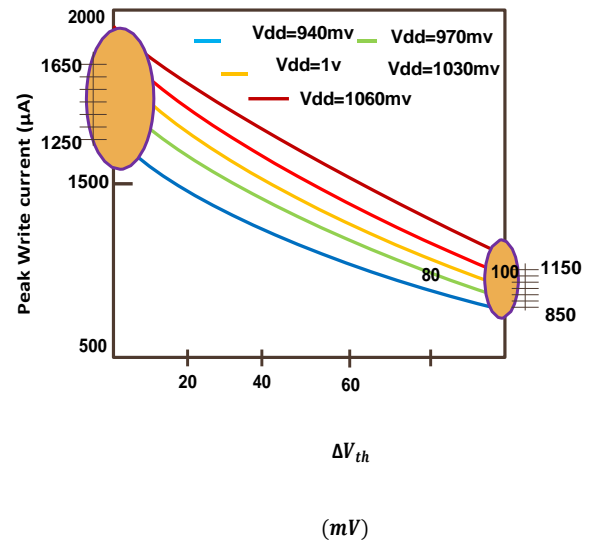
Fig: 11 Parametric variation of "Peak Write current vs threshold voltage variation of NMOS" for Different supply voltage
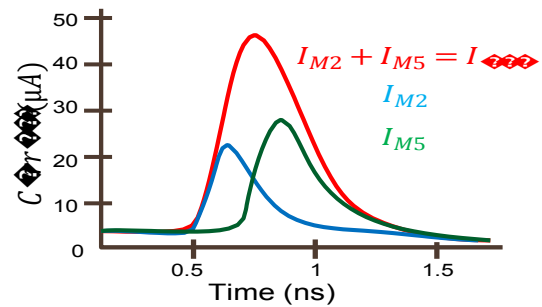
Fig: 12 Ivdd during the write operation in SRAM cell is composed of two p-type transistors currents
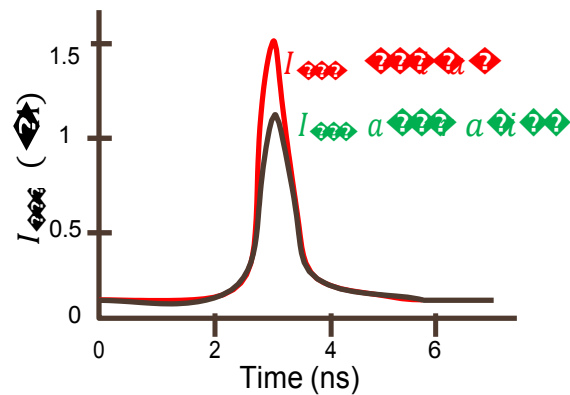
Fig: 13 Effect of aging of one row of SRAM block on Ivdd during the hold and write for SRAM block.
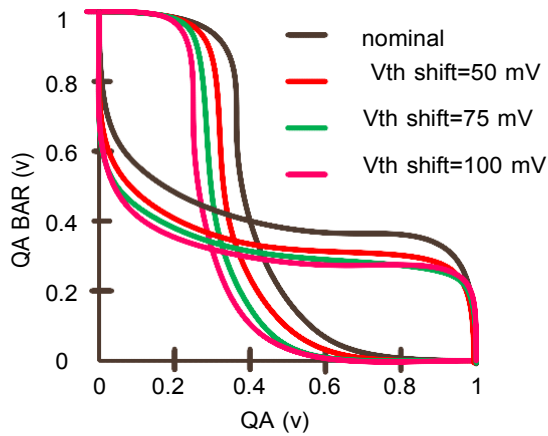
Fig: 14 SNM reduction of SRAM cell over 50-mv, 75-mv, 100-mV Vth shift when p-type transistors are symmetrically aged

Fig: 15 Parametric variation of "Peak Write current vs threshold voltage variation of PMOS" for different temperature values with Correction using BTI sensor
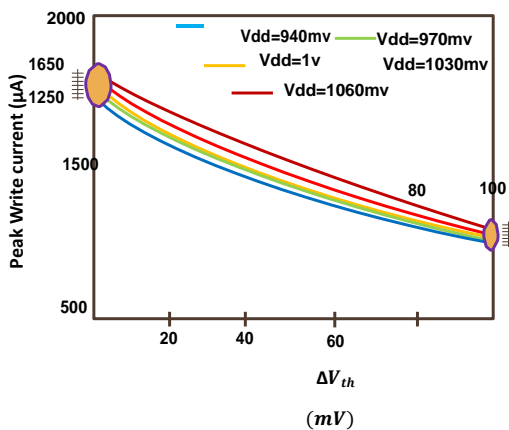
Fig: 16 Parametric variation of "Peak Write current vs threshold voltage variation of NMOS" for different supply voltage with correction using BTI sensor

Fig :17 SNM reduction of SRAM cell over 50-mv, 75-mv,100-mV Vth shift when n-type transistors are Symmetrically aged using BTI sensor.
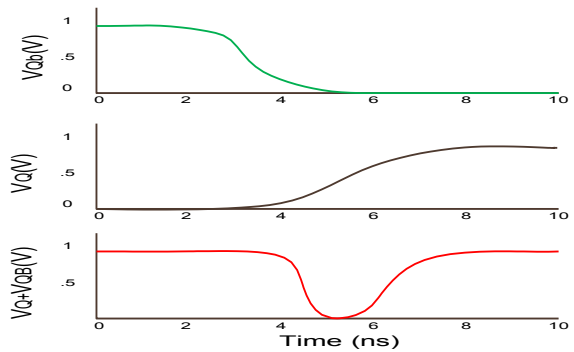
Fig :18. Voltages of SRAM nodes Q,QB, and the summation of the maximum of I_{vdd} is occurred when V_Q+V_{QB} is minimum

6. Conclusion

BTI is the most genuine and important condition identified with unwavering quality of electronic circuit in nano scale innovation. The SNM degrades because of BTI impact in SRAM it significantly influence the threshold voltage of SRAM. So for proper monitoring of SNM of SRAM a BTI sensor prototype is developed which will check the

reliability of SRAM. The precision of sensor is 1.15mv (+-3% error approx.) for 1v supply

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A Survey on Security & Electrical Appliances for Home Automation Systems

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Abstract—**Home Automation has gained more popularity in recent years. It is the process of controlling electrical home appliances remotely through website, mobile phone application or a dedicated hardware. This makes it easier for users to exercise seamless control over their IoT enabled devices from anywhere. With increased dependence on smart devices and reliable Internet connections, the concept of Internet of Things becomes genuinely important. Major issues that are faced in home automaton is cost and interconnection of various devices with each other. Developing affordable implementation techniques may prove to be benecial for everyone. In this paper, an extensive literature survey has been done with comparison of the existing systems based on various parameters. Many different modules that gather to form a generalized architecture have been discussed to infer issues present in these systems. Probable solutions have been stated for the same.**

Index Terms—**Home Automation (HA), Internet of Things (IoT), Raspberry Pi, Arduino, ESP8266, Launchpad, OpenCV, SimpleCV, Bluetooth, GSM, Bluetooth Low Energy, Beacon, MQTT.**

I. Introduction

Although HA is such an interesting topic and useful technology, it has not entered the main stream market yet. Challenges posed by discrete implementation of technologies, cost, fragmentation in market have never allowed Home Automation Systems (HAS) to evolve and gain traction. HA can be implemented using IoT enabled boards like Raspberry Pi, Arduino, and various other micro controllers and System on Chip (SoC) [1]. Interconnection of these devices play an important role and are handled using Wireless technologies like Wireless Fidelity, Message Queuing Telemetry Transport, Bluetooth Low Energy, ZigBee, GSM. [2]

IoT is a network of embedded devices, softwares, sensors and interconnectivity tools for enabling data exchange between devices. This enables creation of complex systems which let the user exercise seamless control over electrical appliances using mobile phone or website based graphical user interface (GUI) applications [3], [4]. The hardware that is used for implementing HAS can also be used for security management using dedicated cameras. The cost factor has to be taken into serious consideration since the aim is to launch it to the mass market. Using tree topology, radio frequency modules, cheap micro controllers, Bluetooth technology and open source softwares can help dramatically reduce implementation costs.

Figure 1 shows the general procedure that is followed by HAS. The GUI applications are supported by various platforms such as Android, iOS and HTML web pages. Further status of the system is retrieved from the values measured by sensors. After having submitted the desired commands and receiving results, the connection is closed or otherwise the task is repeated, if required.
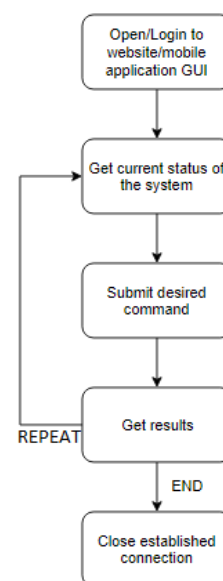
Fig. 1: Overview of General HAS Procedure

The subsequent sections of the paper have been organized as follows: Section II is Literature Survey which contains summary of all the papers and techniques read. Section III is Inferences drawn after reading all the techniques. Section IV contains the Conclusions that we have deduced from the research papers that have been read. Finally in section V we have discussed about the future work that is possible.

II. LITERATURE SURVEY

Figure 2 shows the overall architecture that is followed by [4], [5], [8], [9], [13], [16], [17], [21] in their paper.

Since Raspberry Pi and Arduino have been used in several techniques, their brief description has been given below.

1) Raspberry Pi: Raspberry Pi is an inexpensive computer, the size of a credit card, which was developed so that people could start learning how to code. It costs around INR 2300 ($35). It is literally only a chip with few peripherals like a 3.5mm headphone jack, HDMI pin, USB ports, power-in port to name a few. It is technically a complete Linux computer, even though it is slower than many modern ones.

2) Arduino: Arduino is a micro controller which can be used for performing simple and repetitive computing tasks. It is cheaper than Raspberry Pi and does not have the processing capabilities like it. Its cheapest, most basic version is available for INR 550 ($8.5). Since it is open source makes it easier for people to get help online and that too very fast. Besides, it uses a simplified version of C++ for programming, which is a very popular programming language.
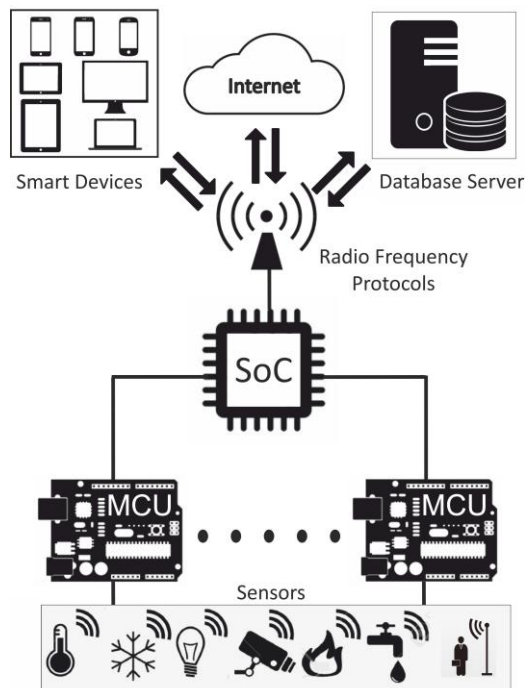
Fig. 2: Overall Architecture of HAS

A. Internet Based Sensor Networking & Home Automation Using Cortex Processor on Linux Platform (Raspberry Pi2)

Raspberry Pi 2 is used as the SoC mentioned in Figure 2, and has various sensors such as PIR/motion sensors. The system consists of two components a server and hardware interface modules. The server which is a normal PC controls the hardware interface modules which in turn control the sensors and actuators. The system is flexible enough to add new sensors in a wider area/range (Example: Security for two adjacent houses) and is easily configurable as long as it is in the range of Wi-Fi Router. The system is accessed & controlled using web pages which is developed using ASP.NET. When anyone enters a room, the sensors detect entry motion and lights are turned on automatically and switched off when no one is there in the room [5].

B. Implementation of Speech Based HAS Using Bluetooth and GSM

In this technique, a HAS has been proposed with the ability to control lights in the house, while also providing security features and intruder detection while the owner is not at home. Comparing the system with general layout in figure 2, it can be seen that the SoC used is Raspberry Pi. The sensor used is PIR. The smart devices used to control the system are mobile phones and tablets with Bluetooth and/or GSM built-in. It uses a Passive Infrared Sensor (PIR) for detection of an intruder and USB Web Camera for capturing footage of the house if an intrusion is detected in the house. It uses a Wi-Fi router for connecting the Raspberry Pi to the Internet. The system has two ways of handling commands from the user. They are:

1. *Bluetooth*
2. *GSM*

Bluetooth can be used at home, involving the Arduino Bluetooth Control application, which can send voice command given as input to the HC 05 Bluetooth module [6] which is connected to Raspberry Pi. Bluetooth has a very short range and thus cannot be used when we are not at home.

If the system is away Short Message Service (SMS) can be used to send commands to Raspberry Pi. SIM 900A GSM Modem [7] is interfaced with Raspberry Pi to achieve this functionality. Using Google's Speech-to-Text application, an SMS can be sent to the modem, which is intercepted by Raspberry Pi.

For security purposes, a Pyroelectric Sensor (PIR) and USB Web Camera can be installed for monitoring the house when the user is not at home. Python programming language has been used for writing the software because of its in-built libraries and also since it is an open source language. Figure 3 shows flowchart of the working system.

Raspberry Pi is conneccted to a Wi-Fi router and ExtraPuTTY software is used for logging into the Raspberry Pi, which then gets connected to the Internet and can be accessed from anywhere to view the stream of USB Web Camera.
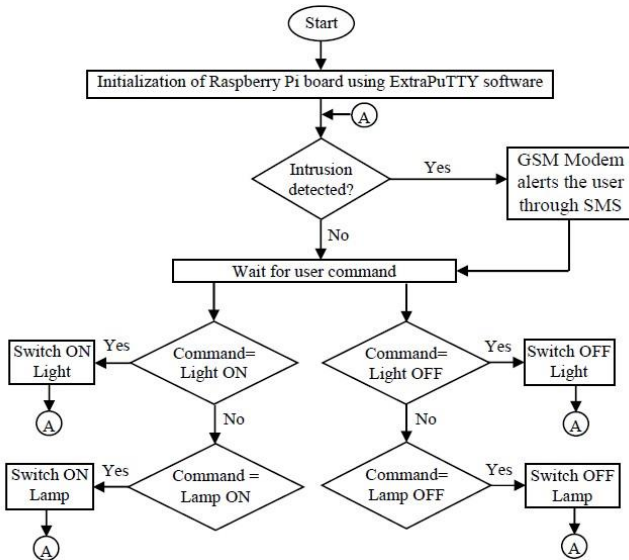
Fig. 3: Flowchart of speech based HAS [8].

The PIR Sensor consists of a material sensitive to Infrared Radiation, which is emitted by humans and even animals. Whenever the PIR Sensor detects the presence of an intruder, SMS is sent to the owner stating that an intrusion has been detected. The user can then connect to the Raspberry Pi via the Internet and view the stream from USB Web Camera installed in the house and inform the relevant authorities if the intrusion is genuine. To ensure that the PIR Sensor does not make false alarms due to the presence of animals in the house, multiple PIR Sensors can be arranged in a form of a tower. Only if all the sensors go off, it means that a human intrusion has occurred.

C. Enhanced Home Automation System using Internet of Things

The system contains Raspberry Pi as SoC defined in Figure 2, and uses Arduino Uno as micro controller unit. An android application is used to visualize the data provided by the raspberry which is intern provided by the sensors to it. Data is collected by the sensors and sent to Raspberry Pi. Raspberry Pi, which is connected to the Internet send and stored the collected data in Firebase. This data is retrieved by the mobile app to be displayed to the user as a feature of monitoring the data and also being able to control the system with help of the same application as a feature of controlling the HAS. Figure 4 shows the diagram of proposed HAS.

D. A Low Cost HAS Using Wi-Fi Based Wireless Sensor Network Incorporating IoT

This paper aims at providing cost effective solutions to HAS which many existing systems have failed to achieve. Tree Topology is extensively used to reduce the cost. Cheaper micro controllers have been installed in quantity. Existing systems use expensive sensors and standardized protocols for communication which make the setup cumbersome and
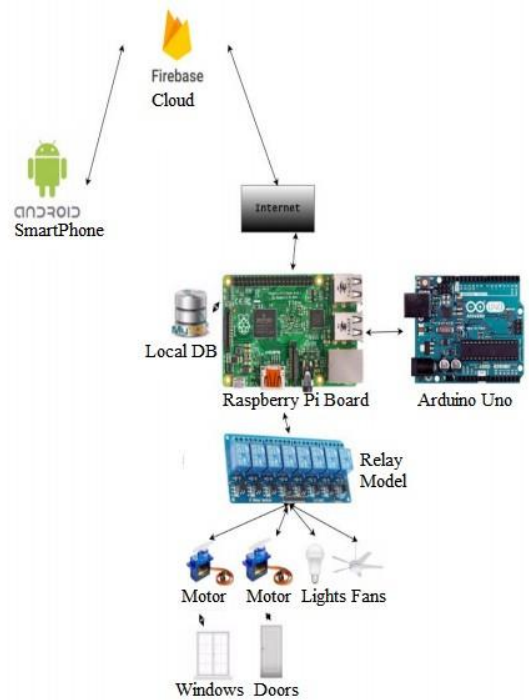
Fig. 4: Enhanced HAS using IoT [9].

expensive. So instead of using Wi-Fi or other standard protocol, Radio Frequency (RF) is used. Each and every device communicates directly with the micro controller using RF. Figure 5 shows how tree topology is implemented
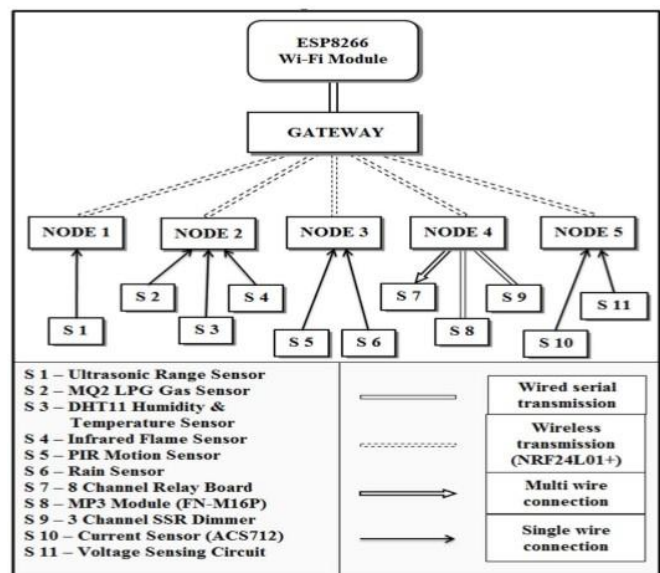
Fig. 5: Organization of nodes in Tree Topology [4]

and connections are established.The user here is provided with a graphical user interface that allows him to exercise seamless control over connected devices. Mobile commands use Message Queuing Telemetry Transport. Overall cost of this system is estimated around USD 100. A gateway is setup

that acts as data coordination sensor. Parameters measured by the sensors is communicated to nearby micro controller. GUI supported - Android application that can access server shown in Figure 6. Features provided include:
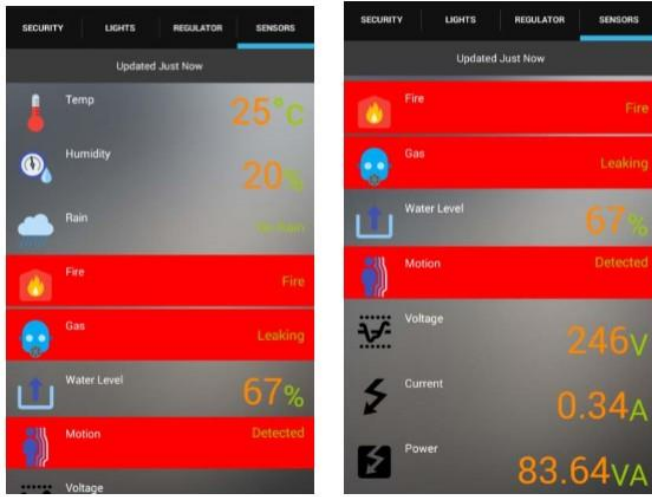
Fig. 6: Application window showing the information console of low cost HAS [4]

1. *Temperature and humidity sensing*
2. *Gas leakage sensing*
3. *Fire management*
4. *Rain sensing*
5. *Regulation of power consumption*
6. *Alarm System for intruders*
7. *Voltage regulation sensing*

This system uses ESP8266 with Wi-Fi Module, Atmel ATmega micro controller, nrf24101+RF modules, and other sensors as hardware [10]. Software design platforms such as ATmega IDE, ESPlorer, and Android Studio were used. Flow Chart for software implementation can be found in Figure 7.

E. An IoT Based Home Automation Using Android Application

This technique proposes a Wi-Fi based HAS using Arduino Mega micro-controller. Instead of only providing on and off functionalities for lights and fans, it also allows us to control the intensity of light and speed of the fan. The Arduino board is connected to the Internet using HLK-RM04 Wi-Fi module [11]. The L293D Motor Driver Integrated Circuit (IC) is used for controlling motion of the fan.

The HAS is controlled using an Android application that has been built for this purpose. After logging into the mobile application, the user connects to the Wi-Fi module, after which user can control the intensity of light and speed of fan. Although Arduino does not have a built-in Digital to Analog converter, the intensity of light and fan can be controlled using output pins and Pulse Width Modulation (PWM) . PWM is a technique which creates a square wave by switching the signal between on and off. This way, we can simulate
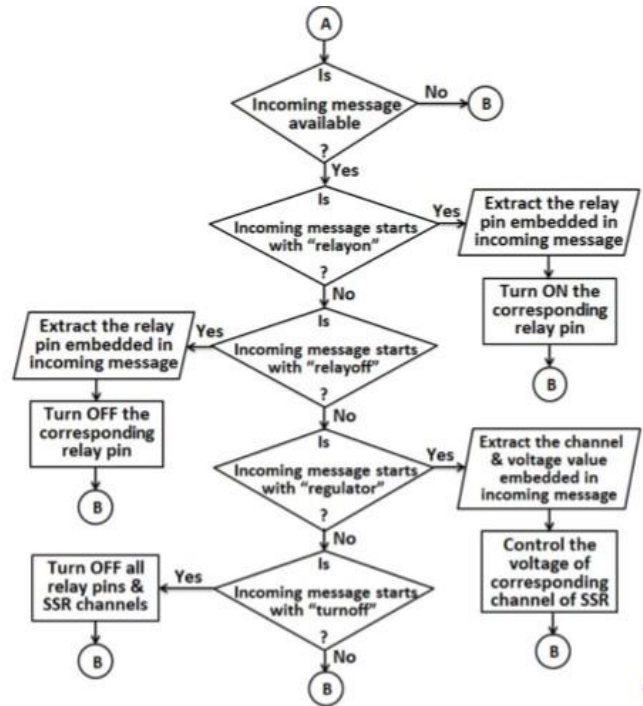
Fig. 7: Flowchart of implementation of low cost HAS [4]

voltages between 0 and 5 volts. This happens by changing the duration of time for which the signal is ON versus the amount of time it is OFF [12]. There is one problem that can arise because of using PWM. It is that the fan can become noisy because of the sharp edges that created by PWM waveform which causes motor of the fan to continuously turn on and off. Figure 8 shows different duty cycles, where a specification of 255 suggests that the signal is on the whole time. A specification of 191 means that the signal will remain ON for 75% of the time, and so on.

A Light Dependent Resistor (LDR) is used for detecting lighting conditions in the house. It works on the principle of photo conductivity. LM35 Temperature sensor is used for detecting temperature. It measures temperature in Centigrades. For a place where it is very cold and the temperature is negative, we can use the LM34 Fahrenheit sensor. This information is displayed on the LCD screen attached to Arduino.

There is also a rain sensor that has been used to detect the presence of rain. The sensor board can be assumed to be a variable resistor which changes its resistance based on the amount of water that falls on it. More water present on the board translates to lesser resistance.

F. MQTT Based Home Automation System Using ESP8266

Message Queuing Telemetry Transport (MQTT) is a light weight protocol used to develop a common gateway for all devices to intercommunicate. An attempt to implement MQTT on ESP 8266 is made in this system. The sensors
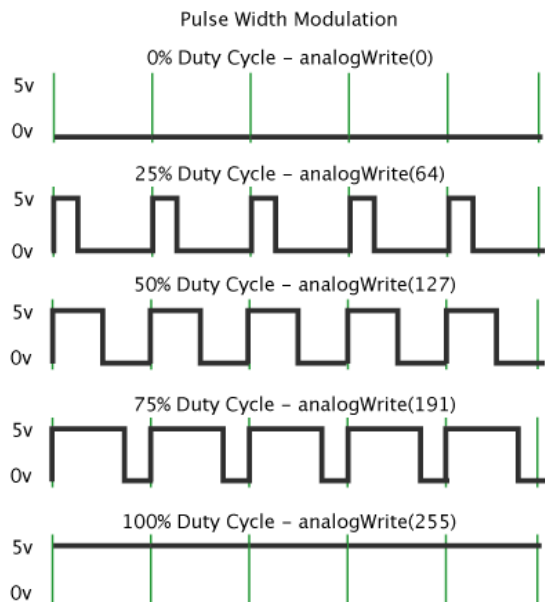
Fig. 8: PWM configurations [12]

Fig. 9: MQTT Commands [13].

and actuators are connected to the ESP 8266 and a broker known as Mosquitto is used to establish a remote monitoring and controlling system. A MQTT service requires two kinds of agents:

1. MQTT client: Can either be a publisher or a subscriber. Publisher publishes messages (sends) and a subscriber receives these messages sent by the publisher. There can be many subscribers for a single publisher. Mobiles phones are examples of MQTT clients.

2. MQTT broker/server: Is responsible for collection and organization of information. A subscriber subscribes to a publisher and a publisher sends messages to the subscribers that have subscribed to them. Sensors are MQTT clients which Publish data and Smart Phones are MQTT clients who receive the data of the topic which they have subscribed to. Figure 9 shows some of the MQTT Commands.

Any data which is transmitted via a MQTT server is known as application message.

G. Home: IoT Based Home Automation Using NFC

The system proposed by authors use Near Field Communication (NFC) and General Package Radio Service (GPRS)/ GSM to control the HAS. It uses LPC2148 [14] Micro-controller, MIFare Classic NFC Card, CR0381 NFCReader, GSM Modem, LM35 Temperature sensor, LDR, an LCD screen and relays to control the light, fan and lock.

NFC is a combination of communication protocols that allow two electronic devices, placed around 4 centimeters of each other, to exchange data quite effortlessly. No pairing is required, and it is much more energy efficient than other wireless communication protocols. NFC is easily usable, is being adapted by a variety of commercial ventures and different businesses. NFC also provides security and safety

[15]. Figure 10 shows the experimental setup of the author.
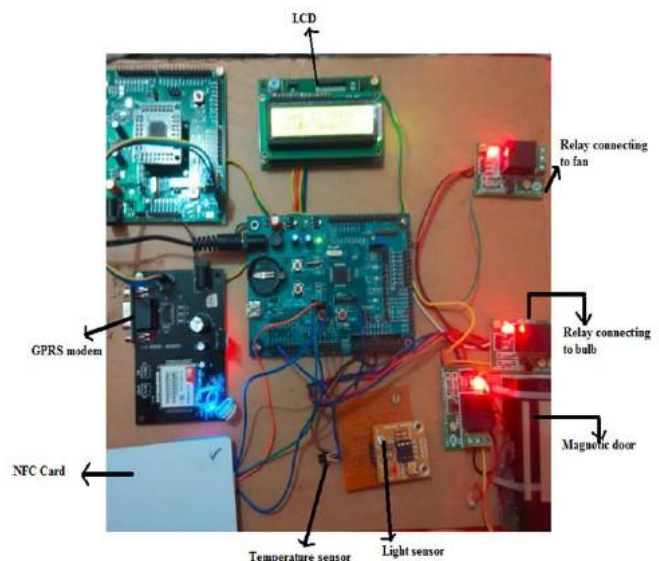
Fig. 10: Experimental setup of NFC based HAS [15].

The board will have an NFC reader attached to it and will be placed near the passageway. User swipes NFC Card near the Reader while entering the house, which will either be accepted or rejected by the system. Reader is configured to accept only specific NFC Cards. If system accepts the swiped card, the following processes take place.

1. The entryway gets unbolted

2. The LDR is used to sense the amount of light present in the house and if required, the light is turned on automatically

3. Temperature in the house is sensed and if it is above the predefined value, the fan is also turned on automatically

Whilst leaving, owner swipes the card again. This time, the following happens:
1. The entryway gets bolted
2. If lights are on, they are turned off
3. If the fan is on, it gets turned off

In case the user is not at home and wants to control the electrical appliances at home, they can do so by using the application that has been suggested. The mobile application has the options to turn ON or OFF the switches. These buttons have a PHP script that is executed when they are pressed which sends corresponding commands to the GSM Modem via which micro-controller executes the required task.

It can be said that using NFC for implementing HAS is a effective solution, since it is very energy efficient and does not require the tedious task of pairing devices and writing complex code just for initializing the entire system.

H. A Smart HA Technique with Raspberry Pi using IoT

Computer implemented on an SoC together with Computer Vision (CV) [16] enable the proposer here to build HAS with security. From the general architecture given in figure 2, it is evident that this technique follows all sequence but not Micro controller module. Raspberry Pi is used here instead of a micro controller because it cannot execute multiple programs at once, or process a video. Here communications take place directly between SoC and Sensors. If at anytime a motion is detected by the sensors, dedicated cameras will start recording the footage and user is sent an SMS and alarm call.

1) Simple Computer Vision Technique: Simple CV [17] is an open source library that can be used to create vision applications. It allows working directly on the images that originate from Internet protocol cameras or USB cameras. Simple CVT is written in Python and is compatible with MAC, Windows, Ubuntu and Linux.

2) M-JPG Streamer: This is a command line tool that can stream JPG on an Internet Protocol based network from cameras to a viewer. This streamer deals with input and output plugins [18]. Since this streamer is faster than most of the streamer it makes it ideal for this remote control application where real time video feed is required.
Users can control any home appliance through their mobile or laptop with Internet connectivity. A program is written that can retrieve the current status of the device i.e ON or OFF. Another program is written that accesses the camera through HDMI. Figure 11 shows the Command Line terminal for results. Figure 12 shows the algorithm that is used for surveillance.

I. Enhanced Smart Doorbell System Based On Face Recognition

This paper aims at proposing a cost effective solution for face recognition HAS using Raspberry Pi Board with OpenCV

Fig. 11: Raspberry Pi Terminal Showing Results [19]
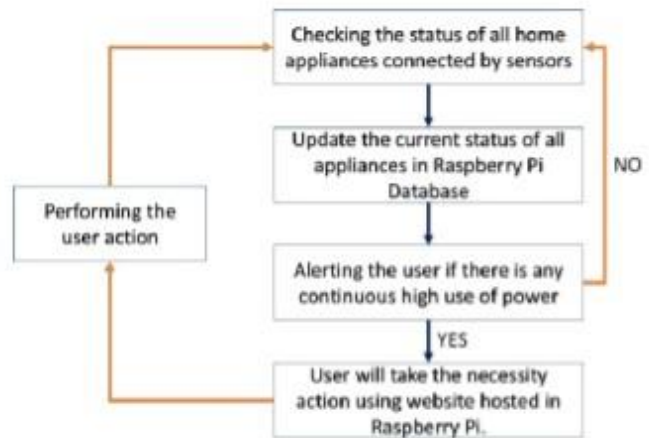
Fig. 12: Algorithm for surveillance system [19]

libraries [20]. Architecture followed here is similar to Figure 2 with no micro controller module. This cheap surveillance can be used in many other fields other than homes like crowded areas, airport, etc. This not only detects faces but also recognizes it using training files stored in databases. Any intruder detection may fork many alerts accordingly. This is based on low power consumption and is activated only when a doorbell is pressed. The system procedures that are followed may be seen in figure 13.

Procedure is as follows: First the specific characteristics are fetched from the image, then it is compared with existing database. If no match is found then the face shape is resolved using Haar-like features [22] and Eigen Face Algorithm [23] to produce a template. Figure 14 shows how Haar Like features can be implemented on LENA Picture. Finally the face is stored in database using other algorithms. Here this procedure is initiated when a doorbell is pressed.

Face Detection is pin pointing the presence of human figure
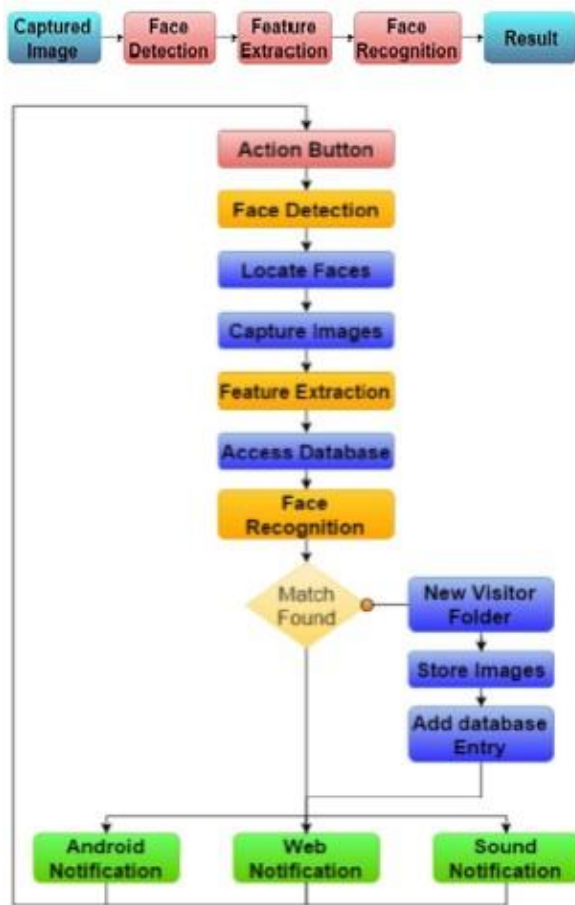
Fig. 13: Algorithm for surveillance system [21]

Fig. 14: Haar-like features on LENA Picture [21]

for processing of the face. To provide independence of face from environmental lightning conditions, feature extraction is an important step. This step transforms face into a vector using training file (XML file). The immediate step now is comparing this vector with available database which is done using eigen face algorithms which follow Principal Component Analysis.

III. INFERENCES

The given table rightly correlates with the generalized architecture design as follows:

1. The Boards show what kind of SoC is being used

2. Technology used shows which smart devices, database server, protocols are compatible with the product

3. Operating Module shows the sensors and MCUs that are involved Thus we can deduce that depending on the functionality that is required, we can select specific components from above mentioned applications. The architecture is modular in nature, inclusion and deletion of certain modules is possible to manipulate cost and functionality.

It was generally observed that the HAS with Security costs above INR 6000 ($90) and systems with only remote control of devices costs approximately INR 4000 ($60). It is evident that there is not much difference between the cost here, so integrating security with HAS is the idea to go with.

Certain techniques have allowed the users to use multiple ways for controlling the HAS, providing high reliability. Using very cheap hardware modules will decrease reliability of the system. If HAS is implemented using commonly available hardware, they can be fixed easily and cheaply, in case of any failure.

IV. CONCLUSION

The main aim of this paper is to gain reviews from the already existing techniques and also know how different modules in HAS work. A generalized architecture has been described here. It is observed that inclusion and deletion of certain modules in the proposed architectures can give cost effective solutions as well as highly secure systems. After reading and summarizing the above mentioned techniques, certain changes have been stated (in Section V) to further improve these systems. It is assumed that in future many other IoT enabled boards will be launched and the proposed systems take great advantage of those modules.

V. FUTURE WORK

With the flexibility offered by different techniques in HA, following functionalities can be added to the existing system easily:

1) Machine Learning approach for detecting presence of humans indirectly maybe integrated

2) Cheap micro-controllers can be used for cost effective solutions

3) Embed more sensors which provide accessibility to disabled users, so that the systems can be installed in orphanages and old age homes

4) A hardware can be introduced that handles security much better than software libraries

5) Increase in Carbon Monoxide levels can be traced to alert

TABLE 1

Parameters	Technique 1	Technique 2	Technique 3	Technique 4	Technique 5	Technique 6	Technique 7	Technique 8	Technique 9
Board	Raspberry Pi	ESP 8266	Arduino	Raspberry Pi	ESP 8266	Raspberry Pi	Raspberry Pi	LPC2148 MCU	Raspberry & Arduino Uno
Focuses On	Security and Motion Detection	Low Cost home Automation	Light intensity control and fan speed control.	Security, light and fan automation.	Device comm., monitoring and control	Light & Fan control & Security.	Low Cost home security based on Face Recognition	Light, fan and entryway locking/unlocking control	Light, Fan, Temperature Control, Water Harvesting
Technology	Computer Vision, M-JPG Streamer, MYSQLDB	Tree Topology, Wi-Fi, Android Application, MQTT	Android, TCP/IP	Python, Android, GSM, Bluetooth.	MQTT, Mosquitto broker, Wi-Fi	Wi-Fi, Server, LAN,	Using Haar like features, Eigen face algorithm.	NFC, GSM/GPRS	Firebase, Raspberyry Pi,
Operating Modules	OpenCV Libraries, Website, SMS	Atmega μC, RF modules, various sensors, SPDT, TRIAC Relay, alarms	Light dependent resistor, rain sensor, Wi-Fi module.	Raspberry board, GSM modem, Bluetooth chip, relays, PIR Sensor.	Sensors and actuators, devices like phones, PC/laptop	Sensors, Modules, WLAN, Devices to operate	Website, SQL, PHP, OpenCV Libraries, Training files.	Relays, GSM Modem, door lock	Firebase, Relay models, Infinite State data flow, Motion sensors
Approx Cost	INR 5000 ($75)	INR 6000 ($90)	INR 4500 ($70)	INR 7000 ($110)	INR 1000 ($ 15)	INR 4000- 4500 ($65-70)	INR 6000 ($90)	INR 3700 ($55 - $60)	INR 4200 ($65)
Details	No face detection, so fake alarms possible. Otherwise Hardware is highly reliable.	No Security provided. Atmega μC are not so reliable. Tree topology is highly reliable.	No security has been implemented. Light and fans can be operated reliably.	Very reliable, since there are two ways we can control our appliances.	Simple & easy to implement, no overhead, doesn't know if receiver exists or not.	Secure WLAN(LAN) connection, can be modified easily, automatic control + device controls.	Face detection level Security provided. OpenCV is used to cut the cost. Android app is also made.	User friendly, easy to setup, and use. It is also secure.	Runs Infinitely, monitoring and data controls through mobile app, Cloud connectivity.

user for maintaining quality lifestyle

6) Including support for Email service with SMS will remove the cost of sending SMS. Besides, if there is no Internet connection, we can still control HAS by sending SMS.

7) Integration of cloud backup systems to train machine learning modules

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G-SMART ATM

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Abstract - **The aim of this system is to design an embedded ATM machine with unique identity. The system consists of database where the fingerprints of an account holder are stored. Wherein further on access of an account the fingerprint stored in the database is compared with the user's fingerprint. On successful matching of fingerprint GSM modem connected to the microcontroller of the system generates OTP which is received on users registered mobile number. After entering the OTP, it is matched with the OTP generated by the system. On successful authentication the right is provided to the user to access his bank account or to work on transactions related to his account.**

Keywords- **Fingerprint Recognition, GSM (global system for mobile), ATM (automated teller machine) Terminal, PIC16F877.**

I. INTRODUCTION

The problem in the existing ATM system is that once the user's bank card is lost or stolen and the PIN is known by unauthorized person, the user's account is vulnerable to attack. Thus, to diminish the problem, our proposed ATM system has three security levels. There are three main stages in our project. First is PIN verification, second is OTP generation and verification and third is Fingerprint Recognition. In this system, first a database containing the user's name, PIN, fingerprint and mobile number is created and stored in PIC 16F8777 microcontroller. The system will ask the user to enter the PIN. This entered PIN would be matched with that in the database and it would then display the user name associated with that PIN. The user needs to remember the PIN and should not share it with others to prevent unauthorized access to his account. Then the system asks the user to enter the PIN. The received PIN is compared with the PIN from database.

OTP generation algorithm typically makes use of pseudo randomness or randomness. This is necessary because otherwise it would be easy to predict future OTPs by observing previous ones. [1] Thus, this project requires OTPs which are valid only for a short period of time. In these OTP systems, time is an important part of the password algorithm, since the generation of new passwords is based on the current time. Minutiae are the points of interest in a fingerprint, such as bifurcations and ridge endings. Thus, points are required to be extracted from the scanned fingerprint and compare with minutiae of the fingerprint in the database. A fast fingerprint enhancement and minutiae extraction algorithm which improves the clarity of the ridge and valley structures of the input fingerprint images based on the frequency and orientation of the local ridges and thereby extracting correct minutiae is required. [7]

II. LITERATURE SURVEY

Kaul Urvashi (2007) in his article, "ATM: The Power of Cash" explained the importance and benefits of ATM, the players in the Indian market and presented various statistical data concerning the growth of ATM. Manager FSDNCR Corporation India Pvt. Ltd. [2] (2008) in his article, "ATMs: Changing Fundamentals" stressed that he Indian ATM industry has seen explosive growth in recent times and Banks have committed to substantial capital outlays on ATM deployment, recognizing the significance of the 3 Ms – Maintenance, Monitoring and Management – of the ATMs to make the self-service channel a reliable and profitable one. [2]

In today's world, fingerprint is one of the essential variables used for enforcing security and maintaining a reliable identification of any individual. Fingerprints are used as variables of security during voting, examination, operation of bank accounts among others. The comparative analysis by the result of the survey conducted by International Biometric Group with other Biometrics in 2012 is shown below.
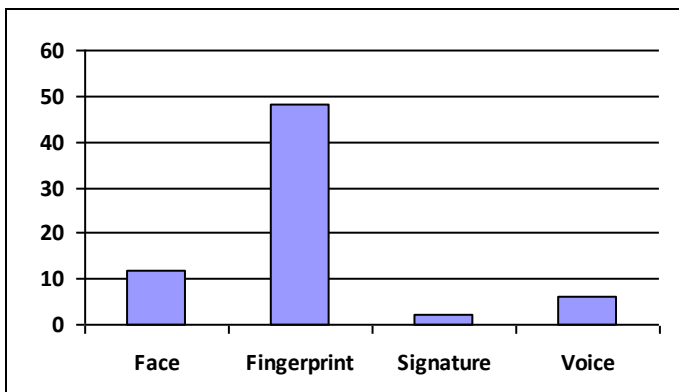
Figure 1: Comparative survey of fingerprint with other Biometrics.

III. SYSTEM DESIGN

A) Authorized Access

Authorized access i.e. for the successful transaction, firstly the system would display "G Smart ATM Security K.J.S.I.E.I.T Year 2017-18" and would ask the user to enter the respective password. For example if the password of a particular user is "786" he will enter it using keypad if at all the password matches with the same as stored in database of the respective user, the system will response using LCD which says "match found". Since the system consist of double security it would generate the OTP and will ask the user to enter the OTP same as received on the user's mobile number. After successful matching of OTP system will ask user to scan its finger which is also authenticated by matching the fingerprint stored in the database of the respective user. If all those steps are done successfully only then the system would allow user to make the transaction by entering the amount he/she wants to withdraw/deposit. SMS about the transaction is received on user's mobile number using GSM.

B) Unauthorized Access

Unauthorized access i.e. for the unsuccessful transaction, the procedure till the system asking for the password in the above section would be same. This is unauthorized i.e. if the password entered by the user is false or the match is not found. The system would ask you to try again and will also inform the user by sending him the SMS about the incorrect password. If the passwords seems to be correct but the OTP sent on the user's mobile is entered wrong, this incorrectness of OTP is also informed to the user using GSM and the system would display "OTP IS MISMATCHED SORRY" and then transaction is not proceeded further it is cancelled.

IV. PROPOSED MODEL

A) Hardware Design

i) LCD

Various display devices such as seven segment displays, LCD display can be interfaced with microcontroller to read the output directly. In our project we use a two-line LCD display with 16 characters each.
FEATURES:
• 5 x 8 dots with cursor
• Built-in controller (KS 0066 or Equivalent)
• + 5V power supply
• 1/16 duty cycle
• B/L to be driven by pin 1, pin 2 or pin 15, pin 16 or A.K (LED)
• N.V. optional for + 3V power supply.

ii) Finger Print Module

This module uses biometrics which secures this system. This module will make port, and sends data to, detect prints, and take photos, search and hash. You can also enroll new fingerprints verification and fingerprint detection simple. It consists of DSP chip that does the calculation, image rendering, searching and feature-finding.[2] This module can be connected to any microcontroller or system with TTL serial directly that is up to 162 finger prints can be stored in the onboard FLASH memory. There's a red LED in the lens that lights up during a scan so you know it's working properly.

iii) GSM Module

This module is today the most successful digital mobile communication system. This second-generation system provides voice and limited data services and uses digital modulation with improved audio quality. GSM Module is used to establish communication between a computer and a GSM System. GSM module consists of communication interfaces like RS-232 for computer. The GSM module that we are using in this unit is the SIM300 module. [6]

iv) Microcontroller

Controller which we are using in this system is PIC 16F877A. This Controller Controls this system.

Microcontroller used in this system is interfaced with LCD display, GSM, Fingerprint Module, and Keypad. As the user enters the passcode through keypad controller will check for the same code in database if it is matched. OTP is send to user's personal number via GSM. User enters this OTP and LCD displays 'Scan Finger'. After Scanning this fingerprint is verified by controller with fingerprint stored in the database. If it gets verified transaction process begins.

B) Software Design

Figure 2. The overall flowchart of software.

The above flowchart shows the overall flow of program of the system. The program consists of two modes, the user mode and the admin mode. The person accessing the ATM machine for transactions would automatically enter the user mode by selecting the option of user mode. If at all the system needs any changes or wants to add the user in it or want to store the fingerprint the person would enter the admin mode automatically by selecting the admin mode.

Figure 3. The flowchart of fingerprint recognition

This algorithm of fingerprint recognition plays an important role in this ATM system. There are two steps to process the image of fingerprint.

1. Fingerprint recognition process.
2. Fingerprint image enhancement.

Fingerprint recognition process:
In this process pre-processing of fingerprint image is required. Pre-processing are the ones like filtering, histogram computing, image binarization and image enhancement. [4] The characteristics obtained from the users fingerprint while accessing is further compared with the image stored in the database to verify whether the characteristics matches or it does not.

Fingerprint image enhancement:
Fingerprint image enhancement is based on Gabor filter. The Gabor filter in used to remove the noise from the image and strengthen it. The Gabor filter best states the definition

between valley and ridge. But this algorithm fails for high capacity requirement. [5]

V. RESULT AND CONCLUSION

Table 1. Comparison of existing and proposed ATM system

Technique	Existing ATM system	Proposed ATM system
PIN (Personal identification number)	Yes	No
OTP (one-time password)	No	Yes
Fingerprint recognition	No	Yes
Time required	1 minute	1 minute 30 secs

The existing ATM system takes less time for the transaction but is insecure due to tremendous increase in the number of criminals and their activities. Instead, the proposed ATM system requires more time for transaction than the existing ATM system but provides immense security due to fingerprint recognition and OTP. So we have to compromise with time for the sake of security. Thus the proposed ATM system works with only the authorized ATM card holder. This system can be implemented firstly at small industries and institutions with limited workers.

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Smart Shopping System

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Abstract-As the population of India grows, there is more and more crowding in urban cities. Consequently, the number of people in the retail shops and malls has increased manifold. Within a span of 5 years, the number of shopping malls in India has almost doubled, so has the number of people visiting these malls. Another factor causing growth of people visiting malls is the decrease in product prices and the large number of sales and discounts with run throughout the year. This has also resulted in an increase in the waiting times at the checkout queue. This is a major inconvenience to the consumers as they have to wait a long time in these queues. We have designed a system to reduce these queues by reducing the checkout times using smart shopping baskets.This isachieved by implementing a system in which the items are scanned before reaching the queue itself. The product information will be stored in the cart and the count will be displayed with a facility to prevent misuse of the system. This can be used to increase the throughput in the shops as it will allow people to get in and out faster and is beneficial for the shop. This paper will discuss the aforementioned system with obtained results.

Keywords-Shopping, barcodes, RFID, application, Android

I. INTRODUCTION

In this consumer age, people prefer to shop at bigger stores like shopping malls and supermarkets. These places usually make use of shopping carts and baskets to ease the process of shopping. The customers have to place the desired products in their cart and then proceed to pay the bill and check out. The billing process is a long-drawn process that requires sufficient manpower, yet takes a lot of times to complete as seen in paper [1]. In this paper, we propose a system through which the waiting time of the customer can be reduced to a great extent. This will allow a smoother process of shopping and prevent the formation of long queues. It will consist of two parts a barcode reader mobile application, and microprocessor with Bluetooth module, a LCD display, and a rechargeable battery on the cart. The customer will scan the barcodes using an application on their mobile device. The barcode information will be stored into the mobile application and sent over Bluetooth to microprocessor. The mobile application process the parameters and display relevant information on the cart screen. If the customer is ready to make a checkout, he would pass the cart through the cashier. The total price and other required details will be sent to the cashier and the receipt will be automatically printed. The customer will just have to pay the bill using the appropriate payment method and then proceed to leave without waiting for a long time. The above details will be mentioned in the following sections. Section II discusses the work done un this field. Section III discusses the current shopping process with its limitations and section IV describes the proposed solution. The results of the application are presented in section V.

II. LITRATURE SURVEY

The idea of making shopping more efficient has been in the works for many years. Even though there has been a rise in sources shopping, people still prefer to make many purchases in shops. In paper [1] the idea of using an individual barcode scanner along with RFID was explored. Using a barcode scanning device however is expensive and not cost efficient. Ganwal, Roy and Banpat[2]father tried to refine this idea by using an error detection system on the basis of weight in conjunction with the RFID and barcode system. Weight becomes an unreliable error control system as it is possible the weight of products might vary thereby giving inefficient error detection. Li, Song, Capurso, Yu, Couture, and Cheng [4] made use of elliptical cryptography to make error detection more efficient as compared to using a weight sensor. They also introduced the idea of putting the concept of internet of things (IoT) to this system, which is a rapidly growing technology. Their system had a complex intermingling of many networks. This idea was further explored by Iyer, Dhabu and Mohanty [7] who continued work on the IoT aspect of the system. Y. Yamamoto, T. Kawabe, S. Tsuruta, Ernesto Damiani, Atsuo Yoshitaka, Yoshiyuki Mizuno, Yoshitaka Sakurai, Rainer Knauf[8] delved into the psychological aspect of the system analyzing how feasible it is in the current competitive environment. We have worked to integrate the internet of things in our system and make it cost efficient by using an application in placed of a physical scanner.

III. EXSISTING SYSTEM
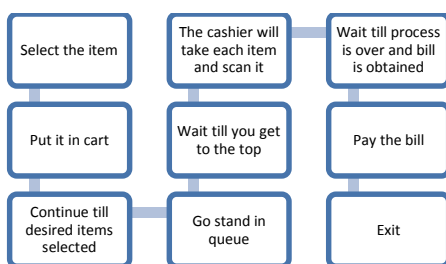
Figure 1. Conventional shopping system

The above flow chart shows the current shopping system seen almost universally in every super market. The customer selects the product he wishes to buy and puts it in the cart/basket. He continues to do this till he gets the desired number of items. He may also remove or replace certain items from the cart. After this is done he will proceed to the checkout counter. There he will have to wait in the queue for some time till his turn. Sometimes it happens that for small number of items the customer has to wait for large amount of time. This happens when person with less items is standing behind people with higher number of items. So a large amount of time is spent which may be comparable to the actual shopping time. Once his turn occurs, the cashier scans the items one by one and the customer has to wait till the bill is generated. After this he pays the bill by any appropriate payment method and then exits.

IV. PROPOSED SYSTEM

A. Proposed system flow
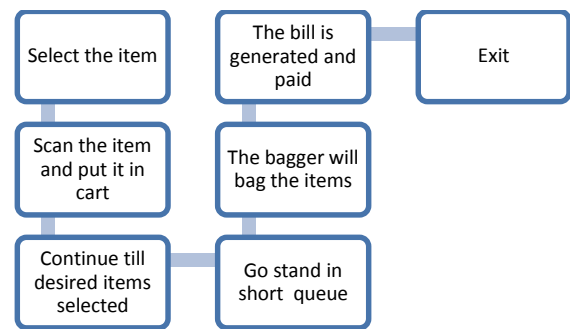
Figure 2. Proposed system

The proposed shopping system consists of two parts; the mobile application and the shopping cart. The features supported by them are mentioned in the following subsections.

a) Features of the mobile application:
1) Scanning the barcode of the product is the basic function of the mobile application
2) It updates the bill as per the incoming items and calculates the total bill.
3) The customer will be able to keep track of the purchased items as well

b) Features of the shopping cart:
1) Contains the main processing unit
2) Takes care of error control
3) Communicates with the mobile application and displays the relevant item information

As the goal of the Smart Shopping System is speeding up the shopping process, one major requirement is to have the bar code of a product scanned by the customer itself, instead of scanning at the checkout counter. RFID tags would also be present on the product to provide additional security. So even if the customer fails to scan the item using bar code the product will be added in the item list on the application.   Hence, this design includes a android-based bar code scanner application and efficient use of RFID technology. The same details will be contained in the RFID tags placed on expensive items. The information contained in the barcode is name, weight, price and class. Each item will be assigned a weight class. The processor would also keep a track of the inventory system. Thus at checkout the data from mobile application is sent to the server through wireless communication. This saves a lot of time of the customer as s/he is not supposed to wait in long queues.

B. Operation
Following is the operation of the smart system:

First, when the customer enters the shop, he picks up the smart shopping cart. When mobile app is launched, Bluetooth needs to be enabled and should be connected to the cart by accepting the connection. Then further s/he would pick an item, scan it using the application and the product details would be displayed on the mobile screen as well as on the LCD screen. Then as more number of items are scanned and placed in the cart, the total amount and total count of items is displayed on the screen. If the customer wants to remove an item s/he would simply select the item from the list and press the remove item button on the screen. Now the updated amount and count is displayed. As the app is connected to the cart via Bluetooth, the product details on the LCD screen are also updated. In any case if the customer does not scan the item and directly puts it in the cart, then the RFID tag contained on it will be read by the RFID programmer and thus the item details will be automatically added in the list on the mobile app. As and when a customer scans the item using the app, the corresponding changes in the inventory would be reflected in the inventory database. When customer is done with shopping, he should press the checkout button on the app and he would get a digital bill. This

bill is sent to the server database .so at the checkout he just has to pay and get the products packed.

V. RESULTS

1) Mobile app was tested and successfully implemented.
2) RFID tag was programmed and verified.
3) Cart Hardware and app were connected and relevant information was exchanged.
The mobile application results are shown below
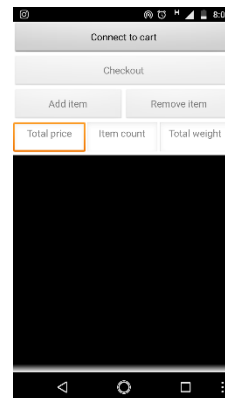
Figure 3   Figure 4

Figure 3 shows the basic layout of the application. It consists of a simple interface that initially has all the buttons locked except the connect to cart button. Figure 4 is the connect screen accessed by selecting connect to the cart. Here the addresses of the Bluetooth devices are displayed and the user needs to connect to the cart.
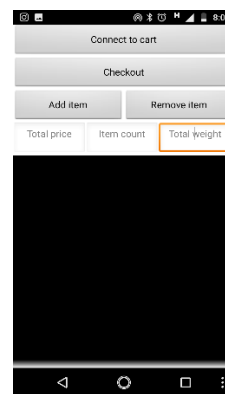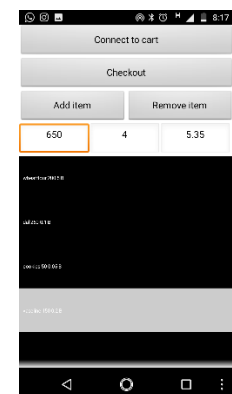
Figure 5   Figure 6

Figure 5 shows the app screen after connection has been established. Now add to the cart button and

remove from cart button has also been enabled. The user can select add to cart post which the barcode scanner will be enabled and scan the barcode. This is seen in figure 6 where a list of items has been added to the cart. The price is updated at every addition or removal of items in the list.
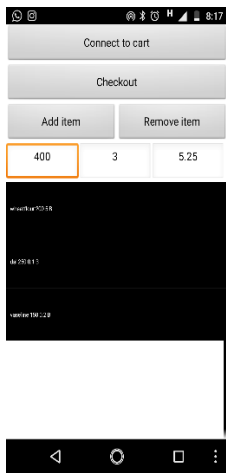
Figure 7   Figure 8

Figure 7 shows the removal of item from the list. This will reduce the total amount. Figure 8 sows the checkout screen where the total bill is presented with the number of itmes.
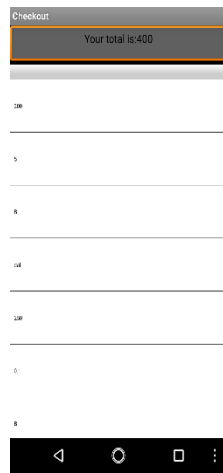
VI.   CONCLUSION

The desired objectives of system were willingly achieved in developed prototype model. Thesystem would successfully demonstrate the use of mobile application for scanning barcode of products for designing a smart shopping system which eases the entire procedure of billing. The cart which was developed would be efficient, fair and price effective. The technology is effective as it requires only one passive sensor (the load-cell). Our application makes uses a simple Bluetooth technique to ease communication with the shopping cart. In a bigger picture it also reduces manpower as the system is automated. As a bill is digitally generated there is no need to print the bill, which saves paper.

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Low Cost Self Assistive Wheelchair

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Abstract— **The Automated Wheelchair facilitates the physically disabled person to automatically operate the wheelchair with the help of a joystick. The aim of this project is to use a joystick to drive a wheelchair. It grants the user to mobilize independently, with the help of joystick from which the motors are driven. A micro-controller is used in the project because of its efficient features & synchronization with various other devices. The whole setup is carried out in an economical way so that it can be afforded by various deprivileged, overcoming financial barriers.**

Keywords— wheelchair, automated, joystick, microcontroller, motors, physically disabled, cost-effective.

I. INTRODUCTION

Wheelchair is an important vehicle for handicapped person to move somewhere. The typical wheelchair is roughly classified as follows: the self-controlled type wheelchair and helper-controlled type wheelchair. The user drives self-controlled wheelchair using physical force imparted by our upper limbs using a mechanical wheel setup equipped at outside of rear wheel. Whereas the helper-controlled type has a support, for instance, joystick-controlled type is equipped with a joystick with the help of which user can move around.

Disability is an impairment that substantially affects a person's life activities. A person with locomotive disabilities needs a wheelchair to perform various functions. One can move the wheelchair manually by pushing the wheelchair with hands. However, it gets difficult for an individual with weak upper limbs to move a wheelchair manually. Hence there arise a need of automated wheelchair that can be controlled via joystick. Thus, we aim to design and develop a smart wheelchair which will facilitate the movement of a disabled people so as to help them live a life with less dependence on others. This project is a simple implementation of this approach. Command are taken through a joystick, processed in computer and sent to the wheelchair and finally the wheelchair acts accordingly.

II. AIM OF PROJECT

The project aims at controlling a wheelchair by means of joystick. It enables a disabled person to move around independently, using a joystick which is interfaced with motors. The wheelchair is built using a micro-controller, chosen for its low cost, in addition to its versatility and performance. The system has been designed and implemented in a cost-effective way so that if our project is commercialized the needy users in developing countries will benefit from it.

III. INDIAN STATISTICS ON DISABILITY

We know that there is rapid growth in the world's population & it is multiplying at an exponential rate. In India 120.5 million people are disabled out of which 41.325% are physically disabled unfortunately, due to various medical conditions or accidents. The graphical representation of disability in India is represented in the figure given below [12]:
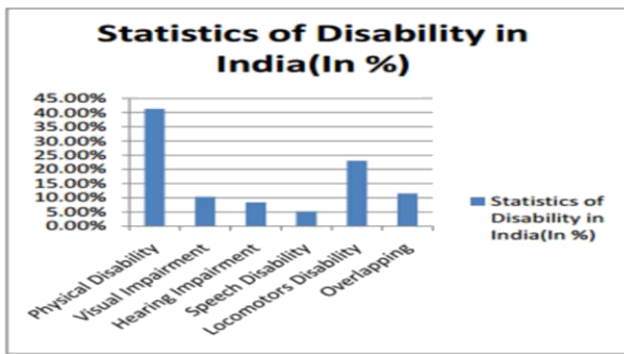
Fig. 1. Statistics Graph

IV. OBJECTIVE

A. Provide the facilities for physically disabled and elderly people who can't move properly.

B. To develop a joystick-controlled wheelchair system by using various integrated circuit components for wheelchair control.

V. BLOCK DIAGRAM
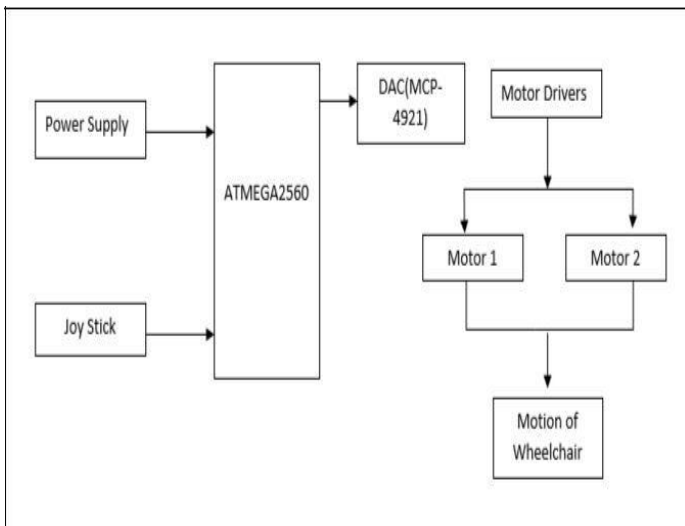
Fig. 2. Block Diagram

VI. WORKING

Automated Wheelchair is low cost joystick assistive wheelchair. It is operated by joystick commands. The input to the system is given by the user through a joystick, which is transmitted to the micro-controller to achieve the proper functionality. The micro-controller detects the command signal and then it takes the required decision to move the wheel-chair left, backwards, front and in the right direction based on a Data to Analog converter(DAC). DAC is a system that converts a digital signal into an analog signal. Motors are used to rotate the wheels appropriately. The DAC passes the

signals to motor drivers. Finally, the motor moves the wheelchair as per the given command.

VII. CIRCUIT DESCRIPTION

A. ATMEGA2560:

1. High-performance, Low-power 8-bit AVR RISC-basedmicrocontroller.
2. 256 Kilobytes of On-chip Self-Programmable Flash memory
3. 4Kbytes EEPROM
4. 8 Kilobyte Internal SRAM
5. 86 Programmable I/O Lines
6. 4.5V - 5.5V for ATmega16
7. 16-channel 10-bit A/D Converter [7].

The Arduino mega is a microcontroller board based on ATmega2560 is used in this project due to its low cost. It can be programmed using the Arduino software [8].

B. Hub Motor:

Brushless DC electric motor (BLDC motor), or synchronous DC motors, are motors which run on DC supply provided by an inverter or a power supply. The BLDC motor generates an AC electric current to run each phase of the motor with the help of a closed loop controller. The controller provides input to the motor windings that control the speed and torque of the motor [6].
Features are as follows:

1. Voltage: 24V - 36V- 48V- 60V
2. Power: 250W-350W-450W-500W
3. Motor type: Brushless gearless hub motor
4. No-load speed: 24 v 250 rpm (0.35 A) 36 v 350 rpm (0.38 A) 48 v 450 rpm (0.42 A) 60 v 550 rpm (0.61 A)
5. Rated speed: 200 - 550 rpm

Fig. 3. Hub Motor

C. MCP4921(DAC):

Digital to Analog Converter(DAC) is a system that converts a digital signal to analog signal. In this project we are using MCP4921. MCP4921 is a single channel, 12-bit DAC with an external voltage reference and SPI interface. It is

highly accurate and consumes low power, it has high efficiency. MCP491(DAC) is used to convert digital signal coming from Arduino to analog signal. These analog signals are provided as an input to the motor driver.
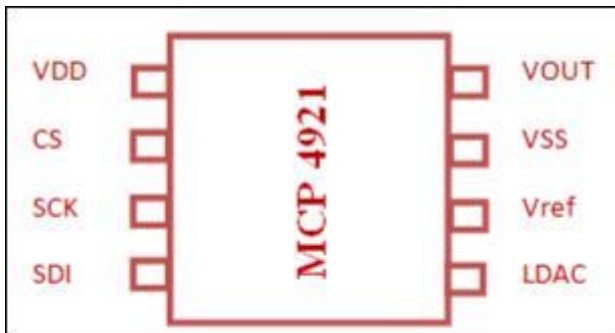
Fig. 4. MCP 4921 DAC[10]

VIII. MOTOR DRIVER

A motor driver is a current amplifier; it works on the principle of converting a low-current input signal into high-current signal needed for the motor to operate.

The motor driver used has following features: [6]

1. Voltage: DC 24V
2. Power: 250W
3. Anti-coaster features,
4. Over current protection,
5. Automatic identification the Hall sensor
6. Automatic identification the Phase angle of 60 degrees and 120 degrees
7. Low level/E-ABS brake,
8. High level/E-ABS brake,
9. 3 - variable speed,
10. Pedal assist,
11. Power assist

Fig. 5. Motor Driver

A. Battery

A lithium-ion battery or Li-ion battery is a type of rechargeable battery in which, During Charging the lithium ions move from the negative electrode to the positive electrode. Li-ion batteries use a lithium compound as one electrode material, compared to the metallic lithium used in a non-rechargeable lithium battery. The electrolyte, which allows for ionic movement, and the two electrodes are the constituent components of a lithium-ion battery cell. Specification of the battery used is 36V/4.8Ah/172.8WH[6]

Fig. 6. Battery

B. Battery Charger:

A battery charger is an equipment which puts energy in a secondary cell or rechargeable battery by forcing an electric current through it, sometimes the input supply has to be decreased to the desired rating suitable for the recharging of the battery. Thus, the various necessary operations are also carries out by the charger [6].

The features of battery charger used for the project are as follows:

1. Input Voltage: 100-240V 50/60HZ
2. Output Voltage: 42V
3. Suitable Voltage/Frequency: 90-264V 47/63Hz
4. Output current: 5A
5. Power: 273W
6. Efficiency: 80%

Fig. 7. Battery Charger

C. Joystick:

A joystick is a device used to input the desired command. It consists of a stick that rotates on a base and reports its angle or direction to the device it is controlling. A joystick, also known as the control column, is a key control device in this project. We have used a 2-axis joystick as an input command.
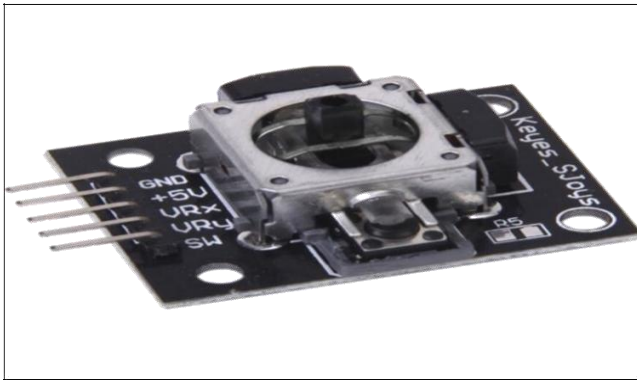
Fig. 8. Joystick[11]

IX. FLOW CHART
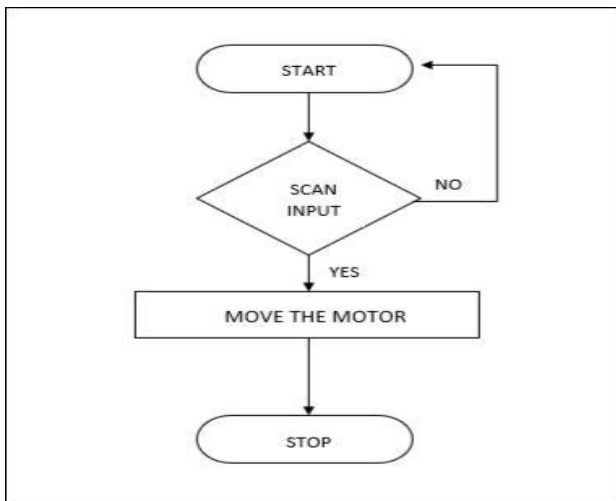
Fig. 9. Flow Chart

X. COST OF PROJECT

Sr.No.	Name of Component	Cost (in Rs.)
1	Hub Motor + Driver	28,320
2	Battery + Charger	13,800
3	Arduino Mega	800
4	WheelChair	5,600
	Total	48,520

This is the total cost of our project. Our project received minor research grant from Mumbai University and was also funded by K.J. Somaiya Institute of Engineering & Information Technology. This is in collaboration with K.J. Somaiya Hospital. This Project will be handed over to Physiotherapy Department of K.J Somaiya Hospital, Sion, Mumbai.

XI. ADVANTAGES

1. Physically disabled people can move around independently.

2. Joystick controlled feature increases efficiency and is propitious or beneficial

3. The hardware connections are less thus it is compact and economical.

4. Reduces manpower & is user friendly.

5. Featuring the HELP button if person is into some kind of trouble.

XII. FUTURE SCOPE

The various modifications that can be done in future could be possible by making it way to efficient by decreasing the power requirements & finding a way to charge the battery automatically with the use of dynamos or inculcating solar panels which could charge the wheelchair via solar power. The Wheelchair could also function by providing voice commands as input from the user end.

XIII. CONCLUSION

This proposed system contributes to the self-dependency of physically challenged and elderly people. It reduces the manual effort for acquiring and distinguishing the command for controlling the motion of a wheelchair, the speed and specified commands. Thus, the only thing needed to ride the wheelchair is to have a command on the joystick. Besides that, the development of this project is done with less cost and is thus affordable. The user has to give commands by pressing buttons available on joystick. Lastly, we hope that this kind of system could contribute to the evolution of the wheelchair technology[13].

XIV. ACKNOWLEDGMENT

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IoT Based Routine Health Checkup

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Abstract- **The Internet of Things(IOT) is an embedded/electronics things connected with internet. The things can be any physical devices, home appliances and other embedded times like software, sensors, actuators and network connectivity. The IOT allows to control things remotely from long distances. The IOT has extensive applications in enterprise (business), infrastructure, medical field etc. The project 'Routine Health Check' consist of micro controller (ATMEGA2560) which is the main component used to communicate with different sensors like temperature sensors and pulse oximeter sensor and other health monitoring component. The controller evaluate sensor data and send it on the mobile application using Bluetooth module.**

Keywords- Arduino, Electrocardiogram(ECG), glucometer, Bluetooth module, pulse oximeter sensor, health monitoring.

I. INTRODUCTION

Internet is used for various purposes and for various research projects. One can get a lot of information from the internet. IoT is embedded physical device which allows objects to connect to the internet and share data. IoT is used in various industries, medical, defence and home automation applications. Sincedevices are connected to internet they can provide better lifestyle. IoT is more eminent in health applications than other applications. This project "IoT Based Routine Health Checkup" gives people to check their health routinely. The health parameters can be temperature, heart beat rate, glucose in blood, electrocardiogram (ECG), and many other

parameters can also be measure. The adruino board reads the sensor data and process it and gives the data to mobile application using Bluetooth and from the mobile user can send data to anybody to the doctor; the user wants to send.

II. THEORY

A) Hardware Design
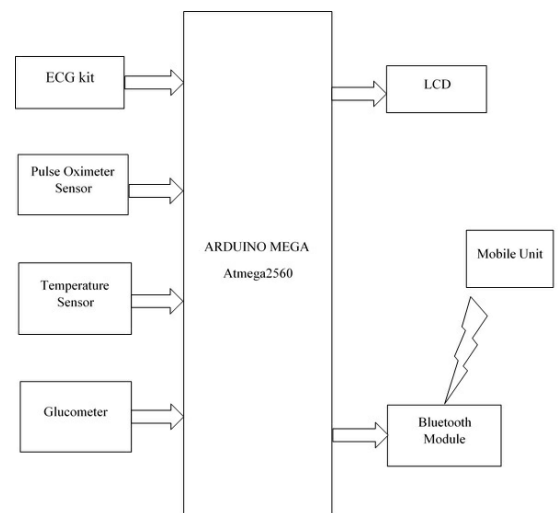
Figure1: Proposed Model

i) ATMEGA2560 (Arduino Mega)

The Arduino Mega is a microcontroller board-based system which has ATMEGA2560. It has 54 digital input/output

pins, 16 analog inputs, 16MHz crystal oscillator, 4 UARTs, USB connection, a power jack, an ICSP header, and a reset button. It has plenty of opportunities and rooms for maintaining effectiveness and simplicity of Arduino platform.

FEATURES:

- Operating voltage - 5V
- Input voltage (recommended) - 7 to 12V
- DC current per I/O pin - 20 mA
- Flash memory - 256 KB (ATMEGA2560) of which 8 KB used by bootloader
- SRAM - 8 KB
- Clock speed - 16 MHz

ii) Electrocardiogram (ECG KIT)

ECG measures the Heart electrical activity to show is it working normally. It records the heart's rhythm by interpreting the peaks and dips on screen. Things an ECG can detect are:

- Heart attack held previously
- Clogging up heart's blood supply
- Enlargement of one side of the heart.

iii) Glucose Meter

Glucose Meter is a medical device for measuring concentration of glucose in blood. In general terms it is used by diabetes patients. In this glucose meter diagnostic strip is used which oxidizes enzymes from glucose. These enzymes transfer electrons to the electrode which is further converted to electrical signal via a INA219 module.

iv) Temperature sensor (DS18B20)

The DS18B20 digital thermometer which is 1 wire sensor. It has three pins in which one is for input voltage, second for ground and third for data output.
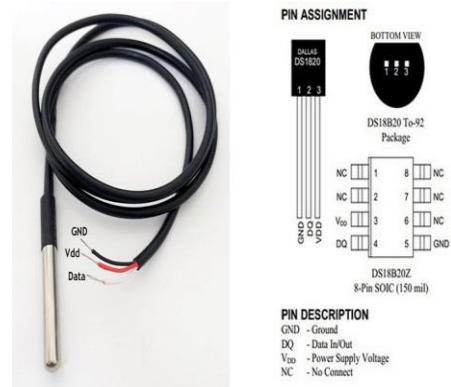
Figure2: DS18B20

FEATURES:

- Unique 1-Wire Interface Requires Only One Port Pin for Communication
- Measures Temperatures from -55°C to +125°C (-67°F to +257°F)
- ±0.5°C Accuracy from -10°C to +85°C
- 9-Bit Resolution
- No External Components Required

v) Liquid crystal display (LCD)

To display arbitrary images or fixed images with low informative content. LCD screens are used in consumer electronics products like DVD players, clocks, etc. In this project we are using 16x2 LCD display which is a very basic module.

FEATURES:

- Low power consumption
- Highly efficient
- Cost effective

vi) Pulse Oximetry Sensors

Pulse oximeters are medical sensors used to measure Oxygen Saturation (SPO2) of haemoglobin in blood. It shows percentage of blood loaded with oxygen. It contains two light emitting diode; one emitting red light and other emitting near infrared light, it also has a photo detector. The photo detectormeasures transmitted light intensity and using the reading difference content of oxygen in blood is calculated.

vii) Bluetooth Module

To send data to the mobile we use Bluetooth module which is connected on serial port of Arduino. Bluetooth module is used for serial communication. Using this module, we are going to show health parameters on the mobile.

B) Software Design

i) Proteus 8.0 Professional

It's a PCB design and simulation software. Simulation of various projects and their testing can be done in it.

ii) Arduino Software

It is Arduino board programming software and is freely available on the internet. It provides **Integrated Virtual Environment** to user. It is compactible to all Arduino boards.

iii) Android Studio

It provides **Integrated Development Environment** to user for developing applications on Android operating system.
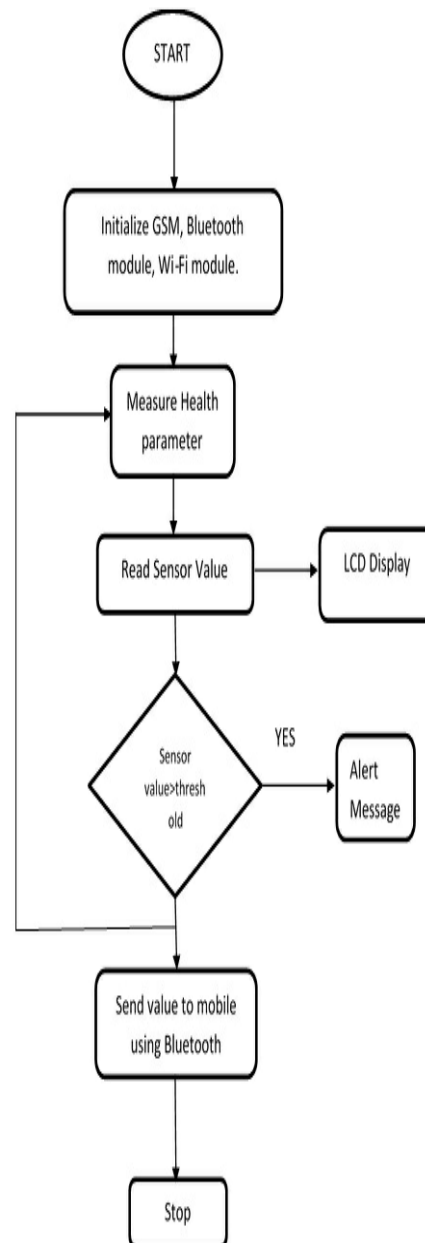
Figure3: Flow chart

III. Proposed Solutions:

The temperature sensor output has been shown on the mobile application step by step
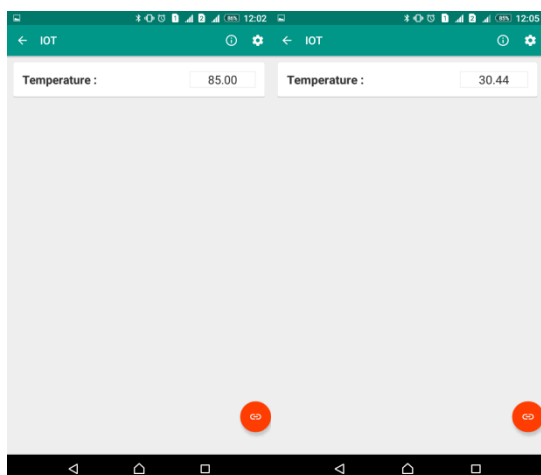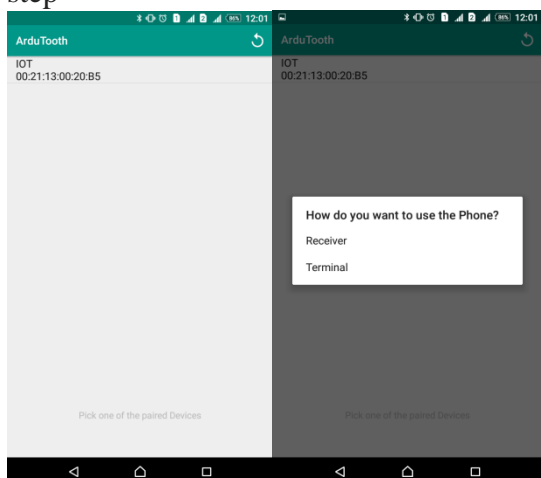
IV. Conclusion And Future Scope:

To describe health status this work is focused to implement a system which shows health parameters like electrocardiogram, heart rate, sugar in the blood, body temperature. In this work, Arduino Mega takes the data from sensors and using bluetooth module send it on the mobile unit. The mobile unit has an application which will show the health parameters and from there the user can send it to the doctor.

In this project, future work is essential to make advancement in project. After observing the health parameters, a database can be made to keep record of the patient and even prescribe the medicines and give precautionary measures in critical conditions.

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Sustainable Water Management System for Smart Cities using IoT

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Abstract: **The main aim is to develop a system that can efficiently and judiciously distribute available municipal water and produce a balance in consumption of the resource leading to increase in availability of water to areas with scarcity of water. If implemented in initiatives like smart cities, this system will provide an ideal solution to solve almost every problem regarding water management in modern metropolises and upgrade the system to a remotely controlled, efficient and user-friendly IoT platform leading to transparency and increased usage informatics. A 3-stage electronic system is used for this purpose. The first stage will include monitoring the available water level in residential buildings and feeding that data in real time to interactive interface for user viewing as well as to the automation system for calculating amount of water to be allocated to the building on a daily basis. The second stage will include remotely controlling the amount of water passed through municipal distribution pipeline using a solenoid valve so as to achieve the target of optimal provision of water to the building based on daily requirement instead of fixed supply and allowing user end pumps to pull water unaccountably. The third stage includes developing and installing smart meters for individual customers to bill them according to quantity of water that is actually utilised in order to bring accountability to every drop of water use and save customer money by charging money based on usage by implementing appropriate billing models. The transmitting and receiving system in smart meters will lead to directly availability of data to municipal database unlike the existing meter system where every meter has to be manually monitored. If this system is brought into utilization in smart cities, it will lead to zero wastage, efficient distribution and utilization of water, which in today's time is a precious natural resource.**

Keywords: Water Management, IoT-Internet of Things, Embedded Systems

I. Introduction
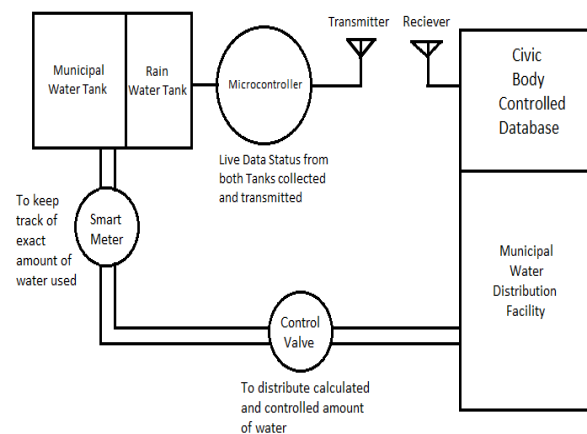
Fig 1.Basic Block Diagram of the System

Water monitoring and controlling system

implementation makes potential significance in home applications. The existing systems of this type include monitoring levels and providing that data to users or water companies. But the part of controlled distribution often involves human interaction which can make the system less efficient and more error-prone. Hence it is necessary to create a smart system which will itself monitor the water level in real time and take

decision as to how much water needs to be allocated to the infrastructure instead of waiting for human decisions and interference, which can lead to loss of time and resource. [1]This machine control can be effectively implemented at junction of pipeline to infrastructure from main pipeline using a remotely controlled, automated valve assembly which will control only the amount of water flowing into the infrastructure without tampering with the flow in the main pipeline. This will also passively solve other problems like leak detection and theft detection. This will ensure that the infrastructure always has the optimal amount of water required at all times without either wastage of water or deficit. Smart meter installation will lead to utility billing to the customer instead of charging predefined amounts. [2] These meters can also be programmed to generate alerts and automatically stop water flow in situations like pipe bursts or long usage intervals leading to water wastage.

II. Literature Survey

During the selection of this topic, pre-study was done on concepts of similar systems developed previously.
In [3] the designers has focused on providing an alert system to indicate faults like pipe leakage, pipe bursts and tap bursts at nodal ends. This is done using GPS facility and GSM based message service alerts. This enables the customers to get status updates and alerts on their existing mobile handset instead of using some new electronic device or system. This also works without an internet connection and hence feasible in rural areas where connectivity is poor.
In [4] a system proposed and implemented in Singapore is studied. The system also implemented water monitoring in source water bodies like dams to estimate the amount of water available for distribution and planning schemes accordingly. The system has also conceptualised the utility billing model that is included in the system.
In [5], the designers have developed a system for industrial application to monitor and bill the amount of water and sewage generated in heavy industries to estimate the amount of water utilised, recycled by sewage treatment by the company and hence billing the company using different billing scheme and also introduces a fining model for water pollution. It was necessary to include these various factors implemented independently and create a comprehensive system that will achieve the purpose of water usage monitoring, optimisation in distribution, create efficient alert systems and implement utility billing. With all these applications combined, an upgradation of the entire working model on the IoT platform will provide an unseamed user accessibility across the globe

making this system approachable in real time in and from anywhere across the globe.

III. Working

The system development is divided in three parts: Monitoring Subsystem, Flow control subsystem and Smart meter subsystem. The monitoring subsystem involves monitoring in real time, the water level. This is done using an ultrasonic depth sensor that functions on a similar principle as SONAR and provides accurate reading. This sensor is driven from a NodeMCU PSoC which consists of an inbuilt WLAN interface which is used for wirelessly transmitting the data to a remote server database. The database is implemented using the ThingSpeak interactive interface which provides graphical, analytical tools for effective display of the data. [6]This data is then directly provided to an analytical program to calculate the amount of water that is required to fill the tank to the optimum required level. The ultrasonic transmitter unit is excited with a 40 kHz pulse burst and an echo from the object whose distance is to be measured, transmitted burst, which lasts for a period of approximately 0.5 ms is expected. It travels to the object in the air and the echo signal is picked up by another ultrasonic transducer unit (receiver) and a 40 kHz pre-tuned unit. [7] The received signal, which is very weak, is amplified several times in the receiver circuit. Weak echoes also occur due to the signals being directly received through the side lobes. These are ignored as the real echo received alone would give the correct distance. Here the microcontroller is used to generate 40 kHz sound pulses. It reads when the echo arrives; it finds the time taken in microseconds for to-and-fro travel of sound waves considering sound velocity of 333 m/s.
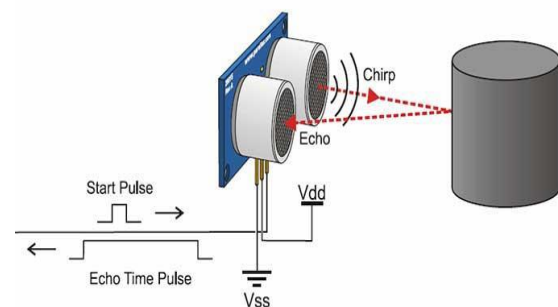
Fig 2.Ultrasonic sensor working

The second part is regarding the flow control subsystem. It implements a solenoid valve operating at 12V and passes water for the time the supply voltage is provided. [8] This electrical system can be automated by providing programmed voltage control to the valve based on calculations involving the amount of water flowing through the

valve in given time interval, the amount of water required based on data provided by the monitoring subsystem. This task is also assigned to the local NodeMCU monitoring the water level to prevent delays for data travel between local controller and database and make the system more efficient. The third part is the Smart Meter Subsystem.[9] It involves calculating the amount of water flowing to the individual household using a flow meter. This sensor sits in line with the water line and contains a pinwheel sensor to measure how much liquid has moved through it.[10]There's an integrated magnetic Hall Effect sensor that outputs an electrical pulse with every revolution. Flow sensors use acoustic waves and electromagnetic fields to measure the flow through a given area via physical quantities, such as acceleration, frequency, pressure and volume. The sensors are solidly constructed and provide a digital pulse each time an amount of water passes through the pipe.[11]
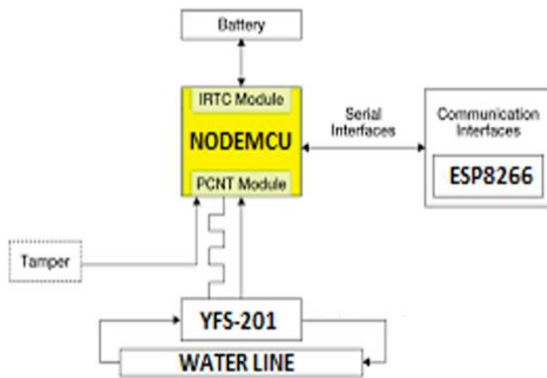
Fig 3.Internal Architecture of Smart Meter

IV. Results

The ultrasonic sensor collects data of the amount of water in the tank which is then transmitted using the WLAN protocol using the inbuilt Wi-Fi module in the NodeMCU PSoC to the database. The processor in NodeMCU simultaneously calculates the amount of water required to keep the tank at optimum level and accordingly sets the voltage HIGH interval of the solenoid valve. This solenoid valve operation is simultaneously monitored by the municipal administrating computer to ensure proper functioning and detecting function disturbances or data abnormalities that may be caused due to pipe bursts or water theft issue which will then raise an alert regarding the area in which the problem has occurred and time and duration of the problem which can be used for problem resolution. Thus the target of consistently maintaining constant water level in the tank is achieved. The smart meter subsystem monitors the water utilised by each household and transmits the data wirelessly in real time to database which then

calculates utility bill. This database that is created using Thingspeak will provide the real time log of the water level in water tank in a graphical format (Water Level to time). When the water level is constant, the graph will show constant horizontal reading with no variation and will show fall along Y axis when water level is reduced in the tank.
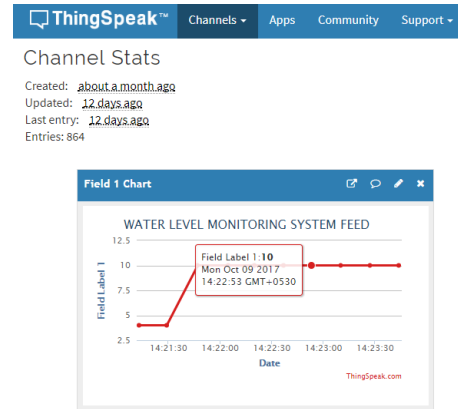
Fig 4.Thingspeak Channel View
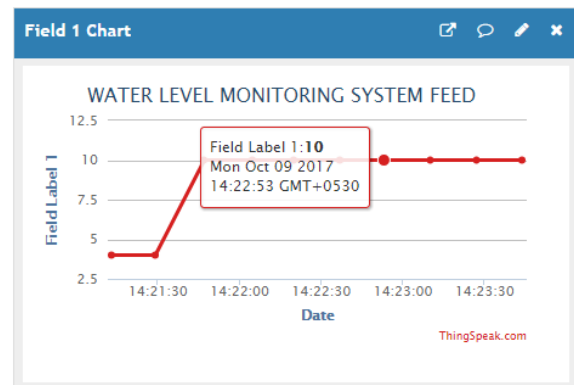
Fig 5. Enlarged view of Feed Chart

V. Conclusion

The system will monitor water level in real time and transmit the data to the central database which will use that data for analysis as well as make it available for display on a user interface to enable users get a real time update the system status. This will be done by the ultrasonic sensor which and will be transmitted by the NodeMCU PSoC to the database created using IEEE 802.11 LAN standards. This data will also be made available to the control valve present on location. The control valve will be synchronised to act in accordance with this data to allow passage of only required amount of water, achieving the purpose of monitoring based controlled distribution. The smart meter will gauge the flow quantity of water to each household and provide real time wireless meter

reading for utility billing. This meter system will also provide alerts to user and the central system about tap bursts, excessive usage and allow remote controlling of the system from anywhere in the world which will save water wastage efficiently. The total development cost of this system will be around 500 rupees and it will help save potable water worth crores of rupees everyday.

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Automated PNG Meter Reading and Monitoring Using Internet of Things

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Abstract— **With the rapid growth in use of PNG by domestic customers for cooking purpose, there is a dire need to automate the PNG meter reading. Currently the process of meter reading is as follows:**

The general pattern of billing is to bill for gas consumption every two months. The first bill is as per the meter reading. It gives actual gas consumption. The second bill is as per "assessed" basis. Thereafter, repetition of actual reading and assessed reading is done alternately for billing purpose. If actual reading is unavailable, for whatsoever reason, the bill is then generated on "estimated" basis.

Thus in order to overcome the drawbacks and to minimize human involvement and efforts, automatic bill reading and monitoring system is required. Since the meter data is readily available, the billing cycles are available to the customers instead of the traditional billing cycles. Automatic bill reading and monitoring system also provides improved billing and tracking of usage.

This project focuses on automatically collecting consumption data from gas meter and transfer of that data to a central database for the purpose of troubleshooting, billing and analyzing.

Keywords—PNG Meter, Internet of Things (IoT), BMP180, Arduino.

I. INTRODUCTION

A PNG meter is primarily used for the measurement of volume of gas consumed at residential, commercial or industrial premises.

Gas meters can be categorized into two types:

1. Basic/Analog: Analog gas meters need a meter reader to record the measured data. multiply current network speed.

2. Smart/Digital: Smart meters are capable of wireless communication, and transmit all the necessary information related to gas consumption.[2]

II. SMART METERS:

1) PNG Smart meters work with a smart energy monitor, that can be placed anywhere in homes, to show how much energy has been used and an indication of how much it's costing the consumer, in desired currency. It can view both your gas and electricity consumption.

2) The smart PNG meters are the new trend setters in energy market because of the major benefits.
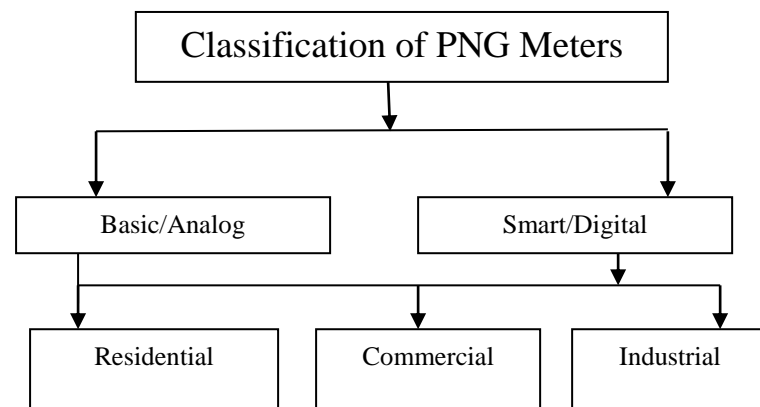
BENEFITS OF SMART METERS:

1) Better management of energy use: The smart energy monitor displays the natural gas consumption rates in real time. It helps the user to manage consumption and restrict gas use through small changes such as switching off appliances when not in use, thereby leading to considerable savings.[2]

2) Personalized report: The smart meter can generate a smart and personalized report which gives valuable insights to the customer about the gas usage as well as about its cost. Report statistics are available on an hourly, daily, weekly, and monthly basis with a detailed breakdown of particular usage.

3) Accurate billing: Smart gas meters provide accurate readings, eliminating the possibility of human error while taking the readings from the meter. The automated utility bills the user appropriately based on their exact consumption.[2]

OBJECTIVES:

1) The users can be aware of their gas consumption. The human work of collecting readings by visiting every home at the end of every two month can be avoided by generating bills automatically. The errors in the system can be identified quickly.

2) The main intention of the project is to automatize the reading and monitoring of the LPG Gas meter reading.

3) To create and maintain a data base of the LPG Gas consumed by the consumers. This timely information coupled with analysis can help control the consumption of the LPG Gas.

4) The main aim of project is to provide lowering the cost of meter reading, provides real-time billing information, reducing estimated readings and re-billing costs, enhances employee and customer safety by reducing the number of personnel on the road and providing safer reading methods, reduces billing errors and disputes, enables flexible reading schedules.

III.COMPONENTS

- ARDUINO UNO:

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller, simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The UNO is the latest in a series of USB Arduino boards and the reference model for the Arduino platform.

Some technical specifications of this device are as follows:

- Microcontroller : ATmega328
- Operating Voltage : 5V
- Input Voltage(recommended) : 7-12V
- Input Voltage(limits) : 6-20V
- DC Current per I/O pin: 40mA
- DC Current per 3.3V pin: 40mA
- SRAM : 2 KB
- EEPROM : 1 KB
- Clock Speed : 16 MHz
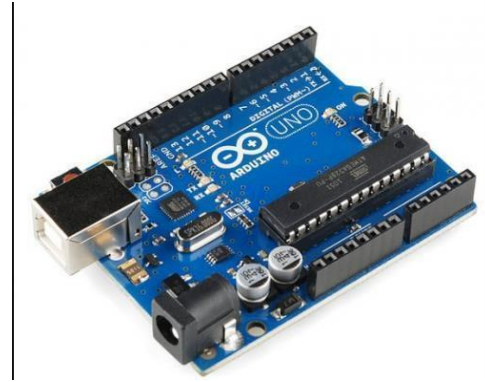
Fig. 1: Arduino Uno

- BMP180:

The BMP180 is a basic sensor that is designed specifically for measuring barometric pressure (it also does temperature measurement on the side to help). It's one of the few that does this measurement, and it's fairly low cost so you will see it used a lot. You may be wondering why someone would want to measure atmospheric pressure, but it is actually really useful for two things. One is to measure altitude. As we travel from below sea Level to a high mountain, the air pressure decreases. That means that if we measure the pressure we can determine our altitude -handy when we don't want the expense or size of a GPS unit. Secondly, atmospheric pressure be used as a predictor of weather which is why weather-casters often talk about "pressure systems."

Specifications:

- Pressure sensing range:300-1100 hPa (9000m-500m above sea level)
- Upto 0.03 hPa/0.25m resolution.
- -40 to +85°C operational range, ÷ -2°C temperature accuracy.
- 2-pin I2C interface on chip.
- V1 of the breakout uses 3.3V power and logic level only.
- V2 of the breakout uses 3.3-5V power and logic level for more flexible usage.
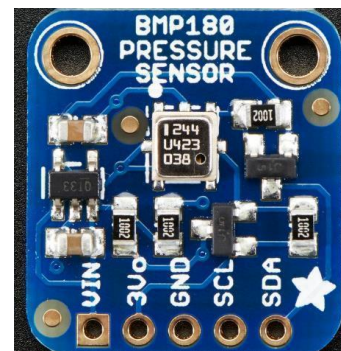
Fig. 2: BMP180 Sensor

- HC-05 BLUETOOTH MODULE:

HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3 Mbps. Modulation with complete 2.4 GHz radio transceiver and baseband. It uses CSR Bluecore04-External Single chip Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature). It has the footprint as small as 12.7mmx27mm.[3]

Hardware Features:
- Typical -80dBm sensitivity
- Up to +4dBm RF transmit power
- Low Power 1.8V Operation
- PIO control
- UART interface with programmable baud rate
- With integrated antenna
- With edge connector
- Power supply: +3.3V DC 50mA
- Working temperature: -20 to 75 Centigrade
- Frequency: 2.4 GHz ISM band

Software Features:
- Default Baud Rate : 38400
- Data Bits : 8
- Data Control: Has supported baud rates 9600, 19200, 38400, 57600, 115200, 230400, 460800.
- Auto connect to the last device on power as default.
- Permit pairing device to connect as default.
- Modulation: GFSK (Gaussian Frequency Shift Keying)
- Security : Authentication and Encryption.4
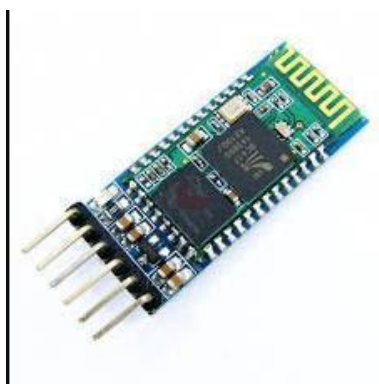
IV. IMPLEMENTATION

❖ Working:
- BMP180 is Pressure sensor which senses the pressure and temperature.
- Sensor is directly connected to a microcontroller via the I2C bus.
- The pressure and temperature data has to be compensated by the calibration data of the E2PROM of the BMP180.
- The BMP180 delivers the uncompensated value of pressure and temperature.
- The E2PROM has stored 176 bit of individual calibration data. This is used to compensate offset, temperature dependence and other parameters of the sensor.
- The arduino receives the readings from the pressure sensor.
- It is further connected to the computer using USB connector.
- Purchase cloud space from the provider.
- The cloud space is used to create a database of the all the users meter readings and the application is also put on the cloud.
- The respective users can get their readings via this application.
- The computer has a program running in Visual Basics. The program in Visual Basics keeps transmitting the values being received from the arduino board to the cloud.
- Another application written in asp.net is put on the cloud space, This app which is running on the cloud can be accessed by any customer via the web browser.

Fig. 3: HC-05 Bluetooth Module
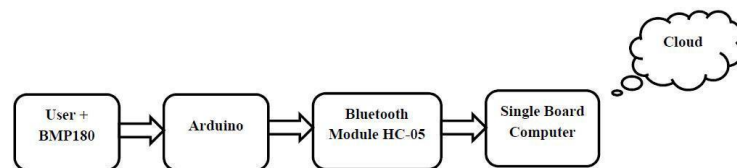
Fig. 4: Block Diagram

- Hardware Implementation:
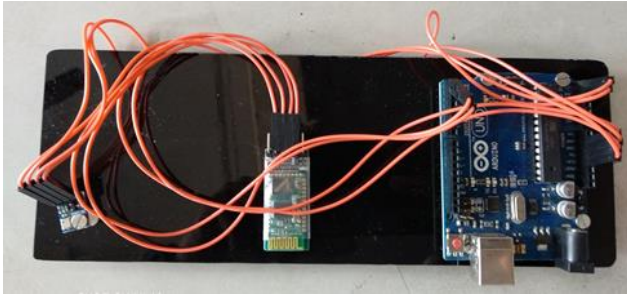
Fig. 5: Hardware Implementation

Connect the VCC pin to a 3.3V power source. The VI of the sensor breakout cannot be used with anything higher than 3.3V so don't use a 5V supply. V2 of the sensor board has a 3.3V regulator so you can connect it to either 3.3V or 5V if you do not have 3V available. Connect GND to the ground pin. Connect the I2C SCL clock pin to the I2C clock pin. On the classic Arduino Uno/Diecimilia/etc this is Analog pin #5. Connect the I2C SDA data pin to your I2C data pin. On the classic Arduino Uno/Diecimilia/etc this is Analog pin #4. Unfortunately, the I2C lines on most microcontrollers are fixed so you're going to have to stick with those pins.

The Arduino Uno is attached to the PC using a USB cable and the latest version of the Arduino IDE has to be installed in the computer to be used.

- Softwares Used:

1. Arduino IDE:

Arduino is an open source computer hardware and software company, project and user community that designs and manufactures single board microcontrollers and microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical world. The project's products are licensed under the GNU Lesser General Public License (LGPL) or the GNU General Public License (GPL), permitting the manufacture of Arduino boards and software distribution by anyone. Arduino boards are available commercially in preassembled form, or as do-it-yourself (DIY) kits.

Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers. The microcontrollers are typically programmed using a dialect of features from the programming languages C and C++. In addition to using traditional compiler tool chains, the Arduino project provides an IDE based on the Processing language project.

2) Microsoft Visual Studio:

Microsoft Visual Studio is an integrated development environment (IDE) from Microsoft. It is used to develop computer programs, as well as web sites, web apps, web services and mobile apps. Visual Studio uses Microsoft software development platforms such as Windows API, Windows Forms, Windows Presentation Foundation, Windows Store and Microsoft Silverlight. It can produce both native code and managed code.

Visual Studio supports 36 different programming languages and allows the code editor and debugger to support (to varying degrees) nearly any programming language, provided a language-specific service exists. Built-in languages include C, C++, C++/CLI, C#, F#,JavaScript, TypeScript, XML, XSLT, HTML and CSS. Support for other languages such as Python, Ruby, Node.js, and M among others is available via plug-ins. Java (and J#) were supported in the past.

The most basic edition of Visual Studio, the Community edition, is available free of charge.
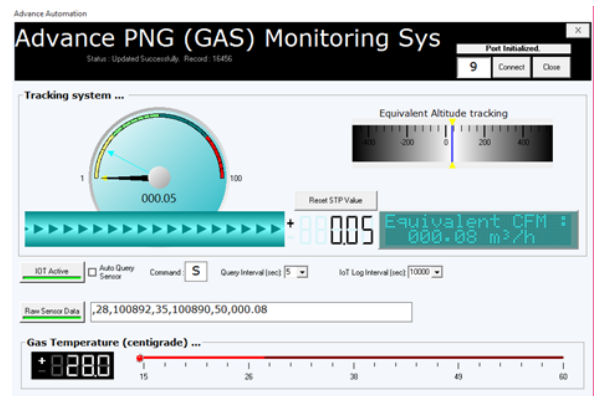
Fig. 6: Microsoft Visual Studio

V. Results And Conclusion:

Thus with this project we will be successfully able to automatize the PNG meter reading at every household, save utility providers the expense of periodic round trips to each physical location to read a meter. We will also create and maintain a database of the PNG consumption. This information coupled with analysis can help control the consumption of the gas. We wish to reduce manual labor which obviates capital cost. Additionally this will be an accurate and cost effective model.

In our prototyped project the readings obtained from arduino board are stored in computer using visual basic software, however in future for commercial use the SBC (single board computer), such as Raspberry pi can be used.

Also home automation can be provided by reading and monitoring the energy meter along with LPG gas meter using

Internet of Things (IoT). If implemented professionally „N‟ number of I2C sensors can be ordered with each one having a unique slave address, when the socket application updates the data onto the cloud it can be programmed to send both the address and the pressure value.

Applications:

- Domestic Gas Meters.
- Commercial Gas Meters.
- Prepaid Gas Meters.

Future Scope and Benefits:

Benefits of advanced metering:

Advanced metering systems can provide benefits for utilities, retail providers and customers. Benefits will be recognized by the utilities with increased efficiencies, outage detection, tamper notification and reduced labor cost as a result of automating reads, connections and disconnects. Retail providers will be able to offer new innovative products in addition to customizing packages for their customers. In addition, with the meter data being readily available, more flexible billing cycles would be available to their customers instead of following the standard utility read cycles. With timely usage information available to the customer, benefits will be seen through opportunities to manage their energy consumption and change from one REP to another with actual meter data. Because of these benefits, many utilities are moving towards implementing some types of AMR solutions.
The benefits of smart metering for the utility:

- Accurate meter reading, no more estimates.
- Improved billing.
- Accurate profile classes and measurement classes, true costs applied.
- Improved security and tamper detection for equipment.
- Energy management through profile data graphs.
- Less financial burden correcting mistakes.
- Less accrued expenditure.
- Transparency of "cost to read" metering.
- Improved procurement power though more accurate data - 'de-risking' price.

The benefits of smart metering for the customer:
- Improved billing and tracking of usage.

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Urban Farming Using Artificial Light

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Abstract—**The system proposed in this paper is advanced level of agricultural technology. This system is carried out where there is unavailability of land for perfect farming. This is a new level of approach which deals with methodology, water management, cultivation and maintenance of harvest. Vertical Farming is an advanced and efficient solution for growing food in urban area with less requirement of space. The whole purpose of this project is to create a better standard of urban life through the establishment of more green areas dedicated to harvesting healthy food that requires minimum area. This type of farming is an innovative method of food production which is destined to reinvent modern agricultural practices across the world. This paper examines the rise of vertical farming and the advanced ways for commercial food regime and encouragement in urban elite consumption.**

Keywords— Vertical farms; local food movements; Urban reconstructing; Humidity & temperature Sensors; Arduino IDE;

I. INTRODUCTION

Urban agriculture can be termed as growing of plants using artificial light for food in and around the urban areas. It is also related to the activities such as production, processing, delivery and marketing of products.In urban areas, agricultural land can be scarce and expensive. Due to evergrowing population, demand for land to grow food is increasing. The main aim of this project is to investigate the opportunities for implementation of LED based cultivation solutions with adjustable spectrums for the consumer market and in household environments which can be achieved using vertical farming[3].Vertical farming involves growing crops in controlled indoor enviornments, with precise light, nutrients, and temperature.Growing plants are stacked in layers in vertical farming. Vertical farming can be stacked in warehouses from two levels to several levels. The three soil free systems commonly used in vertical farming are hydroponics, aeroponics and acquaponics. The primary focus of the project will be to investigate the possible applications of the technology and to determine a suitable design, functionality and interface that makes it accessible to the user.

II. Literature Survey

The first section of the Literature Review begins by recognizing that urban agriculture is practiced around the world and is often suited to or limited by the climate in which it takes place. As a result, there are many different forms of urban agriculture in existence and some forms are more suitable or beneficial to a particular region than others. [1] Since urban agriculture takes different forms around the world, it has different meanings to different people – there is more than one definition of the phrase.

The second section of the Literature Review looks at how some of the consequences of increasing populations can be mitigated using urban agriculture. Urban agriculture has the potential to offer food security to urban residents, while also offering environmental, social and economic benefits. However, if urban agriculture is poorly planned, it has the potential to have negative environmental consequences. [2]

III. FLOWCHART
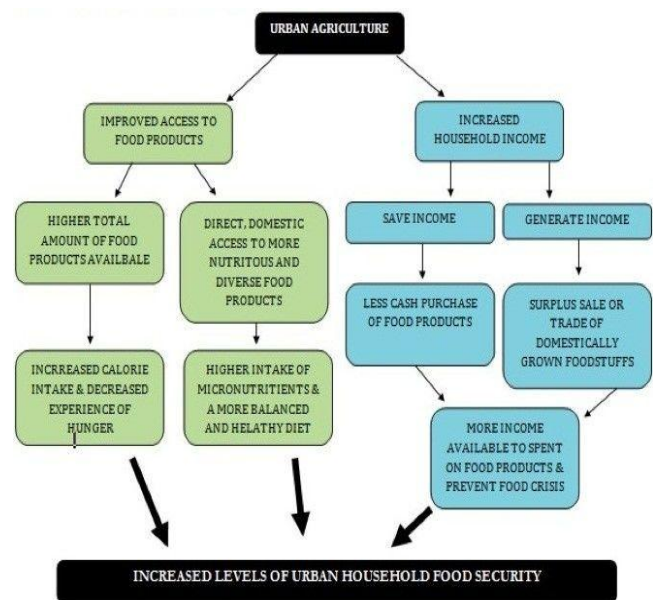
Fig. 1 Flowchart of urban agriculture

The figure-1 shows various benefits of urban farming. Broadly the benefits can be classified into two classes viz. a) improved access to food products b) increased household income. Since urban farming can be implemented at household and commercial level, both implementations provide monitory benefits. On the other hand, urban farming improves access to variety of food products.

IV. WORKING PRINCIPLE
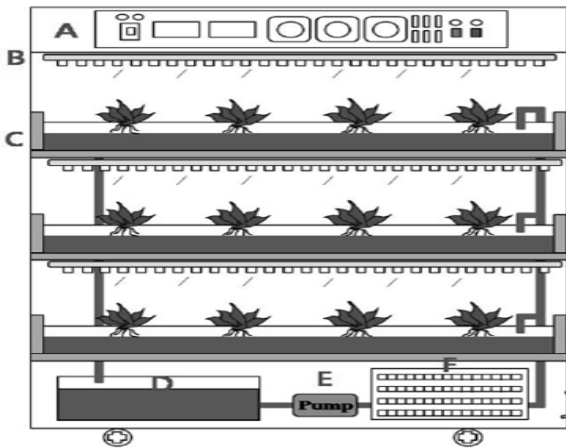
Fig.2 Vertical farming Assembly

Above Figure-2 shows vertical structure of farming where LED Lights are used as an artificial source of light for the growth and photosynthesis of vegetation of plants. The Soil Moisture Sensor is used to detect the content of moisture in the soil, which is used for the vegetation of plants. The value of moisture content sensed by the moisture sensor will be displayed on LCD Display. Pump motor is used here to provide water supply to the plants, since the motor pump operates at a voltage range between 12V-24V Motor Driver IC is used. In order to maintain the pace between all the elements Atmega328p microcontroller is used. The Fig-1 represents the schematic prototype of the farming which will be used for the growth of plants using artificial light/led light. The control panel will be consisting of the switch turn on/off the supply of water to different stages of vegetations and LCD display on which various parameter i.e duration of light kept on, moisture contents etc. The pump motor and water tank will be fitted at the bottom of the prototype model. The water to various stages will be supplied through pipes.

V. LIGHT SOURCE

a) White light:
- We perceive a white light from the sun actually consists of all colours of rainbow. The three most important colors of light are red, blue and green.
- Plants appears green to our eyes because they don't absorb green light.
- If the leaves don't appear red or blue, means they absorb those parts of light spectrum which makes them grow.

b) Red light:
- Flowering and production of fruits in plants depends on spectrum of red light.
- It is also responsible for seed germination, root growth and bulk development which is also essential.
- Few plants that can be grown using red lights are Lettuce, Capsicum, tomatoes etc.

c) Blue Light:
- If a plant is getting leggy or losing the green color in its leaves odd is its not getting enough blue light.
- Such plants have weak stem and roots. These plants can be grown using blue lights.
- Plants like Green leafy vegetables can be grown using blue light.

Figure 3: LED lights

- The LED Lights are basically used as an Artificial source of light for the growth and photosynthesis of vegetation plants.

- The project goal is to develop a lighting solution and luminaries that enhances the ability of growing and keeping plants in a household environment can be achieved using LED lights.

- By using LED light the modern farmer is no longer dependent on natural light sources. Regardless of whether it's raining or the middle of the night, the constant light produced by the light emitting diodes ensures faster and more fertile plants development, whatever the weather is like.[3]

VI. ATMEGA328p
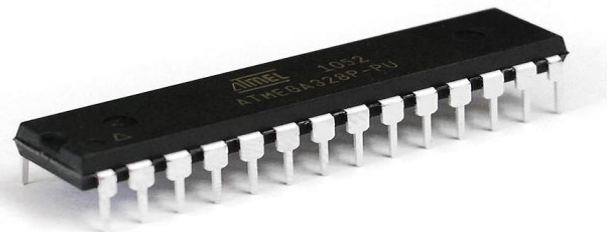
Fig. 4 Atmega 328p

- The Atmega328p comprises of 32 general purpose registers. Each register is directly connected to the Arithmetic Logic Unit (ALU) which allows access to two independent registers in a single instruction executed in one clock cycle. If compared to conventional CISK microcontroller. This resulting architecture is more code efficient while achieving through puts up to ten faster.

- The ATmega328/P possess the following features:

- 1Kbytes EEPROM, 2Kbytes SRAM, 32 general purpose working resistors, 23 general purpose I/O lines, 32Kbytes of In-system programmable flash with Read – While Write capabilities; Real Time Counter(RTC), 1 Serial programmable USARTs, three flexible Timer/Counters with compare modes and PWM, 6 channel 10-bit ADC (8 channels in QFN/MLF and TQFP packages); 1 byte oriented 2-wire serial Interface (12C) ; A programmable watchdog Timer with internal Oscillator, an SPI serial port and six software selectable power saving modes.

- The Idle mode will allow the SRAM, SPI port, Timer/Counters and interrupt system to continue functioning and it will stop the power-down mode but it freezes the oscillator and disable all other chip

functions until the hardware is reset or next interrupt occurs. The power save mode allows the user to maintain timer base while rest of the device is sleeping and the asynchronous timer continues to run. The ADC to minimize switching noise during ADC conversions and it stops CPU and all I/O modules.

VII. TEMPERATURE/HUMIDITY SENSOR DHT11

DHT11 temperature and humidity sensor feature a temperature and humidity sensor complex with a calibrated digital signal output. By using the exclusive digital signal acquisition technique and temperature and humidity sensing technology, it ensures high reliability and excellent long tern stability. This sensor includes a resistive type humidity measurement component and an NTC temperature measurement component and connects to high performance 8-bit microcontroller , offering excellent quality , fast response, anti interference ability and cost effectiveness. Each DHT11 element is strictly calibrated in the laboratory that is extremely calibrated in humidity calibration. The calibration coefficients are stored at program in the OTP memory, which are used by the sensors internal signal detecting process. The single wire serial interface makes systems integration quick and easy. Its small size, low power consumption and up-to-20 meter signal transmission making it the best choice for various applications, including those most demanding ones. The component is 4-pin single row pin package can be provided according to users request.

VIII. TEMPERATURE SENSOR

Temperature sensor senses the atmosphere and give a comparative indication of hot or cold . The value is indicated in ^{0}C or ^{0}F. two types of sensors are available ie. Contact or Non-Contact type sensors. Major properties that has to be taken into consideration are as follows:-

- **Range –** Range is the maximum and minimum value of temperature over which the sensor works well.
- **Accuracy –** Accuracy indicates the precise availability of sensor to measure in an absolute sense.
- **Resolution –** Resolution is the ability of sensor to see minor differences in readings.
- **Repeatability-** Ability of sensor to repeat a measurement when the sensor is put back into the same environment or condition. The value sensed by the
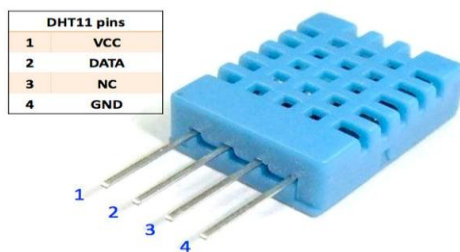
filtering data signal between VDD and GND. When the data transferring and visiting starts between Atmega 328 and DTH11, the program burned in the Atmega 328 MCU increase the voltage and waits 20ms-40ms for DTH11's response.

IX. SOIL MOISTURE SENSOR

Fig.6 Moisture Sensor

Soil moisture sensor senses all the water content from the soil. The gravimetric measure of soil moisture content, drying, and weighting of a sample, soil moisture sensors senses the water content by using some properties of soil such as electrical resistance, dielectric constant or interaction with neutrons as a proxy for the moisture content in the soil .The relation of measured properties with the soil moisture must be calibrated and may differ depending on the type of soil. Temperature and electric conductivity also affects the value of moisture content.

The other type of sensors measure different property of moisture in soil known as water potential. These Sensors are usually called as water potential Sensor and also includes tensiometer. Such type of potable instruments are used in modern agriculture.

From Agriculture point of view measuring the soil moisture content is very important as it helps the farmers to regulate the supply of water to the soil. Moisture sensor also helps to prevent excessing watering to the soil.

X. OBSERVATION

While testing various plants under different kind of artificial lights we observe that the yield of few vegetation plants can be increased by using specific colored artificial lights. Moreover, using various sensors and automated irrigation facilities we can reduce the human intervention and make the agriculture process more automated.

XI. RESULTS

Fig.5 DHT11 Temperature Humidity Sensor

sensor is in the form of streams of 1s & 0s. DHT11 operates at the voltage supply of 3-5V DC. It is recommended not to send any instruction to the sensor for the duration of 1 second in order to pass the unstable status. A capacitor of 100F can also be used for power

Fig. 7 Growth of plants under artificial light

Fig.8 Growth of plants under artificial light

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Universal Data Logger

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Abstract—**This paper reports design of an automated, low cost universal data logging system for measuring application. Different measuring parameters such as environmental temperature, voltage, current is acquired in real time and stored in a database such as memory card and personal computer for future reference. The data can be analyzed in standard condition or using Personal Computer (PC) for offline analysis and report. PIC18F8720 micro-controller (in-built ADC) and MP Lab Software are used to develop the system.**

Keywords—*PIC(Programmable Interrupt Controller), ADC(Analog to Digital convertor), Sensors, Data-Logger, MAX 232, RTC(Real Time Clock).*

I. INTRODUCTION

A data logger is a compact, battery-powered device which is equipped with a micro-controller, data storageunit and one or more sensors and sensor ports. Data loggers can be employed in variety of environments, for recording measurements at set intervals of time, unattended. Depending on a particular data logger, measurements can include air temperature, relative humidity, AC/DC current and voltage, time-of-use (lights, motors, etc.), light intensity, water temperature, soil moisture, wind speed and direction, plug load, and many more. A data logger can be astand-alone device, a single unit that fits in the palm of a human hand, or it can be a multi-channel data collection instrument which can be equipped with one or more external sensors [1]. There are many advantages of using a data logger such as measurements are always taken at the right time as per the timing requirements. Unlike a human, the computer will not forget to take a reading at specific time interval, neither it will take a reading with delay. Mistakes are not made in reading the results in a digital form whereas human can make errors, data can even be sent to areas where humans cannot reach. But the main disadvantage of using a data logging system is the initial cost of investing in the equipment. For example, if we purchase a thermometer it will cost us around 200 rupees and the component cost for data logger system for recording temperature is very high. So, to overcome this, we have tried to make a low cost multi-channel universal data logger [1].

The main aim of this paper is to develop a low-cost data logging system (Data Logger), which can be used to measure voltage(Ac/Dc), current and temperature. This data logger has following structure-an interfacing of LCD to display the output of various modules, an interfacing of real-timec lock with the microcontroller, an interfacing of EEPROM with the microcontroller and then interfacing of the data logger to the personal computer by serial communication using (RS-232).

II. SENSOR INTERFACING TO THE CONTROLLER

The basic equipment for adata-logger issensors, a sensor is a device which measures physical quantity and converts it into equivalent electrical signal, that can be analog as well as digital. This analog/digital signals can be visualize by the observer or the instrument. The main function of data-logger is monitoring the variables provided by the sensors which are used to sense the changes in the parameter and forward it to controller which is than displayed on LCD or monitored time to time and also can be stored. The parameter which are measured here are voltage, current and temperature. So, the sensors used are voltage, current and temperature sensors [2].

A. Voltage Sensor

Here we have developed a voltage sensor to measure high AC voltage. To measure high AC voltage (above 230V), it is of prime importance that this high voltage should be stepped down, as microcontrollers cannot measure voltages greater than 5V. If a voltagegreater than 5V is given to the analoginput of the microcontroller, then there is a high chance of the microcontroller getting damaged permanently. So, to assure protection of the microcontroller, oneshould step down 230 volts AC into an equivalentAC voltage, whose peak value wouldbe less than 5V. For example, 230V ACmean RMS value and its peak value is equal to 311 volts. Similarly, onemust step down high AC voltages in such a way that its peak value does not exceeds 5 volts. The method used here is differential amplifier method. Differential amplifiers are economical method for measurement of high AC voltages. Differential amplifiers are used to simply amplify voltages from 2 voltage levels. In case of Alternating voltage, we have 2voltage levels,a positive level with respect to ground and a negative level with respect to ground. One can adjust the gain of this difference amplifier according to their requirements by selecting proper value of resistors. In this project the gain of differential amplifier is equal to -

$$Gain = R8/ (R1+ R2+ R3);$$

In Alternating Voltage measurement, thesecond voltage level is equal to zero,asduring positive cycle and negative cycle the other side is considered zero or ground. So,the output voltage of the differential amplifier will be given as-

$$V(out)= gain * V(input)$$
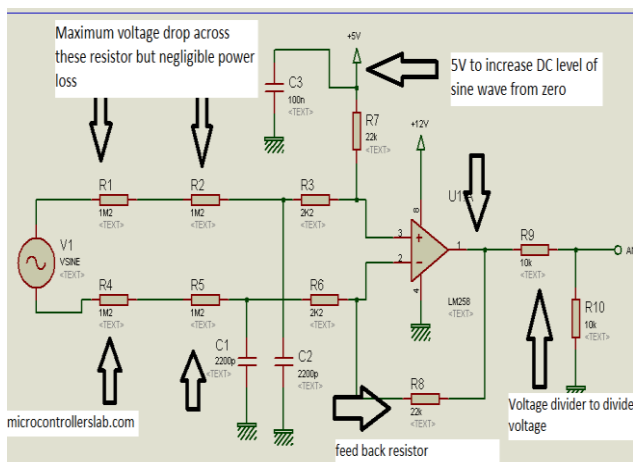
Fig. 1 Differential amplifier for stepping down voltage

In the above figure, resistors R1, R2, R3, R4 and R5 have high values which do not allow a high voltage to appear across the Op-amp LM-258. As high input resistors are used here, hence micro ampere value of

current will flow in the circuit and the power loss value will be in themill watts range. According to the difference amplifier gain formula, the gain of the circuit will be:

$$Gain= (22K)/(1.2M + 1.2M + 2.2K) = 0.0091$$

$$V(out) = 0.0091 * 311 = 2.8301 \text{ volts (peak output voltage)}$$

As seen in the above figure, other terminals of R7 are connected to 5 volts instead of ground, as normally done while using difference amplifier for various applications. Resistor R7 is used to increase the DC voltage level of Op-amp output. A sine wave has zero DC voltage level and a negative voltage cycle; hence microcontrollers cannot sense negative voltages.Hence when input 230 V is applied to the circuit, after the series combination of 1M resistor, the voltage drops to about 1.3 V. Due to the application of DC voltage, the output of the sensor's IC LM258 pin no: 1 comes to across 4.6 V. But, for avoiding damage to the micro-controller, this voltage is stepped-down by a resistor network of 10 K to about 2.3 V which can be efficiently used to signal the micro-controller's pin. The final output after resistor divider is given by the formula -

$$V(out) = 4.6/2 = 2.3 \text{ V};$$

Harmonics from input voltage are filtered with the help of capacitors C1, C2 and C3 and these capacitors also provide reduction in harmonics for protection of the microcontroller.Now a pin can be connected to the micro-controller's analog pin to measure this voltage easily[3].

B. Current Sensor

Thisdevice has a precise, low-offset, linear Hall circuitwhich contains a copper conduction path that is located near the surface of the die. Applied current thatflows through this copper conductionpath will generate a magnetic field which is then converted by a Hall IC into aproportional voltage. Device accuracy is optimized through theclose proximity of the magnetic signal with the Hall transducer.A precise and proportional voltage will be provided by the low-offset,chopper-stabilized Bi-CMOS Hall IC, which is programmedfor accuracy after packaging.
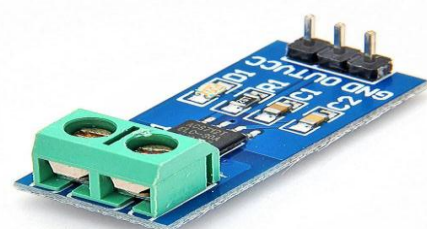
Fig. 2 ACS712 Current Sensor

The conversion rate of this sensor is about 66mV/A.The output of this device has a positive slope (>VIOUT(Q)) when an increasing current flows through the primary copper conduction path (from pins 1 and 2, to pins 3 and 4), this path is usuallyused for current sampling purpose. The internal resistance of this conductive path is approximately equal to1.2 M, providing low powerloss. The thickness of this copper conductor allows the device to withstand up to fivetimes the overcurrent condition. The terminals of the conductive path are isolated electrically from the signal leads of ACS712 (pins 5through 8). This allows the ACS712 to be used in applications requiring electrical isolation without the use of opto-isolators or other costly isolation techniques[4].

A. Temperature Sensor

Here we are using K type thermo-couple as temperature sensing component. A thermocouple is used to sense the temperature of the surrounding where it is employed. One end is made by joining two dissimilar metals, which is called as the Hot Junction and the other end of these dissimilar metals is called as the Cold Junction. The cold junction is formed at the ending point of the thermocouple material. The Type K thermocouple has a Chromel positive leg and an Alumel (Nickel- 5% Aluminium and Silicon) negative leg.
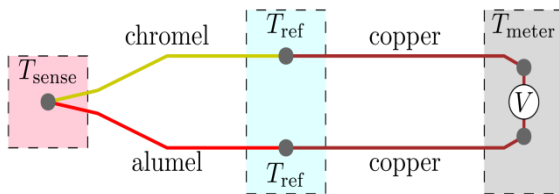
Fig. 3 Type K Thermo-couple

Type K is used in an oxidizing and in completely inert environments. Because it's oxidation resistance is far much better than Types E, J, and T, they have found widespread use at temperatures above 1200 F. Type K, should not be used in sulphurous atmospheres, or in a vacuum or in low oxygen environments where selective oxidation will take place. The temperature range for Type K is about 0 to 1472F and its wire colour code is white(positive) and blue(negative)[5].

III. MICRO-CONTROLLER (PIC18F8720)

The PIC18F8720 micro-controller inherits the same advantages of all the PIC18 microcontrollers – namely, high computational performance at an economical price – with the addition of a high endurance, enhanced Flash program memory. The PIC18F8720 also provides an enhanced range of program memory options and versatile analog features that makes it an ideal device for complex, high-performance applications.
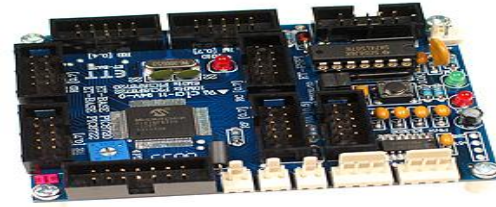
Fig. 4 PIC18F8720 Micro-Controller

PIC18F8720 micro-controller is an 80 pin IC. PIC18F8720 micro-controller introduces many key features such as expanded memory, external memory interface, easy migration, in-built ADC convertor, self-programmability, easy to communicate and many more [6,9].

IV. Interfacing RTC with Micro-controller
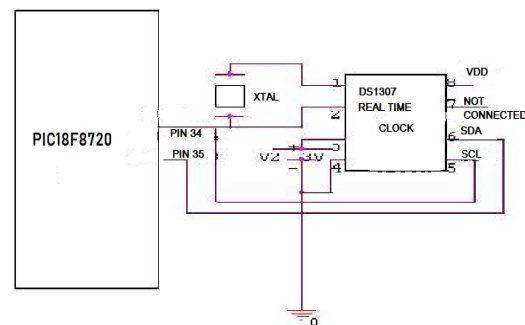
Fig.5 RTC(DS1307) interfaced with Micro-controller

The PIC18F8720 has a built-in I2C (Inter-Integrated Circuit) bus. I2C is a 2-wire synchronous serial bus which is used for communication between sensors and micro-controller. With the help of unique address multiple devices can be connected to the same I2C bus without any collisions and errors. We are using DS1307 real-time clock (RTC) that communicates over I2C to set (write) the time and date and also read from it. The DS1307 is a low power serial real time clock/calendar from Maxim Integrated with full binary coded decimal (BCD) clock/calendar plus 56 bytes of Non-Volatile Static Random-Access Memory. Data and Address are transferred serially through a bidirectional I2C bus. The RTC provides year, month, date, hour, minute and seconds information. The end date of months is automatically adjusted for months fewer than 31 days including leap year compensation up to year 2100. It can operate either in24-hour format or 12-hour format with AM/PM indicator. PIC pin 34 is connected to Pin 5 of DS1307 RTC IC (i.e. SCL pin), and PIC pin 35 is connected to pin 6 of DS1307 RTC IC (i.e. SDA pin). There is power sensing circuit in-built in it which senses the failures and automatically connects to backup supply. Micro-controller operates as a master whereas DS1307 operates as a slave on the I2C bus[2].

V. PC INTERFACING WITH MAX 232
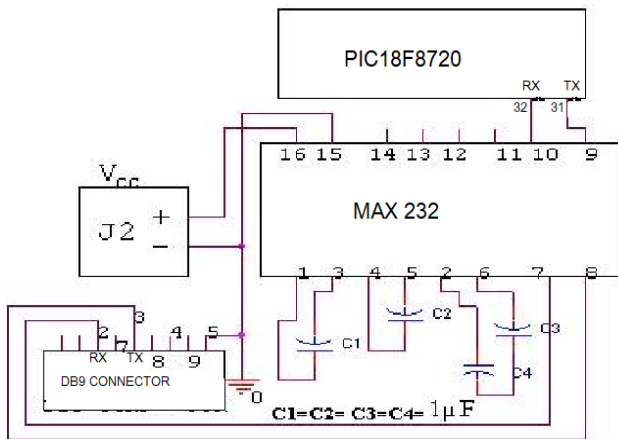
Fig. 6 Interfacing with micro-controller

For communication between PC and micro-controller we are using MAX 232. For TTL compatible digital logic circuits MAX 232 is used to convert the signals from RS232 serial port to proper signal level. Signals like RX, TX, CTS, and RTS can be converted using MAX 232. It is also a dual receiver/driver. With the help external capacitor and on chip charge pumps Driver increases the output voltage level of TIA232 from 5 volts to 7 volts. On the other hand the receiver is used to reduce the input levels from 25 volts to standard 5 volts of TIA232 of TTL levels and there is some threshold of 1.3 volts and hysteresis of 0.5 volts for the receiver [2].

VI. FUTURE SCOPE

In future we can improve the data logger by incorporating wireless transmission in it. So that it can transmit data continuously and no human is needed to collect the data. By using real time clock, it will transmit data time to time without any human interference required. By using GUI, we can make graphs of the collected reading, so it will be easier to read and will require less space to store. Many other sensors can also be included to measure different parameters. So, a standalone device can be used to measure many parameters. USB(universal serial bus) communication can be included so that we can transfer the data at higher data rates, presently we are using RS232 for transferring data.

VII. RESULTS AND DISCUSSION

We have made the sensors required and tested. All the sensors are working properly. All the sensors are giving the desired output. RS 232 serial communication through MAX 232 between micro-controller and PC has been interfaced. RTC has been interfaced with the controller. All the required connections have been interfaced and tested on proteus software.

TABLE I. VOLTAGE OUTPUT

Voltage sensor	
Input voltage 230v	Measured output voltage
05V	0.241V
12V	0.198V
20V	0.186V
50V	0.328V
100V	0.800V
150V	1.276V
180V	1.578V
230V	2.047V
260V	2.344V

TABLE II. TEMPERATURE OUTPUT

TEMPERATURE (DEGREE CELCIUS)	VOLTAGE (mV)
0	0
30	1.203
70	2.851
110	4.509
140	5.735
180	7.340
220	8.940
270	10.971
320	13.040
380	15.554
450	18.516
510	21.071
570	23.629
650	27.025
740	30.798

VIII. CONCLUSION

In this paper we have tried to develop a low cost universal data-logger. While designing this data-logger cost have been kept in mind. The micro-controller in this data logger has an in-built ADC. So, there is no need for external ADC, which reduces cost of the data-logger. There are multiple channels so that multiple parameters can be measure simultaneously. RTC has been used so that data is collected time to time without any human interference, PC interference have also been included so that along with memory card, data can also be stored in PC.

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A Comparative Study of Different Similarity Measures for Texture Based Color Image Retrieval

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Abstract—Description of images with color and texture features plays very important rolein Content Based Image Retrieval System (CBIR) when images are retrieved from a vast image database. Though these features are very significant, many a times, it is equally important to determine effective similarity measure to construct an effective search system that provides fast and accurate retrieval. Thus, determining similarities among given dataset is anessential task of content-based retrieval system. Representing the contents of the database with better feature representation and determining the similarities among the retrieved images of dataset by applying different distance measures to find their efficiency and effectiveness will help in establishing better similarity measure method for image retrieval. This paper discusses the behavior of different similarity measures on a given datasetand suggests the best among the considered measures in terms of retrieval accuracy. The findings will help in providing direction in the development of efficient system for content based image retrieval.

Keywords—similarity measures, content-based retrieval, Retrieval accuracy

I INTRODUCTION

Internet provides a super freeway of information for the user. Over the years, there is a vast growth in the number of users that are accessing huge amount of data from the internet. This growth has led to the development of huge image database such as databases for multimedia and digital libraries. This rapid growth of information has generated the necessity for image retrieval system with effective and efficient search algorithm.

Content- Based Image Retrieval (CBIR) is an area which is devoted to image retrieval problems [1] and already has large number of developed image database systems [2]. Three main features such as color, texture and shape of image take significant part in content based retrieval systems [3] that exists today.

II. LITERATURE SURVEY

The main goal of any efficient system for image retrieval is to acquire the image that is different from other similar images by capturing its important characteristics. Most of the indexing techniques are centered on features provided by spatial domain such as color [4], texture [5],

and shape [6]. Color is most extensively used feature for retrieval as it is easier to acquire the color images. Different methods based on texture such as texture analysis, classification and segmentation are also proposed encompassing the study to texture in color images thus providing faster way of achieving texture based image retrieval. The color bands are used to extract the texture characteristics of images to provide color texture information. [7,8,9,10,11]. In all these cases, creation of image database with robust and effective indices that are useful for efficient retrieval become important aspect of image databases [15]. In CBIR based systems; extraction of feature vectors from visual information of the images is carried out and stored as database. Features are also extracted from query image in a similar fashion. The comparison of query features with database features is carried out by using different distance measures to retrieve similar images [12]. Color histograms are also implemented for image retrieval in majority of retrieval techniques. The problems such as histogram dimensionality, immunity to noise etc. still exist though; histogram-based techniques provide better results. The requirement of good similarity measures has led to the development of new techniques.

In this paper, study of several distance measures and their behavior on the selected database is carried out. We have implemented these distance measures on Wang image database. The texture features of the images in Wang database is considered for image retrieval. The texture feature extraction is carried out using DT-CWT (Dual Tree Complex Wavelet Transform) to extract the prominent features of the images. The extracted features are represented as vectors for image database. Image similarity is determined by using different distance measures [13].

The main goal of this paper is to determine an efficient method that provides effective distance measure to obtain better average retrieval accuracy. The paper is organized as follows. Section I provides the introduction. Discussion on Dual Tree Complex Wavelets and extractionof texture features is provided in section III. Section IV discusses various distance measures that are

implemented for color image retrieval based on texture. The experimental results are discussed in section V and conclusion based on results is given in section VI.

III. FEATURE EXTRACTION AND REPRESENTATION

It is necessary to represent the images using feature vector in order to determine the effective indexing method. Different researchers have proposed large number of researches based on frequency domain indexing. These frequency domain techniques extract the features from various frequency domain methods such as wavelet transform, Gabor transform and Fourier transform etc. These indexing techniques have become more prevalent as they are less complex. The Dual Tree Complex Wavelet Transform (DT-CWT) is found to be one of the most efficient methods for texture feature extraction. Though, there are many different techniques that provide various algorithms for efficient extraction of texture features. The computational advantage of approaches based on complex wavelet has emerged as effective over other methods. The disadvantages related with other transforms are overcome in Complex wavelet [9] since they are orthogonal and provide fast computation. The shift invariant property and generation of separate sub-bands make DT-CWT more special. The DT-CWT provides sub bands with orientation in six different directions that include both positive and negative orientations making it superior over other wavelets [15]. The wavelet transform overcomes the drawback related with conventional wavelets like shift variance, poor directional selectivity etc. The Complex Wavelet Transforms (CWT) retrieves the texture features in an effective manner with less redundancy and computational complexity. These properties are attained due to dual tree structure of the Complex Wavelet. The CWT replaces the tree structure representation of conventional wavelet transform. In this, real part is produced by one tree of the dual-tree complex wavelet coefficients while imaginary part is produced by other tree at each scale [15]. This helps in achieving symmetric real parts and anti-symmetric imaginary parts. The overall complex impulse responses obtained by alternate use of even and odd filters. Thus, the final feature vector consists of the texture features of color image that are extracted from dual-tree complex wavelet filter.

A. Dual- Tree Complex Wavelet transform (DT-CWT)

The low pass data represents the approximated version of high-resolution image in all multi resolution analysis of wavelets, the sharper variation details of the image are always provided by high pass filter. The output is generated by incorporating two trees in parallel. The output of dual Tree complex wavelet is interpreted real and imaginary part of complex coefficient. The analysis branch provides real and imaginary coefficients by using two sets of QMF pairs [3]. The decomposition of image by transform at each stage into sub bands provides two approximated versions and information about orientation in six different directions. All these analysis filters are real & orthogonal [16, 17]. The outputs obtained by the QMF filters are represented as follows.

$$\Phi_1(x,y) = \Phi_h(x).\Phi_h(y), \Phi_2(x,y) = \Phi_g(x).\Phi_g(y) \quad (1)$$
$$\Psi_{1,1}(x,y) = \Phi_h(x).\Psi_h(y)\Psi_{2,1}(x,y) = \Phi_g(x).\Psi_g(y) \quad (2)$$
$$\Psi_{1,2}(x,y) = \Psi_h(x).\Phi_h(y)\Psi_{2,2}(x,y) = \Psi_g(x).\Phi_g(y) \quad (3)$$
$$\Psi_{1,3}(x,y) = \Psi_h(x).\Psi_h(y)\Psi_{2,3}(x,y) = \Psi_g(x).\Psi_g(y) \quad (4)$$

Equation (2), (3) and (4) generate resultant wavelets in six different directions as follows:

$$\Psi_i(x,y) = \Psi_{h,i}(x) + \Psi_{g,i}(y) \quad (5)$$
$$\Psi_{i+3}(x,y) = \Psi_{h,i}(x) + \Psi_{g,i}(y) \quad (6)$$

These resultant wavelets are redundant but directional. These six wavelets obtained are oriented in $\{+15^0, +45^0, +75^0, -15^0, -45^0, -75^0\}$ to provide information in mentioned direction and shift invariant.

.

IV. DIFFERENT DISTANCE MEASURES

Content based image retrieval system comprises of three major constituents i.e. feature extraction, indexing and system design. An image is characterized by a set of relevant features that can yield better retrieval performance. In order to have an effective retrieval, it is essential to incorporate suitable similarity measure that works similar to human judgment. Therefore, it is required to carry out comparison of retrieval results using such similarity measures that can provide better results. Lot of literature survey on usage of different distance measures has been carried out to discover most efficient measure to retrieve the images. Accordingly, different similarity measures have been proposed for retrieval to match the human similarity judgments. The analysis has been carried out on retrieval results obtained by different similarity metrics such as Euclidean, City block, Matusita, Chi-square, Canberra and modified Canberra and the results are compared for retrieval accuracy. If 'x_i' and 'y_i' are the ith feature vector components of the database and query image respectively. The 'D' is the distance between query and database feature vector is given for different similarity measures discussed in next section.

A. Euclidean Distance (l2)

Euclidean distance is one of the best common distance metrics used in many of the literature related to image retrieval [18]. When r=2, it relates to the Minkowski-form distance, and is given as:

$$D = \sqrt{\sum_i (x_i - y_i)^2}$$

B. City Block Distance (Or Manhattan Distance)

The Minkowski-form distance for r=1 is known as the city block distance. The computation time required by the

City Block Distance is less as compared to many of the distance metrics[18], and is defined as:

$$D = \sum_i |x_i - y_i|$$

C. Matusita Distance

The Matusita distance is given as[18]:

$$D = \sqrt{\sum_i \left(\sqrt{x} - \sqrt{y}\right)^2}$$

D. Chi-Square Distance

Theun–binned distributions can be handled by Chi-square statistics. But comparison between binned distributions like histograms also uses this distance measure [18]. Chi-square distance is the widely used distance metric and is represented as:

$$D = \sum_i \frac{(x_i - y_i)^2}{x_i + y_i}$$

E. Wave - Hedges Distance

The Wave-Hedges metric[18] is given as:

$$D = \left(1 - \frac{min(x_i, y_i)}{max(x_i, y_i)}\right)$$

F. Canberra Distance

Canberra metric is widely used in many CBIR applications due to its popularity. It provides high retrieval efficiency with low computational complexity as compared to other distance matrices [18]. In this, the numerator indicates the difference between the feature vector components and denominator normalizes the difference. Thus, the distance will be one when any of the attributes is zero, but not exceed one. Thus, it is a good similarity measure that avoids scaling effect.

$$D = \sum_i \frac{|x_i - y_i|}{|x_i| + |y_i|}$$

G. Modified Canberra Distance

A new similarity measure has been proposed which is the modification of Canberra distance for efficient color image retrieval. The proposed distance measure performs better than Canberra distance measure and resolves the ambiguity arising if feature vector components of both database & query images happen to be identical. The modified Canberra distance is given by:

$$D = \sum_i \frac{|x_i - y_i|}{1 + |x_i| + |y_i|}$$

V. RESULTS

The experiment was implemented 1000 images belonging to Wang database of size 256x384 or 384x256 respectively. There are 10 different classes under Wang database. These classes are categorized as People, Beach, Elephant, Horse, Food, Monument, Rose, Dinosaur, Bus and Mountain[3]. The resizing of images to 256x256 is carried out in pre-processing stage and changing into gray scale images. The extraction of texture feature is carried out by down scaling the image up to fourth level. The energy and standard deviation parameters are calculated at each scale. Thus, the texture feature vector for each database image consists of 64 features corresponding to DT – CWT. The similarity of query image with the images in database is calculated using different distance measure methods as discussed in section 3 by considering each of the images in database as query image. The performance evaluation of the system is carried out by considering only the texture features obtained by DT-CWT. The retrieval accuracy of each class is carried out followed by average retrieval accuracy for image under consideration is calculated w.r.t query image. The expression for Retrieval Accuracy is given as [15],

$$\text{Retrieval Accuracy} = \frac{\text{No.of Relevant images Retrieved}}{\text{Total No.of Relevant Images}} \quad (7)$$

The Average Retrieval Accuracy of each class is given by,

$$\text{Average Retrieval Accuracy} = \frac{1}{n}\sum_{i=1}^{n} \text{Retrieval Accuracy} \quad (8)$$

Where n=No. of images in each class

The average retrieval accuracy of the class is calculated. The retrieval accuracy is calculated for different distance measures. All these methods are compared with respect to average computation time and the retrieval accuracy.
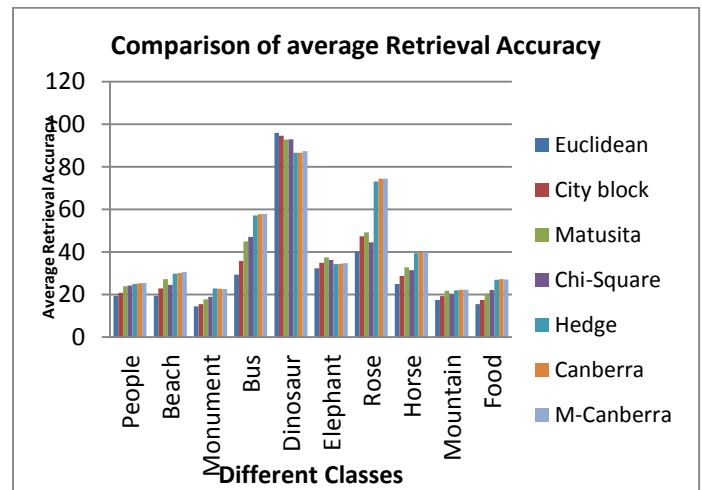
Figure1. Comparison of Average Retrieval Accuracy of database for Different Distance measures

Figure 1 represents the average retrieval accuracy obtained using the different distances measures for all the classes present in the database.
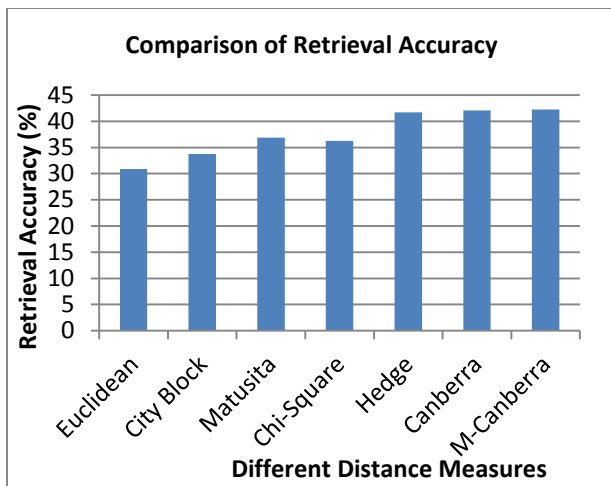
Figure2. Comparison of Retrieval Accuracy of database for Different Distance Measures

Figure 2 provides the retrieval accuracy achieved for database with different distance measures.
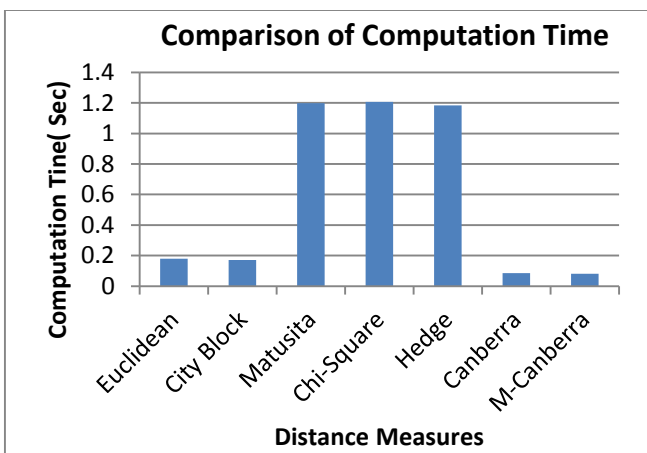
Figure3. Comparison Computation Time for Database with Different Distance Measures

Figure 3 provides the information of the computation time required for calculating the retrieval accuracy of database.

VI. CONCLUSION

In this paper, we have examined several distance measures that can be implemented for the color image retrieval. In the retrieval system, feature vectors are generated to represent all the color images belonging to different classes. These vectors are then used as database indices for each color image [15]. The retrieval is carried out for the above discussed distance measures. It was found that retrieval accuracy using Euclidean distance was found to be poorer as compared to other similarity measures. The retrieval accuracy of many classes is better for Canberra and modified Canberra measure as compared to other distance metrics. It is found that the average retrieval accuracy of Canberra & M-Canberra is more almost

all the classes except dinosaur and elephant classes. The time required for computation in both of these distance measures is also less compared to other methods. Hence, by taking into account the computational time and retrieval accuracy of each the distance measure, it can be concluded that the Canberra and modified Canberra metrics are preferable as compared to other distance measures.

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Image Security Enhancement using Steganography

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Abstract— **A novel data hiding method is proposed for embedding significant Facial Data in a single fingerprint image. This technique uses the properties of Discrete Cosine Transform (DCT) and Discrete Wavelet Transform (DWT) to embed the facial image onto the Fingerprint image. LSB steganography is used to hide text in the face hidden image. The Face Image is first compressed using Discrete Cosine Transform and then is embedded into the HH sub-band of the fingerprint Image which is acquired using 1-level DWT. Fingerprint features i.e. minutiae stay unaffected during and after the process. The evaluation if this embedding technique shows that it is capable of handling larger facial data and text for a single Image. Also it gives good results in the form of computed PSNR, SSIM and Normalized Cross Correlation.**

Keywords-watermark; DWT; DCT;Face;Fingerprint;text.

I.   INTRODUCTION

Steganography is often confused with cryptology because the two are similar in the way that they both are used to protect important information. The difference between the two is that Steganography involves hiding information so it appears that no information is hidden at all. The purpose of steganography is to protect your data from illegitimate manipulation; in short it's a way which provides security of information from manipulation of original data. The information or message which is digitalis hidden in digital signal that contains owner information data to provide secure and avoid the modification or duplication of the original data (video, audio, Image, etc.). For better copyright protection, we should have to notice some important fact that the imposing of secret data should not affect original information quality. The algorithm should be affective and robust, unauthorized distributer cannot eliminate and manipulate the Secret data. It means the content should be detected by authorized person. There are several important factors useful to check integrity. For providing much secureness it depends on the embedding technique which is used by the owner. When hiding information inside images the LSB (Least Significant Byte) method is usually used. When hiding information inside files the technique usually used is low bit encoding which is somewhat similar to LSB that is generally used in Images. The problem with low bit encoding is that it is usually noticeable, so it is a rather risky method for someone to use if they are trying to mask information inside of a file. Spread Spectrum is another method used to conceal information inside of a file. This method works by adding random noises to the signal, the information is conceal inside a carrier and spread across the frequency spectrum. When

information is hidden inside video the program or person hiding the information will usually use the DCT (Discrete Cosine Transform) method. Steganography in Videos is similar to that of Steganography in Images, apart from information is hidden in each frame of video. When only a small amount of information is hidden inside of video it generally isn't noticeable at all, however the more information that is hidden the more noticeable it becomes. So Steganography in Images is preferred. In today's modern world authentication and security is of major concern. In such case biometrics plays a vital role as it offers high security as compared to traditional methods. Finger print recognition is one of the most widely used biometric security system as it is easy to access and implement. The existing finger print technology does not provide much accuracy thus resulting into implementation of fusion techniques in the existing technology. Fusion at sample level finger print recognition also called as finger print recognition using hybrid technology provides high security at low cost. With the widespread applications of fingerprint techniques in authentication systems, protecting the privacy of the fingerprint becomes an important issue. Traditional encryption is not sufficient for fingerprint privacy protection because decryption is required before the fingerprint matching, which exposes the fingerprint to the attacker. Therefore, in recent years, significant efforts have been put into developing specific protection techniques for fingerprint.

II.   LITERATURE REVIEW

A.   *Traditional Methods for ssecuring data.*

Three complementary techniques are being used: encryption, steganography and watermarking [1]. Encryption is a conspicuous and secure technique to converse data into a scrambled code that can be distributed and deciphered through a private or public network. Generally speaking, in both research and application fields, encryption and cryptographic algorithms serve copyright owners as an approach to protect the secure transmission of confidential multimedia data between a distributor or publisher and the purchaser of the multimedia data over public channels. Using variations of symmetrical and asymmetrical styles or forms of encrypting data, the permutated original multimedia contents are non-recognizable in appearance, unsystematic, and disorderly [2]. Although encryption algorithms can be applied to avoid illegal access to digital contents, it appears that encryption by itself is not sufficient enough to prevent an unauthorized pirate from illegally replicating multimedia content and protect multimedia data all along its lifetime. Once multimedia content has been

decrypted into its original style and the protection of information is invalidated for further manipulations because there is no degradation of quality in subsequent works and no verification differences between one copy and any other derivative copy. Therefore, unauthorized replicating copy and transmission of multimedia data cannot be obstructed [2]. Steganography [3] represents a technique that is used to convey communicating secret data by writing hidden messages into an appropriate multimedia carrier, e.g., audio, image and video. The existence of the message is suspected except by the sender and intended receiver. Unlike cryptography techniques, the goal of steganography is to conceal the very existence of the hidden messages, together with avoiding arouse suspicion and not attracting attention to themselves. However, steganography conventionally involves associating secret point-to-point transmission and Communication. Thus, steganography approaches are typically not resistant to transformation of the carriers, or hold only restricted robustness.

B. Previous works

The [5] states the four different images of fingerprint, where every image is further isolated into 4 different quadrants and every quadrant watermarked image with the encrypted numeric digit. As four watermarked image of fingerprints with a modified ATM pin number of the same client, the proposed work discovers application in security usage in view of cryptographic unique fingerprint watermarking. Such a combination of watermarking strategies and encryption gives a level of security and further shields the client's personality from assaults because of the procedure's strength. The experimental study is complete on a limited number of clients and the outcomes show that hybrid methodology gives enhanced results as far as other existing methodologies. [6] Shows a technique to hiding biometric information, which uses a combination of steganography and asymmetric digital watermarking. The combination of these strategies enables system to the handle numerous problems associated with storing and also transferring information of raw biometric. What it proposes is a multilayer system that initially, encodes eigen-components removed from the raw face images, into the fingerprint image. Consequently, every watermarked fingerprint image is encoded within an arbitrary host image unrelated to biometrics or crime scene investigation, transfer image securing.DWT has shown better performance in terms of robustness and payload capacity [9], [10], butas the payload is increased, imperceptibility and robustness are decreased. Multi-level DWT can be used to improve imperceptibility, but it reduces the robustness and size of the payload [11]. The understanding of the previous works is required as a pre-requisite for the implementation of the algorithm being proposed. This was explained in the current chapter, whereas the next chapter gives a brief overview about some of the important concepts that would be required to understand the algorithm in a smooth manner. [12] A steganography system is designed for encoding and decoding a secret file embedded into an image file using random LSB insertion method in which the secret data are spread out among the image data in a seemingly random manner. This can be achieved using a secret key. The key used to generate pseudorandom numbers, which will identify where, and in what order the hidden message is laid out. The advantage of this method is that it incorporates

some cryptography in that diffusion is applied to the secret message.

III. METHODOLOGY

Before A single-level of DWT is performed to get the high frequency sub-band HH and LL of the host fingerprint image. The DCT algorithm is used for compression, quantization and conversion purposes to convert a grayscale image into a compressed binary array of data. The embedding procedure is completed by taking the inverse discrete cosine transforms (IDCT) of the HH and LL sub-bands, followed by the inverse discrete wavelet transform (IDWT) of the resultant image. The extraction steps are similar but in the reverse order. The watermarked sub-band regions LL and HH are then independently subjected to DCTs to recover the modified DCT coefficients, from which the watermark greyscale facial and text are extracted.

A. Discrete Wavelet Transform (DWT)

The fingerprint image is first decomposes into a low frequency band (LL) and high frequency bands (HL, LH and HH) as shown in figure. The low frequency sub-band (LL) contains most of the energy of the image. Thus, embedding data in this band will cause degradation to the image. Also Hh band contains mostly high frequency component and is mostly irrelevant to the original data.
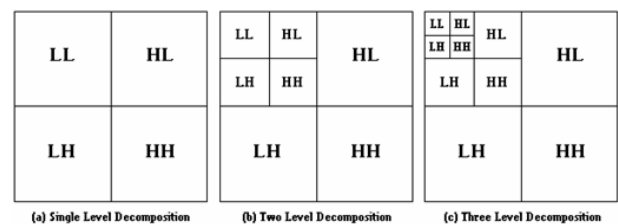
Fig.1 DWT levels

B. Discrete Cosine Transform (DCT)

A discrete cosine transform (DCT) expresses a finite sequence of data points in terms of a sum of cosine functions oscillating at different frequencies. DCTs are important to numerous applications in science and engineering, from lossy compression of audio (e.g. MP3) and images (e.g. JPEG) (where small high-frequency components can be discarded), to spectral methods for the numerical solution of partial differential equations. The use of cosine rather than sine functions is critical for compression, since fewer cosine functions are needed to approximate a typical signal. The DCT-based algorithm is implemented for compression, quantization and conversion of the grayscale facial image to binary image. The image compression using the DCT is utilized to add redundancy which will improve the robustness of the algorithm.

C. Text Hiding

In the last years the Internet has been considered as a suitable medium for transferring digital data and multimedia. Its main advantage is the availability to almost everyone and data can be received within a few seconds. The main disadvantage of using the Internet is the weak data security, because data can be monitored by any unauthorized viewers.

That is why steganography should be used. Steganography is a technique for embedding a secret data into a cover image. Any unauthorized user can view the stego image but only authorized users can extract the secret data. Any steganography approach must be secure to avoid any unauthorized access. In this study LSB data hiding is used. Along with this scheme data scrambling has been used to secure the data to another level. Scrambler often referred as randomizer basically removes long stream of o's and 1's from the data. It is used in wireless transmitter and receiver.
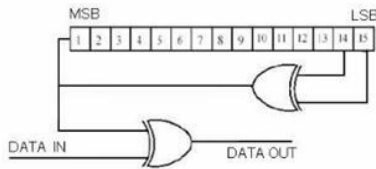
Fig.2 Scrambler Circuit

IV. IMPLEMENTATION

A. Proposed Method

The main objective of this research is to develop a new watermarking schema for fingerprint image by utilizing DWT, DCT and loss-less image compression at the same time. The combined DWT-DCT watermarking algorithm is developed to embed two watermarks into fingerprint image, including one grayscale facial image and text which contains information such as ID, DOB, name, etc. which are belong to the fingerprint owner. The aim is simply to embed large amount of watermark payload without corrupt fingerprint minutiae. The DCT based method is used for compression, quantization, and conversion of the grayscale facial image to binary image, which allows for embedding and extraction of larger size of greyscale facial and text in a single level DWT transformed of fingerprint image as compared to that in [13]. The overall algorithm is conveyed through the block diagram in figure 4.
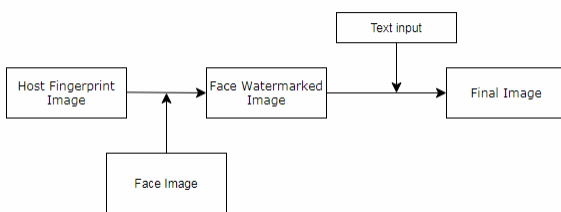
Fig.3 Block Diagram

The host fingerprint image is also the cover image for the secret data i.e. text also the face image is watermarked in the fingerprint image as shown in fig. 4. The image given by the owner is used into two parts for different process one, for face embedding and the face embedded image for text hiding. After the termination of both processes the final Stego image is ready for the purpose of authentication of a user identity

B. Implementation

The Step-by-step implementation of the algorithm is presented in figure 5.
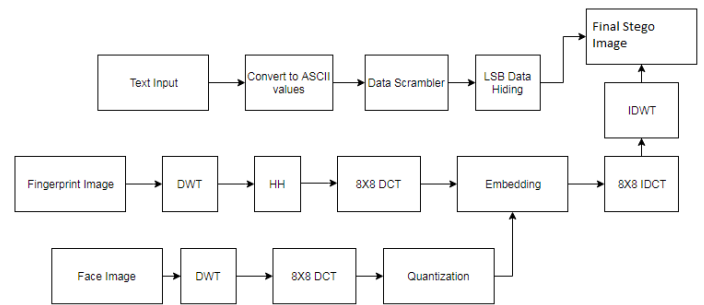
Fig.4 Implementation

Fingerprint Processing

The Fingerprint Image has a 512X512 dimensionality and is being taken for test from the NIST database-4. The Fingerprint images are picked randomly from various images which were taken in almost different conditions i.e. pressure etc. The acquisition of fingerprint can be performed using two different methods, touch and touch less [10] the touch-less acquisition technology is in the initial stages and is gaining more attention from researchers and sensor industries

- Step 1: 2-D DWT of the fingerprint image.

- Step 2: Isolation of the HH sub band.

- Step 3: Division of HH in 8x8 Block and applying DCT to all blocks.

- Step 4: Face image embedding in HH blocks respectively.

- Step 5: 8x8 IDCT and stitching the blocks in a whole image

- Step 6: Taking IDWT of the new Image.

- Step 7: Hiding the scrambled text String values.

Face Processing

The face images are taken from another NIST database which have different poses and light condition etc. The face image is resized to 256x256 to avoid unnecessary computational complication.

- Step 1: 2-D DWT of the face image.

- Step 2: Division of the image in 8x8 Block and applying DCT to all blocks.

- Step 3: Quantization of the DCT coefficients using the matrix:

$$\begin{bmatrix} 16 & 11 & 10 & 16 & 24 & 40 & 51 & 61 \\ 12 & 12 & 14 & 19 & 26 & 58 & 60 & 55 \\ 14 & 13 & 16 & 24 & 40 & 57 & 69 & 56 \\ 14 & 17 & 22 & 29 & 51 & 87 & 80 & 62 \\ 18 & 22 & 37 & 56 & 68 & 109 & 103 & 77 \\ 24 & 35 & 55 & 64 & 81 & 104 & 113 & 92 \\ 49 & 64 & 78 & 87 & 103 & 121 & 120 & 101 \\ 72 & 92 & 95 & 98 & 112 & 100 & 103 & 99 \end{bmatrix}$$

- Step 4: Embedding the quantized values into the fingerprint.

Text Processing

The text input can be taken via both input, prompt or directly allotting it in the hard code itself. The string length considered in this study are for 8,16.24 characters or 64,128,192 bits. The input string is first converted to ASCII.

- Step 1: Taking the text as input

- Step 2: Conversion of the Text to ASCII values

- Step 3: Using a Scrambler circuit code to shuffle the data

- Step 4: Hiding the shuffled data in the face watermarked image using LSB's.

V. RESULTS

In order to provide an evaluation of the proposed algorithm, 50 fingerprint images of size 512x512 pixels and 10 face images resized to 256x256 are used. These images are obtained from the National institute of Standards and Technology. To quantify the distortion of the proposed watermarking algorithm on different watermark payloads, constant size of watermark images are considered.A detailed quantitative testing on a database of fingerprint images has been investigated as described below. The JPG compression technique uses compression of 8x8 blocks. Hence, the original grayscale facial images need to be multiple of 8. Different measures such as correlation, the peak-signal-to-noise ratio (PSNR) and mean square error (MSE) are used to determine degrees of similarity between the original and the watermarked fingerprint images and the original face images with their correspondence extracted images.The results are averaged and clubbed together from the 50input images with each of the 10 faces giving us 500 observation thrice for different string lengths as follows for different string lengths:

Table.1 PSNR for string length 8

Sr.no	Input and Final Image(dB)	Original and extracted Face (dB)
1	33.95789	26.88836
2	35.16095	28.64285
3	34.6892	27.92741
4	34.08619	27.06027
5	34.33247	27.421
6	34.66402	27.89579
7	34.42322	27.54416
8	33.95713	26.88074
9	34.60654	27.80828
10	35.21545	28.72351
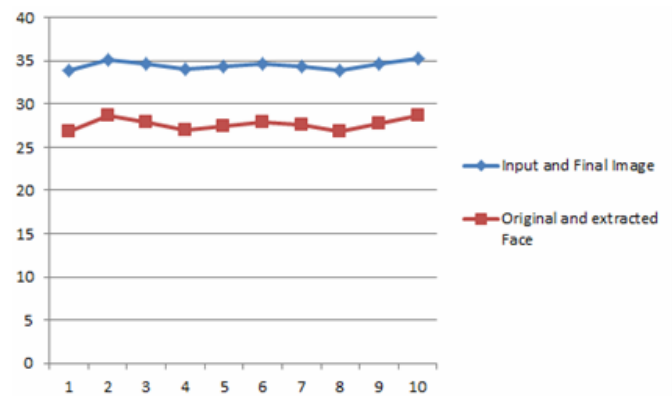
Fig.5 PSNR plot

Table. 2 SSIM & NC values for length 8

Sr. No	SSIM	NC
1	0.963067	0.995288
2	0.97248	0.996425
3	0.968713	0.996016
4	0.95981	0.995424
5	0.961245	0.995676
6	0.966055	0.995993
7	0.967277	0.995765
8	0.962709	0.995287
9	0.965852	0.995939
10	0.969623	0.99647
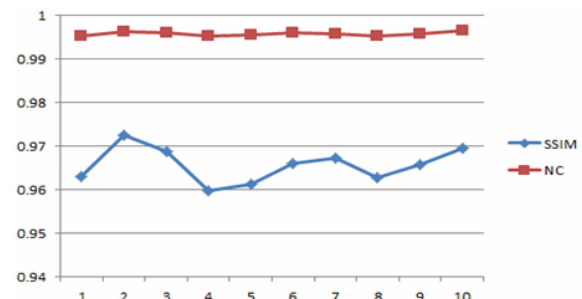
Fig.6 SSIM & NC plot

Table. 3 MSE values for length 8

Sr. No	Input and Final Image	Original and extracted Face
1	0.000402	0.002047
2	0.000305	0.001367
3	0.00034	0.001612
4	0.000391	0.001968
5	0.000369	0.001811
6	0.000342	0.001623
7	0.000362	0.00176
8	0.000402	0.002051
9	0.000347	0.001656
10	0.000301	0.001342
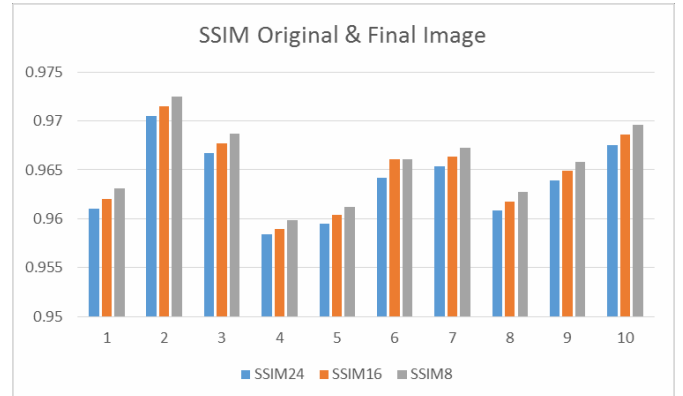
Fig.9 SSIM comparison plot
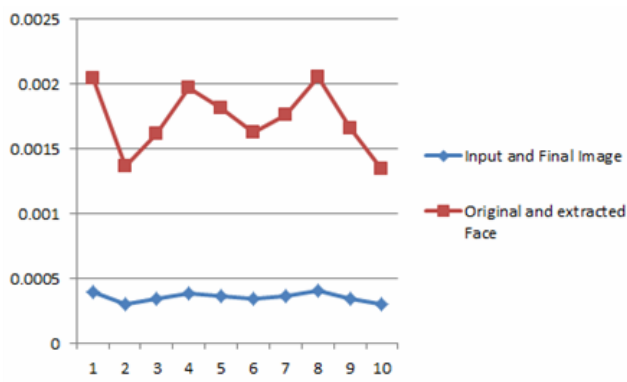
Fig.7 MSE plot
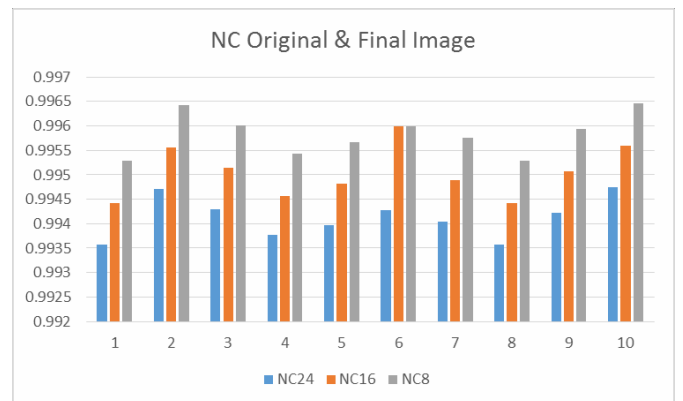
Fig.10 SSIM comparison plot

Performance for different String lengths:

For the different string lengths, the nature of algorithm is presented as follows:
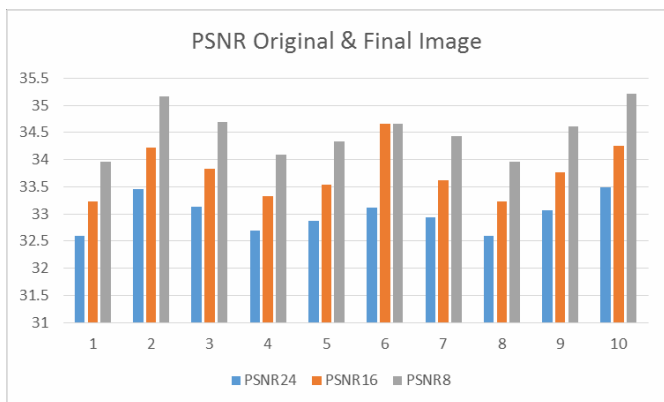
Fig.8 PSNR comparison plot
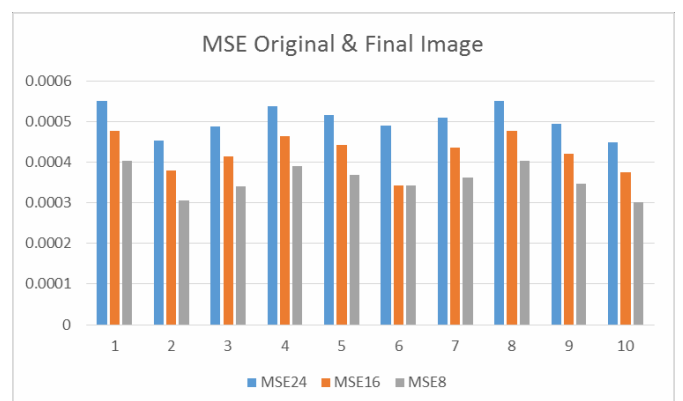
Fig.11 MSE comparison plot
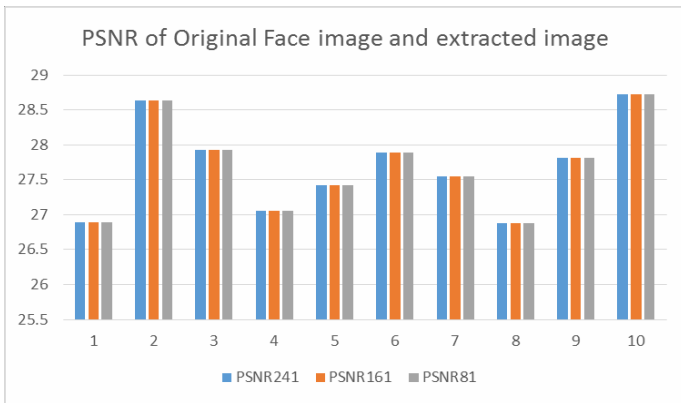
Fig.12 PSNR for face comparison plot
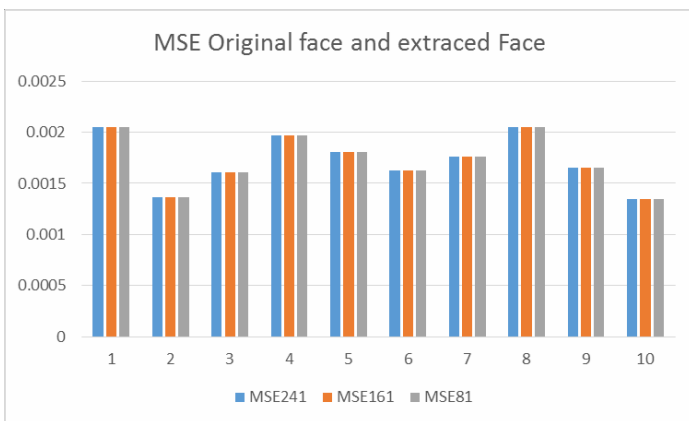
Fig.13 MSE for face comparison plot

VI. CONCLUSION

Data Hiding after scrambling in their corresponding fingerprint images helps in creating a new virtual identity for the user. User facial and identification information in the form of text data are embedded into owner's fingerprint image. The proposed algorithm utilizes the strengths of DWT-DCT techniques. The algorithm performs robustly due throughout the face images set with minimum or no distortion. For every face image as long as the dimensions are unchanged the results are similar throughout the fingerprint image set. The variations of the observations are boiled down to a single factor as long as the images are same i.e. string/character length. As the number of character increases a drop in the values of PSNR, SSIM,NC is observed. PSNR values decrease with the increase in character length. The same is followed by SSIM and NC. The MSE values increase along the length

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Low Level Signal Processing System for PCB based Rogowski Coil

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Abstract—**Rogowski coils are used for measurement of high value of current flowing through transformer windings using principle of electromagnetic induction. Recently developed printed Circuit based (PCB) based Rogowski coils are cost effective and give uniform performance. However, their output is as small as a few tens of microvolts which is to be processed in the presence of noisy industrial environment. This paper describes the design and development of signal processing system which is capable of processing low level signals down to μV levels. The circuit was designed to operate with low power of as small as 20 mW. For this DC restoration circuit was designed to compensate the errors introduced due to input bias current (I_B) and offset voltages (V_{OS}).**

The circuit was tested for the sine wave, square wave inputs voltage as small as 50μVpp with integration in linear region over 20 Hz to 2000 Hz .

Index Terms—**PCB based Rogowski coil, low level signal processing system, integrator, DC Restoration**

I. INTRODUCTION

Measurement of current is one of essential circuit functions. It can used in deciding limits of operation of peripheral loads, whether to turn off to save power or operate on balanced limits. In various Current measurement methods, each method has its pros and cons that can be critical. Methods of direct measurements define direct connection with the circuit being measured in such a way that its measurement components are touching to the line voltage, whereas in case of contactless measurement is safe as it provides needed isolation. Indirect current measuring devices such as current transformers has its magnetic saturation due to its ferromagnetic core [1], [2], [3]- [7] which results in limiting the range of currents to be measured.

A wide range of industrial applications requires that AC current transducers should be able to match both metrological requirements, such as accuracy, linearity, bandwidth, etc., and application-oriented requirements, such as high-level galvanic insulation, ruggedness, lightweight, etc. Unfortunately, none of the commercially available AC current transducer is able to comply with the above requirement. Resistive shunts are characterized by a wide bandwidth and linearity, but they do not assure galvanic insulation. Hall Effect based on current transducers feature wide bandwidth, compact size and galvanic insulation, but are still limited in their accuracy and linearity

and in the thermal drift. Classical electromagnetic current transformers assure a good compromise between accuracy, long-term stability and galvanic insulation, but become inadequate when wide band, compact size and lightweight requirements are necessary [8] In the other prior research, for low-frequency applications, it is reported that in low frequencies (25 Hz to 400 Hz), the output of the current transformer in fault state is less accurate and requires more correction factors [8] Emerging modern protective relays increases the applications of Rogowski coil for measuring-current in power systems. Rogowski coil measures the changes in magnetic field using contact less measurement technique. This coil interacts with magnetic field and produces a voltage which is proportional to di/dt. Rogowski coils have better performance in a vast majority applications; sudden short circuit test, lightning test and partial discharge monitoring, as compared to the other current measuring devices. A new configuration of Rogowski coil based on printed circuit board is useful in transient current measurement. In that study, the amplitude of the coils output signal is increased without decreasing its bandwidth, by increasing the number of PCB coils. It is evident that the phase angle between output voltage and input current is very inconsistent. Occasionally the output of Rogowski coil is associated with lot of noise and common mode signals also. The signal proportional to Ldi/dt has to be extracted and integrated with high speed integrator to find out the value of current. Large number of papers have reported use of Rogowski coils [8], [9] and associated signal processing circuits.

A. Principle

An 'air-cored' coil is placed around the conductor in a toroidal fashion and the magnetic field produced by the current induces a voltage in the coil. The voltage output is proportional to the rate of change of current This voltage is integrated, thus producing an output proportional to the current [10]

1) Relationship between Rogowski coil and ampere's law: Amperes Law provides the relationship between the current flowing and the magnetic field around it. If a line is drawn in a loop which totally encircles the current then, according to Amperes Law, the line integral of the magnetic field around the loop is equal to the net current enclosed by it no matter

what path the loop takes. If the loop encloses no net current the line integral is zero. Mathematically, this is expressed as

$$\oint H.\cos a.dl = i \qquad (1)$$

Where dl is a small element of length along the loop, H is the magnetic field and a is the angle between the direction of the field and the direction of the element,
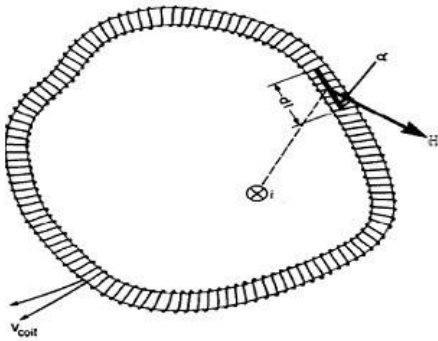
Fig. 1.   Flexible Rogowski Coil [10]

$$V_{coil} = \frac{-d\varphi}{dt} = -\mu_0.n.A\frac{di}{dt} \qquad (2)$$

where, n are turns per meter and cross-sectional area A which encircles a conductor carrying a current. [10]

B. Problems associated with conventional wire wound Rogowski coil

1) Signal Strength: The voltage induced is of very low level. Improvement can be made to facilitate measurement which include reduction in the coil diameter, but it comes with the trade-offs like decreasing the size results in increasing turns per unit length, reduction in the coil reliability, increases fragility of wire gauge [11] A good level of output is attainable with an increase in size, but it restricts the use of coils at compact, more tighter spaces and limits its use as well as addition of layers has its improved results but comes with the trade-off of increases in interwinding capacitance which limits the bandwidth [11]

2) Structure: Many of the errors generated as coil varies from one to another in terms of uniformity turns density as well as area of turn [11] This is a common issue with conventional toroidal wire wound flexible coil, where a turn structure varies. Errors in measurement occurs in overlapping of winding in presence of powerful external magnetic fields. It its position sensitive while measuring small current values, Bending changes area per unit as coil deform to oval structure from circular Earlier Rogowski coil technique had limitations due to low output voltages and demands of higher sensitive equipment Various configurations of Rogowski for special applications are made. As the conventional wire wound technique

for Rogowski Coil design has some limitation for measurement of small value of current which can be improved by The use of more PCB based Rogowski coils. These PCB based Rogowski Coil provide higher accuracy, lower sensitivity to positioning the conductor, and better external field rejection performance than the normal wire wound configurations. Another advantage of this is lower production costs.

II. PCB BASED ROGOWSKI COIL

A Printed circuit board technique brought a more advanced way in the fabrication of Rogowski coils. Compared to the conventional coils PCB coil has its winding structure more symmetrical. Attachment of windings are compact and tight to the baseplate which keeps the shape of coil stable. Mutual inductance of coil does not vary with temperature.

Fig. 2.   PCB based Rogowski Coil [12]

A. Measuring system

Integration of coil output voltage is needed to obtain accurate and original waveform [13], [14], [15] It must be properly in shape, phase, and magnitude. While doing so DC offset emerges as a function of amplification and integration of the output, which is typically in the of range 1 mV to 50 mV.

B. Sources of DC offset

The output of the Operational Amplifier is ideally zero when both the inputs are zero, but because of some mismatch in characteristics of the devices there exists a non-zero output voltage (V_{OS}), input bias current (I_B) and input offset current (I_{OS}). I_B, V_{OS}, I_{OS} charges capacitor while performing integration and its output voltage is saturated.

$$V_0(t) = V_{OS} + \frac{1}{C}\frac{V_{OS}}{R}t + \frac{I_B}{C}t \qquad (3)$$

C. DC Restoration Technique

To eliminate the effect of V_{OS}, I_B and I_{OS} on Operational Amplifiers we need a DC restoration circuit which will compensate these DC errors and make the circuit error free.

III. DESIGN AND DESCRIPTION OF THE CIRCUIT USED FOR SIGNAL PROCESSING OF ROGOWSKI COIL

The output voltage of the Rogowski coil is proportional to the rate of change of the current flowing through it. Since this current need to be measured, the output voltage of coil is required to be integrated. However, any integrator will also integrate I_B and V_{OS} present at the input of Instrumentation amplifier resulting into the saturation of its output. Hence,
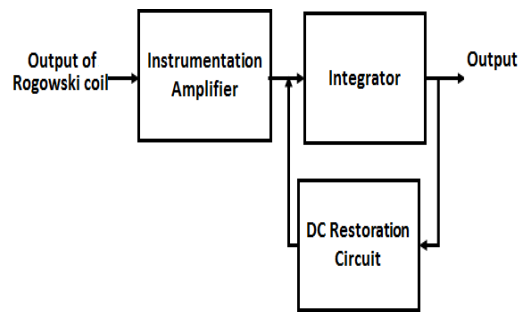
Fig. 3.   Block diagram for signal processing circuit of Rogowski coil

proper DC restoration circuit has been designed to compensate errors due to integration of I_B and V_{OS}. This compensation has to be very accurate since the amplitude of input signal to be integrated is much smaller as compared to the errors introduced because of I_B and V_{OS} of op-amp. Low power op-amps have been used with supply voltage of ±5V to obtain the power dissipation of less than 20mW.
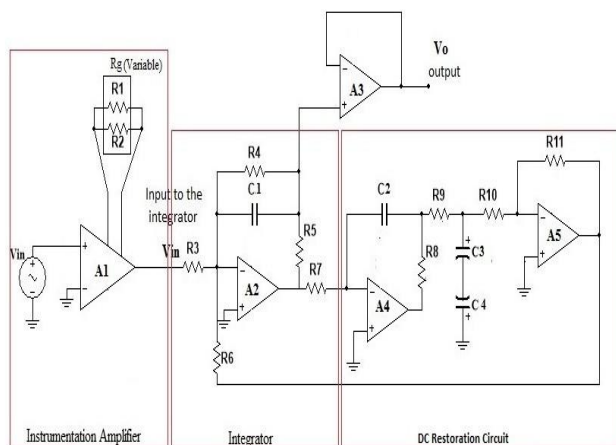
Fig. 4.   Circuit diagram for signal processing circuit of Rogowski coil

A. Instrumentation Amplifier

This instrumentation amplifier AD 620 shown in Fig.5 was chosen because of its low noise handling qualities and is mainly used for rejecting the common mode noise present in the surrounding environment at low power.

B. Integrator

The resistor R_4 is connected in parallel to the capacitor C_1 in order to prevent integrator from saturation state. The resistor allows the DC current pass through, which is getting blocked at the capacitor as it offers infinite Impedance to the DC.

Here,

$$X_c = \frac{1}{j\omega C} = \frac{1}{j \times 2 \times \pi \times f \times C} \qquad (4)$$

from the above equation, for the zero frequency, capacitor offers infinite impedance to DC. As a result, the DC current will pass through resistance, But some of AC current also passes through the resistor. Only AC should be passed through the capacitor for the behaviour of integrator in linear region. The value of the resistor should be 100 times of the impedance of the capacitor. The values of R_4 and C_1 are properly chosen so that time constant $R_4 C_1$ offered by the circuit does not affect the signal frequencies of interest. The resistor R_5 has been added at the output of amplifier A_2 to limit the current so that it does not get overloaded due to the low value of capacitive impedance offered by capacitor C_1 at higher frequency.

$$Gain = \frac{1}{(j \times 2 \times \pi \times f \times R \times C + 1)} \qquad (5)$$

C. DC Restoration Circuit

The obtained output of Integrator stage is given to DC Restoration Circuit, which contains another integrator but with higher value of time constant. The value of R_7 and C_2 are quite large, due to which the AC signals from Op-Amp Integrator are suppressed and results in integration of only the lower frequency signal, i.e. DC signal. Again a combination of R_9 and C_3 and C_4 is provided to bypass the leftover low frequency AC signal. This integrated DC signal gets inverted and is fed back to previous stage. This DC Signal subtracts the DC offset present at the input of integrator. This action in continuation eliminates offset. The combination of integrator and RC stages together forms the DC restoration Circuit.

IV. Observation and Results

The circuit was designed, constructed for the gain of 165 and 20mW power dissipation with SMD components. Proper PCB was designed for this circuit. This circuit was tested for the input range 50μVpp to 1000μVpp with frequency range 20Hz to 2000Hz and found that it was satisfactorily worked with good linearity

The Fig. 5 shows the complete integration of the sinusoidal wave with phase shift between input and output of 90 degrees.
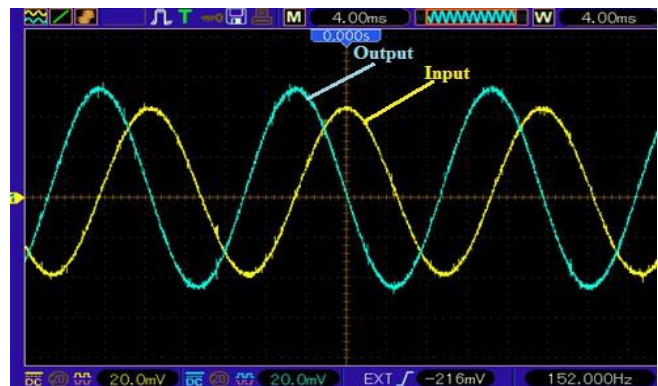
Fig. 5.   Integration of the sinusoidal wave

The single cycle response (Delay) of the circuit for the given input was observed as 0.25 ms which is shown in Fig. 6

Fig. 6.   The single cycle response (Delay) of the circuit

The DC restoration circuit which provide complete elimination of positive and negative offset as shown in Fig. 7 and & Fig. 8.
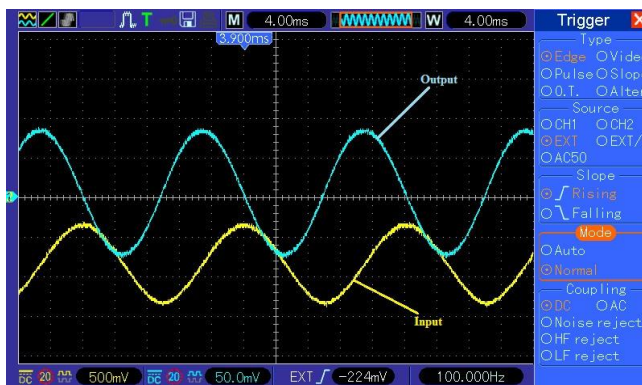
Fig. 7.   Stable output of Rogowski coil circuit with Negative offset
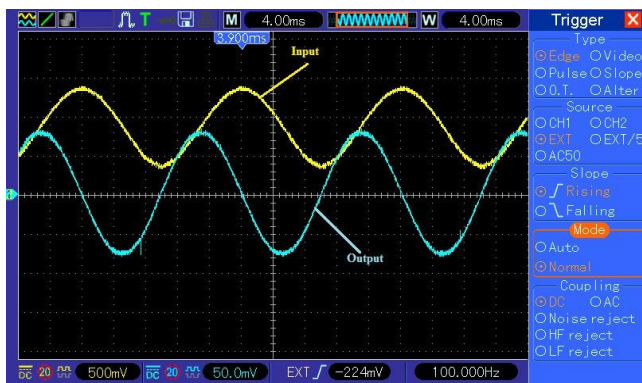
Fig. 8.   Stable output of Rogowski coil circuit with Positive offset

Generating a signal below millivolt level and its observation itself a difficult task. In order to achieve so, We need to have microvolt generator or to attenuate a signal of high level down to microvolts by using a voltage divider , Here we use a method in which the input signal is attenuated by a factor of 1000 and fed to the input of the signal conditioning system as shown in Fig. 9

Fig. 9.   Voltage Divider Network

$$V_o = \frac{R_2}{R_1 + R_2} \times V_{in}$$
$$V_o = \frac{1k\Omega}{1M\Omega + 1k\Omega} \times V_{in} \quad (6)$$
$$V_o = \frac{1}{1001} \times V_{in}$$

Table I gives input-output relationship of designed circuit for input voltage ranging from 50μVpp to 1000μVpp for 50 Hz of signal frequency.

TABLE I
OUTPUT OF THE ROGOWSKI COIL SIGNAL PROCESSING CIRCUIT

Vinpp(μVpp)	Voutpp(mVpp)	Gain
50	8.25	165
100	16.5	165
200	33	165
300	50	165
400	66	165
500	83	165
600	99	165
700	116	165
800	132	165
900	149	165
1000	165	165

From table I, it was observed that the circuit processes the input of microvolt level and amplifies it with a constant gain of 165. The Fig. 11 shows an Input output response of the Circuit for 800 μVpp input and 132 mVpp Output
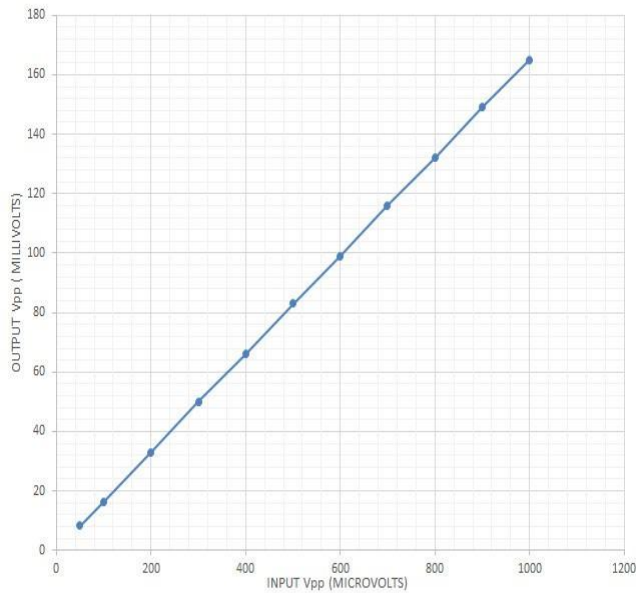
Fig. 10. The input-output response of the Rogowski Coil signal processing circuit
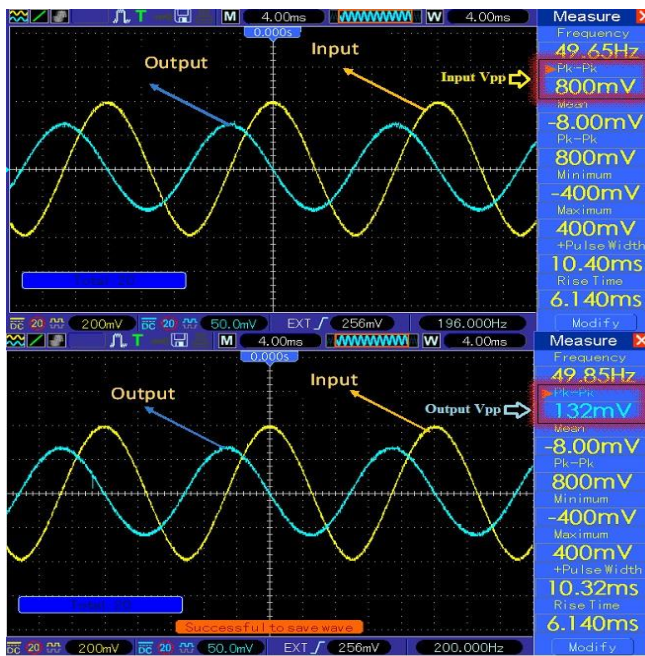
Fig. 11. Input output response of the Circuit for 800 μVpp input and 132 mVpp Output

V. CONCLUSION

Low power Rogowski coil signal processing circuit was designed and tested for the sine wave, square wave inputs and found to be working functionally for input voltage as small as 50μVpp over 20Hz to 2000Hz with integration in linear region with DC restoration circuit. The delay time measured was 0.25 ms which is much less than normal requirement of 1ms. Power dissipation calculated for the designed circuit was 20 mW.

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Review of Fractional and Complex-order Derivatives and Integrals

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Abstract—Conventionally the normal integer-order (IO) derivatives are used for modeling and any system and its control. Since last four decades, their extensions, fractional order (FO) derivatives have been found to provide a better representation for many real order system and processes. FO control has also proved its superiority over the conventional IO control. The next paradigm shift in this field is the exploitation of non local and memory features provided by complex-order (CO) operators (integral and derivatives) for even better modelling and efficient control. This idea holds immense research potential provided one is ready to extend, modify and apply the conventional modeling and analysis technique with these new tools. In this paper a brief survey of involve analysis of linear and non linear CO systems in all the essential system representations like transfer functions, state space structure, etc. is presented. The paper also analyzes the linear multi input multi output CO systems and investigate various features.

I. INTRODUCTION

Fractional calculus is a 300 years old subject which involves the study of differentiation and integration to non-integer order. The field of fractional calculus is almost as old as classical calculus, but over the last decades the usefulness of this mathematical theory in applications has become more and more evident. Recently, fractional calculus has played an important role in modeling complex phenomena in the fields of physics, chemistry, biology and engineering. The origin of fractional calculus is dated back to the Lebnitzs letter to LHôpital in the year 1695, where the notation for derivative of non integer order, $\frac{1}{2}$ is deliberated. In addition to it Lebnitz writes : Thus it follows that $d^{\frac{1}{2}}x$ will be equal to $x\sqrt{dx} : x$. This is an apparent paradox from which, one day useful consequences will be drawn [1]. The question raised by Leibniz for a fractional derivative was an ongoing topic in the last 300 years. Several mathematicians contributed to this subject over the years. People like Liouville, Riemann and Weyl made major contributions to the theory of fractional calculus. The story of the fractional calculus continued with contributions from Fourier, Abel, Leibniz, Grünwald-Letnikov. Fractional calculus, as its name suggests, refers to fractional-order integration and fractional-order differentiation.

A recent extension of fractional-order system is the complex-order (CO) systems. The basic underlying mathematical tool for this is the definitions of complex-order derivatives and integrals, where the order is a complex number $z \in c$, that is, $z = a + jb$ with a, b $\in$ R. Thus, the order of the differentiation and integrals are already generalized to incorporate complex-order powers. This is true because these derivatives and integrals, being linear operators are Laplace transformable. So it is possible to analyze the solution of linear complex-order differential equations. Thus, the necessary mathematical framework for the analysis of complex-order systems is already available. Already, it has been shown in the literature that fractional-order description of the real-world and engineering system provides a more faithful representation. This is due to the infinite-dimensional nature of fractional-order system. So it can be very well guaranteed that differential equation with complex-order integro-differential operators will surely provide an even better representation of these systems.

The fractional derivative of a function to order a has some boundary conditions, these are discussed in detain in [2, 3]. Further generalizations have been made to the complex-order operator [4–6] Hartley et al. showed that when a complex-order operator is paired with its conjugate-order operator, real time-responses are created. This is analogous to a complex pole of an integer-order system. A single complex pole has a complex time-response, but when encountered with its complex conjugate pole, the resulting time-response is real valued. Complex poles always occur in complex conjugates. Similarly, for a real time response complex-order operators always occur in complex conjugate pairs [7]. Systems with complex-order differintegrals can arise from a variety of situations. The CRONE controller makes use of conjugated-order differintegrals in a limited manner [8]. Such a system can also be artificially constructed and implemented using the techniques of Jiang et al. [9]. Such a system results from identification, as proposed by Adams et al. [10].

II. BASIC CONCEPTS

Fractional calculus, as its name suggests, refers to fractional-order integration and fractional-order differentiation. Fractional-order integration often means Riemann-Liouville integral. But for fractional-order differentiation, there are several kinds of fractional derivatives. In this section, some of the definitions are introduced.

A. Riemann-Liouville Integral Definition

The left fractional-order integral (or the left RL integral) and right fractional-order integral (or the right RL integral) with order $a > 0$ of the function f(t), $t \in (a, b)$ are defined as,

$$D^{-a}_{a,t}f(t) = {}_{RL}D^{-a}_{a,t}f(t) = \frac{1}{\Gamma(a)} \int_a^t (t-s)^{a-1} f(s)\,ds, \quad (1)$$

and

$$D^{-a}_{t,b}f(t) = {}_{RL}D^{-a}_{t,b}f(t) = \frac{1}{\Gamma(a)} \int_t^b (s-t)^{a-1} f(s)\,ds. \quad (2)$$

B. Riemann-Liouville Derivative Definition

The left and right Riemann-Liouville derivative with order $a > 0$ of the given function $f(t)$, $t \in (a, b)$ are defined as,

$$_{RL}D^a_{a,t}f(t) = \frac{d^m}{dt^m} D^{-(m-a)}_{a,t} f(t), \quad (3)$$

$$= \frac{1}{\Gamma(m-a)} \frac{d^m}{dt^m} \int_a^t (t-s)^{m-a-1} f(s)\,ds, \quad (4)$$

where m is an integer value and $m-1 < a < m$, if $0 < a < 1$ then $m = 1$.

C. Grünwald-Letnikov Derivative Definition

Grünwald and Letnikov independently developed another non-integer derivative nearly the same time when Riemann and Liouville developed Riemann-Liouville fractional derivative to solve fractional differential equations. Later on many other authors use this Grünwald-Letnikov fractional derivative to construct numerical methods for fractional differential equations. The left and right Grünwald-Letnikov with order $a > 0$ of f(t), $t \in (a, b)$ are defined as,

$$_{GL}D^a_{a,t}f(t) = \lim_{h \to 0} h^{-a} \sum_{j=0}^{N} (-1)^j \binom{a}{j} f(t-jh), \quad (5)$$

and

$$_{GL}D^a_{t,b}f(t) = \lim_{h \to 0} h^{-a} \sum_{j=0}^{N} (-1)^j \binom{a}{j} f(t+jh), \quad (6)$$

where h is the step size and $\binom{a}{j} = {}^a C_j$.

D. Caputo Derivative Definition

The left and right Caputo derivatives with order $a > 0$ of the function f(t), $t \in (a, b)$ are defined as,

$$_C D^{-a}_{a,t}f(t) = \frac{1}{\Gamma(m-a)} \int_a^t (t-s)^{m-a-1} f^{(m)}(s)\,ds, \quad (7)$$

and

$$_C D^{-a}_{t,b}f(t) = \frac{(-1)^m}{\Gamma(m-a)} \int_t^a (s-t)_{m-a-1} f^{(m)}(s)\,ds, \quad (8)$$

where $m - 1 < a < m$.

III. Literature Survey on Fractional Calculus

Many real dynamic systems are better characterized using a non-integer order dynamic model based on fractional calculus or, differentiation or integration of non-integer order. Tradiional calculus is based on integer-order differentiation and integration. The concept of fractional calculus has tremendous potential to change the way we see, model, and control the nature around us. Denying fractional derivatives is like saying that zero, fractional, or irrational numbers do not exist. YangQuan Chen, Ivo Petras and Dingyu Xue offered a tutorial on fractional calculus in controls [11]. In this tutorial, basic definitions of fractional calculus, fractional-order dynamic systems and fractional-order PID controllers are introduced which makes fractional-order controllers ubiquitous in industry.

Applications of Fractional calculus can be broadly classified into modeling and control. For last five decades, fractional calculus has been increasingly used in modeling real world and engineering systems.

A. Fractional-order Modeling

- **Modelling of lossy coils using fractional derivatives**
  Coils exposed to eddy current and hysteresis losses are conventionally described by an inductance with equivalent core-loss resistance connected in parallel. The value of the equivalent core-loss resistance depends on the working frequency and the external wiring. Thus the model is less than satisfactory. Schäfer, Ingo, and Klaus Krüger [12] proposed to describe loss inductance using fractional derivatives containing both a loss term and a storage term in their paper. The operating mode of the fractional coil model is explained by the authors with the example of an RLC oscillating circuit. Subsequent measurements of a series resonant circuit with a lossy coil impressively confirmed the theoretical model with regard to both the frequency and time domains.

- **Modeling of transformer characteristics using fractional-order transfer functions**
  In the advanced maintenance techniques of the transformer, Sweep Frequency Response Analysis (SFRA) method is one of the established techniques that include the modelling of the transformer frequency response. This includes identifying the transfer function and realising into circuit parameters so that the incipient fault detection is correlated with the changes in the circuit parameters. A.K Kamath, J.R Gandhi, A.S Bohra, A. V. Goel, D.U Patil, O.V Kulkarni and J.O Chandle [13] have proposed a fractional-order transfer function in their paper which has been observed to be the most appropriate mathematical model for almost all the real time processes, the frequency response of the transformer being one of them is modelled in this paper.

- **Fractional modeling and identification of thermal systems.**
  Heat transfer in homogeneous media obeys to diffusion phenomenon which can be modeled with the help of fractional systems. J.D Gabano and T. Poinot [14] have used a

parsimonious black box model based on an original fractional integrator whose order $\frac{1}{2}$ acts only over a limited spectral band in their paper. The authors have carried out simulations of front face thermal experimentations which consist in measuring the temperature at the surface of a material where a random heat flux is applied. The authors considered the characterization of the thermal behaviour of a sphere and experimental results are given.

- **Fractional-order models of the super capacitors in the form of RC ladder networks**
  W. Mitkowski and P. Skruch [15] have investigated mathematical models of the super capacitors in their paper. The models are based on electrical circuits in the form of RC ladder networks. The dynamic behaviour of the circuit is described using fractional-order differential equations and its properties are analyzed. The results of numerical simulations are compared with the results measured experimentally in the physical system.

B. Fractional-order control

Fractional-order control is found to provide a better robust closed loop design with lower control effort from the representative literature discussed below.

- **Fractional-order systems and $PI^\lambda D^\mu$ controllers**
  In 1999, Igor Podlubny [16] has presented a paper in which, dynamic systems of an arbitrary real order (fractional-order systems) are considered. A concept of a fractional-order PID controller, involving fractional-order integrator and fractional-order differentiator, is proposed. The Laplace transform formula for a new function of the Mittag-Leffler type made it possible to obtain explicit analytical expressions for the unit-step and unit-impulse response of a linear fractional-order system with fractional-order controller both for the open and closed loop. An example using the obtained formulas and the advantages of the proposed PID controllers is given.

- **Fractional-order feedback control of a D.C motor**
  Petr$\acute{a}\tilde{s}$, Ivo [17] deals with the feedback control of a DC motor speed with using the fractional-order controller in his paper. The mathematical description of the fractional-order controller and its implementation in the analog and the discrete domains are presented by the author. An example of simulation and possible realization of the particular case of digital fractional-order $PI^\lambda D^\delta$ controller are shown as well. The hardware realization is proposed in digital form with the microprocessor and in analog form with the fractance circuits.

- **Evaluation of a fractional-order PI controller applied to induction motor speed control**
  Manuel A., Duarte-Mermoud, Felipe J. Mira, Ian S. Pelissier and Juan C. Travieso-Torres [18] have published a paper which deals with the speed control of induction motor applying a fractional-order proportional integral (FOPI) controller within a field oriented control (FOC) scheme. This allows obtaining responses of the controlled system with different characteristics such as oscillations,

stability and rise time. In this study FOPI strategy is simulated within a FOC scheme using a mathematical model of an induction motor.

- **Analysis of nonlinear dynamics and chaos in a fractional-order financial system with time delay**
  Wang Zhen, Huang Xia and Shi Guodong [19] have proposed a delayed fractional-order financial system and the complex dynamical behaviours of such a system are discussed by numerical simulations. A great variety of interesting dynamical behaviours of such a system including single-periodic, multiple-periodic, and chaotic motions are displayed. In particular, the effect of time delay on the chaotic behaviour is investigated, it is found that an approximate time delay can enhance or suppress the emergence of chaos. Meanwhile, corresponding to different values of delay, the lowest orders for chaos to exist in the delayed fractional order financial systems are determined, respectively.

- **Model predictive control for fractional-order System**
  Mandar M. Joshi, Vishwesh A. Vyawahare and Mukesh D. Patil [20] in their paper have applied model predictive control methodology, to solve a classical servo problem in the context of linear fractional-order (FO) system with the help of an approximation method. A finite horizon optimal control problem is solved at each sampling instant to obtain the current control action. The optimization delivers an optimal control sequence and the control thus obtained is applied to the plant. Oustaloups recursive approximation delivers equivalent integer-order transfer function for a fractional-order system, which is then utilized as an internal model in model predictive control. Analytically calculated output equation for FO system has been utilized to represent process model to make simulations look more realistic by considering current and initial states in process model. The paper attempts to present the effect of modeling and approximations of fractional-order system on the performance of model predictive control strategy.

- **Fractional-order nonlinear systems modeling, analysis and simulation**
  The book by Ivo Petras [21] as titled above presents a brief introduction to fractional-order chaotic systems. It provides fundamentals of fractional calculus, its properties and integral transfer methods. This book also includes a presentation of fractional-order systems, their description and properties. Fractional linear time-invariant (LTI), nonlinear systems, and fractional-order controllers are also considered.

IV. LITERATURE SURVEY ON COMPLEX-ORDER DERIVATIVES

Use of complex-order derivatives in modeling and control is quiet recent field of research. There are only few refrences available and these are broadly classified as contributions in complex-order(CO) calculus, CO modeling and CO control.

A. Complex-order calculus

Following are the references available for complex-order calculus :

- **A use for a derivative of complex-order in the fractional calculus**
  In 1977, Bertam Ross , Francis H. Northover, [22] have presented an alternative technique in which an explicit use is made of a derivative of complex order. The Riemann-Liouville operator of arbitrary order D_x^v is applied to the Euler type differential equation,

$$x^2 y^n + axy^l + \beta y = 0. \tag{9}$$

  This result is the same as that obtained by standard classical means but the method of fractional calculus is used.

- **Fractional derivatives in complex planes**
  Changpin Lia, Xuanhung Dao and Peng Guo [23] have presented a paper in which they have first studied the important properties of the Caputo derivative in real line. Then they have studied the recently developed fractional derivative in complex plane by Ortigueira, which was very useful in signal processing. They have also generalized the Caputo derivative in real line to that in complex plane then studied its properties. These discussions were helpful in understanding fractional calculus and establishing fractional models in science and engineering.

- **Definitions of complex order integrals and complex order derivatives using operator approach.**
  Raoelina Andriambololona, Ranaivoson Tokiniaina and Hanitriarivo Rakotoson [24] have stated in their paper that for a complex number s, the s - order integral of a function f fulfilling some conditions is defined as the action of an operator, noted J^s, on f. The definition of the operator J^s is given firstly for the case of complex number s with positive real part. Then, using the fact that the operator of first order derivative D^1 , is the left hand side inverse of the operator J^1, an s-order derivative operator, noted D^s , is also defined for complex number s with positive real part. Finally, considering the relation $J^s = D^{-s}$ the definition of the s-order integral and s-order derivative is extended for any complex number.

- **A solution to the fundamental linear complex-order differential equation**
  This paper by Jay L. Adams , Tom T. Hartley, Lynn I. Adams [25] provides the solution to the complex-order differential equation,

$$_0 d_t^q x(t) = kx(t) + bu(t), \tag{10}$$

  where both q and k are complex.
  The time-response solution is shown to be a series that is complex-valued. Combining this system with its complex conjugate-order system yields the following generalized differential equation,

$$_0 d_t^{2Re(q)} x(t) - \bar{k}_0 d_t^q x(t) - k_0 d_t^{\bar{q}} x(t) + \bar{k}kx(t)$$
$$= p_0 d_t^q u(t)) + \bar{p}_0 d_t^{\bar{q}} u(t)) - (\bar{k}+k)u(t). \tag{11}$$

The transfer function of this system is,

$$p(s^q - k)^{-1} + \bar{p}(s^{\bar{q}} - \bar{k})^{-1} \tag{12}$$

having a time-response

$$2 \sum_{n=0}^{\infty} t^{(n+1)u-1}(Re(\frac{pk^n}{\Gamma((n+1)q)})cos((n+1)v lnt)$$
$$- Im(\frac{pk^n}{\Gamma((n+1)q)})sin((n+1)v lnt)). \tag{13}$$

The transfer function has an infinite number of complex-conjugate pole pairs. Bounds on the parameters $u = Re(q)$, $v = Im(q)$ and k are determined for system stability.

- **Euler-Lagrange Equations for Lagrangians containing complex-order fractional derivatives**
  Teodor M. Atanackovi , Marko Janev , Stevan Pilipovi and Dusan Zorica [26] have considered two variational problems of finding the Euler-Lagrange equations corresponding to Lagrangians containing fractional derivatives of real-and complex-order. The first one is the unconstrained variational problem, while the second one is the fractional optimal control problem. The expansion formula for fractional derivatives of complex-order is derived in order to approximate the fractional derivative appearing in the Lagrangian. It is shown that the sequence of approximated Euler-Lagrange equations converges to the original one in the weak sense as well as that the sequence of the minimal values of approximated action integrals tends to the minimal value of the original one.

B. Complex-order modeling

Following are the references available for complex-order modeling :

- **Complex order dynamics in hexapod locomotion**
  Manuel F. Silva and J.A Tenreiro Machado [27] presented a set of model based experiments reveals the influence the locomotion velocity on the foot ground transfer function, which presents complex order dynamics. In this paper, the simulation results for different robot velocities are consistent with each other and reveal that, in the range of locomotion velocities under consideration, this system reveals complex order dynamics.

- **Fractional order system identification using complex order distribution**
  Jay L. Adams, Tom T. Hartley, Carl F. Lorenzo [28] presented a paper in Workshop on Fractional Differentiation and its Applications Porto, Portugal, July 19-21, 2006, which discusses the identification of fractional systems using the concepts of complex order-distribution. Based on the ability to define systems using complex order distributions, it is shown that system identification in the frequency domain using a least squares approach can be performed.

- **Complex order fractional derivatives in viscoelasticity**
  In their paper on complex order, Teodor M. Atanackovic,

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Sanja Konjik, Stevan Pilipovi and Dušan Zoric [29] have introduced complex order fractional derivatives in models that describe viscoelastic materials. This cannot be carried out unrestrictedly, and therefore they have derived, for the first time, real valued compatibility constraints, as well as physical constraints that lead to acceptable models. As a result, they introduced a new form of complex order fractional derivative. Also, they considered a fractional differential equation with complex derivatives, and study its solvability. Results obtained for stress relaxation and creep are illustrated by several numerical examples.

- **Complex order Van der Pol oscillator**
Carla M.A., Pinto and J.A. Tenreiro Machado [30] considered a complex-order van der Pol oscillator in their paper. The complex derivative $Da \pm j\beta$, with $a, \beta \in R+$ is a generalization of the concept of integer derivative, where $a = 1, \beta = 0$. By applying the concept of complex derivative, the authors have obtained a high-dimensional parameter space. Amplitude and period values of the periodic solutions of the two versions of the complex-order van der Pol oscillator are studied for variation of these parameters. Fourier transforms of the periodic solutions of the two oscillators are also analyzed.

- **Conditions for stable and causal conjugate-order systems**
Jay L. Adams, Tom T. Hartley and Robert J. Veillette [31] have studied the stability properties of the fundamental linear conjugate-order system in their paper. The values of the complex order for which this system is stable and causal are determined. It is shown that all stable, causal systems have orders that lie within unit-radius circles centered $at \pm 1$ or on the imaginary axis in the order plane. Plots are given to illustrate these results for several examples. It is shown that as the system bandwidth moves to large or small values relative to unity, the stability region in the order plane becomes more fragmented.

- **Effect of drug-resistance in a fractional complex-order model for HIV infection**
Carla M.A., Pinto and Ana R.M. Carvalho [32] have studied fractional complex-order (FO) model for drug-resistance in HIV infection during therapy. The authors simulate the model for different values of the fractional derivative of complex order (FD) $Da \pm j\beta$, where $a, \beta \in R+$. The FD is a generalization of the integer order derivative where $a = 1, \beta = 0$. The FO system reveals rich dynamics. The novelty of this paper is attributed to the dynamics of the model promoted by the variation of the complex-order derivative. The obtained interesting dynamics may point in other directions to model the intracellular delay.

- **Vibrations of an elastic rod on a viscoelastic foundation of complex fractional KelvinVoigt type**
Teodor M. Atanackovic ,Marko Janev , Sanja Konjik , Stevan Pilipovic and Dusan Zorica [33] have considered the vibrations of an elastic rod loaded by axial force of constant intensity and positioned on a viscoelastic

foundation of complex order fractional derivative type. The solution to the problem is obtained by the separation of variables method. The critical value of axial force, guaranteeing stability, is determined.

C. Complex-order control

Following are the references available for complex-order control :

- **Outer synchronization between fractional-order complex networks: A non-fragile observer-based control scheme**
In 2013 ,Meichun Zhao and Junwei Wang [34],addresses the global outer synchronization problem between two fractional-order complex networks coupled in a drive-response conguration in their paper. In the paper, they have proposed a novel observer-based control scheme for outer synchronization between two complex networks with fractional-order derivatives. The designed controllers have the following two features:

   1) They use only scalar output signals to couple two FCNs in a drive-response manner
   2) They are non-fragile for both additive and multiplicative control gain perturbations

- **Robust control of nonlinear PEMFC against uncertainty using fractional complex order control**
Masoomeh Shahiri, Abolfazl Ranjbar, Mohammad Reza Karami and Reza Ghaderi [35] have proposed their work of a fractional complex order controller (FCOC) design strategy to cope with uncertainty in a proton exchange membrane fuel cell (PEMFC) model. The fuel cell dynamic behaviour is inherently nonlinear and time varying. Accordingly, a locally linearization technique is used to achieve a linear interpretation in form of transfer function instead of nonlinear dynamics. When the current load is suddenly changed, the voltage and consequently the operating point are dramatically varying. Therefore, the resultant linearized model of the PEMFC changes. The discrepancy between those deviated models from the nominal plant will be regarded as system uncertainties, which must be cured by robust controller. In PEMFC dynamic, the ratio of the oxygen with respect to the air supply.

- **Combination complex synchronization among three incommensurate fractional-order chaotic systems**
In the paper titled above Cuimei Jiang, Changan Liu, Shutang Liu, Fangfang Zhang [36] have introduced, analyzed, and validated a novel form of chaos synchronization that can involve two drive systems and one response system, namely combination complex synchronization. On the basis of the stability theory of in commensurate fractional-order systems and the feedback control approach, authors designed controllers to realize combination complex synchronization among three fractional-order chaotic systems with incommensurate orders. The proposed synchronization scheme directs the attention of

secure communication to fractional-order chaotic complex systems within commensurate orders, which may increase the number of state variables to further enhance the security of private communications.

- **New tuning design schemes of fractional complex-order PI controller**

  The manuscript presented by Masoomeh Shahiri, Abolfazl Ranjbar, Mohammad Reza Karami and Reza Ghaderi [37] shows two systematic design procedures, to tune parameters of a fractional complex-order PI (FCO-PI) controller in the form of PI^{a+ib}. The PI^{a+ib} controller uses extra parameter(s) than the conventional fractional and/or integer order PI controllers. The proposed design procedures are based on realizing some frequency domain restrictions. These are eventually stated in terms of M_s and M_p constraints, developing integral gain optimization tuning method. In this method, optimized amount of parameters are assessed based on minimizing the integral error indices with a constraint on the maximum sensitivity functions. Tuning of parameters of fractional complex-order controller via M constraint integral gain optimization (FC-MIGO)algorithm is innovatively defined and then the so-called FC-MIGO rule is proposed by applying FC-MIGO algorithm on a test batch.

- **Optimal Controllers with Complex Order Derivatives**

  The paper of J.A. Tenreiro Machado [38] studies the optimization of complex-order algorithms for the discrete-time control of linear and nonlinear systems. Complex-order control schemes and their implementation are evaluated in the perspective of evolutionary optimization. The results demonstrate not only that complex-order derivatives constitute a valuable alternative for deriving control algorithms, but also the feasibility of the adopted optimization strategy.

- **Robust Design Based on Complex-Order Integrator Loop Gain**

  Mohammad R. Rahmani ,Mehdi Abadi, Khosro Khandani, Iraj Kheirizad, and Ali A. Jalali [39] have proposed a novel, easy-to-use, robust design method for stable time delay processes. The purpose is obtaining a desired phase margin at a known crossover frequency. The design methodology is based on complex order integration. Complex-order controllers are the extended version of fractional order controllers in which the order of the transfer function has imaginary and real parts, rather than integer or non-integer real part. Introducing a complex order for the open-loop transfer function makes it possible to fulfil additional specifications of design ensuring a robust performance of the closed-loop system with respect to gain variations. This extra parameter enables designing a controller which makes the phase diagram remain flat around the gain crossover frequency. This leads to a fixed phase margin around the crossover frequency. The design procedure and the validity of the results are illustrated through some examples.

V. CONCLUSION

The paper has discussed the basics of fractional and complex-order control. It has been proved from the refrences and literature survey that fractional-order (FO) derivatives have been found to provide a better representation for many real order system and processes. The exploitation of non local and memory features provided by complex order (CO) operaters for even better modelling and efficient control have also been studied.

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Smart Pick and Place Robotic Arm Using Belt Drive

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Abstract: **Robotic arm plays an important role in industries. In this paper the smart robotic pick and place arm is a robotic arm with six degrees of freedom and enhanced control and feedback system to properly place the object at desired position and platform. The smart arm first confirms the existence of a surface and only then places the object on the surface. Optical Encoders, proximity sensor and Limit switch are used for feedback system.**

Keywords: pick and place arm, enhanced control and feedback system, microcontroller, belt drive, six degrees of freedom.

I. INTRODUCTION

Robots are generally used to perform unsafe, highly repetitive and unpleasant tasks. They have many different functions such as material handling, assembly, welding and machine tool load and unload functions, painting, spraying, etc.

There are mainly two different kinds of robotic arms: a service robotic arm and an industrial robotic arm. Service robotic arm is a robot that operates semi or fully autonomously to perform services useful to the well-being of humans and equipment, excluding manufacturing operations [1]. Industrial robotic arm, on the other hand, is officially defined by ISO as an automatically controlled and multipurpose manipulator programmable in three or more axis [2]. Industrial robotics arm are designed to move material, parts, tools, etc.

In 2007 the world market grew by 3% with approximately 114,000 new installed industrial robots. At the end of 2007 there were around one million industrial robots in use, compared with an estimated 50,000 service robots for industrial use [3]. Due to increase using of industrial robot arms, an evolution to that topic began trying to imitate human movements in a detail mode. For example, a group of students in Korea made a design of innovations that robotic arm take account of dancing hand, weight lifting, Chinese calligraphy writing and color classification [4]. Another group of engineers at USA develop eight degrees of freedom robot arm. This robot is able to grasp many objects with a lot of shapes from a pen to a ball and simulating also the hand of human being [5].

In this paper, the smart robotic arm receives a command from controller for picking up a particular object and then places the object at pre-programmed location. Also before placing the object the existence of surface on which the object is to be placed is confirmed. Due to this the damages to the objects in case of absence of surface is avoided. For smoother functioning of smart arm timing based pulleys and belts are used instead of gear mechanisms.

II. IIMECHANICAL DESIGN

A. Free Body Diagram

The mechanical design of the smart robotic arm is based on a robot manipulator with similar functions to a human arm.As shown in Fig. 1, the gripper is not included in the design because a commercially available gripper is used. This is because that the gripper isone of the most complexparts of the system and it turns out it is much easier andeconomical to use a commercial one than build it.
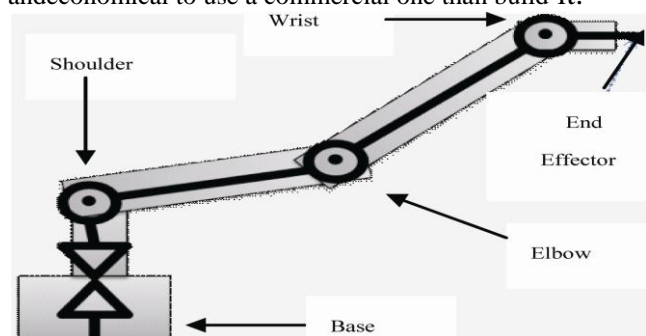
Fig. 1

B. AutoCAD Design

Fig. 2

TABLE1 BELT &GEAR DRIVE

Belt Drive	Gear Drive
The slight misalignment is tolerated.	The misalignment is not tolerated.
Belt drives do not require lubrication.	Gear drives do require lubrication and that too on a regular interval.
The driven element in belt drives is isolated from the driving element so driven element stays safe from shocks, vibrations etc.	The driven element in gear drives is not isolated from the driving element.
Belt drives are quieter in operation.	Gear drive is not quieter in operation due to gear interfacing.
Belt drive can be used to transmit power between two shafts which are far apart.	In gear drive, both driving and driven gear should be touched.
Belt drive is lot smoother.	Gear drive is not that much smoother.
Easy, flexible equipment design.	Complicated equipment design.

Due to these advantages belt drive is preferred. Cost and weight of belt drive is also less as compared to gear drive. The biggest advantage is that it can be used to transmit power between two shafts which are far apart. Depending on the type of pulleys and belt the efficiency and power transmission can be adjusted.

As shown in Fig. 2, the smart arm consist of multiple timing based pulleys and belts. Each pulley having XL-26 teeth.Width of pulleys are variable as per the application. The smart arm is basically divided into Base, Shoulder, Elbow, Wrist and Gripper section. All movements of these sections are controlling via motors placed in base section. Base section consists four motors out of that two motors are for driving wrist movements. Shoulder and Elbow movements are also controlling by one motor each. These base motors are placed in a base station and below the base station there is another motor to rotate horizontally whole arm (not shown in design). Any pulley which is transferring the force to next stage is consisting bearing inside it to rotate frictionless on that particular stage.

In wrist section three bevel gears are used. Two of them are connected to base motors and remaining gear is placed between two bevel gears. So gripper is connected to this third bevel gear placed between two. When base motors of bevel gears rotate in same direction then gripper gets vertical movement and motors rotate opposite to each other then gripper gets rotational motion.

C. Belt Drive vs Gear Drive

Each drive serves its purpose, comparison between belt and gear drive are given in Table.

III. CONTROLLING

Block diagram for controlling section is shown in Fig. 3. The motors are mounted with optical encoders which gives the feedback of rotation of motors. By pre-feeding the number of counts of encoders in the program the motor rotations are controlled. A gyro sensor is attached on the gripper to maintain the orientation of object. Also a proximity sensor is attached near the wrist of arm.
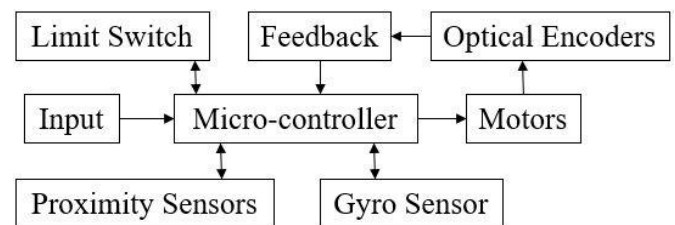
Fig. 3

A proximity sensor gives a feedback if a platform is present within the set distance. The distance can be adjusted according to requirement. While placing the object on the platform, the proximity sensor gives feedback as the platform comes within specified range. Then the speed of arm slows down. A limit switch is attached at the bottom of grippers. Now as the arm approaches the platform the bottoms of gripper and the object are touched to the

platform. The limit switch at the bottom of the gripper gets pressed and a feedback is received to open the grip. In this way first it is confirmed whether a platform is present or not to successfully place the object.

IV.   CONCLUSION

The need of robotic arm in industry is increasing due to the increased need of efficiency and flexibility, innovation has begun in this field to imitate human arm details.In this paper a concept of smart robotic arm is kept forward. The arm maintains the orientation of the object and also confirms the existence of platform before placing an object on it. For smoother functioning and flexibility belt drive mechanism is used.

V.   RESULTS

The smart pick and place robotic arm successfully traverses the defined path pick up an object and after confirming the existence of platform places the object.

Fig. 4Picking up of object
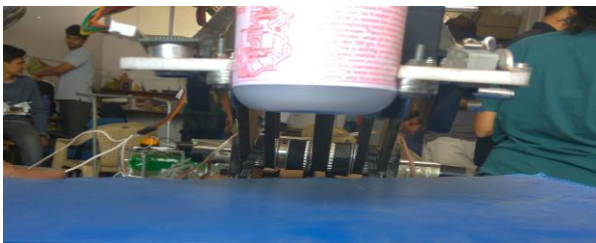
Fig. 5Traversing the path

Fig.6Determining the platform existence for lacing object

VI.   FUTURE SCOPE

The smart pick and place robotic arm can be integrated with a camera and through image processing it can be converted into a real time response system which can be implemented in nuclear power plants, chemical industry etc. where hazardous environment exists.

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Review on Graph Signal Processing

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Abstract—**The emerging field of Graph Signal Processing (GSP) directs to develop data processing tools which are present in complex and irregular graph structures. In this paper, we first discuss an overview of the idea of GSP which is analogous to classical signal processing. We then provide a summary of the basic concepts theorized for understanding GSP. At last, we finish by providing an overview about the recent application areas which uses the concepts of GSP, including fresh research on the processing and analysis of data present in the sensor network, and applications to machine learning and image processing.**

Index Terms—**Graph signal Processing, Graph Laplacian, eigenvalues, eigenvectors.**

I. INTRODUCTION

A massive amount of data is present all around us and is being recorded at all measures. This high dimensional data is now present on irregular and complex structures [1]. Some of the examples of this complex structures are sensor networks, images, online social media, etc. We cannot analyze the data present on it by standard tools because of complexity of the structure [2].

Graphs hold the ability to model the irregular structure and their complex interactions with each other [2]. For instance, consider a facebook user as a vertex of graph, its friends other vertices on the same graph and the friend connections can be considered as edges between the vertices [2]. These vertices carry a lot of information about the facebook user like their year of graduation, date of birth, etc. This information present on such vertices can be modeled as signals on a graph and then they can be used for processing and analysis. The field that collects all this and merges the concepts of graph theory and classical signal processing is called Graph Signal Processing (GSP) [1].

II. BASIC CONCEPTS

In this section, the basic definitions and notation for graphs are stated and how the signals on graphs can be represented. Next, the classical signal processing Fourier transforms are generalized to the irregular structure of graph. Finally, an overview of operators for processing graph signals in a distributed fashion is discussed.

A. Weighted Graphs and Graph Signals

Consider, an undirected, connected, weighted graph $G = (V, E, W)$, where V represents a finite set of vertices V with $|V| = N$ where N is the number of nodes or vertices, E stands for the set of edges in the graph, and W is a weighted adjacency matrix or the matrix of edge weights [1]. The entry $W_{i,j}$ in the weighted adjacency matrix depicts the edge weight, if there is a path or an edge $e = (i, j)$ between vertices i and j, $W_{i,j} = 1$; otherwise, $W_{i,j} = 0$ [1]. When the graph G is not linked and contains M linked components ($M > 1$), signals on G can be separated into M pieces analogous to the M linked components, and can be separately processed as independent signals on each and every subgraphs [1].

When an application could not naturally define the edge weights, a thresholded Gaussian kernel weighting function can be used to define the edge weights connecting the vertices i and j [1] and is given by

$$W_{i,j} = \begin{cases} exp\left(-\frac{[dist(i,j)]^2}{2\theta^2}\right) & \text{if dist(i,j)} \leq \kappa \\ 0 & \text{otherwise,} \end{cases} \quad (1)$$

In the above equation $dist(i, j)$ stands for the Euclidean distance joining two feature vectors representing i and j or a physical distance joining vertices i and j, for two of the parameters θ and κ.

A function or signal $g: V \rightarrow \mathsf{R}$ specified on the vertices of the graph might be represented as a vector $\mathbf{g} \in \mathsf{R}^N$, where the ith component of the vector $\mathbf{g}$ represents the function value at the ith vertex in V [1]. The Fig. 1 below shows the graph signal as an example [1].

B. The Graph Laplacian

The combinatorial graph Laplacian is defined as $L := D - W$, where D represents the degree matrix and is a diagonal matrix whose i_{th} diagonal element d_i is equal to the sum of the weights of all the edges incident to vertex i [1]. For any signal $\mathbf{g} \in \mathsf{R}^N$, the graph Laplacian is said to be a difference operator and it satisfies the below condition [1] which is given by

$$(Lg)(i) = \sum_{j \in N_i} W_{i,j}[g(i) - g(j)], \quad (2)$$

where the neighborhood N_i represents a connection by an edge between vertex i and a set of vertices.

If u is an eigenvector of a square matrix A, then it satisfies [1] $Au = \lambda u$, where λ is a scalar and eigenvalue corresponding to the eigenvector u. For a graph Laplacian L with a complete set of orthonormal eigenvectors denoted by $\{u_l\}_{l=0,1,\ldots,N-1}$, the
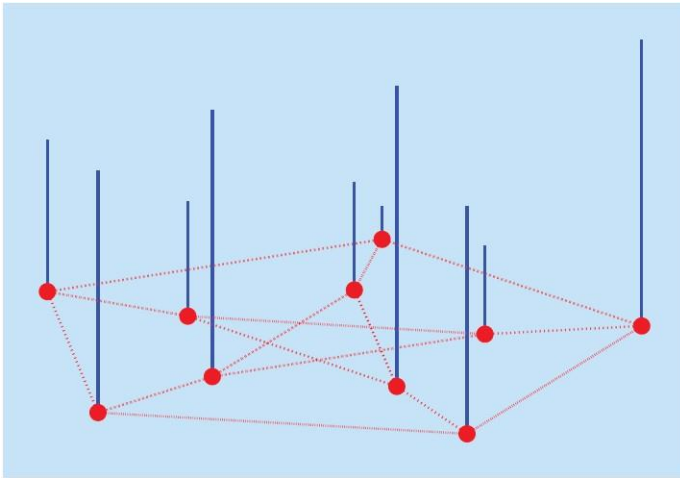
Fig. 1. The figure [1] shows a random Petersen Graph with a graph signal value which is positive on the vertices of it. The signal value or magnitude at the vertex is represented by each blue bar.

property says that L is a real symmetric matrix. Assuming that a set of eigenvectors is fixed and chosen as there are not a set of distinctive graph Laplacian eigenvectors. The real and non negative eigenvalues associated with these eigenvectors are $\{\lambda_l\}_{l=0,1,...,N-1}$ and satisfies $Lu_l = \lambda_l u_l, for\ l = 0, 1, ..., N-1$. Assume the ordered graph Laplacian eigenvalues as $0 = \lambda_0 < \lambda_1 \leq \lambda_2 ... \leq \lambda_{N-1} := \lambda_{max}$ and the entire spectrum can be denoted by $o(L) := \{\lambda_0, \lambda_1, \lambda_2, ..., \lambda_{N-1}\}$. For an $N \times N$ matrix, there exist N eigenvalues and also N corresponding eigenvectors. The set of eigenvalues of graph Laplacian matrix is known as graph spectrum [1]. The eigenvalues and eigenvectors of the graph Laplacian provide means for analyzing graph signals in frequency domain, and thus, make the graph Laplacian as the basic building block of graph signal processing. Let us discuss the properties of Graph Laplacian: [1]

1) The Laplacian matrix is symmetric.
2) The eigenvectors and eigenvalues are real for the Laplacian matrix. The symmetric nature of the Laplacian results in this property.
3) The Laplacian matrix is positive semi-definite, i.e., all the eigenvalues of the Laplacian are greater than or equal to zero. It holds true only for graphs with positive edge-weights.
4) The Laplacian matrix always has at least one zero eigenvalue. Moreover, for connected graphs it has only one zero eigenvalue. This property results from the fact that all the rows of the Laplacian matrix sum to zero and thereby, ensuring at least one zero eigenvalue.
5) It has a set of eigenvectors which is orthonormal and complete, i.e., it forms a complete orthonormal basis.

C. Graph Fourier Transform

Specifically, the eigenvalues and eigenvectors of the graph Laplacian matrix has been used for the generalization of the traditional Fourier transform to graph locale [3], for which

graph signals hold a notion of frequency. Specifically, signals that vary slowly across the graph are closely related to the eigenvectors of graph Laplacian (they correspond with tiny eigenvalues), therefore the notion of low frequency can be associated with them [4]. To put in a different way, when two edges are joined by a path or an edge with a huge weight, at those areas the values of eigenvectors of low frequency are probably going to be comparable. The eigenvectors related with bigger eigenvalues take values that change more swiftly on the graph; they are more probable to have different values on vertices linked by an edge with more weight [4]. This can be illustrated by two figures that are shown below. Fig. 2 demonstrates divergent graph Laplacian eigenvectors for an arbitrary sensor network graph and Fig. 3 demonstrates each and every graph Laplacian eigenvector's amount of zero crossings [1]. The definition of collection of zero crossings of a signal f on a graph G is the set of edges connecting a vertex with a positive signal to a vertex with a negative signal and is given by $Z_G(f) := \{e(i,j)\ E\ E : f(i)f(j) < 0\}$ [1].
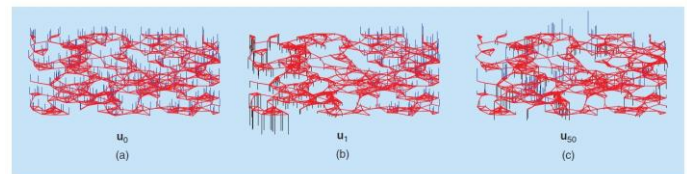
Fig. 2. (a) - (c) An arbitrary sensor network graph shows the three Graph Laplacian eigenvectors. The blue and black bars (are considered negative and positive respectively) emerging out of the vertices shows the signal's component values. It is accounted that u_{50} holds greater extent of zero crossings compared to the smooth Fiedler vector u_1 and the constant eigenvector u_0 [1].
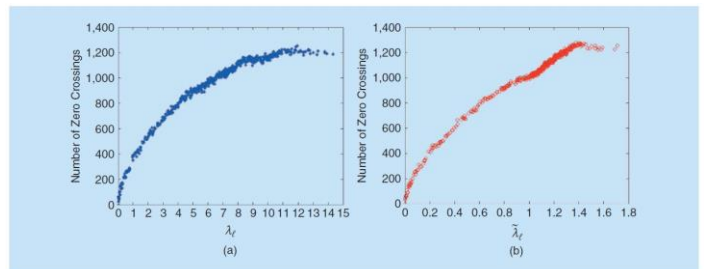
Fig. 3. This figure in (a) and (b) illustrates the amount of zero crossings of the sensor network graph shown in Fig. 2, of the graph Laplacian eigenvectors unnormalized and normalized respectively. The Laplacian eigenvectors related to greater eigenvalues pass zero more frequently in both the cases and therefore, explaining and establishing the fact of graph Laplacian eigenvalues as notions of frequency [1].

Hence, it is believed that a Fourier basis for graph signals can be depicted by the eigenvectors of graph Laplacian [1]. The definition of the graph Fourier transform $\hat{y}(\lambda_l)$ on the graph vertices, for any function y at frequency λ_l, can be given by the below equation eq. (3) and is therefore stated as the inner product with the related eigenvector u_l [3],

$$\hat{y}(\lambda_l) = (y, u_l) = \sum_{n=1}^{N} y(n)u_l^*(n), \qquad (3)$$

where (y, u_l) stands for the dot product and it is conjugate linear in the first argument. $u_l^*(n)$ is the conjugate value of the eigenvector u_l at node n [4].

The inverse graph Fourier transform [3] is given by

$$y(n) = \sum_{l=0}^{N-1} \hat{y}(\lambda_l)u_l(n), \ \forall \ nEV. \qquad (4)$$

The Fourier bases can be selected as the eigenvectors of either normalized graph Laplacian or the combinatorial matrices. The interpretation possessed by both the spectrums is similar to frequency [1]. In the traditional Euclidean settings, the spectral domain characterization gives essential information regarding the graph signals. This can be explained with an illustration, analogously to the traditional case, the graph Fourier coefficients decline swiftly of a smooth signal. As such signals can be nearly approximated by precisely a limited set of Fourier coefficients, they are compressible [5]. This property is utilized as a part of numerous applications, for example, regularization or compression of graph signals [4].

D. Representation of Graph Signal in Two Domains

Alternatively, a signal can be depicted in two distinct domains that are the vertex domain and the graph spectral domain, this approach is given by the graph Fourier transform eq. (3) and its inverse eq. (4) [1]. It is frequently seen that it might be helpful to characterize a signal $\hat{g}$ specifically in the graph spectral domain, while a signal g can begin in the vertex domain [1]. Such signals are referred as kernels. The Fig. 4 (a) and (b) shows one such signal in both the vertex and the graph spectral domain that is a heat kernel [1]. The graph Fourier coefficients slump swiftly of a smooth signal as shown in Fig. 4. As only a small number of graph Fourier coefficients can nearly be used to estimate such signals, so they are compressible [1].
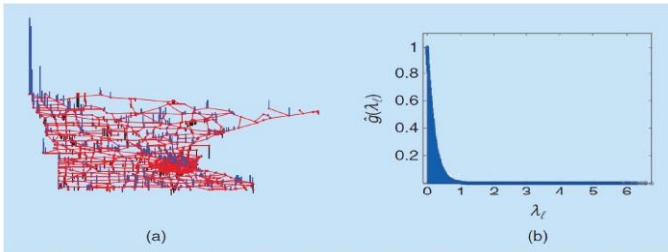
Fig. 4. The two domains are the graph spectral domain and the vertex domain and the figure shows its representation. (a) It shows the Minnesota road graph where a signal g stays on its vertices with Gaussian edge weights. The two coloured bars i.e. blue (positive) and black (negative) which are protruding out of the vertices represents the signals component value. (b) The graph spectral domain of the aforementioned signal [1].

III. GENERALIZED OPERATORS FOR SIGNALS ON GRAPHS

Using graph Fourier transform, classical signal processing concepts such as convolution, translation, or filtering can also be generalized to graph settings, other than its utilization in spectral analysis.

A. Filtering

Filtering is one of the basic operations of graph signal processing. In traditional signal processing, frequency filtering [1] is the process of depicting an input signal as a linear combination of complex exponentials and attenuating or amplifying the contributions of some of the complex exponential components.

$$\hat{y}_{out}(\xi) = \hat{y}_{in}(\xi)\hat{h}(\xi) \qquad (5)$$

where $\hat{h}(\xi)$ is the transfer function of the filter.

The inverse Fourier transform of above eq. (5) [1], multiplication in the frequency domain corresponds to convolution in the time domain, the above equation becomes

$$\begin{aligned}
y_{out}(t) &= \int_R \hat{y}_{in}(\xi)\hat{h}(\xi)e^{2\pi i \xi t}d\xi \\
&= \int_R y_{in}(\tau)h(t-\tau)d\tau \\
&=: (y*h)(t)
\end{aligned} \qquad (6)$$

Similar to traditional signal processing, the outcome y_{out} of the filtering of a graph signal y with a graph filter h is defined in the spectral domain [1] as the multiplication of the graph Fourier coefficient $\hat{y}(\lambda_l)$ with the transfer function $\hat{h}(\lambda_l)$ such that

$$\hat{y}_{out}(\lambda_l) = \hat{y}_{in}(\lambda_l)\hat{h}(\lambda_l), \ \forall \ \lambda_l \ E \ \sigma_L. \qquad (7)$$

The filtered signal y_{out} at node n is given by taking the inverse graph Fourier transform of eq. (7) [1], such that

$$y_{out}(n) = \sum_{l=0}^{N-1} \hat{y}_{in}(\lambda_l)\hat{h}(\lambda_l)u_l(n). \qquad (8)$$

Eq. (8), can be illustrated in matrix notation [1] as follows

$$y_{out} = \hat{h}(L)y \qquad (9)$$

where

$$\hat{h}(L) = u \begin{bmatrix} \hat{h}(\lambda_0) & & 0 \\ & \ddots & \\ 0 & & \hat{h}(\lambda_{N-1}) \end{bmatrix} u^T$$

B. Convolution

Specifically, the relationship between the spectral graph domain and the vertex domain, on the graph, can been used to describe the convolution. Stated two graph signals y, h the outcome of the convolution of above-mentioned two signals on vertex n is explained as [3], [6]

$$(y * h)(n) = \sum_{l=0}^{N-1} \hat{y}(\lambda_l)\hat{h}(\lambda_l)u_l(n). \qquad (10)$$

which exhibits the property that the multiplication in the graph spectral domain is analogous to convolution in the vertex domain [1].

C. Translation

In general, the translation operator of a graph signal y to a node n can be defined as a generalized convolution with a Kronecker δ function centered at vertex n [3], [6], [7]:

$$T_n y = \sqrt{N}(y * \delta_n) = \sqrt{N} \sum_{l=0}^{N-1} \hat{y}(\lambda_l)u_l^*(n)u_l \qquad (11)$$

where the normalizing constant $\sqrt{N}$ makes certain that the translation operator keeps the mean of the signal (When the Fourier basis is formed by the eigenvector of the normalized Laplacian, $\sqrt{N}$ is substituted by d , where d is a vector containing the elements of the degree of each node). The Kronecker function δ_n is an N-dimensional signal that has no value anywhere on the graph apart from node n, where it holds the value of one [4]. The Fig. 5 elucidates an instance of the translation operator on a signal g, the heat kernel (previously shown in Fig. 4), in various vertices of the graph [1]. It is noticed that the long-established shift in the traditional definition of the translation operation does not employ on graphs [4]. A thorough explanation of above-mentioned basic operations can be discovered in [1].
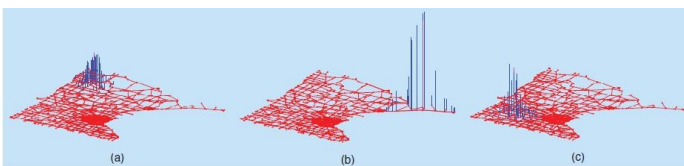
Fig. 5. Translation of the same signal g, the heat kernel (previously shown in Fig. 4), $T_n g$ to three different vertex (n) on the graph (a) $T_{100}g$, (b) $T_{200}g$, and (c) $T_{2000}g$ [1]. The height of each blue bar represent the magnitude of the signal value at each vertex. Due to the irregular topology, the translated signals appear different but contain the same graph spectral information [4].

IV. GRAPH SIGNAL PROCESSING APPLICATIONS

In this section, two of the applications of graph signal processing are presented. Some of the efforts from the literature that employ graph-based tools to handle graph signals in two of the settings that is centralized and distributed settings are introduced. It can be said that it is necessary to rely on graphs to model the geometrical structure of high-dimensional signals.

A few works that use graph-based transforms and filters for processing graph signals in a wide range of applications are mentioned below:

- Hu, C, et al in [8] have used the graph Fourier transform for matched signal detection through hypothesis testing.
- A novel method of facial expression recognition using graph signal processing (GSP) is proposed in [9].
- Based on the Digital Signal Processing on graphs an approach to big data analysis is presented in [10].
- This emerging field of graph signal processing has found applications in sensor network, smart grid and smart city [11].
- In recent times, a foundation for active semi-supervised learning found on sampling theory for graph signals has been presented in [12].
- GSP allows us to apply signal processing techniques while taking into account the connections among vertices which provides immense flexibility. Because of this advantage, graph signal processing introduces applications in social networks [13], image and video processing [14], and so on.

While in all these applications graph transforms have been shown to provide significant benefits, the design of adaptive transforms, that are particularly adapted to the graph signals, is expected to improve the performance even more in such applications. For example, by calculating graph Fourier transform of a graph signal and keeping just a tiny fraction of its spectral coefficients, which have huge magnitudes, it can be compressed [4]. By calculating the inverse graph Fourier transform, the compressed graph signal can be remodeled with the retained coefficients [4]. It can be seen that when the graph signal is less frequent in the Fourier domain, that is, when almost all energy is directed in a small number of frequencies, the presence of error is very little in the restored compressed signal [15].

A. Improved Facial Expression Recognition (FER) using GSP

One of the recent applications of GSP is proposed in [9]. In present times, different applications in neuroscience, surveillance, human-computer interaction etc requires the interpretation of facial expressions. The face registration, representation, dimensionality reduction and recognition are the vital blocks of the facial expression recognition algorithm [9].

The proposed FER algorithm is illustrated in Fig. 6 [9]. To extract the feature and the dimensionality reduction, it uses the discrete wavelet transform (DWT) in company with principal component analysis (PCA) [9]. The DWT is used to decompose each of the images into low and high frequency components and after that linear discriminant analysis (LDA) approach is applied for feature extraction from these frequency components [9].

The Table I shows the results of the proposed application of GSP with comparison to exiting methods in [9]. The experimental outcomes prove that the suggested recognition scheme has enhanced accuracy against prevailing techniques.
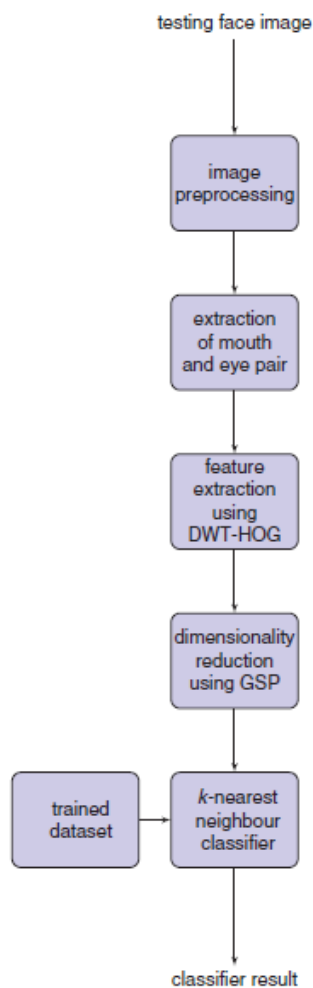
Fig. 6. The block diagram of FER algorithm [9].

TABLE I
THE TABLE SHOWS THE COMPARISON OF GSP WITH EXISTING METHOD
OF DWT [9]

Method	Accuracy, %
Wavelet packet decomposition	83.7
DWT + PCA/LDA	88.89
Proposed method using GSP in [9]	92.1

The graph signal processing (GSP) has recently attracted a lot of researcher's attention for the study of high-dimensional signals and it makes a graph which contains the proximate data of the available dataset [1]. Earlier for face recognition, the abstract idea of locality preserving projection was used which is quite similar to GSP. The important measure for the GSP technique is to explain the weight between the nodes (using feature vector calculated from DWT-histogram of oriented gradients (HOG)) and calculate the final lower dimensional feature vector by the projection of first feature vector on the generalised eigenvector basis [9]. The main inspiration for using the graph signal processing is build on the reason that

GSP retains the proximity structure in the dataset [1]. Hence, it allows in the enhanced collection of qualities which leads to the superior categorization of the facial expressions and ends up being more accurate than existing methods.

B. GSP in Application to Sensor Networks, Smart Grids and Smart Cities

Advancement in computation of complex frameworks is essentially bestowed by development in sensing technology and signal processing. In earlier decades, limited number of sensors were used to conduct studies, and signals processing techniques tended to this conceivable outcomes and necessities. In recent times, remarkable evolution in sensor technology, data science and communication systems have coined new standards for the computation systems, which associates large quantity of data brought together in millions of sensors in the structured sensor networks. What is more, both of them, datasets and sensor networks can be diverse in their structures and users request more detailed information and operation in quick mode. In this application, the data taken from environment about the concentration of ozone in Poland serves as a desirable model as shown in Fig. 7 [11].
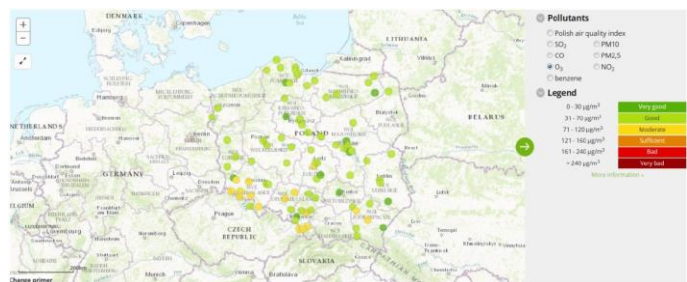
Fig. 7. Ideal map about concentration of ozone in the country Poland [11].

In the primary phase of research, complex network structures were reconstructed from experimental information for different time scales. By transforming these graph structure into the graph spectral domain uncovered collecting patterns at chosen time scales. In the end, it is proved that reconstructed graphs can get the hidden patterns in complicated system properties and the way it conducts itself, since geometric pairwise separation between the sensors in network are obviously not quite the same as from the pairwise separation calculated for graph signals. It is as shown in Fig. 8 [11]. It is provided in [11] that a new toolbox, GSPBOX from MATLAB has been used for plotting necessary graphs.

The examinations explained in this application can additionally supplement considering the other method of complicated networks analytics, for example representation of network estimates defined in complicated network theory. It has been proved in this application that the approach is feasible for complicated network remodeled from ozone data. The results of this proposed application is provided in the Table II [11] and the calculations over a week's time of sensors deployed in the complicated network to check the concentration of ozone, calculated values of the average shortest path length (*LP*), the
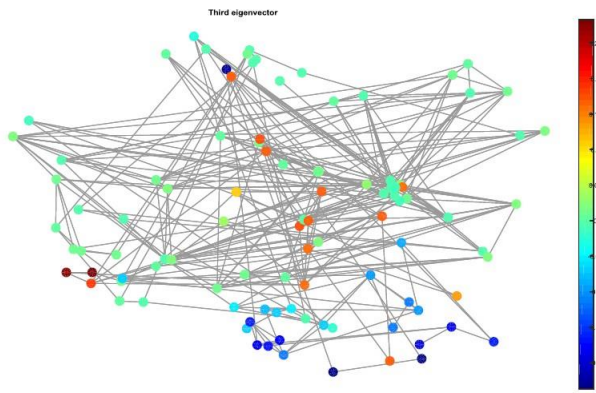
Fig. 8. Protrusion of eigenvector values computed for graph remodeled from one-week readings of ozone data in sensor network installed in Poland [11].

network efficiency (E), the average node degree ($< k >$) and the clustering coefficient (C) are tabulated.

TABLE II
THE TABLE SHOWS THE MEASUREMENTS IN THE COMPLEX NETWORK OF SENSORS DEPLOYED TO CHECK THE OZONE CONCENTRATION OVER A WEEK'S TIME [11]

LP	E	C	< k >
0.36	17.26	0.11	5.67

V. GSPBOX: A NEW MATLAB TOOLBOX FOR GRAPH SIGNAL PROCESSING

The new toolbox, GSPBOX is specially designed for signal Processing on graphs and helps to meet in an integrated framework a sequence of analysis for graphs signals and graph and also provide visualization tools for them [16]. It has improved plotting capabilities to provide effective and proper toolkit for signal processing on graphs as it is seen that the code is properly documented, flexible, and simple to understand [16].

VI. CONCLUSION

The recent procured knowledge of work carried out by various people in this emerging field of graph signal processing is summarized. A significant amount of work has been dedicated to the development of graph-based transforms that can represent and process graph signals. They are designed by borrowing ideas from Euclidean settings and at the same time incorporating the irregular graph structure. The graph Fourier transform or wavelet-like type of transforms have found applications in a lot of challenging problems such as sensor networks, semi-supervised learning, image processing and many more. However, a lot of research is still needed to carry out within each of the applications to understand more advanced ways to merge the graph theory concepts with existing signal processing techniques.

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Rail track monitoring technique currently used in India for crack detection

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Abstract–**Railways are one of the mostly largely used modes of public transportation throughout the world. Monitoring rail tracks for detection of cracks is necessary to prevent accidents. Various monitoring techniques are practiced across the world for rail track crack detection. Indian railway utilizes ultrasonic waves based rail track monitoring technique. This paper discusses and analyzes this technique. The drawbacks of this technique are also listed in this paper. In order to overcome the drawbacks of currently used rail track monitoring technique for crack detection in Indian railways, crack detection robot concept along with the use of web page for rail track monitoring is introduced and proposed in this paper.**

Keywords–*Monitoring, rail tracks, cracks, robot, microcontroller, infrared (IR) sensor, Global Positioning System (GPS), Global System for Mobile Communications (GSM), General Packet Radio Services (GPRS), web page.*

I.INTRODUCTION

A huge percentage of population throughout the world majorly relies on railways for transportation. There are various advantages associated with railways. For e.g. trains moving on rail tracks travel at a very high speed, due to which it is able to cover vast distance in a very short time. Also, the cost of traveling through railways is quite cheap, which makes it affordable for everyone. Besides, railways also contribute to the economy of every country across the world. In India, rail network is very extensive and is an important contributor in Indian economy.

II. WORKING PROCESS OF RAILWAYS

Railways consist of very huge infrastructure. Many trains travel in different directions across the rail tracks on a daily basis. In order to avoid any confusion and to ensure smooth management of railways, the working process of railways is divided into different stages. The first stage is proper scheduling of trains. The next stage is monitoring of rail track for detecting faults in it. After monitoring, the next stage is servicing of trains.

A) Scheduling of trains

Across the whole rail area in India, a huge number of trains run on a daily basis. If trains keep on running on railway tracks without any proper scheduling then, there is a possibility of a clash of trains or heavy traffic of trains occurring on rail tracks. To ensure that there is no clash or traffic of trains, trains are scheduled by making a time table for trains and also signaling system is used to make sure that if there is any delay in running time of trains, then the trains running on same track do not clash with each other.

B) Monitoring of rail track

After scheduling of trains, monitoring the rail tracks is quite essential. Monitoring of rail tracks is usually carried out when trains are not running on rail tracks. Monitoring is done to find out whether the track consisting of any fault or not. If fault like crack is present on rail track then, it can cause rail accident to occur. Hence, monitoring is a very important stage in working process of railways.

C) Servicing of trains

Along with giving importance to monitoring rail tracks, servicing of trains time to time is also necessary. During servicing, the trains are checked for flaws and are repaired if detected with any flaws.

III. RAIL TRACK MONITORING TECHNIQUE FOR CRACK DETECTION CURRENTLY USED IN INDIA

In India, the railways most widely use the broad gauge. A gauge in rail network means the measurement between the two inner faces of the rails. Four types of gauge are present in railways in India. They are broad gauge, meter gauge and two different narrow gauge. The broad gauge is 1676mm in width.

The height of rail in Indian railways is 172 mm and its width is 74 mm. At present, a rail car which works on manual operation is used for monitoring the rail tracks in India. There are two types of rail cars, i.e. single rail tester and double rail tester car. Single rail tester car can test upto two kilometer (km) of rail track per day and double rail tester car can test upto four km of rail track per day. Different probes i.e. 0^0 probe, 37^0 probe, 70^0 probe and 45^0 probe are utilized in this crack detection process. These probes generate ultrasonic waves to detect cracks. An oscilloscope is used to scrutinize the behavior of ultrasonic waves passing through the rails. The waves get reflected back on detection of a crack. 0^0 probe helps in checking whether the rail track consists of horizontal head cracks, while 37^0 probe is used for examining bolt hole cracks. 70^0 probe checks the rail for detecting presence of rail head crack and 45^0 probe examines whether any vertical head cracks exist on rail surface or not. The frequency of testing rail cracks is decided on the basis of gross million tonne (GMT) traffic, which is basically the indication of the traffic of the train passing through a rail track on daily basis.

IV. LIMITATIONS OF CURRENTLY USED CRACK DETECTION TECHNIQUE IN INDIA

A) The rail car requires to be operated manually.

B) The oscilloscope needs to be observed carefully continuously to find out if any wave is getting reflected back, which indicates the presence of crack.

C) Single rail and double rail tester car are limited to testing two and four km of rail area per day respectively.

V. INTRODUCTION OF CRACK DETECTION ROBOT WITH WEB PAGE

The limitations of the current crack detection technique can be overcome using crack detection robot with web page.

A) Use of crack detection robot

Crack detection robot is a robot which is specially made for moving on tracks for monitoring it for crack detection purpose. A system is proposed based on this robot. There are two different units in the proposed system. The first unit is the robotic unit, while the other unit is the receiver unit. Fig. 1 and fig. 2 show the block diagram of robotic unit and receiver unit respectively. The robotic unit constitutes of motor driver, direct current (D.C.) motors, infrared (IR) sensors, motor driver, direct current (D.C.) motors, microcontroller, Global Positioning System (GPS) and Global System for Mobile

Communications/General Packet Radio Services (GSM/GPRS) module. The receiver unit constitutes of a personal computer (PC) or laptop with internet connection GSM/GPRS module. The robotic unit constitutes of a robot with four wheels. This robot will driven by D.C. motors with the help of motor driver. L293D motor driver shall be used in this system. The robot shall start detection of cracks on rail tracks after receiving a message to start the monitoring process. The GSM/GPRS module of the robotic unit shall receive this message. ARM7 LPC2148 microcontroller and SIM900 GSM/GPRS module shall be utilized in this proposed system. The cracks on the rail tracks will be detected with the help of IR sensors. The reason for selecting IR sensors for detecting cracks is their working principle, i.e. a change will be observed in the voltage of the receiver circuit of IR sensor in accordance to the IR light received from the emitter circuit of the sensor. Based on this working principle, the IR sensor's voltage variations obtained on presence of crack as compared to the voltage variations obtained without any presence of cracks will help in detecting the crack quite easily. During monitoring of track, if the robot detects the presence of any crack, it will stop there at that instant. The detected crack location will be obtained using the GPS module. GSM/GPRS module shall send the information regarding the crack detected and its location to the registered mobile number via short message service (SMS).

B) Role of web page

The information that will be sent via SMS to the registered mobile number, the same information will also be displayed on the web page through the internet connection. Besides, the status of the rail track and the location of the robot will be regularly updated on the web page.
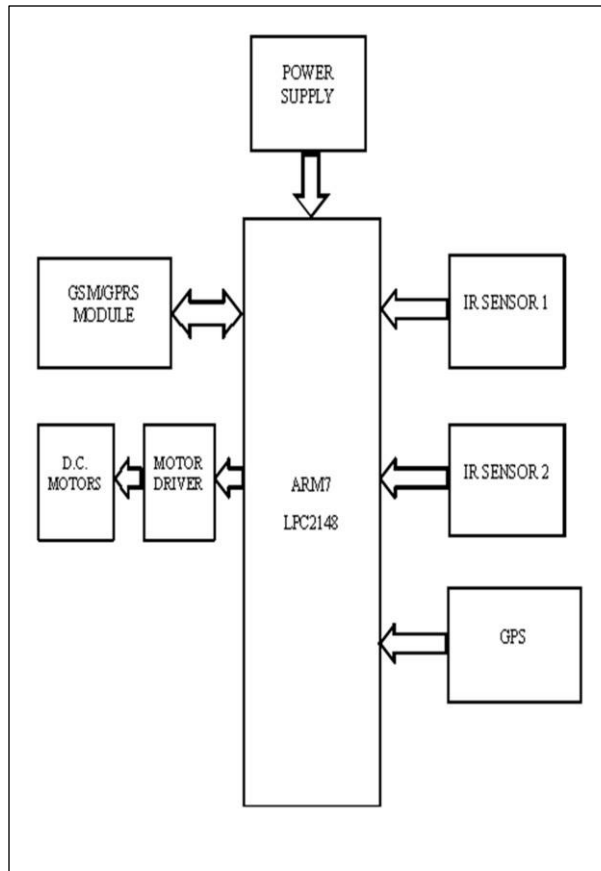
Fig. 1. Block diagram of robotic unit.
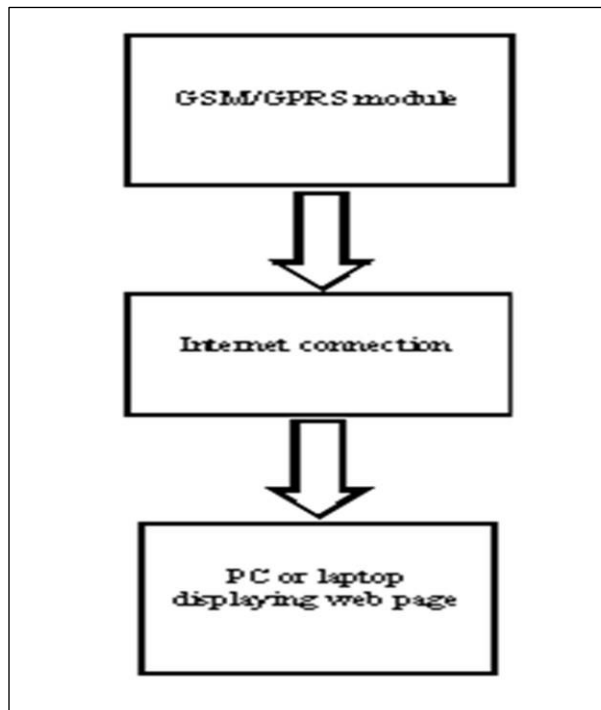
Fig. 2. Block diagram of receiver unit.

VI. ADVANTAGES OF CRACK DETECTION ROBOT

A) Rail track monitoring will not require any manual work.

B) Precise location of the crack will be obtained with the help of GPS.

C) Control section will receive notification regarding the detection of crack and its location through SMS.

D) The web page will keep on updating the status of rail track and the location of the robot continuously throughout the entire period of rail track monitoring.

VII. CONCLUSION

In the past few years, Indian railways are witnessing various accidents that are costing human lives. A huge percentage of these accidents are caused to due presence of cracks on rail tracks. The increasing number of rail accidents occurring each year in Indian railways, owing to the presence of cracks, indicates that the current rail monitoring technique used in Indian railways is unsuitable for detection of cracks in rail tracks. The proposed concept of crack detection robot along with the use of web page provides various advantages over the existing rail track monitoring technique and shall overcome the limitations of the existing technique.

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Implementation of Time based 3-Axis Capacitive Accelerometer using COMSOL Multiphysics

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Abstract—**Micro-electro-mechanical system or MEMS simply can be understood as a miniaturized mechanical and electro-mechanical elements i.e sensors, actuators, and microelectronics, that are made using methods of fabrication. Capacitive accelerometers are devices that measure the acceleration on a surface using capacitive sensing techniques. It can sense both static and dynamic acceleration. After this, it converts this acceleration into voltage or current. Whereas, in the capacitive pressure sensors, the pressure is sensed by mechanical elements such as plates, shells, and tubes that are designed and constructed to deflect when pressure is applied. These Capacitive pressure sensors have an edge over the piezoresistive ones since they consume less power. They are usually less temperature sensitive and have a lower fundamental noise floor. This model performs an analysis of a hypothetical sensor design using the electromechanical interface. The results throw light on the importance of considering packaging in the MEMS [micro-electro-mechanical system] design process. The sensor is part of a silicon that has been bonded to a metal.**

Keywords-Micro-electro-mechanical system(MEMS); Capacitive Accelerometer; Capacitive Pressure Sensor.

1. INTRODUCTION

The accelerometer is an electromechanical device that can measure the change in velocity or force of acceleration caused by gravity or movement over time. It can measure acceleration in one, two or three axes. Most of them are MicroElectro- Mechanical-Sensors(MEMS) Two of the most common types are capacitive sensing and piezoelectric effect to sense the displacement of the proof mass which is proportional to the applied acceleration. The output voltage of the capacitive sensor is dependent on the distance between the two capacitive plates. The acceleration of piezoelectric sensor is directly proportional to the force. Whenever certain type of a crystal is compressed, the charges of opposite polarity accumulate on opposite side of the crystal.In addition to this, we also have a piezoresistive pressure sensor which is one of the very first products of the MEMS technology. These devices are widely used in household appliances. We are using the capacitive sensing accelerometer because it is

known for its accuracy and stability. In addition to this, they are less prone to noise and its variation with temperature is also marginally less.

1.1. Problem Statement

An accelerometer is an electromechanical device that will measure both static (gravity) and dynamic (motion or vibration) accelerations. The evolutiont of the MEMS accelerometers has revolutionized the application of accelerometers, making them smaller, lower power and easily integrated into a wide range of applications. MEMS accelerometers are used in cars, planes, industrial applications, mobile phones in fact almost everywhere. There are three main MEMS technologies for converting acceleration to an electrical signal i.e. piezoelectric, piezore-sistive and capacitive. We have selected capacitive sensing because it offers the best in terms of long-term stability while achieving outstanding sensitivity. For this reason, our high-performance sensors are used in some of the most challenging applications that are addressed by MEMS sensors.

2. CAPACITIVE SENSOR

According to those implemented using capacitive sensing, give a voltage output dependent on a distance between two planar surfaces i.e. capacitive plates. Both these plates are charged with the help of electric current. By changing the gap between capacitor plates, the electric capacity of the system changes. This is measured as the output voltage [16]. The biggest advantage of using capacitive sensor is that they have a very large bandwidth due to internal feedback circuitry. Furthermore, these sensors are very stable and accurate. In addition to this, they dissipate very less power [1].

2.1. Parallel Plate Capacitance

The electric field between two parallel plates is given by

$$E = \frac{\sigma}{E}$$

Where

$$\sigma = ChargeDensity$$

$$E = permittivity$$

$$\sigma = \frac{Q}{A}$$

The voltage difference between the two plates is expressed as work done on positive test charge q when it moves from positive to negative plate.

$$v = \frac{workdone}{charge} = \frac{Fd}{q} = Ed$$

$$c = \frac{Q}{V} = \frac{Q}{Ed} = \frac{QE}{d\sigma} = \frac{QAE}{Qd} = \frac{AE}{d}$$
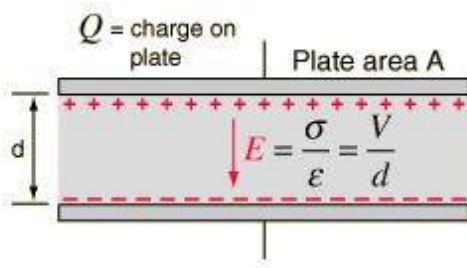
Figure 1. Capacitor Plates [1]

2.2. Hook's Law
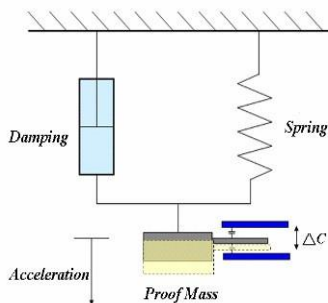
Figure 2. Proof Mass [3]

Hooke's law is a principle of physics that states that the force (F) needed to extend or compress a spring by some distance X scales linearly with respect to that distance. That is:

$$F = kX$$

where, k is a constant factor characteristic of the spring,and X is small compared to the total possible deformation of the spring. When we equate this law with the standard Newton's equation of force i.e

$$F = ma$$

we get,

$$F = kX = ma$$

Equating them we get,

$$kX = ma$$

Proof mass also is known as test mass is basically a known quantity of mass, that is used in a measuring instrument, as a point of reference for the measurement of an unknown quantity [2]. A proof mass actuators is a linear machine which is mounted to a structure for the purpose of acting as a linear force actuators to damp out vibrations in the structure brought on by impulsive disturbances. It deforms the spring to which it is attached to an accelerometer [3].

2.3. 2-axis Capacitive Accelerometer

The figure given below is called as a two-axis accelerometer. We can also design the 3-axis accelerometer if we keep one more set of capacitors in 90 degrees to each other. A simple MEMS transducers mainly consists of a movable microstructure or a proof mass that is connected to a mechanical suspension system and thus on to a reference frame. The movable plates and the fixed plates act as the capacitor plates [18]. When acceleration is applied, the proof mass moves accordingly. This movement will produce a capacitance between the movable and the fixed plates. When we apply acceleration , the distance between the two plates displace as X1 and X2, and they turn out to be a function of the capacitance produced [1]. From the image below it is clear that all sensors have multiple capacitor sets. Here all the upper capacitors are wired parallel to produce an overall capacitance C1 and the lower ones produce an overall capacitance of C2 [4].
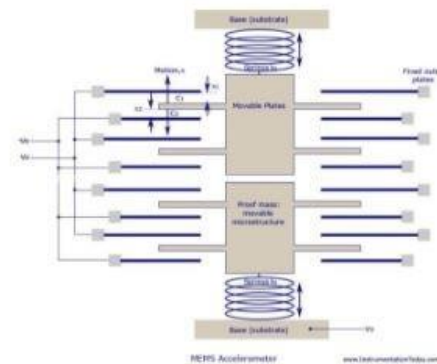
Figure 3. 2-axis Capacitive Accelerometer [1]

2.4. 3-axis Capacitive Accelerometer

Here we get a method for inputting the motion measurement data into a computationally based device. The first version of three-axis accelerometer determines components of an inertial force vector with respect to an orthogonal

coordinate system [6]. The accelerometer comprises of a sensor die that is made up of a semiconductor substrate having a frame element, a proof mass element, and an elastic element mechanically coupling the frame and the proof mass [15]. The accelerometer also contains three or more stress-sensitive IC components integrated into the elastic element next to the frame element for electrical connectivity without any metal conductor traversal of the elastic element [17].
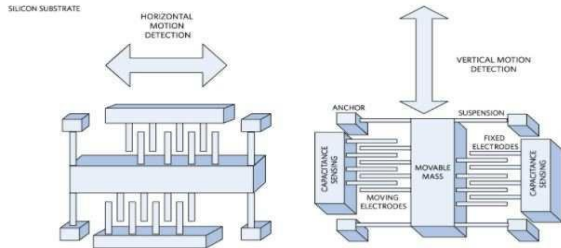
Figure 4. 3-axis Capacitive Accelerometer [9]

3. MATERIAL REQUIRED

The choice of good material for MEMS devices in not largely based on the carrier mobility of microelectronics, but more on the mechanical aspect. In MEMS devices, silicon and silicon compounds are widely used in the fabrication of micro pressure sensor. Silicon has excellent mechanical properties. It is a strong material but lighter than steel [13]. It has large critical stress and no elasticity limit at room temperature and is also a perfect crystal that ensures it will recover from large strain. It has a large piezoresistive coefficient for sensing application. Silicon has a greater density in a liquid state than in solid state, and so like water, unlike most substances [6]. Silicon material is used to design the diaphragms of the pressure sensors and is also used to measure ultra-low pressure. Steel AISI material is also used in the MEMS devices [5].

4. SOFTWARE REQUIRED

COMSOL Multiphysics version 5.2 delivers new features, enhanced stability and robustness, and faster execution. It also improves your simulation capabilities with better features to the core functionality. In COMSOL Multiphysics version 5.2, the Model Builder and Application Builder are more tightly integrated. You now have the option to include dynamic graphics updates to plots while solving [17]. A new Editor Tools feature enables you to quickly create standard interface components in apps. COMSOL Server launches apps up to five times faster and lets users set a specific app to open automatically when they log in.Additional updates to this version of COMSOL Multiphysics include more powerful meshing, plot annotations, and a simple way to import externally generated mesh. For mechanical simulations, you can now express nonlinear materials as C code [2].

5. IMPLEMENTATION OF MODEL

We have already implemnted capacitive accelerometer in COMSOL multiphysics.
The flowchart for the model in COMSOL is given below:-
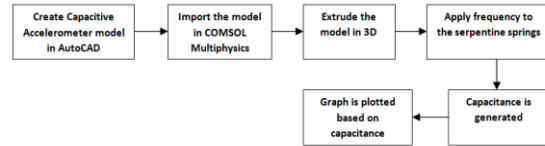
Figure 5. Flowchart
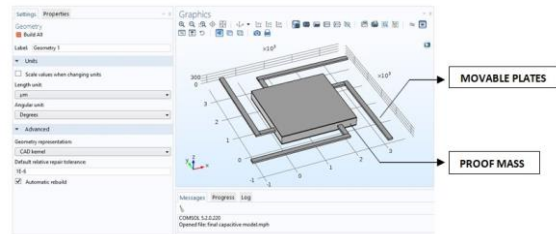
Figure 6. Capacitive Accelerometer
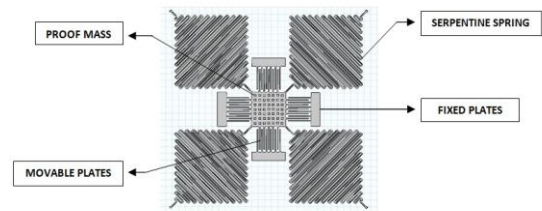
Figure 7. 2-axis Capacitive Accelerometer

Implementation steps of the Model in the COMSOL multiphysics are given below:-

Step:1 In the First step we have to design 2D or 3D geometry. It can be done by two way importing supporting file in COMSOL or by constructing geometrical shapes as we have shown in figure 8
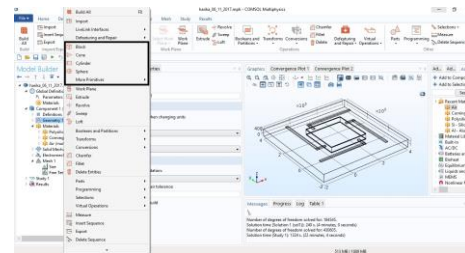
Figure 8. Step:1 Designing Geometry

Step:2 In second step we have to select material to appropriate domain of the model.

- To **Add Material**, click on **Add Material** from Home Toolbar.
- In the tree which is on the right-hand side, select the material.
- Click **Add to Component** in the window toolbar.
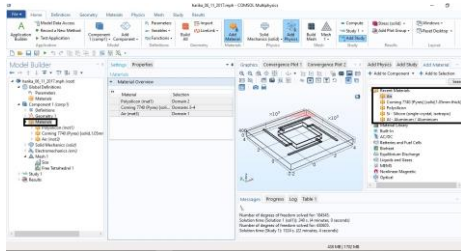
Figure 9. Step:2 Selection of Material

Step:3 After applying material, now we have to select physics for the model.

- To **Add Physics**, click on **Add Physics** from Home Toolbar.
- In the tree which is on the right-hand side, select the physics.
- Click **Add to Component** in the window toolbar.
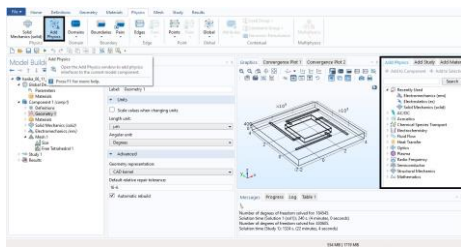
Figure 10. Step:3 Selection of Physics

Step:4 After applying physics, we have to apply mesh and then we have to apply study to get solution for the model.

- Click on the **Mesh** from the mobile builder.
- To **Add Study**, click on **Add Study** from Home Toolbar.
- In the tree which is on the right-hand side, select the study.
- Click **Add to Component** in the window toolbar.
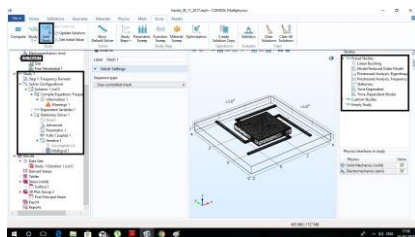
Figure 11. Step:4 Selection of Study

Step:5 After applying study, we want to generate graph which we will get using result.

- To **Get Result**, click on **Result** from Home Toolbar.
- In the tree we have to access various tools whcih are present here.
- Click on various tools in the toolbar
- After that we will get the simulations from the converge plot.
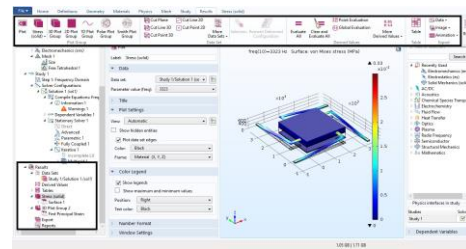
Figure 12. Step:5 Solving Methods

6. RESULT

This is a graph of displacement of proof mass versus acceleration.
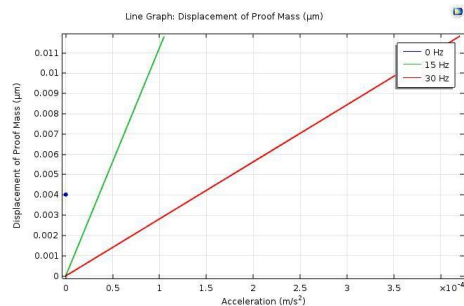
Figure 13. Displacement versus Acceleration Graph

7. APPLICATION

- In the recent years, there has been a lot of development in the medical industry. One such development is the pacemaker. The introduction of MEMS technology has transformed the pacemakers from bulky, single-chamber, asynchronous units to small ,multi-programmable, dual chamber, rate adaptive devices with diagnostic functions.
- In our project, we are using the MEMS capacitive accelerometer to generate the required voltage for the pacemaker. Whenever there is a vibration in the proof mass , the distance between the capacitive plates change which in turn produces a change in voltage. This vibration is caused by the blood flow in the human body. Therefore, we are trying to use

the body energy i.e. blood flow in the vessels, for charging the pacemaker.

- In addition to this, the MEMS capacitive accelerometer has been implemented in many commercial applications, such as automobile air bags, navigation, and instrumentation.

8. ADVANTAGES

- It requires simple signal conditioning.
- Capacitive accelerometers are very sensitive.
- Capacitive accelerometers are ideally suited to measure low-frequency low level acceleration.
- Reliable accuracy
- Excellent Price Performance
- Measures DC Acceleration

9. DISADVANTAGES

- Low Bandwidth(frequency B.W. upto 5000Hz)
- Relatively Fragile
- Sensitive to temperature
- Hysteresis error
- Less longevity
- Increased efficiency with time
- Spring system is not always accurate.
- Fluctuations in mass leads to wrong calculations.

10. CONCLUSION

In this paper, the various types of accelerometers and the various materials required in its designing are studied thoroughly. A three-axis MEMS capacitive accelerometer is implemented in COMSOL Multiphysics where we are applying the force in the positive z-direction. The results can be used to calculate the change in distance between the capacitive plates w.r.t change in capacitance which is linear in nature.This has its applications especially in the bio-medical industry where we can use this in pacemakers, eye surgery, kidney dialysis and much more other life-saving operations.

ACKNOWLEDGEMENT

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Improved Ant Colony Optimization for MANETs

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Abstract— **Mobile Ad Hoc Network (MANET) is a dynamic multihop wireless network which is established by a set of mobile nodes on a shared wireless channel. Its complexity increases due to various characteristics like dynamic topology, time varying QoS(Quality of Service) requirements, limited resources and energy etc. Routing in an ad hoc network is extremely challenging because of its dynamic nature, limited bandwidth and power energy. Swarm Intelligence based techniques such as ant colony optimization (ACO) algorithms will be a good technique for developing routing algorithms for ad hoc networks because their routing scheme is based on the behaviour of foraging ants. We propose improvement in ACO as IMVPACO algorithm to be used as a routing protocol in Mobile ad hoc networks(MANETs).**

Keywords— **MANETs, Quality of Service(QoS), Routing, Swarm Inteligence, Ant Colony Optimization(ACO)**

INTRODUCTION

In mobile ad hoc network (MANET), the nodes work together in a distributed fashion to enable routing among them. Because of the lack of centralized control, routing becomes a central issue and a major challenge as the network topology is constantly changing. It is a collection of mobile nodes that are dynamically and arbitrarily located in such a manner that the interconnections between nodes are capable of changing on a continual basis. Each node can act as a receiver, transmitter or router. The main problem of the ad-hoc network is mobility of the nodes resulting in fast variations of their availability. At one time the node is in range and while at other that node is out of the range. Another problem is the power and battery lifetime of each device in the network. There are many applications for MANET. For example, in a military field, search and rescue operations, or any remote geographical area where is no base station for communication.

In order to solve the problems faced in MANETs, the basic ant colony optimization (ACO) algorithm is improved to propose an efficient and intelligent ant colony optimization (IMVPACO)algorithm. In the IMVPACO algorithm, the updating rules and adaptive adjustment strategy of pheromones are modify in order to better reflect the quality of the solution based on the increment of pheromone. The dynamic evaporation factor strategy is used to achieve the better balance between the solving efficiency and solving quality, and effectively avoid falling into local optimum for quickening the convergence speed. The movement rules of the ants are modify to make it adaptable for large-scale problem solving, optimize the path and improve search efficiency. A boundary symmetric mutation strategy is used to obtain the symmetric mutation for iteration results, which not

only strengthens the mutation efficiency, but also improves the mutation quality. Finally, the proposed IMVPACO algorithm is applied in solving the traveling salesman problem. The simulation experiments show that the proposed IMVPACO algorithm can obtain very good results in finding optimal solution[10]. And It takes on better global search ability and convergence performance than other traditional methods.

LITERATURE REVIEW

For any project planning activity, a good reading of existing projects, ideas and technology is needed. The following subsections provide much needed excerpts from important research papers and literary documents. These research papers were a huge help for understanding the working of Ant Colony Optimization algorithm and the different routing protocols used in Ad Hoc Networks.

1) **Ping Duan and Yong ai - "Research on an improved ant colony optimization and its application"[10]-**
   This paper has suggested the new IMVPACO algorithm on which the system will be built. It contains the new improvements in the basic ACO algorithm and the analysis done on the IMVPACO algorithm based on the standard datasets of TSP on MATLAB.

2) **Anuj K. Gupta, Harsh Sadawarti, and Anil K. Verma – "MANET Routing Protocols Based on Ant Colony Optimization"[11]-**
   This paper suggests the working of ACO for MANETs. We learned about the basic routing protocols used in the MANETs and how the ACO algorithm can be used as one of the routing algorithms.

3) **Nabendu Chaki, Sugata Sanyal-"Ant Colony based Routing for Mobile Ad-Hoc Networks towards Improved Quality of Services"[12]-**
   This paper suggests improvement in the routing protocols. It takes into the account the Quality of Services offered by different routing protocols.

PREVIOUS WORK

Some works related to ACO and OLSR are found in the literature. In [1], the authors described a hybrid routing algorithm for MANETs based on ACO and zone routing framework of bordercasting. A new QoS routing protocol combined with the flow control mechanism has been done in [2]. This proposed routing solution is modeled by an systems. The proposed routing protocol in [2] uses a new metric to find the route with higher transmission rate, less latency and better stability. P.Deepalakshmi. et.al [4] proposed a new on demand QoS routing algorithm based on ant colony metaheuristic. An algorithm of ant colony optimization for mobile ad hoc networks has been described in [5]. But the QoS issues end-to-

end delay, available bandwidth, cost, loss probability, and error rate is not considered in [5]. A hybrid QoS routing algorithm has been proposed in [6]. In [6], the authors used ant's pheromone update process approach for improving QoS. But the authors described only bandwidth. Other QoS issues are not considered in [6]. Shahab Kamali. et.al [7] implemented a new ant colony based routing algorithm that uses the information about the location of nodes.

PROPOSED SYSTEM

A Mobile ad hoc network (MANET) is a decentralized group of mobile nodes which exchange information temporarily by means of wireless transmission. Since the nodes are mobile, the network topology may change rapidly and unpredictably over time. The network topology is unstructured and nodes may enter or leave at their will. A node can communicate to other nodes which are within its transmission range. This kind of network promises many advantages in terms of cost and flexibility compared to network with infrastructures. MANETs are very suitable for a great variety of applications such as data collection, seismic activities, and medical applications.

Unfortunately nodes in MANETs are limited in energy, bandwidth. The main problem solved by any routing protocol is to direct traffic from sources to destinations, but nowadays, because of increasing complexity in modern networks, routing algorithms face important challenges.

The routing function is particularly challenging in these networks because the network structure is constantly changing and the network resources are limited. Routing algorithms lack of adaptability to frequent topological changes, limited resources, energy availability reduces network performance.

The working of IMVPACO algorithm for Travelling Salesman Problem(TSP)[10] is as follows:-

Step 1. Initialize parameters.

The parameters of the proposed IMVPACO algorithm are initialized. These parameters include the ant size(m), the maximum iteration times(max T), the pheromone factor, heuristic factor, evaporation factor of pheromone, pheromone amount (Q), initial concentration of pheromone, initial uniform probability and so on.

Step 2. Classification of cities.

These cities are divided into the centre city and boundary city according to the geographic coordinate information of cities. The classified result is saved and sorted in order to prepare for the subsequent running of the IMVPACO algorithm.

Step 3. The m ants are randomly placed into n cities, and this city is added into. Tabu list of the ant.

Step 4. For each ant, when Tabu table is not null, the selection probability to the next city is calculated according to the equation in the dynamic movement rules of ants. Then this city is added into the Tabu list, and the pheromone is locally updated.

Step 5. After the ants have completed a choice, the path length is calculated. Then the respective Tabu list is modified. Repeat **Step 4** until the completed touring of the ant. The current

optimal path length is saved, and the global optimal path is updated in this iteration.

Step 6. Update the pheromone

The pheromone on the optimal path is globally updated according to the equation in the improved updating rules of pheromone.

Step 7. Iteration control

Set the iterative counter $t = t + 1$. If max $t = T$, return to Step 4. Otherwise, the proposed IMVPACO algorithm is terminated, and the optimal solution is output.
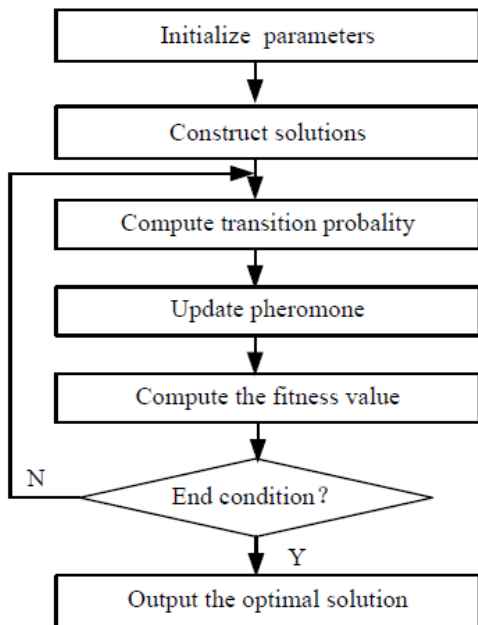
Fig 3.1 Flowchart of IMVPACO algorithm

EXPECTED RESULTS AND ANALYSIS

To improve routing in Mobile Ad-Hoc Networks(MANETs), we have proposed the use of IMVPACO[10] algorithm as a routing protocol. The routing in MANETs is expected to be improved since in IMVPACO, the updating rules and adaptive strategy of pheromones are used to optimize the path. Since in MANETs the routes keep changing dynamically these adaptive strategies are perfect for such topologies.NS3 will be used as a Network Simulator as it has wide range of use in both optimization and expansion of the existing networks.

The proposed method will be compared with existing routing protocols such as AODV on the following parameters:-

1)Throughput: In data transmission, Network Throughput is the amount of data moved successfully from one node to another in a given time period. It is typically measured in bits per second.

2)Packet Delivery Ratio(PDR): The calculation of Packet Delivery Ratio(PDR) is based on the received and generated packets as recorded in the trace file. In general, it is defined as the ratio between the received packets by destination and the generated packets by the source.

CONCLUSION

Routing in an ad hoc network is extremely challenging because of its dynamic nature, limited bandwidth and power energy. Swarm Intelligence based techniques such as ant colony optimization (ACO) algorithms will be a good technique for developing routing algorithms for ad hoc networks because ACO based routing is an efficient routing scheme based on the behaviour of foraging ants. The collective behaviour of ants helps to find the shortest path from the nest to a food source, by deposition of a chemical substance called pheromone on the visited nodes. This mechanism from collective intelligence is applied to the ad hoc network. We have proposed IMVPACO algorithm for routing in Mobile ad hoc network(MANETs)to improve the performance of the network.

ACKNOWLEDGMENT

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Health Monitoring and Disease Prediction System

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Abstract—**There has been a tremendous growth in medical industry over the years, due to the advancement in technology and an increase in health problems have been observed. Due to the hectic and busy schedules of people has led to increased health issues. But as almost everyone in recent times carries their smartphones a healthcare android application can prove very beneficial. The intention behind this project is to create an android application which can be used by people for managing their health. Prediction of whether a person will suffer from diabetes or not will be obtained using decision trees. The user will have to answer a questionnaire which will consist of various parameters regarding the user's health. This application will consist of features such as Order medicines, Book doctor's appointment, medications and diet reminders. The classification models of decision tree resemble to actual tree structure, with branches and leaves. The dataset is divided into smaller branches which are subsets, the leaves store the decision. The tree classifies the dataset considering the instances. The value is in the branch which helps in classifying. Decision tree can handle discrete and continuous data. The classification takes from root node and continues till it reaches any root node.**

Key word — **data mining techniques, decision tree, C5 classifier, data sets**

I. INTRODUCTION

Data mining is the method of examining huge pre-existing databases for generation of new information. Diagnosing and Predicting an individual's health is an important goal of this project. This goal can be attained by implementing advanced machine learning algorithms of decision tree. An Android application is one of the easy method for a person for health management due to the increased use of smartphones. The application will consist of a set of questions which the user will have to answer. This will then immediately predict the possibility if diabetes. Besides this the app will also consist of features like diet monitoring where a user can monitor his/her diet and the app will send notifications or reminders about the same. Other features will be the provision the book

a doctor's appointment. The app will also allow the user the order medicines. Different factors like gender, age, blood sugar level, cholesterol, hereditary disease and many other factors are taken into consideration in this proposed system. Thus to find out whether the user is prone to diabetes or not.

The main objective is predicting the occurrences of diabetes and monitor a person's health based on the answers provided by the user of the questionnaire. Other features also include diet monitoring, booking doctor's appointment and ordering medicines. There are many predictions algorithms used but because of the parameter consideration or algorithm inefficiency the accuracy is not so high. Hence, we are considering many parameters and also using C5 Classifier algorithm which gives a high accuracy.

The rest is divided into 7 sections. In section 2 and 3, related work and proposed work is presented paper is structured. In section 4, the proposed methodology is presented and details regarding the algorithm to be used is explained. In section 5, results obtained by implementing in python are discussed. The conclusion and future work is in section 6 and 7 respectively.

II. RELATED WORK

Health Monitoring Android Application and Diabetes Prediction using Data Mining Techniques [1], in this paper the authors have proposed a project which seeks to apply information and to create an android application which can be used by patients for management of their health care problems and would thus enable them to have a good life. The applications also creates a system for predicting whether a person has a risk of developing the disease diabetes in the next 10 to 15 years. The system uses questionnaire method using Naïve Bayes algorithm.

[2], in this, the authors have proposed such a system that

can predict heart disease occurrence with the help of neural networks**.** This system is capable of predicting with an accuracy of 100%. The system considers 14 medical parameters like age, sex, BP, etc. Disease Predicting System Using Data Mining Techniques [3] have proposed a system which also used data mining for better disease prediction. Classification, clustering, association rule mining are the different data mining techniques used to implement and find the different kinds of heart problems a patient can suffer from. Survey of Machine Learning Algorithms for Disease Diagnostic [4] have provided us with the analysis of many algorithms of data mining which can be implemented on system that can predict diseases of heart, lungs, diabetes, dengue. C5.0 Algorithm has better feature selection and reduced error pruning compared to all previous algorithms.

The best results are obtained by C5.0 classifier. C5.0 classifier has capacity to give output with greater accuracy and it also uses less space compared to other. Feature selection technique removes all the features which have no effect and which provide no important information. The over fitting problem of the decision tree is solved by the Reduced Error Pruning Technique.

TABLE I
Comparison of existing projects

Research Paper	Data set used	Methodology used	Limitations
Health Monitoring Android Application and Diabetes Prediction using Data Mining Techniques	Gender, exercise smoking , body type, alcohol, prediabetes and family hereditary.	Naïve Bayes Classifier	Accuracy is not up to the mark, as the simplest algorithm is used.
A Data Mining Approach for Prediction of Heart Disease Using Neural Networks	Age, sex, cholesterol level, chest pain, heart rate, blood sugar, exercise, blood pressure, etc.	MPNN with back Propagation	As such no limitation, the algorithm with all parameters results in almost 100% accuracy, but only for heart disease.
Disease Predicting System Using Data Mining Techniques	Age, sex, cholesterol level, exercise, chest pain, heart rate, blood sugar.	MAFIA (Maximal Frequent Item set Algorithm); C4.5 Algorithm; K-means clustering	The datasets have a small sample space. 94% accurate for a particular data of a region.

Fig. 1. Comparison of existing projects

Decision trees can handle both classification and regression problems. Decision trees require only a table of data with

which they will build a classifier directly. On the other hand, Naive Bayes requires you build a classification by hand. If given a bunch of tabular data, it will fail to pick the best features which can be used to classify. Using C5 Classifier Decision Tree the prediction will be done.

III. PROPOSED WORK

This application requires the user to answer a questionnaire which will be related to symptoms of the patient and his habits. This will be taken as input and by using decision trees algorithm the possibility of diabetes can be predicted. The application has a feature where the user can enter his/her diet. This app will monitor it and give the required analysis. The medication consumed by the user will also be monitored. The user can also book a doctor's appointment using this app. The details of the appointment will be sent to the doctor.

The following are the modules of the system:

1. Prediction
2. Diagnosis
3. Diet plan
4. Reminders and alarm and
5. Ordering medicines.

The possibility of the user being prone to diabetes or not, will be accurately predicted by this system using prediction algorithm computations. New users need to register themselves in order to create their respective accounts in the system. Access to the system is provided to the user through a login interface. The user can login using username and password on which the user will be directed to the home page of the system. The user can then enter data for prediction of diabetes. We are mainly focusing on Mellitus type of diabetes. The user can also use the additional features like maintaining a diet, reminding of dosage, call for an appointment of a doctor, etc. The following are the parameters which would be considered in the data set for the prediction algorithm:

1. Gender
2. Age
3. BMI
4. Blood Pressure
5. Smoking
6. Weekly exercise
7. Consumption of Salty Food
8. Consumption of Alcohol
9. Work Stress
10. Family History of Blood Pressure/Diabetes
11. Pregnant (if female)
12. Blood fat level
13. Health food consumption
14. Fatty food consumption

The flow for prediction of diabetes will be:
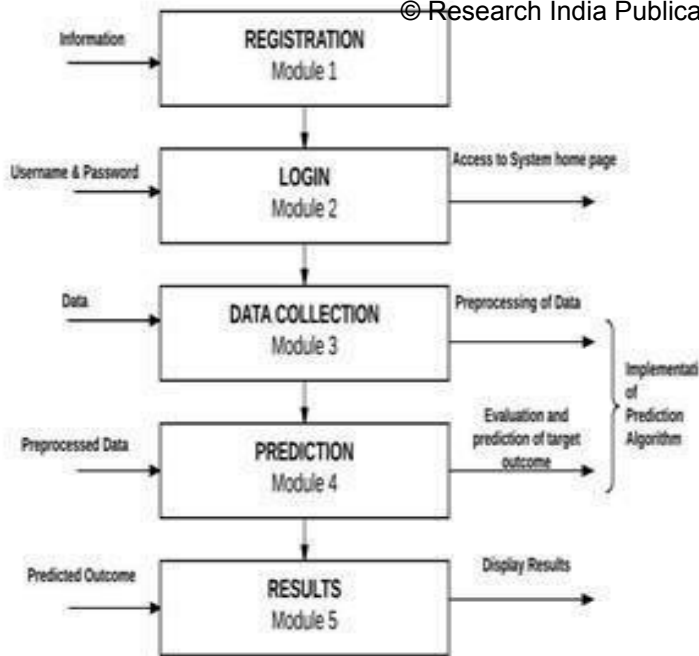
Fig.3.1. Flow for prediction of Diabetes

IV. PROPOSED METHODOLOGY

Decision Trees comes under Supervised Machine Learning (that means we need to explain the input and output in the training data) where continuously splitting of data takes place according to a certain condition/parameter. The leaves and decision nodes are two important entities of the tree. The result is in the leaves and the decision nodes, based on some condition split the data.

Example of a decision tree is given below
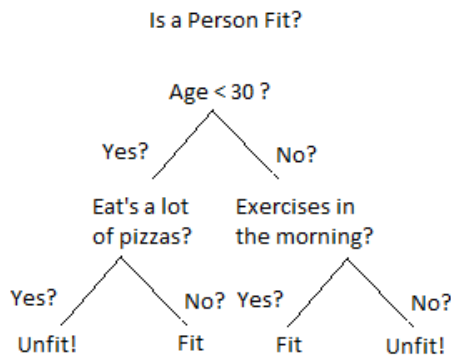
Fig. 4.1: Decision tree [5]

Let us suppose we need to find whether a person is healthy or not healthy. We have parameters like age, type of food intake and exercise time. Here we have decision either yes or not, this can be called as a binary classification problem. The final output at the leaf would be healthy or not healthy.
There are two main types of decision trees
The above example is of binary type of classification (Yes/no), where output is either healthy or not healthy. But

here the decision is variable, that is categorical, that is the output is continuous.
Regression trees (continuous data types), Steps for Decision tree:
Algorithm: Generate a decision tree from the training tuples of data partition, D.
Input: Data partition, D, is a set of training tuples and their associated class labels; list of attributes, a set of candidate attributes; Attribute selection method is a procedure to find out whether splitting criterion best partitions the tuples into individual classes. This criterion consists of a splitting attribute and, possibly, either a split-point or splitting subset.
Output: A decision tree.

Algorithm:
 (1) Define node N;
 (2) If the tuple in D, are of the same class, C, then
 (3) return N as the leaf node assigned with the class C;
 (4) if the attribute list is empty then
 (5) return N as the leaf node assigned with the majority class in D;
 (6) use Attribute selection method (D, attribute list) to find the "best" splitting criterion;
 (7) label the node N with splitting criterion;
 (8) if splitting attribute is discrete-valued, also multiway splits is allowed then
 (9) attribute list ← attribute list – splitting attribute;
 (10)   for each and every outcome "j" of splitting criterion
 (11)   let Dj be the set of tuples in D satisfying the outcome j;
 (12)   if Dj is empty then
 (13)   attach a leaf labeled with the majority class in D to node N;
 (14)   else attach the node returned by Generate decision tree(Dj , attribute list) to node N; end for
return N;

   C5 Classifier:
The classifier is tested first to classify unseen data and for this purpose resulting decision tree is used. There are certain rules, which are to be followed by the new algorithms. So the algorithm we are using C5 has to follow the following rules.
Algorithm has features like:
1. The decision tree which is generated can be called as the rules to be followed.
2. Unlike preceding algorithms, C5 algorithm gives acknowledgement of missing data.
3. C5 algorithm fully rectifies the problem of error pruning as noisy data can be acknowledged and over fitting is also solved.
4. C5 algorithm has a property to distinguish between useful data and useless data i.e. data which gives no information.
Algorithm of C5 Classifier:
 1. Creation of root node
 2. Check the base case
 3. Apply Genetic Selection technique bestTree = Construct a decision tree using training data
 4. Apply Cross validation technique 1. Division of training data into N disjoint subsets, Z = Z1 , Z2 , ...,

ZN 2. For each j = 1, ..., N do
5. Assign Test set as Zj
6. Assign set as Z – Zj
7. Creation of decision tree using the training set+
8. Deduce the performance accuracy X using Test set
9. Reckon the N-fold cross-validation technique to estimate the performance = (X1 + X2 + ... + XN)/N. Highest info gain of attributes is found by (A_Best) Classification Reduced error pruning technique: For each tj є D, apply the DT to determine the class.

Efficiency of Algorithm:
[16] C4.5 is used as a free data mining tool that is descended from ID3 and is then followed by C5.0. For comparison of C4.0 and C5.0 we use 3 sizable datasets:

- Sleep stage scoring data (*sleep*, 105,908 cases). Every case in this monitoring application is described by six numeric- valued attributes and belongs to one of six classes. C5.0 and C4.5 use 52,954 cases to construct classifiers that are tested on the remaining 52,954 cases.

- Census income data (*income*, 199,523 cases). The goal of this application is to predict whether a person's income is above or below $50,000 using seven numeric and 33 discrete (nominal) attributes. The data are divided into a training set of 99,762 cases and a test set of 99,761.

- Forest cover type data (forest, 581,012 cases) also from UCI. This application has seven classes (possible types of forest cover), and the cases are described in terms of 12 numeric and two multi-valued discrete attributes. As before, half of the data -- 290,506 cases -- is used for training and the remainder for testing the learned classifiers.

Classifier	Error Rate	Leaves	Time (secs)
C4.5	27.7%	3,546	3
C5.0	27.7%	2,160	1

Fig 4.2: Comparison for dataset sleep stage scoring

Classifier	Error Rate	Leaves	Time (secs)
C4.5	5.0%	264	5
C5.0	4.9%	122	1

Fig 4.3: Comparison for dataset census income data

Classifier	Error Rate	Leaves	Time (secs)
C4.5	6.1%	10,169	62
C5.0	6.1%	9,185	1

Fig 4.4: Comparison for dataset forest cover type

V. RESULTS
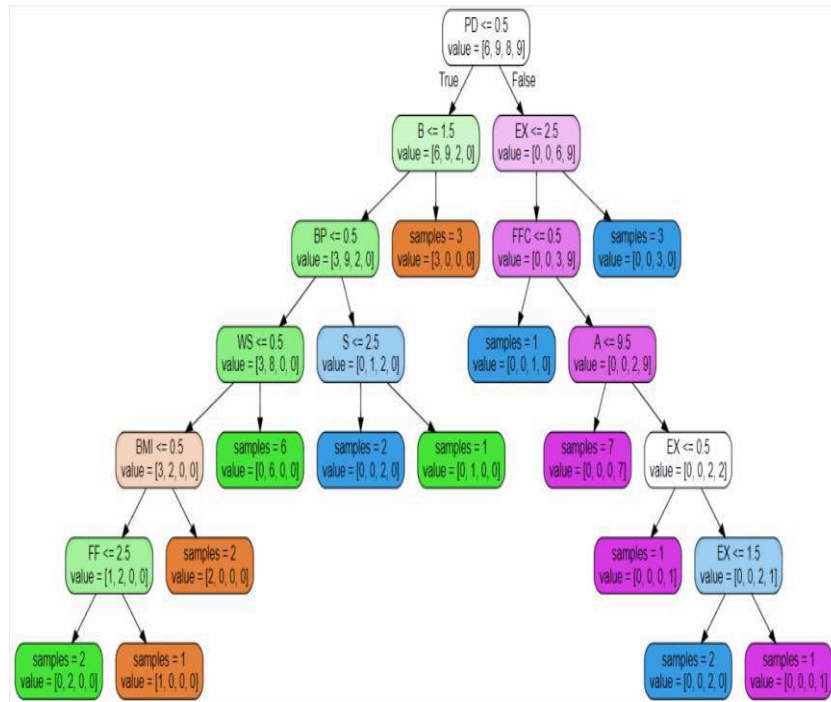
Fig 5.1 Decision Tree

A	B	BP	S	EX	SF	Al	WS	F_BP	F_DB	FF	CF	FW	PD	OC
5	0	0	0	4	1	1	3	0	0	2	3	3	0	0
9	1	0	3	1	2	2	1	1	1	2	2	3	0	1
8	3	0	4	0	2	3	4	1	1	3	3	0	1	3
5	1	0	1	4	1	2	1	2	1	1	1	2	0	1
5	0	0	1	2	1	1	2	2	2	2	1	1	0	1

Fig. 5.2 Dataset sample

A   – Age Class
B   – Body Mass Index
BP   – Blood Pressure
S   – Smoking
EX   – Exercise
SF   – Salty Food Consumption
WS   – Work Stress Level
F_BP   – Family Blood Pressure
F_DB   – Family Diabetes history
FF   – Fatty Food Consumption
CF   – Carbohydrate Food Consumption
FW   – Fiber - Whole grain Consumption
PD   – Pre-Diabetic Symptom
OC   – Output Class

VI. CONCLUSION

This report provides the comparison of different systems for disease prediction. We have studied various data mining and machine learning algorithms and have come to the consensus that Decision trees is the most efficient. The algorithm C5 classifier, which we are using predicts disease to a better extent. The application is software specific, hence it is cost effective and can be widely used. The application provides a diabetes prediction system which would help the patients take precautions and hence avoid or prevent the occurrence of diabetes. The automated message facility for major fluctuations of vital signs can be useful during the time of emergencies. The application also helps in regulating the diet of a person and also the remind him/her of medicines dosage. Hence the proposed system will make the process of health care management quite easy and efficient.

VII. FUTURE WORK

The current system only deals with the prediction of diabetes. Using advance machine learning algorithms and data mining the system can be updated for other diseases. The system can be updated to take the patient's blood report as an input and determine the possible diseases or complications that may arise. In the future, the concept of image processing can play an important role in prediction of diseases, the patient's health can be predicted using images of the patient. There are also many types of diabetes, as we have selected mellitus diabetes, furthermore, applications can perform prediction of other types of diseases using machine learning algorithm or image processing. The application in near future can search hospitals according to the area in which the user is located. It is impossible to generate or get data set of all the existing individuals, but it can happen that someone generates data set with many parameters and data of almost every individual.

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Malware Classification Using Machine Learning

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Abstract— **Malwares are commonly found headache in almost all the mobile phones, laptops, memory cards etc. Most common technique used by malwares to avoid detection is binary obfuscation either by either by using encryption. One of the techniques used by malware to escape detection is binary obfuscation either by encryption(polymorphism) or metamorphic attacks (different code for the same functionality). For detecting them quickly and effectively, we should group them in accordance of their family. This gives rise to a growing need for automated, self-learning, fast and efficient technique that will be robust to these attacks. In this paper we only intent to classify the malwares into their respective families and not detect them (identify if they are malwares or not). A criterion of 500 counts of an observed value is to be selected for our feature dataset which will be used by our machine learning algorithms. In this paper we focus on novel data visualization techniques like image representation of the malwares and classification based on Artificial Neural Networks and K-Nearest Neighbour.**

Keywords— **malwares, machine learning, malware classification, malware analysis, k-Nearest Neighbours, Artificial Neural Network.**

I. INTRODUCTION

New signatures of malwares are generated daily, Symantec report states corpus ranging from 169,323 new signatures in 2008 to 2.89 million in 2009 to 286 million in 2010 [9]. Because of this malware classification is important.
Malware analysis is usually done as 'Static Analysis', 'Dynamic Analysis' and also 'signature based'. In static analysis, the disassembly code files are analyzed for the malicious system calls. A model is to be built for the control flow graphs [12]. Whereas, in Dynamic malware analysis technique, Data is analyzed in controlled environment and it's also traces (system logs). This mentioned process is extremely slow and also resource and time consuming. Both of the mentioned techniques work's well, but static code analysis suffers from malware implementation differences, while dynamic malware analysis is limited to environment and the malware triggering conditions, and hence it is also a scalable option. To analyze the malware signature, the signature has to be built using N-Gram techniques. The malware disassembly is analyzed for the most repetitions of the op-codes, and N-Grams are to be built on top of that [4] .

In order to visualize the data, we make use of malware visualization techniques. We will convert every malware bytes code to a grayscale image. Malwares from different families have similarities in visual appearance, this is the basic principle which is followed [1]. These images are to be use for image based classification. OPCODE is to be calculated from disassembly code.

II. OBJECTIVE

The purpose of this paper is to implement machine learning algorithms in order to classify the malwares into their respective families. Data is to be taken from www.kaggle.com provided by Microsoft containing 10868 samples of malwares belonging to total 9 different classes namely- files are from nine different malware families, namely Ramnit, Lollipop, Kelihos ver3, Vundo, Simda, Tracur, Kelihos ver1, Obfuscator. ACY, and Gatak respectively. Objective here is to analyze, visualize malwares and to parse data beforehand. So the objective is to develop new integrated model which takes advantage of all the models.

III. PROBLEM DEFINITION

Extensive work has been done in terms of analyzing malwares. Static, Dynamic and Signature based malware analyzing techniques have been researched in many papers. A publication based on image based malware visualization was one of the preferred way [1] it explains how to form an image out of binary malware files, how to visualize those images. In the alternate approach to extract data from disassembly code, which could be used for classification [2] data accuracy was not optimal. This paper suggests a way to extract novel features based on N-Grams, code sections and op-codes sequence and DLL calls. But even before we could develop signatures for malwares certain tasks has to be carried out within the scope of Malware detection and classification.

IV. RELATED WORK

There has been extensive work done on analyzing malwares. Many papers are published which denotes Static, dynamic and signature based malware analyzing techniques. A publication based on image based malware visualization was one of the preferred way [1]. This paper explains how to form an image out of binary malware files, how to visualize those images. This, machines are used for image based classifications. We also referred a paper which defines how to extract data from disassembly code, which could be used for classification. [2]. This paper suggests a way to extract novel features based on N-Grams, code sections and op-codes sequence and DLL calls. But even before we could develop signatures for malwares certain tasks has to be carried out within the scope of Malware detection and classification.

91% of proposed accuracy was achieved using random forest for Gray-Scale Format. The accuracy rate of 86% was achieved for colored images and 91% for gray-scale images using Random Forest algorithm[6].

Performance Analysis of Machine Learning and Pattern Recognition Algorithms for Malware Classification paper states every malware belonging to a family has a distinct signature pattern. KNN performs the best with accuracy rate of 96.6% among the classifiers in this project. Whereas ANN performs satisfactorily with accuracy rate of 94.6% [4].

Image Visualization Techniques are implemented to obtain average predictive accuracy of 95% using Deep Neural Network [2].

V. ANALYSIS

Research analysis indicates that Malware Images: Visualization and automatic classification[1], Deep Neural Network based Malware Detection Using 2-D Binary Programs features [2], Machine learning based Malware Classification for Android Applications using Multimodal Image Representations[3] are the methodologies for the Malware classification. By analyzing the performance of these models on standard dataset it is found that in case of missing data multi-layer perception model and logic regression is also good. So the objective is to develop new integrated model which takes advantage of all the models. Image Visualization Techniques are implemented to obtain average predictive accuracy of 95% using Deep Neural Network. We also found that the method gives optimal result. Whereas in the Machine learning based Malware Classification for Android Applications using Multimodal Image Representations [3] is bit slow, when it comes to data processing.

VI. PROPOSED METHODOLOGY

To analyze the signature, the signature is built from N-Gram techniques. The malware disassembly is analyzed for the most repetitions of the op-codes, and N-Grams are built on top of that. We propose to use malware visualization techniques. We aim to convert every malware bytes code to a grayscale image. In research and analysis it was observed that malwares from different families have similarities in visual appearance, presenting us an opportunity to exploit this weakness. These malware images will be used for image based classification. From the disassembly code, we will compute the OP-CODE counts, DLLs and section count from assembly codes provided. The top features parsed out of all the assembly files were used for classification of the malwares. A criterion of 500 counts of an observed value is to be selected for our feature dataset which will be used by our machine learning algorithms [11]. These different parsed data sets would be used for classification, done on MATLAB's machine learning toolbox. In this paper, we have described the data visualization methods, parsing, selection of classification algorithms, and the outputs expected. We will be using testing and training data provided at Kaggle.com [8].

We will try to tune the hidden nodes in ANN[7] and distance K-values in KNN to get best performance. We will also try different number of hidden layers to obtain highest accuracy on classification of data. ANN algorithm with different variable size will observe the results [10]. We will try KNN with different neighboring values and distances. For this we will use data files obtained from disassembly files and the images (grayscale).

We will analyze the performance of KNN algorithm for different neighbor. Learning rate is 0.5. We used random values for training dataset.

Total iterations are 1500. Variable Hidden layer and sizes. 100 used for best players. Learning rate is equal to 0.5.

A. Data Visualization

As suggested in malware image generation and classification technique, every byte of data is converted into a grayscale pixel. The array or the byte stream was converted in to an image [1]. Image representation of the malwares, produce a very convincing images of malware. The polymorphic malwares appear similar with slight deviation of the code segments. Segments/fragments from the binary file.

From the figure (3), the parts of the sections can be observed. The .text segment contains all the code and the zero padding.
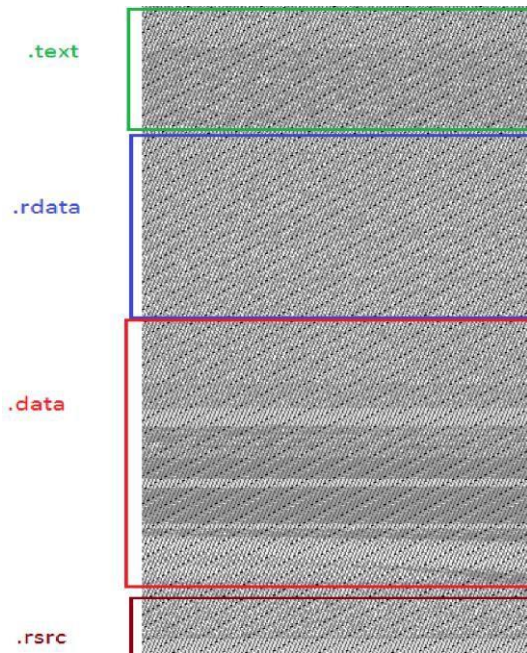
Figure 2: Segregation of malware image [1]

The .rdata segment contains all the constants. The .data segment contains all the data, which is initialized. The .Rsrc section involves icons of the files. The author of [1] also managed to obtain various pictures from this segments on his test data. In our observation, we did not get any icons from/for the malwares. Every class of data provided unique texture to the image, which helped features selection.
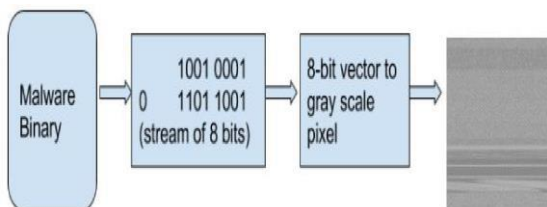
Figure 3: Conversion into grayscale image [1]

B. Data Parsing

The malware binary files will be converted to a grayscale image. Since these images are variable and very high at dimensions. We at first will shrink the images in direction to a constant small dimensional image. We will also use python's numpy library for the image formation and reducing the dimension size. One these small images, we computed gist to summarize the gradient information of the images. Gist computes Gabor filter's which are similarity measures of texture in images and as malwares produced, similar textures in images, these features could be used as data. From the disassembly, extracted are all the lines of code segments, all the op-codes and the DLL calls. After the extraction, summation is to be performed on all the columns to see the

highest valued features. Top valued 321 frequencies as features are to be selected. This model is hybrid data retrieval model [4]. We will obtain an open BSD licensed parser written in python code which does this same.

VII. DESIGN OF A SYSTEM

The figure (4) shows the proposed flowchart of the system we
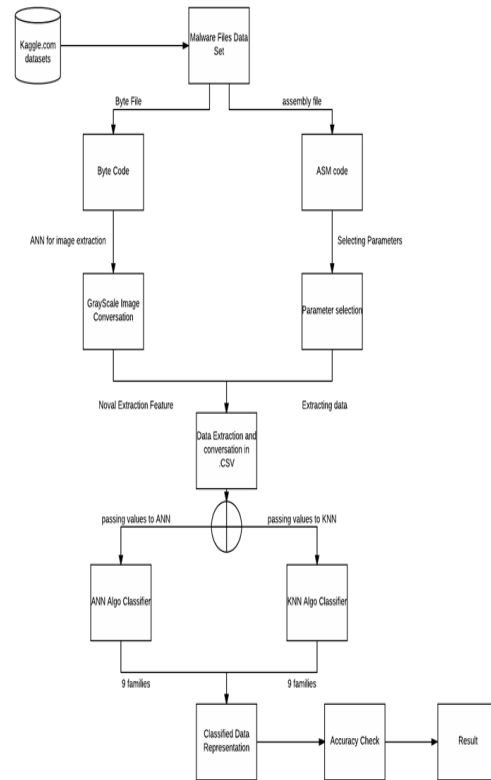
Fig 4: Proposed Working Flowchart

are proposing for classification of malwares based on machine learning.

VIII. PROPOSED RESULTS AND ANALYSIS

We will try running ANN with Various Different Neighboring values and distances. For this we will use both the data files we obtained, i.e. one from the disassembly file and one from the images Fig. 3. ANN tuning on disassembly data [1]. ANN tuning on image data [1] We compiled the same on MATLAB's tool box for 10 folds, and the results obtained were as follows: We wrote a MATLAB code to analyze the performance of KNN algorithm for different Neighbor values and the distances From the tuning data obtained, we got least objective function value for Cityblock, and with distance 1, on image data. From the code we developed, and we got 91.26% accuracy. It is very close to the output we obtained from machine learning toolbox on Matlab. From the tuning data obtained, we got least objective function value for Sphereman,

and with distance 1, on .asm data. From the code we developed, and we got 98.8% accuracy. It is also very close to the output we obtained from machine learning toolbox on MATLAB.

IX. EXPECTED PROJECT OUTCOMES

We will be able to understand the functioning of different machine learning algorithms and also deduce which one of them produces optimal results. We will also learn novel data extraction techniques to convert malware files into grey scale images and classify them into their respective families based upon their signatures. This Project would be very beneficial for AV vendors as it is a self-learning and automated classification process.

X. CONCLUSION

Amongst the classifiers mentioned in this paper we hope to achieve optimal results from ANN. We will study analyze and compare two machine learning algorithm techniques i.e. ANN and KNN algorithms. The desirable result's to be expected from ANN would be around 95% in terms of accuracy. We plan to achieve better results using ANN using Novel data extraction techniques. This is due to the fact that images obtained from the malware files from same family is so similar that the distance between them is similar. In case of greater distance files different families are considered. We are also hopeful to get a detection rate of 91% along with False-positive rate of 0.1%. Apart from this our approach needs modest computation to perform and also to analyze. It also comes to attention that dataset can be trained to automatically classify malwares into their respective families on the basis of the given or self-defined parameters.

XI. FUTURE WORK/EXTENSION

We plan to implement Xgboost and ensembles to combine the result of different models we tried, which gave best results. Also, there is a possibility to work around on the dis-assembly code, and simulate the malwares in controlled environment. We can collect the system calls and the logs could be used as another data set. With all, this could be combined with the other models for the ensembles. Also, we can try to extract N-Grams from the hex data, and this could be combined with data obtained from dis-assembly code to build a training data set. As per the publications, this should produce better result.

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Car Parking System

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Abstract- **The rapid increase of vehicles is causing the problem of unavailability of parking space. Most of the times we struggle to find free parking space and have to go through a lot of slots to find one available space .It is a time consuming process and needs a fully automated parking system which not only regulates parking in a given area but also keeps the manual intervention to minimum. The car arriving at the entrance will be stopped at the main gate. Only after the verification of the QR code the car would be allowed to enter the premise. The user has given one more option of parking the car without using the android app i.e. by using the offline option, the user can enter his details into the console and get registered at that time itself. Our system has two main modules i.e. identification module and slot checking module. Identification module identifies the visitor. Slot checking module checks the slot status. Once the user gets authenticated the Boom Barrier will get open according to the input forwarded. This will save the time of users looking out for parking space.**

Keywords- Android application, QR code, Automobiles, Google Maps, GCM.

I.   INTRODUCTION

We visit a lot of public places on various occasions. Places like 4-star, 5-star hotels, shopping malls, cinema halls, etc. We face a lot of problem at these places for finding the availability of parking space. Most of the times we struggle to find free parking space and have to go through a lot of slots to find one available space. The problem is much more serious with multi-storeyed. Therefore, it is a time consuming process and we need to a fully automated parking system which not only regulate sparking in a given area but also keeps the manual intervention to minimum.

Our project presents a fully automated car parking system which lets the user find a free space and also regulates the number of cars that can be parked in a given space.

When the user arrives at the gate, the user has to register to our system through an android application. Upon registration the user data will be passed on to the administrator. The administrator is responsible for generating the QR code. This QR code is responsible for validating the user. The user can choose an available location for parking the vehicle but the main entry will be allowed only after the user has verified his QR code at the entrance. Otherwise the sensor will deny access.

The user has given one more option of parking the car without using the android app i.e. by using the offline option, the user can enter his details into the console and get registered at that time itself.

Use of QR code:

QR code is nothing but a type of barcode. It is used to provide access to information in an easy way. The mobile user opens the barcode reader app and points it towards the QR code for scanning it and using it for various purposes.

Use of Google Cloud Messaging:

Google Cloud Messaging (commonly referred to as GCM) is a service which was developed by Google. It is used for mobile notification that enables third-party application developers to send notification data or information. It is available to developers for free. The data or the information can be send from developer-run servers to applications that target the Google Android Operating System, as well as applications or extensions developed for the Google Chrome internet browser.

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The paper is categorized intro several modules. The I module presents the introduction of our project. Giving details on how and why our car parking system is useful. The II module is

literature survey explaining why existing systems are not efficient. The III module gives comparison between the existing system and our implemented system. The IV module gives the system architecture describing the process flow of our system. The V module describes the methodology in detail. The VI module shows the result of the implemented system. The VII module gives the conclusion of this paper.

II. LITERATURE SURVEY

The paper "**A Prototype Parking System using Wireless Sensor Networks** "is based on wireless sensor network technology. This paper presents an outdoor smart parking prototype using the wireless sensor networks as a possible solution for solving the problem of vehicle parking.It provides several advanced features like remote parking monitoring, automated guidance, and parking reservation mechanism. All the details are included from the hardware implementation to the software implementation**.** [1]

The main objectives of the "**Smart Parking Systems**" are to design and develop a cost-effective car parking system. The efficient circular design is introduced which has a rack-pinion special mechanism. This mechanisms used to lift and place the car in its proper position. The design of rack pinion mechanism is also simulated using AUTODESK INVENTOR and COMSOL software. Therefore high computation cost is required making the system less reliable. [2]

The paper**"Automated Car Parking System Commanded by Android Application"**regulates the number of cars to be parked on designated parking area by automating the Parking and Un-parking of the car with the help of Commands of an Android Application. The automation is achieved by means of feature of Path Tracing using Sensors. But the system does not include parking reservation functionality with Google Map web services to provide navigation feature in the Driver App to guide vehicle drivers to their selected outdoor parking lots.[3]

The paper**"Effective Car Parking Reservation System based on IOT"**aims to make vehicle parking efficient in urban cities. The users will be able to park their automobiles by finding an empty parking lot through Android Application. An Intelligent Parking System is implemented based on Slot Allotment. There are two modes using which the Android user can book the parking slots easily like Adance & Current Booking. Using these modes the application user can also choose the easiest and nearest route and destination.

But the application has further scope of improved security. This can be done by using encrypting algorithms. So that more numbers of customers will find it safe to use. [4]

III. COMPARISON BETWEEN EXISTING SYSTEM AND IMPLEMENTED SYSTEM

A. Existing System:
As the no of vehicle are extending it becomes tough for parking so the existing system is not that supportive for the drivers to park the vehicle at the appropriate places.it becomes tough to find the place and park the vehicle. Because of this gets traffic. The existing system had disadvantages such as:
1) Time Consuming
2) No centralized system
3) Manually find paring slot

B. Implemented System:
The implemented system mainly consists of two main architectures i.e. user architecture and the admin architecture as shown in figure-1 and figure-2 respectively.

The user architecture shows the interaction of user with the android application where he has to register and login. After login the location of the user along with available parking spaces will be shown on google maps. The user can then choose the parking space and get verified through the QR scan. This module is also available in offline mode.

The admin architecture however is more important as it verifies QR code of the customer. Only after the QR code matches, the boom barrier would open and the user would be able to enter. Otherwise the user has to verify again.
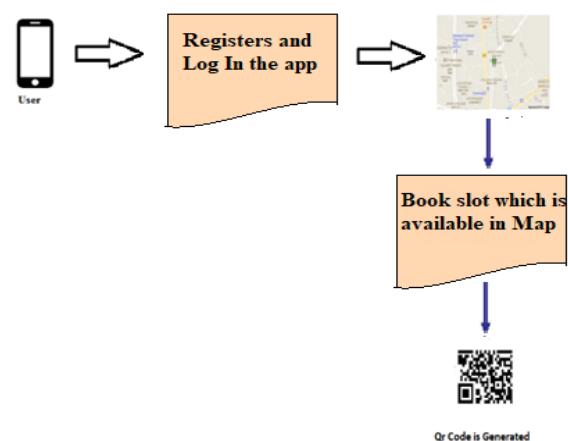
Fig -1 User Architecture

The Figure-1 shows the interaction of the user in the User Module. The user first Registers or Login into the application. Once the user logins he/she has to select whether they want to park a two wheeler or a four wheeler. Afterwards they need to select the parking location where they have to park the vehicle. After booking at the slot a QRcode is generated for the user which will be used for authentication purpose.

The table-1 shows the comparison between the existing system and our implemented parking system. We have tried to overcome the drawbacks of the existing car parking systems.

One of the major drawbacks of the existing system was regarding the security. We have designed a login system so that only authenticated users can have access to the system.
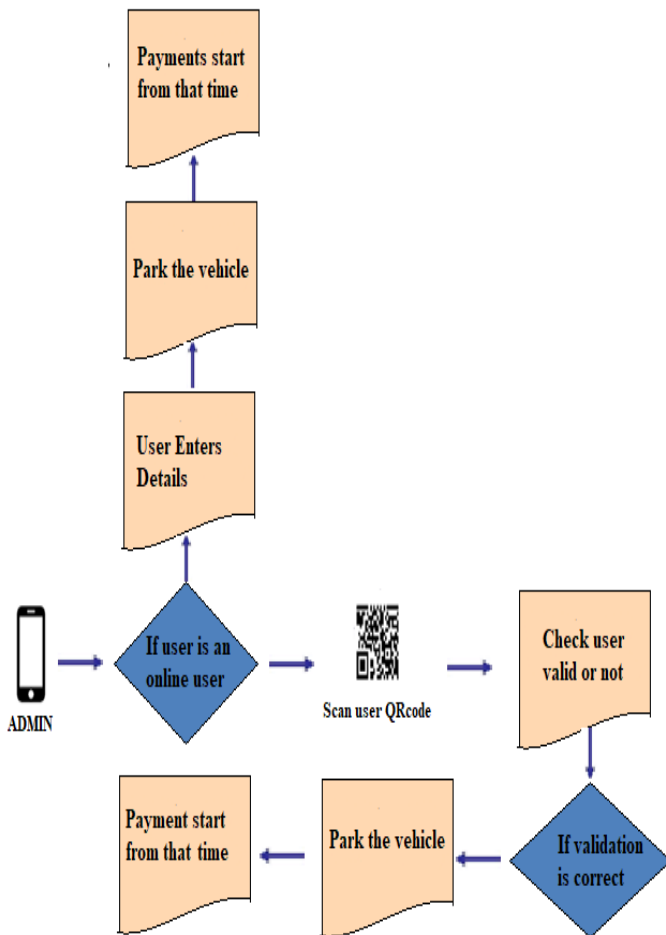
Fig -2 Administrator Architecture

Implemented System	Existing System
In the system security is one of the prime concerns. A login system has been designed for the security reasons.	In existing system security is always at stake.
In implemented system also makes people aware extended time feature with flexibility to increase the parking time.	Existing system does not consist of such activity
In implemented system, a person who is wishing to park their vehicle in offline mode can do that easily.	Existing system does not have such facility.
Implemented system not only scans the QR code but also opens the boom barrier only after they get authentication	Existing system doesn't have this feature.

Table-1 Existing system Vs Implemented system

The Figure-2 shows the interaction of the user with the Admin Module. First the user has to check in and afterwards scan the barcode. The barcode is generated in the user module. The slot is booked for the user only after the authentication. During the checkout the user again has to scan the barcode which will stop the booking time and the slot will be available again for parking.

IV. SYSTEM ARCHITECTURE

We explain the working of our system through the following flowchart. The user has options to select either a two wheeler or a four wheeler. Afterwards they can book the slot and pay as per their usage. The figure- 2 gives glimpses of the car parking system. The implemented system not only scans the QR code but also opens the boom barrier only after they get

authenticated as shown in the flowchart. The boom barrier will not open if the user is not an authorized user.

Fig-3: Flow chart of implemented system

V. METHODOLOGY

Phase 1:

Our work starts during the first time the user installs the application. It collects all the required user information like Username, Password, Email, Phone number , Type of Car and Vehicle Number as shown in Figure-3. The information will be stored in the user mobiles and SQLite database. So that each time the user books the slot, this user information is sent

to the database. This is done to protect the user data from any misuse by using the QR code.
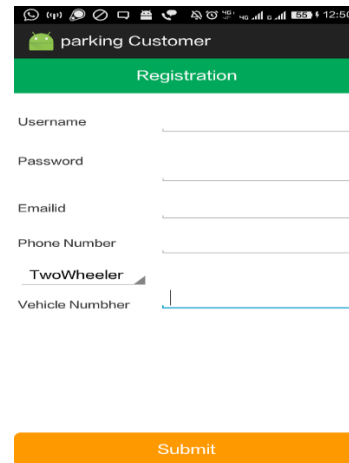
Fig 4 – Registration of Customer

Phase 2:

The user has to select the type of vehicle he/she wants to park. This helps the system to find the appropriate place according to the user's vehicle.

Phase 3:

The coupon number which is generated and time of buy details are saved in the My SQL database are further sent to Google Chart APIengine which generate the user's location using latitude & longitude. Here all the users personal and order information are displayed on the phone screen and sent back to the user mobile as HTTP response and saved in the memory of the application.

Phase 4:

As shown in Figure- 4,the system identifies the location of the user and displays the parking places which are near to the users location after that the user has to select the parking slots.

Phase 5:

This system identifies whether the user is an authenticated user or not as shown in Figure- 5. Only after the scanning and validation of QR code will allow the user to park their vehicles. The user can perform this task in offline mode also.
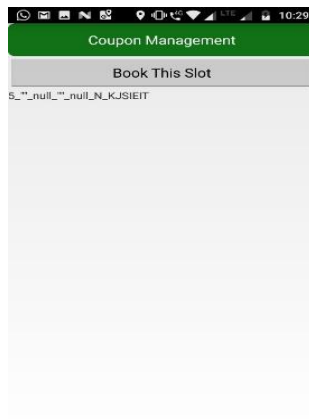
Fig 5 – Slot booking using Google API's

Fig 6- QRcode Generation

Phase 6:

This module will finally calculate the time and generate the bill according to the time. The user can also extend the booking time. A lot of times, user do not know in advance how much time they will spend at a particular location. Our application comes in handy. The user will scan the QR code and pay the bill. This becomes easy and reduces the time.

Phase 7:

Once the user is authenticated by scanning the QRcode then the boom barrier will opened. If not then the user has to again try to get authenticated. The boom barrier will not open if the user is not an authorized user.

VI. RESULT

Our implemented system helps in reduction of time for obtaining the available parking space. This in turn helps in reduction of vehicle pollution. The figure- 7 and figure- 8 gives a sneak peek of our system's results.

Figure- 7 shows various options provided to the customers. They can view the available parking slots, QRcode as well as the payment details. The customer can also avail the parking space for extended time using this interface.
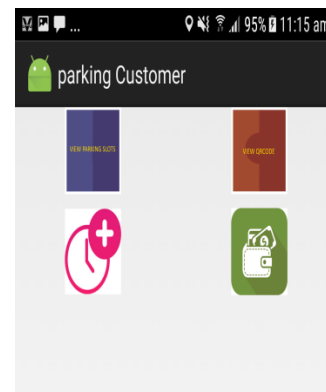
Fig 7- Parking Customer Interface

Figure- 8 shows the balance details of the customer. The customers can check and update the balance in their account according to their convenience.
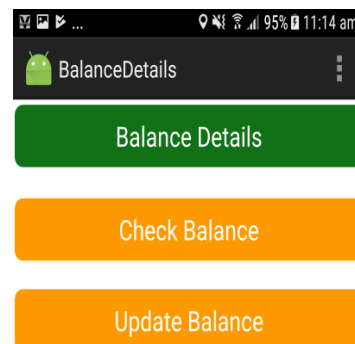
Fig 8- Balance Details Interface

VI. CONCLUSION

The searching for the availability of parking space is a major problem faced by many people today. Our implemented system built an Android App would reduce the human intervention to the minimal and also save the time of users looking out for available space to park. They don't have to manually drive through each slot and waste their time. The application is not only beneficial in urban areas but also will be useful in various remote areas..

Our implemented system resolves problem of traffic congestion by automating the car parking. The system can regulate and manage the number of cars that can be parked in a given space at any given time based on the availability of parking spot.

The existing car parking systems are not efficient. This is because they require human interaction with the application. This major drawback has been resolved in our implemented system. We have built our system in such a way that it is least human dependent.

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Result Accuracy Authentication of Outsourced Frequent Itemset Mining

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Abstract— **Now a days, most of the small companies and research teams have started to deal with third party service providers (cloud server), to store their huge amount of data. These services provide various cloud computing facilities along with data mining based services. Such outsourcing of data is effective, efficient and helpful but also raises various serious problems. One of these problems is the chances regarding inauthentic results returned by cloud servers to users or clients. To overcome this issue of verification of outsourced frequent itemset mining, a probabilistic and deterministic approach is been used to check if the server returns the complete and correct results. Probabilistic approach catches the incorrect results with high probability, while the determinist approach measures the result correctness with 100 per cent certainty.**

Keywords— Cloud computing, data mining, frequent itemset mining, result integrity.

I. INTRODUCTION

Cloud computing is often referred to as 'the cloud' were the delivery of on-demand computing resources is provided over the internet. This service provided is on a pay-as-you-go basis. Cloud computing also provides dynamically scalable and often the virtualized resources. Cloud computing now-a-days is gaining popularity because of its mobility, huge availability and low costs.

Frequent itemset is a set of data values, whose no. of co-occurrences exceeds a given threshold. It is an important technique used in various applications like market data analysis, networking data study.

Previous researches shows that frequent itemset mining can be computationally intensive. For such clients of limited computational resources, outsourcing frequent itemset mining to computationally powerful cloud service providers is a natural solution. It is a cost effective method, but the end user hesitates to place full trust on the cloud service providers. This raises a serious security issue of integrity of the mining results. There could be many reasons for the service providers to return incorrect answers. So the focus is to verify whether the

server returned correct and complete frequent itemsets. Correctness means that all itemsets returned by the server are frequent and completeness means that no frequent itemset is missing in the returned result.

To overcome these issues an efficient and robust result accuracy authentication technique is discussed in this paper. Firstly, a probabilistic approach is designed to catch mining results that does not meet the predefined correctness/completeness. To achieve this, a set of (in) frequent itemset is constructed from the real items, and is used as the evidence to check the integrity of the server's mining results. Second, a deterministic approach is designed to catch any incorrect/incomplete frequent itemset mining. This involves construction of cryptographic proofs of the mining results. The measurement of correctness and completeness of the mining results will be compared against the proofs.

The rest of the paper is structured as follows; section II describes literature about current work in this direction. Section III explains the proposed approach. Section IV describes the illustration of the proposed approach with the help of an example and finally the conclusion is provided in section V.

II. LITERATURE SURVEY

Below literature review focuses on different techniques used to ensure result integrity.

An efficient probabilistic and deterministic approach is proposed in [1], for the verification of the returned result from the server. In probabilistic approach evidence generation takes place for both the frequent and infrequent itemset. In deterministic approach a cryptographic proof is constructed using a merkle hash tree and results are compared with the root hash values. The proposed approach is similar to the technique mentioned in [1] except the use of budget value which is explained in section III.

A novel hybrid method is implemented in [2]. Hybrid here means adding and removing some data items, in order to

provide privacy. In this method, the original transaction database is encode. The proposed approach is experimented on one real and one synthetic dataset. The results analysis shows that the techniques are effective, scalable and protect privacy. The association rule mining and the frequent item set mining are used in [3], for privacy preserving. Here, the data owners learn the frequent itemset from a collection of data and disclose a little information of their sensitive or private data. To provide data privacy, an efficient homomorphic encryption scheme and a secure comparison scheme is proposed. The solutions are designed in a way where the data owners can share their data without the leakage of their sensitive data. The resource consumption at the data owner end is low as both the data and the computing work are outsourced to the cloud servers.

In [4], to provide security to the transactions which are carried out between the client and server, an encrypt/decrypt module is proposed. In this module, the client encrypts its database using AES algorithm and sends it to the server. The server then performs data mining and sends the pattern back to the client. The client then matches the pattern with true support using FP – growth algorithm.

In [5], the client uses two or more different clouds, instead of one cloud to perform the computation. The client verifies the correct result of computation as long as at least one of the cloud is honest. The result is obtained by comparing the computable functions of the servers.

III. PROPOSED APPROACH

Figure1 depicts the proposed system for verifying whether the server returned correct and complete frequent itemsets to their data owners. Correctness means that all itemsets generated by the server are frequent and completeness means that no frequent itemset is missing. Cloud server generates the frequent itemset. Data owner verifies the correctness and completeness of frequent items with the help of probabilistic and deterministic approach.
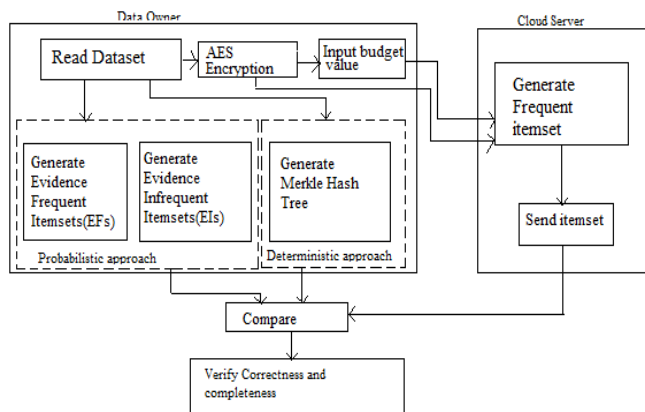
Figure 1: Proposed System Architecture

In this system, initially data owner sends dataset for example the Retail Dataset or National Climate Data Center (NCDC) to the cloud server. To improve the security of dataset, the dataset is encrypted using AES algorithm. In addition to the existing system, the client will consider a budget to generate frequent itemset on owner side, e.g. Assume the budget value input by the client is RS 100/-. Then, we generate frequent itemsets which fit to the given budget. The encrypted dataset and budget value is sent to the cloud server. On receiving this dataset and the budget, cloud server generates frequent itemset based on the budget by using Apriori Algorithm. Also, minimum support value is calculated for each itemset. Minimum support value indicates how frequently the items appear in the dataset. The cloud server sends calculated frequent itemset to the data owner. On receiving the itemsets from cloud server, data owner checks for the correctness and completeness of the result returned by cloud server using probabilistic and deterministic approach.

The probabilistic approach is used to verify the mining result from the cloud servers for accurate and complete dataset. This method is used to construct the evidences which are generated from the infrequent itemsets. These evidences are then used to check the integrity of the cloud servers mining results. An artificial evidence infrequent itemset (EIs) is constructed by removing the real items from the original dataset which checks for the correctness of the retrieved data, which is defined by calculating the precision. An artificial evidence of frequent itemset (EFs) is constructed by inserting copies of items that exist in the dataset which is used to check the completeness of the retrieved data, which is defined by calculating the recall. The aim of this approach is to catch the answer that does not meet the predefined precision/recall requirement with high probability.

The Deterministic Approach is another method to detect the incomplete and incorrect results returned from the cloud servers, with 100 percent probability. In this approach, Merkle hash tree is constructed to decide whether the server is returning all frequent itemsets or not.

In Merkle tree, for each transaction / itemsets generated by data owner and cloud server, hash value is assigned. Hash value is generated by using SHA 256 algorithm. The data owner verifies the root hash values with server side root value. If the hash values are not matched with hash value of the server transactions, then that particular itemset is not generated or sent by cloud server. In this way, Deterministic Approach identifies the completeness of the itemset retrieved.

The flow of the proposed system can be depicted from the figure 2 and 3. Figure 2 represents the tasks performed at the data owner whereas figure 3 shows server side functioning.

Following is the algorithm for proposed system at the data owner side.

Input: Dataset (Retail/NCDC), Budget

Output: Verified frequent itemset

1) Read the dataset and calculate minimum support using the equation (1).

$$Minsupp = \frac{\square\square\ \square\square\square_a\ \square_{ac}\ \square\square\square_{wh}\ \square\square\square_i\ \square_c\square\square}{\square\square_l\ \square\square\square\square\ \square\square_a\ \square_{ac}\ \square\square\square\square} \quad ---- (1)$$

2) Encrypt the dataset using AES Algorithm.

3) Input the budget.

4) Evaluate the frequent and infrequent itemset at the server and owner side based on the budget using Apriori Algorithm. Probabilistic Approach:

5) Calculate the recall using Equation (2).

$$R = \frac{|F \cap F^S|}{F^S} \quad ------ (2)$$

Where, R : Recall, F : Real frequent itemsets in the database,

$F^{\Diamond}$: result returned by the server
6) Generate an Evidence Frequent Itemsets (EFs) from the frequent and infrequent itemsets (refer section IV for illustration).

7) Calculate the precision using equation (3).

$$P = \frac{|F \cap F^S|}{F^S} \quad ------ (3)$$

Where, P : Precision, F : Real frequent itemsets in the database, $F^{\Diamond}$: result returned by the server.
8) Generate an Evidence Infrequent Itemsets (EIs) from the frequent and infrequent itemsets (refer section IV for illustration).
Deterministic Approach:

9) Construct a Merkle Hash Tree from the itemsets (refer section IV for illustration).

10) Compare the root hash value at the owner side with the retrived hash value from the server. This will verify the completeness and correctness of the dataset.
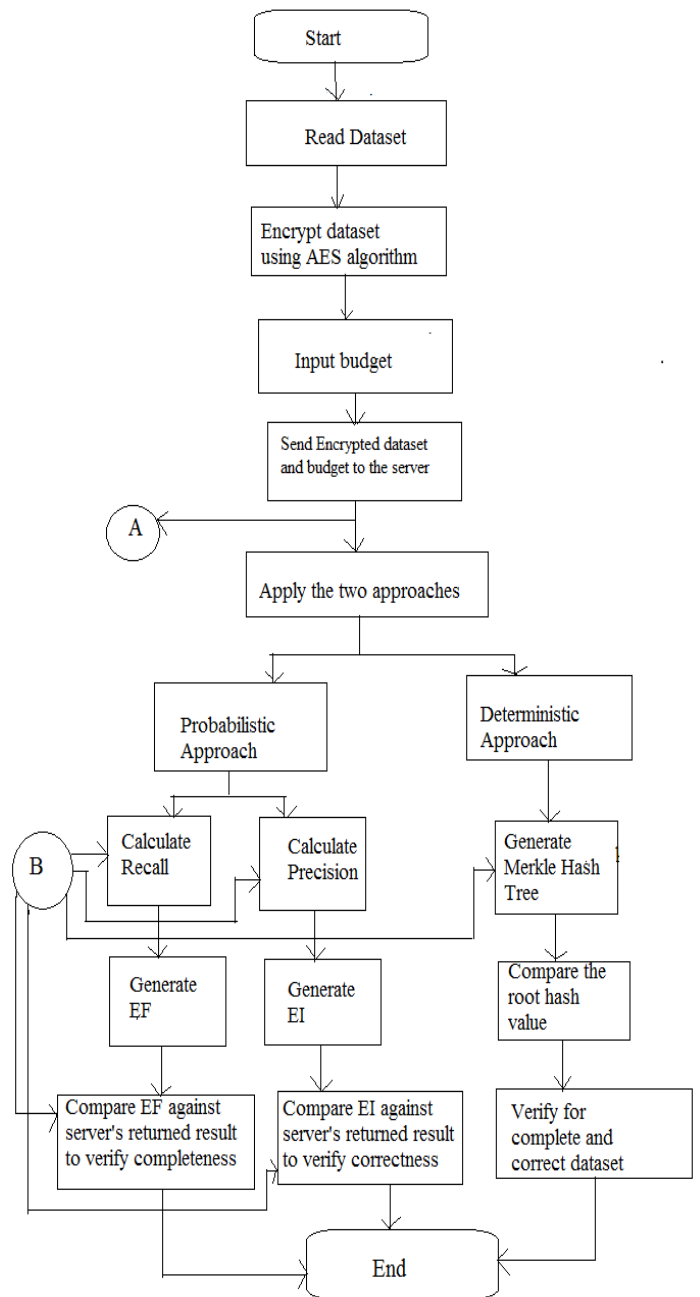
Figure2: Data owner side flow
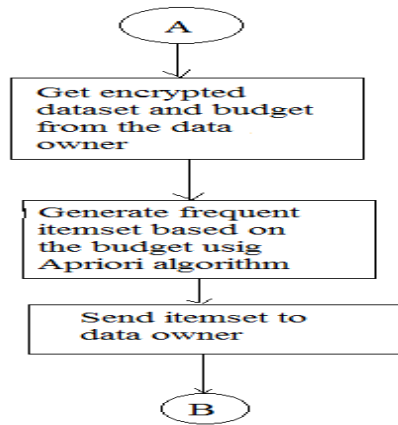
Figure3: Server side flow

IV. ILLUSTRATION WITH EXAMPLE

The probabilistic and detrmininstic approach is illustrated below with the help of an example

Probabilistic approach : Construction of EFs
Consider a data set:

Table 1. Sample Dataset

Transaction ID	Itemset
T100	I1,I2,I5
T200	I2,I4
T300	I2,I3
T400	I1,I2,I4
T500	I1,I3
T600	I2,I3
T700	I1,I3
T800	I1,I2,I3,I5
T900	I1,I2,I3

According to Equation (1),
Minsupp = 3
Assume the infrequent itemset as follows:
I2,I4,I5
I1,I2,I3
Now, Evidence Frequent itemset is constructed usig Mini Grapgh approach as follows:

Step 1: The itemset having highest frequency is assigned as Iseed value.
Eg: I2 : 2   →
      Iseed I1 : 1
      I4 : 1
      I5 : 1
      I3 : 1

Step 2: Construct the mini graph as below
  • The Iseed is considered as the root

  • The above transactions: I2,I4,I5 and I1,I2,I3 are used to construct the mini graph.
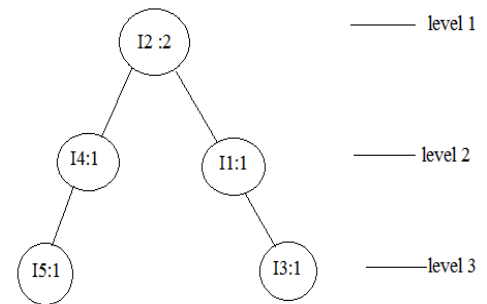
Figure 4: Mini Graph Construction

Step 3: Thus,for above example insert the itemsets at level 2 in the EF
EF => I4 : 1, I1 :1
If it satisfies the completeness then move to next step else insert the itemsets at level 3 and repeat till it satisfies the completness,

Step 4: For each picked EF, the number of artificial transactions are to be added. The calculation is as follows:
i)Calculate

    Total frequency

    = Addition of frequenciesof itemsets appearing in EF
                                      -------(4)
Therefore, f = 2 for above example.

ii) Compute no. of itemset need to be added as,

 No of itemsets to be added = minisupp − f .   ------(5)
Here, No. of itemsets to be added = 3 -2 = 1

iii) 1 artificial transaction will be added into the dataset.
Thus, EF contains inserted copies of items that exist in the original dataset.

Proabilistic Approach : Construction of EI

Step 1: Exclude the itemsets considered in the construction of EF. Add the number of 1- frequent itemset in the evidence repository. Consider the repository to be R.
If it satisfies the correctness with 1- frequent itemset considered in R, stop else continue to step 2.

Step 2: If in Step 1, R is not satisfied with the correctness then transform some frequent itemset to infrequent.To transform select a set of transactions from original dataset for itemset removal.

i)To help pick the transactions, construct the matrix $M_{u,n}$ where u: no of itemset and n: no of transactions. M[i,j]=1
when itemset I_i appears in T_j else 0.
ii)let V be the binary vector. The value is 1 when the transaction is picked.

iii) Consider A to be the no of transaction having the frequent itemset. Where A= V*M.

Step 3: Remove the itemset from the transaction.For which construct $IM_{u \times w}$ matrix where u is the number of itemset contains the number of unique itemset. IM[i,j]=1 when $I_j \subseteq I_i$ else 0. Then,IM[i,1]= 1 are added into the output and are removed.

To elaborate this,consider a dataset shown in table 2.

Table 2: Sample dataset

Transaction ID	Itemset
T100	I1,I2,I5
T200	I2,I4
T300	I2,I3
T400	I1,I2,I4

Here,consider that step 1 is not satisfied so construction is done from step 2 as follows:

Step 2: i)Construct the matrix M for the above transactions given

$$M = \begin{bmatrix} 1 & 0 & 0 & 1 \\ 1 & 1 & 1 & 1 \\ 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \end{bmatrix}$$

$$[1\ 0\ 0\ 0]$$

ii) Here we considere T100 and T400 are the picked transactions, so

$$V = \begin{bmatrix} 1 \\ 0 \\ 0 \\ 1 \end{bmatrix}$$

iii) $A = V*M = \begin{bmatrix} 2 \\ 2 \\ 0 \\ 1 \end{bmatrix}$

Step 3: For the above example the IM is constructed as

$$IM = \begin{bmatrix} 0 & 0 \\ 0 & 0 \\ 1 & 0 \\ 0 & 0 \end{bmatrix}$$

$$[0\ 1]$$

The EI contains I3,I5, which are to be removed.

Thus, EI contains the real item which are removed from original dataset.

Detrministic approach: Construction of merkle hash tree. Figure 5 represents the merkle hash tree construction.
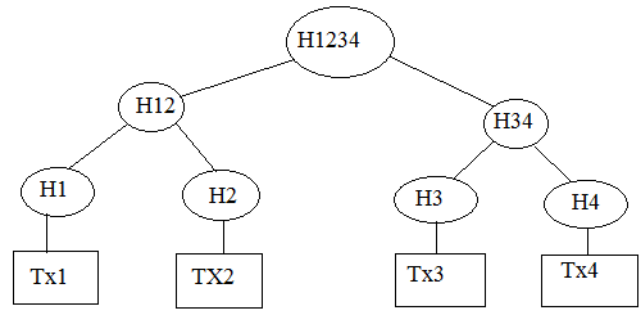
Figure 5: merkle hash tree construction

Step 1: Consider 4 transaction Tx1,Tx2,Tx3 and Tx4. The hash values of these transactions are obtained using the SHA 256 Algorithm.

Step 2: To construct merkle hash tree, the given transactions are considered as leaf nodes. Then we calculate hash values of these transactions using SHA 256.The non leaf node is an aggregation of hash values of its child nodes. Thus, finally root node is created. Here, in the Example, H1234 is the root node.

Step 3: To verify completeness and correctness the root hash values of retrived data set is monitored.In the above example, if the retrived dataset having root hash value is H234, means the transaction Tx1 is missing.

V. CONCLUSION

Outsourced data may have many issues one of which is the integrity verification. The two approaches probabilistic and deterministic are presented for outsourcing of the frequent itemset mining. The probabilistic approach constructs two evidences for the correctness and completeness verification with high probability. The deterministic approach constructs the merkle hash tree, where the correctness and the completeness of the retrieved dataset are verified.

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Recommendation Engine for E-commerce with additional modules

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Abstract— **As the exponential blast of different substance created on the Web, Recommendation strategies have turned out to be progressively vital. Incalculable various types of proposals are made on the Web each day, including music, pictures, books proposals, question recommendations, and so on. Regardless of what sorts of information sources are utilized for the proposals, basically these information sources can be displayed as charts. Suggestion frameworks are broadly utilized as a part of web-based business applications. The motor of a present proposal framework prescribes things to a specific client considering client inclinations and past high appraisals. Different suggestion plans, for example, cooperative sifting and substance-based methodologies are utilized to fabricate a proposal framework. Affiliation run mining is an information mining system. It is utilized for finding the things from an exchange list which happen together often. The vast majority of current proposal frameworks were created to fit a specific space, for example, books, articles, and films. We propose a half and half structure suggestion framework. In this paper, going for giving a general system on digging Web diagrams for suggestions. We initially propose a novel dispersion technique which proliferates likenesses between various suggestions and prescribe items utilizing Apriori based affiliation run mining. At that point we outline how to sum up various proposal issues into our diagram dissemination structure. The proposed system can be used in numerous proposal assignments on the World Wide Web, including inquiry proposals, picture suggestions, and so on. We additionally propose a novel framework for marking down and offering procedure to be consolidated in the web application.**

Keywords— **Apriori, recommendation, association rule mining.**

1. LITERATURE SURVEY

1.1 Traditional recommendation and prediction approach:

The following are traditional recommendation and prediction approaches:

1..1.1 Content-based filtering:

Content-based recommender frameworks work with profiles of clients that are made toward the start. A profile has data about a client and his taste which depends on how client rates the things. By and large, while making a profile, recommender frameworks influence a study, to get introductory data about a client so as to maintain a strategic distance from the new-client issue. In the proposal procedure, the motor analyzes things that were at that point decidedly appraised by client with things he didn't rate and searches for likenesses. Those things that are generally like the emphatically evaluated ones, will be prescribed to the client. Content-based recommender frameworks generally utilize labels or catchphrases for proficient and better separating. For this situation the profiles of different clients are not basic, and they don't impact the proposals of the client, as the suggestions depend on singular data. Going in points of interest of strategies for collective sifting, we can recognize most prominent methodologies: client based, thing based and mod-el-based methodologies.

1.1.2 Collaborative Filtering:

Shared separating ended up a standout amongst the most re-looked procedures of recommender frameworks since this approach was specified and depicted by Paul Resnick and Hal Varian in 1997. The possibility of communitarian separating is, finding the clients in a group that offer thanks. On the off chance that two clients have same or relatively same appraised things in like manner, at that point they have comparable tastes. Such clients construct a gathering or a purported neighborhood. A client inspires proposals to pick things that he/she has not appraised previously, but rather that were at that point emphatically evaluated by clients in his/her neighborhood. Community sifting is generally utilized as a part of internet business. Clients can rate books, melodies, films and after that get suggestions in regard to those issues in future. Besides cooperative separating is used in perusing of specific records (e.g. reports among logical works, articles, and magazines).

1.2 Modern recommendation and prediction approach:

The following are the modern approaches for recommendation and predictions:

1.2.1 Context aware approach:

Setting is the data about the earth of a client and the points of interest of circumstance he/she is in. Such points of interest may assume substantially more noteworthy part in proposals than appraisals of things, as the evaluations alone don't have itemized data about under which conditions they were given by clients. A few suggestions are more reasonable to the client in night and doesn't coordinate his inclinations early in the day at all and he/she might want to complete one thing when it's

One of the most serious issues of setting mindful recommender frameworks is acquiring setting data. The data can be acquired expressly by straightforwardly cooperating with client asking him/her to round out a shape and making an overview. In spite of the fact that it is for the most part alluring to acquire setting data without making the entire rating and inspecting process convoluted. Another way is gathering data verifiably utilizing the sources like GPS, to get area, or a timestamp on exchange. The last method for data extraction is examining clients and watching their conduct or utilizing information mining systems.

1.2.2 Semantic-based approach:

The majority of the depictions of things, clients in recommender frameworks and whatever is left of the web are displayed in the web in a literary shape. Utilizing labels and catchphrases with no semantic implications doesn't enhance the exactness of proposals in all cases, as a few watchwords might be homonyms. That is the reason comprehension and organizing of content is an exceptionally noteworthy part suggestion. Customary content mining approaches that base on lexical and grammatical investigation demonstrate depictions that can be comprehended by a client yet not a PC or a recommender framework. That was a reason of making new content mining methods that depended on semantic investigation. Recommender frameworks with such procedures are called semantic based recommender frameworks.

The execution of semantic recommender frameworks depends on information base typically characterized as an idea graph (like scientific classification) or philosophy.

1.2.3 Peer to peer approaches:

The recommender systems with P2P approaches are decentralized. Each peer can relate itself to a group of other peers with same interests and get recommendations from the users of that group. Recommendations can also be given based on the history of a peer. Decentralization of recommender system can solve the scalability problem.

1.2.4 Cross-Domain based approach:

Finding comparable clients and building an exact neighborhood is an imperative piece of prescribing procedure of community-oriented recommender frameworks. Likenesses of two clients are found in light of their thanks of things. In any case, comparable thanks in one space don't most likely imply that in another area valuations are comparative too.

1.2.5 Cross Lingual approach:

The recommender framework considering cross-lingual approach gives the clients a chance to get proposals to the things that have depictions in dialects they don't talk and get it. Yang, Chen and Wu purposed an approach for a cross lingual news amass suggestion. The primary thought is to delineate content and catchphrases in various dialects into a solitary component space, in other words a likelihood appropriation over inactive themes. From the depictions of things, the framework parses catchphrases than deciphers them in one characterized dialect utilizing word references. From that point onward, utilizing cooperative or other separating, the framework offers suggestions to clients.

1.2.6 Bidding:

The hypothetical model proposed here isn't limited to online closeouts; it adds to the general sale hypothesis writing. Dissimilar to most past work on successive sell-offs that spotlights on value slants in limited groupings of closeouts (spurred by the "value decrease irregularity" reported in true sale arrangements by Ashenfelter [1989] and others), this article examines the impact of open data about not so distant future sell-offs on infinite horizon consistent state offering. The model broadens Milgrom and Weber's (2000) limited skyline and indistinguishable merchandise model to an unending skyline and on a level, plane separated products show. A basic separation into a limited number of totally unrelated composes is accepted, so the augmentation adds up to expecting a few haphazardly interweaved successions of indistinguishable merchandise groupings. In this manner, the proposed demonstrate is the easiest model that includes unit-request bidders and nontrivial data about the not so distant future sales. Since the model considers a grouping of closeouts for nonidentical objects with learning of future items, it likewise broadens the model of Gale and Hausch (1994), who look at the instance of consistently heterogeneous questions by concentrating on the uncommon instance of two bidders and two sales. The expansion past two closeouts is proficient because of the rearranging presumption that the item heterogeneity is caught by a limited number of sorts. The nearest less complex benchmark is given by the model of heterogeneous yet inconspicuous future items (EngelbrechtWiggans 1994), an extraordinary instance of which is settled in the proposed display; when just some settled basic conveyance of future items is known, bidders can in any case participate in forward-looking methodologies, yet they can't utilize the forward-seeing techniques examined here. Inside the online sale writing, the issue of multi-auction offering has not been tended to, aside from in crafted by Bajari and Hortacsu (2003), who think about bidder section in like manner esteem sales, and Dholakia and Soltysinski (2001), who discover a "grouping inclination" (i.e., customers running to prevalent closeouts regardless of the presence of different sell-offs for substitute things). The grouping inclination is particularly significant to the present work since it gives another layer of behavioral many-sided quality past the levelheaded conduct portrayed here.

2. PROPOSED SYSTEM

In this we are attempting to depict, dissect, actualize and update the for the most part utilized technique for web mining i.e. affiliation govern mining. This strategy can be effectively utilized as a part of suggestion frameworks and it is adaptable. This strategy gives high exactness, and just gives paired weight to the pages that are gone to i.e. to discover whether the page is available or not. In this paper we are giving cross breed suggestion approach which utilizes web use mining and content mining. We are introducing the new information mining approach which depends on HITS and weighted affiliation control digging for the effective web suggestion framework. This strategy is utilized for giving the client a customized web understanding.

2.1 Methodology:
The following are the description of modules in the given system.

2.1.1 Product Queries:
The enlisted clients will peruse diverse classifications in the web application. Distinctive results of various classifications will be shown by client inquiries and snaps. We are exhibiting the new information mining approach which depends on HITS and weighted affiliation administer digging for the effective web suggestion framework. This technique is utilized for giving the client a customized web understanding.

2.1.2 Product Ranking:
Items will be bunched by client's utilization design. By and large while prescribing the information there is an issue of seldom went by pages or recently included pages as they could never be added to the proposal set. So, to conquer this issue in our approach we are incorporating these pages in the informational index by utilizing HITS and Client Snaps.

2.1.3 Recommendations:
As the items are positioned in view of HITS and Snaps, the suggestion set will be produced in light of the Weightage Affiliation Govern Mining. In this strategy we relate weight parameter with each page to mirror the enthusiasm of client which is called as weighted affiliation govern mining. This proposal framework is an online part of personalization framework which figures out which things to be prescribed to the client. The suggestion score is computed by increasing match score and weighted certainty. At last best n-most comparable pages are arranged to be utilized as a part of the following stage.

2.1.4 Predictions:
In our work, we needed to influence the following coherent advance by enabling anything to be dealt with as a class to name—its esteem is to be anticipated in light of the nearness or nonappearance of different things. Put another way, knowing a subset of the shopping baskets substance, we need to "figure" (foresee) the rest. Assume the shopping basket of a client at the checkout counter contains bread, margarine, drain, cheddar, and pudding. Might someone be able to who

met a similar client when the truck contained just bread, margarine, and drain, have anticipated that the individual would include cheddar and pudding? Verifiably or unequivocally, this assignment remained at the support of this field in the 1990s; now that numerous useful snags (e.g., computational expenses) have been decreased, we need to come back to it.

2.1.5 Purchase Discounts:
The test is the means by which to consider the personalization include. Personalization is attractive for some situations where distinctive clients have diverse data needs. For instance, our proposed framework has been the early adopter of personalization innovation to prescribe items to customers on its site, in view of their past buys. It makes a broad utilization of community separating in its personalization innovation. The reception of personalization won't just sift through unessential data to a man, yet additionally give more particular data that is progressively significant to a man's advantages.
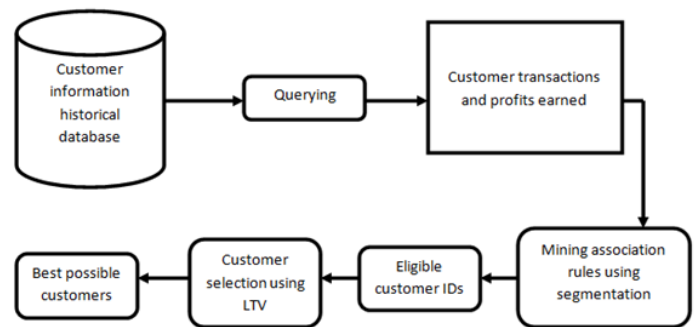
Figure1: Purchase Discount Workflow

2.1.6 Bidding:
We propose a closeout-based plan for clients to buy restricted items. We for the most part center around the clients which are prepared to pay huge sum for restricted items. In this framework, the enrolled clients will present their offers for the item as needs be in the given schedule opening. Clients can see the offers originating from different clients and refresh their offers as needs be. The chairman will sort the offers as per the offer cost and item will be dispensed to the most astounding bidder as needs be. An affirmation SMS will be sent to the client winning the sale.

1] Admin decides the time slot and base price of bid, then bidding will start.

2] User starts bidding, each user can bid maximum 3 times.

3] Depends on bid, admin sort and display the highest bid values.

4] After session expires then the highest bidder allocates the product then, they do the payment.

2.2 Algorithm Used:

The Apriori calculation was proposed by Agrawal and Srikant in 1994. Apriori is intended to work on databases containing exchanges (for instance, accumulations of things purchased by clients, or points of interest of a site frequentation). Different calculations are intended for discovering affiliation governs in information having no exchanges (Winepi and Minepi) or having no timestamps (DNA sequencing). Every exchange is viewed as an arrangement of things (an itemset).

Given an edge C C, the Apriori calculation distinguishes the thing sets which are subsets of at any rate C C exchanges in the database.

Apriori utilizes a "base up" approach, where visit subsets are broadened one thing at any given moment (a stage known as competitor age), and gatherings of applicants are tried against the information. The calculation ends when no further fruitful expansions are found.

Apriori utilizes broadness first pursuit and a Hash tree structure to check competitor thing sets productively. It creates hopeful thing sets of length b b from thing sets of length $b-1$ b-1. At that point it prunes the applicants which have an occasional sub design. As per the descending conclusion lemma, the hopeful set contains all incessant b b-length thing sets. From that point onward, it examines the exchange database to decide visit thing sets among the hopefuls.

The pseudo code for the calculation is given beneath for an exchange database T T, and a help edge of ϵ ϵ. Common set theoretic documentation is utilized, however take note of that T T is a multiset. C_{b} C_{b} is the hopeful set for level b k. At each progression, the calculation is expected to produce the applicant sets from the huge thing sets of the former level, paying attention to the descending conclusion lemma. $count[c]$ count[c] gets to a field of the information structure that speaks to hopeful set c c, which is at first thought to be zero. Numerous subtle elements are precluded beneath, ordinarily the most vital piece of the execution is the information structure utilized for putting away the hopeful sets and tallying their frequencies.

Pseudo-code: C

b: Applicant itemset of size b

D

b: visit itemset of size b

D

1 = {frequent items}; for(b = 1;Db !=∅; b++) do start

Ab+1 = competitors created from

D

k; for every exchange

t in database do

increase the include of all hopefuls

Ab+1 that are contained in

t

Db+1 = hopefuls in

Ab+1 with min_support

end

return ∪b Db;

3.   IMPLEMENTATION RESULTS

The snapshot of figure 2 represents the User Interface of the system. Here the user can register if he/she is first time user.
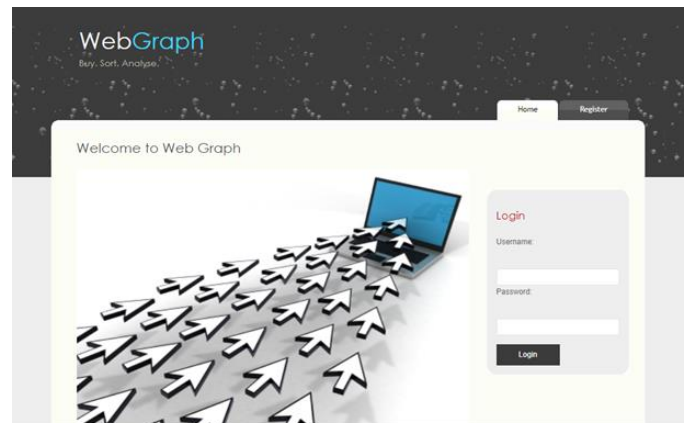
Figure2: UI of Recommendation Engine

The snapshot of figure 3 and figure 4 represents the registration page of Recommendation. After Registration user can purchase items and can give ratings on a product. After user registration is done he is directly landed to page to buy products.
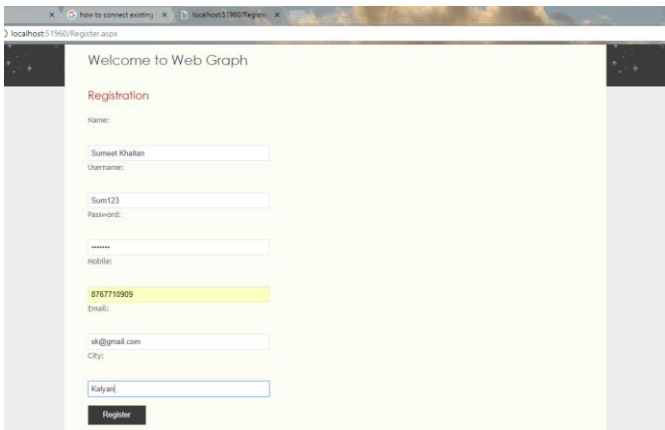
Figure 3: Registration Page

Figure 4: User's Personal Page

The snapshot shown in Figure 5 shows that user has logged in system and he is product search page. The page also represents recommendation of products that are frequently searched in Most Searched columns.

Figure 5: Product Search and Recommendation of Most Searched Products

The snapshot of figure 6 represents the products list according to the category chosen by user
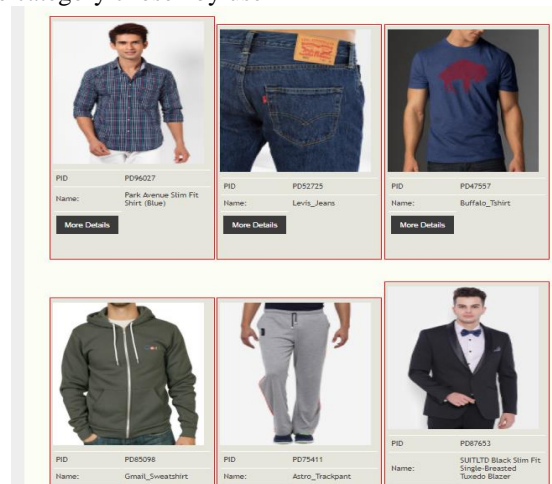
Figure 6: Products List

The snapshot of figure 7 represents that Transactions made by user and products purchased by him.

Figure 7: products purchased by user

4. CONCLUSION AND FUTURE SCOPE

Here we have proposed another web suggestion framework in view of weighted affiliation lead mining and content mining. In this approach, weight is doled out to each page to demonstrate its significance relying upon the time spent by every client on a specific page or going to recurrence of each page. The component announced in this paper centers around one of the most seasoned assignments in affiliation mining: in view of deficient data about the substance of a shopping basket, would we be able to anticipate which different things the shopping basket contains? Our writing study shows that, while a portion of the as of late distributed frameworks can be utilized to this end, their functional utility is compelled, for example, by being restricted to spaces with not very many things. Another web -based offering approach is utilized for constrained release items with the goal that the two clients and merchants can have the advantages.

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ThumbPay

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Abstract — **The paper is about Biometric Payments using our idea, ThumbPay. This application will allow operators to make payments at a sales terminal using their finger impressions in an active fashion, hence, eradicating the necessity of carrying numerous magnetic cards for making payments. ThumbPay is expected to be an industrial uprising in the customer payments industry to have such an application that will accept payments through biometric means and not be divulging the actual details of the consumer during the processing of the transaction.**

Keywords— Biometrics, SDK, FPS, Fingerprints.

I. INTRODUCTION

In last few years, the perspective of how things actually happen among us has completely changed. The Industry of Payment is not an exclusion. It's also seen a lot of advancements after just being a Fiat-currency based System to an Electronic Reimbursement System. These Electronic Payment Systems have evolved from traditional cards like MasterCard & Visa cards etc., to Contactless Cards to Net Banking also, convenient Mobile Wallets. Now, the next enormous improvement in the line of payments is making payments using Biometric features.

Earth will soon experience a fully functional Biometric Payment system where a user will make a reimbursement using imprint of a finger. Some of the big technology colossuses have predicted the latent paybacks of integration of Payment platforms with biometrics and hence concentrating on deriving a key which offers many benefits like the convenience of cardholders & security of payments. However, in today's available solutions the use of Biometrics is presently limited to just Authentication of Cardholders or initiating Application Login. Our idea inculcates implementation of a Payment application using Biometrics which will empower customers to pay any retail point with just the imprint of their finger. Also,

the main aim of the system is to exclude the need for carrying Wallets along with cards and cash & purchasing exclusive cell phones, subscribed just for the solitary purpose of making payments in a convenient manner. also to eradicate the jeopardy of misplacing valuables as your fingers will always be with you and that is all that you will need to make a payment. Our System "ThumbPay" proposes a Biometric Payment model using our idea of making payments just with using your thumb or any particular finger. The General applications can be imagined but the future scope can be expanded to unimaginable places of work.

This Biometric system will basically work in the following steps:

- The consumer comes to the stage of payment where he has to pay a certain amount.
- The retailer will now add the bill amount to the ThumbPay app.
- The consumer will now be asked to scan the finger on the FP Scanner.
- The app will identify the person.
- After identification comes to the verification stage.
- The consumer is asked for the 4-character pin.
- The consumer enters the pin.
- Voila! The Payment is now done directly from the consumer's account to retailer's account.

This is how making payments will become a much shorter and hassle-free plus easy process to pursue.

II. LITERATURE SURVEY

A. A Review of Existing Systems and limitations.

Lots of accomplishment stories about the Mobile platforms using biometrics. Tech companies like Samsung, PayPal, and Apple have by now constructed reimbursement solutions with the help of biometrics for their individual cellular stages where clients can perform economic transactions using relevant touch IDs or with the scans of their thumbprints. Separately from this, a portion of effort is made in the domain of payments using Biometric Authentication. Let's take an example, customers will be able to validate their uniqueness in an Automated Teller Machine or at a trade Point of Sale (POS) unit by just using their biometrics. Conferring to one media proclamation made via Gartner, 30% of administrations will custom Biometric Authentication for Mobile Devices by 2016. Figures disclose that internationally biometric tech market is emergent at a multi-layered twelve-monthly development degree of about

21.6%. Nonetheless, while it originates to Biometric Expenditures at Mercantile Point of Sale, however, a little exertion has been completed by many businesses in an internal atmosphere, a fully-fledged biometric payments open-loop stage is still to be raised inhabitation.

According to a source which is apparently payments, a bronzing barbershop executed a solution where an alternative is offered in the direction of the clienteles to recompense store charges by the use of their finger impressions in place of spending via magnetic card. One more fascinating resolution constructed by Carnegie Mellon University scholars permits an operator to catalog numerous finger impressions by linking to a bank or some magnetic card for improvised safekeeping. Likewise, prominent payment grid supplier,

B. Analysis of Requirements

Effecting Payments made with the use of Biometrics will create the requirement to alter mercantile setup in a huge way. So, implementation of Payments using biometrics could be an affluent proposal. (A Fingerprint Scanner will be required).

Individually finger impression scan is transformed into some unique value called as Byte Arrays. Refined programs which are proficient in computing Byte Array value matchlessly & precisely is essential to be advanced. (To manage the accuracy a Finger Print Scanner Software Development Kit will be required).

Security, Storage of all the Biometric Data strongly is an immense encounter as thumbprint arrangement of an individual can be pilfered through by the likes of impostors for making deceitful reimbursements and payments. Also, a different layer may be required for authentication, to reduce scams, deceptions and heighten the system's security. It could be accomplished by dispensing a PIN, such as Palm imprint, multiple fingerprints during transaction approval, processing, and authorization. (OTP Authorization or PIN authorization can be used).

III. COMPARISON BETWEEN EXISTING SYSTEM & PROPOSED SYSTEM

A. Existing System

Lots of accomplishment stories about the Mobile platforms using biometrics. Tech companies like Samsung, PayPal, and Apple have by now constructed reimbursement solutions with the help of biometrics for their individual cellular stages where clients can perform economic transactions using relevant touch IDs or with the scans of their thumbprints. Separately from this, a portion of effort is made in the domain of payments using Biometric Authentication. Let's take an example, customers will be able to validate their uniqueness in an Automated Teller Machine or at a trade Point of Sale (POS) unit by just using their biometrics. Conferring to one media proclamation made via Gartner, 30% of administrations will custom Biometric Authentication for Mobile Devices by 2016. Figures disclose that internationally biometric tech market is emergent at a multi-layered twelve-monthly development degree of about

21.6%. Nonetheless, while it originates to Biometric Expenditures at Mercantile Point of Sale, however, a little exertion has been completed by many businesses in an internal atmosphere, a fully-fledged biometric payments open-loop stage is still to be raised inhabitation.

We also need to carry a lot of things with us including wallets or cards, cash etc. which makes the payment process bulkier.

B. Proposed System

The proposed system basically focuses on the need to travel hassle-free and without carrying physical devices or any sort of cash. Be it magnetic or hard paper cash. Our System "ThumbPay" presents a Payment model which is biometric i.e., using our idea of making payments just with using your thumb or any particular finger. This application will assist operators to make payments anywhere at any mercantile station just by using fingerprints in a safe method, hence, eradicating the necessity of carrying numerous magnetic cards for making payments. It is expected to be a technological revolution in the consumer payments industry. This system will practically eliminate the need to carry cash or any cards with us. The General applications can be imagined but the future scope can be expanded to unimaginable places of work.

Proposed System	Existing System
1. Time consumed for making a payment will be reduced because nothing needs to be fetched, fingers are right in the hand of the consumer	1. Payment takes time, as the consumer needs to do the painstaking job of finding out and taking out the cash/ card/ device.
2. Banks earn profit ominously because of fewer scams and lesser rates of chargeback	2. Banks face a lot of frauds online and offline for payments
3. Customers will no more need to carry physical cards or purchase costly cell phones just for the solitary purpose of joining in NFC qualified payments	3. Consumers need to carry wallets, cards, cash, and devices just in order to make payments.

4. Will require a gigantic change in infrastructure.	4. No specific targeted infrastructure for payment. It is all diverse for cards, cash, and Devices.
5. Technology can be used for various new future scopes and has a vast area untouched yet for expansion apart from serving the monetary purpose.	5. No other application apart from serving monetary needs.

TABLE 1: PROPOSED SYSTEM V/S EXISTING SYSTEM
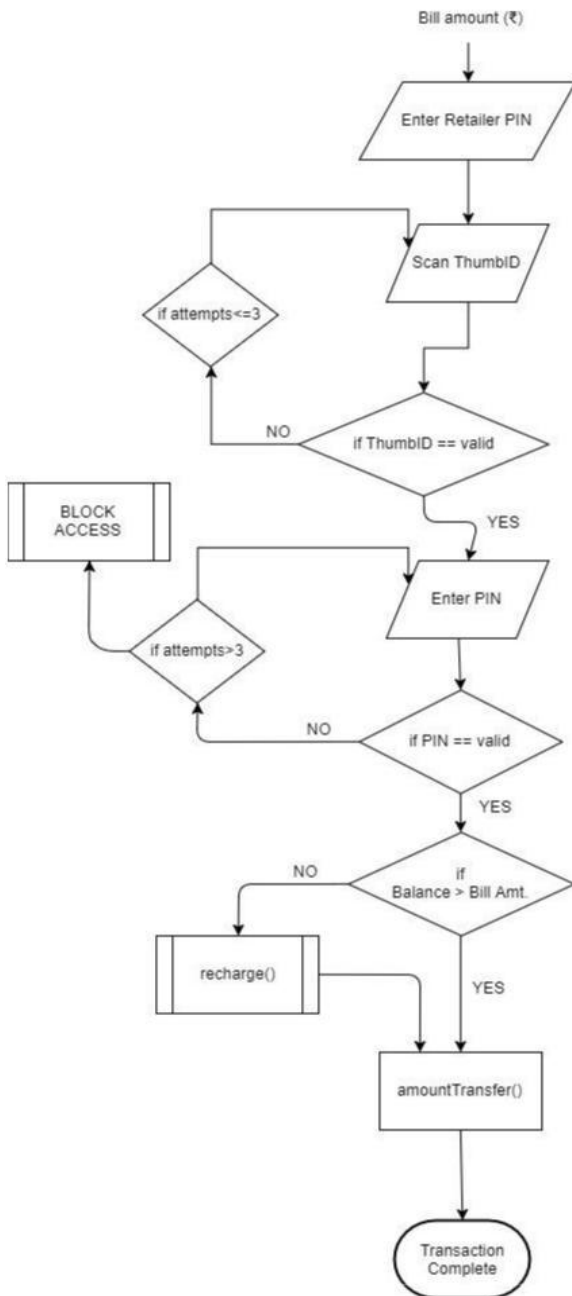
Figure 1– Proposed System (Flow Diagram)
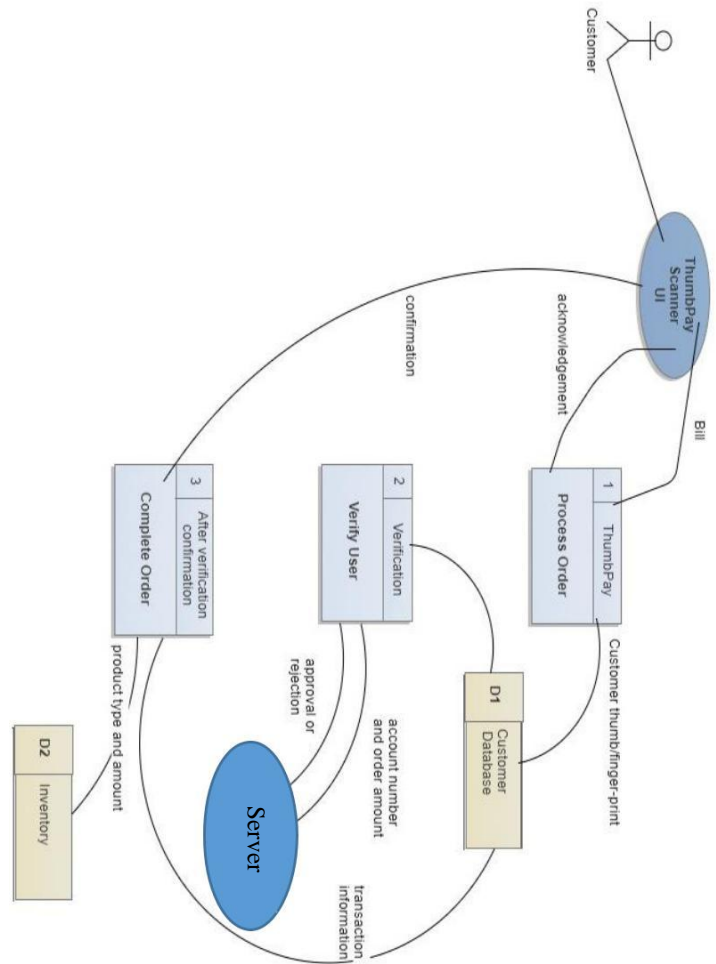
Figure 2 – DFD of ThumbPay Billing System

IV. METHODOLOGY

The customer will first visit the Retailer's Store and purchase enough products for making the customer eligible to generate a bill. When the customer will receive a bill, the customer will scan his thumb/finger to pass the ThumbID to the ThumbPay system. The ThumbPay system will then automatically and instantly identify the user using the ThumbID and then the customer will be redirected to the next step i.e., inputting the PIN till three attempts. If the customer fails to enter the correct pin in three attempts, then his access to the payment as well as the account will be temporarily blocked. This is obviously for security reasons. And if the PIN is valid then the customer will be redirected to the next step which is paying the bill. But first the balance is checked and the customer is allowed to proceed only and only if Balance is greater than the bill amount. If not

so, then the customer is redirected to the recharge subroutine. And the payment is made final after the balance is eligible to make the complete payment. After the payment is made the bill amount is transferred from the consumers account to the retailer's account. After the amount is transferred both of them i.e., consumer and the retailer are notified and finally, after that, the transaction is complete.

V. IMPLEMENTATION PLAN

As we have seen the flow diagram above we know how the transaction is going to take place through ThumbPay.

The fingerprint sensor will be required for scanning a vector input map of the thumb/fingerprint, which will act as an authentication measure for the consumer when the consumer will pass the authentication.

Now comes into picture the other design details which are PHP, MySQL, and MariaDB which will properly authorize the user, uphold the transactions and keep the records.

All of the interaction will be taking place on an Android device which will have a fingerprint sensor built-in or attached via a USB.

VI. CONCLUSION

Biometric Payments is the succeeding huge entity in the payment industry. Magnetic cards will be exemplified with user's exceptional features like Thumbprints, Retinal Scan, Facial Scan, Thumb/Palm imprint etc. Though acceptance of payments using biometric will stance numerous encounters, it's

undeniably a mandatory step to achieve expansion in customer payments. It eventually will eradicate the need for carrying magnetic cards & purchasing costly cell phones, promised for the solitary resolution of expedient payments. It'll similarly disregard the jeopardy of trailing our cards or cell phones because our biometric imprints (or Payment Fingers) will always be with us and that's what is wholly what we require to make a reimbursement. In a husk, even though there are numerous encounters for the implementation of the Biometric payment system, it surely delivers an upcoming roadmap to amalgamated, benign, secure and cool payments experience.

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IoT Based Petrol Level Detection

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Abstract- **Nowadays, the actual record/measurement of fuel filled and fuel used by the vehicles is not maintained. While filling the fuel the customer has to rely on the fuel filling machine to know the amount of fuel filled which will avoid a financial loss. To avoid this we are implementing an IOT fuel level filing and monitoring system. We are using two sensors namely one flow rate sensor and one float rate sensor and the output will be seen on the display device in tabular form. Flow rate will be active only when filling is done and then float rate sensor will measure the amount of liquid.**

Keywords - Petrol Level, IoT, Ultrasonic, flow level, GUI, LED display, fuel tank.

I. INTRODUCTION

As Automotive industry is growing very fast and estimation of fuel level and its indication is very much required to make aware the vehicle owner about the distance it can cover. Thus the requirement of fuel level management system and associated algorithms becomes more prominent. The system have to be robust, effective and durable. So as to provide the exact calibrated value to the owner, and will be more effective if it can give you the idea of estimation of distance it can travel at different velocities. The embedded system and the associated algorithms with complete hardware helps in achieving this. Involvement of M2M (Machine to machine) communication helps in providing the information to the user within his/her reach (i.e. data can be transported to user smart phone). This paper aims at the system which can pinpoint the issues like calibrating fuel level in bumpy surfaces, hilly areas (fuel sloshing problem); porting the fuel level information to the user's phone. To achieve the set goal a system is developed using a system comprising microcontroller, sensor and display unit.

II. LITERATURE SURVEY

A. Working of the existing system.

Fig.1: Existing Fuel Gauge Mechanism

In today's vehicles the fuel gauge consists of two parts:

- The sensing unit which is located in the tank
- The indicator which is located on the dashboard

A float connected to a potentiometer is used by the sensing unit which typically is printed ink design in a modern automobile. As the tank level starts to decrease, the float drops and slides a moving contact along the resistor, increasing its resistance. In addition, when the resistance is at a certain point, it will also turn on a "low fuel" light in all vehicles .Magneto resistance type fuel level sensors, now becoming common in small aircraft applications, offer a potential alternative for

automotive use. These fuel level sensors work similar to the potentiometer example, however a sealed detector at the float pivot determines the angular position of a magnet pair at the pivot end of the float arm.

These are highly accurate, and the electronics are completely outside the fuel. The non-contact nature of these sensors address the fire and explosion hazard, and also the issues related to any fuel combinations or additives to gasoline or to any alcohol fuel mixtures. Magneto resistive sensors are suitable for all fuel or fluid combinations, including LPG and CNG. The fuel level output for these senders can be ratio metric voltage or preferable can be digital. These sensors also fail-safe in that they either provide a level output or nothing. [1]

III. PROPOSED SYSTEM
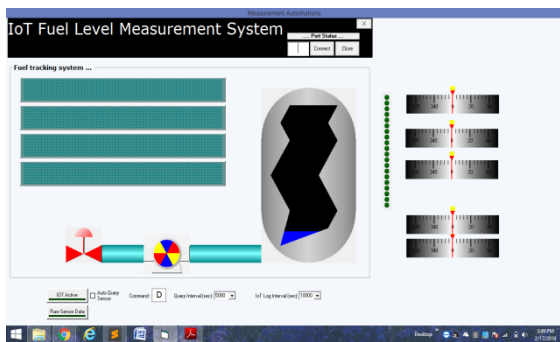
A. Sensor Mechanism and Formula

The fuel level can be sensed using a fuel level sensor, which should be robust and strong enough to work during mechanical shocks. The conventional step for fuel level estimation is to mount a float-arm assembly to either a resistive, capacitive or inductive sensor which is finally digitized using an analogue to digital converter. But the calibration done using float-arm based assembly is not absolute. Thus, to avoid the errors and to capture the data from the fuel tank two sensor mechanism logic can be followed

* Pulse frequency (Hz) = 7.5Q, Q is flow rate in Litres/minute

*Flow Rate (Litres/hour) = (Pulse frequency x 60 min) / 7.5Q

In other words:
*Sensor Frequency (Hz) = 7.5 * Q (Litres/min)
litres = Q * time elapsed (seconds) / 60(seconds/minute)

*litres = (Frequency (Pulses/second) / 7.5) * time elapsed(seconds)/60*litres = Pulses / (7.5 * 60) Once the flow started, application will start. [2]

B. Hardware and Software Details

Hardware:

- Arduino Microcontroller
- RAM: 4GB or more
- Ultrasonic sensor
- HCSRO4 Sensor.

Software:

- WAMP Server version 2.2
- Windows Operating System.

C. Technologies Used

1. PHP (The Hypertext Preprocessor):

PHP is one of the three dynamic web-page technologies i.e. ASP, JSP and PHP. This technology will be used as a business layer scripting technology. PHP is an open source server-side scripting technology which proves very useful at business layer because of its easiness. PHP version used for development of this web application is 5.3.5. This version also supports object-oriented programming in PHP which will prove very useful as OOP is the concept which reduces the programming load by a large amount. PHP runs on WAMP (Windows AJAX MySQL PHP) as well as LAMP (Linux AJAX MySQL PHP) server. This server is available free of cost on internet. Other than these two servers XAMPP server can also be used which will on both Linux and Windows platform.

➢ Back End

- **MySQL** is used for the purpose of web database which is also the most widely used open-source database (back-end). It uses structured query language. It runs on all platforms namely Linux, Unix, Windows. It is relational database management system [3]

D. Scope of the project

The scope of the project is the system on which the hardware is installed, i.e. the project is developed as a system which will monitor the amount of fuel or liquid present in the container. [4]

IV.   COMPARISON BETWEEN EXISTING AND PROPOSED SYSTEM

A.   Existing System

In the existing system the customer does not get the exact count of fuel. We don't get fuel count (flow rate). Petrol theft is a high possibility. The existing system is being used since past so many years and no innovation has been made. In the existing system, the customer has to rely on petrol filling system (machine) and hence does not get the exact amount of petrol that has been filled

B.   Proposed System

In the proposed system we get the exact count of petrol that has been filled in the petrol tank. We also use the flow rate sensor which helps to measure the flow rate at which petrol is being filled. There is no chance of fuel theft. Two sensors used are flow rate sensor and float rate sensor which give output on a led device which has a user-friendly interface for the better understanding of the customer.

Existing System	Proposed System
In the existing system the customer does not get the exact count of fuel.	In the proposed system we get the exact count of petrol that has been filled in the petrol tank.
We don't get fuel count (flow rate)	We also use the flow rate sensor which helps to measure the flow rate at which petrol is being filled.
Petrol theft is a high possibility.	Petrol theft is not possible
The existing system is being used since many years and no innovation has been made.	The proposed system is fairly new and innovative which helps you give the exact measurement

Table 1: Existing System v/s Proposed System

The main purpose of IoT based petrol pump sensor is to provide exact amount of fuel which is currently present in the container

- We can cross check how much fuel is deposited.
- We can also check total amount of fuel we have deposited.
- Instant Notification.
- The proposed system will make sure that how much amount of fuel is exactly deposited to avoid loss of amount of money.

V.   METHODOLOGY
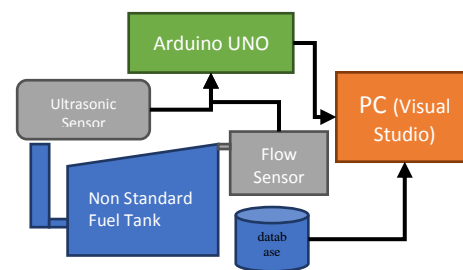
Fig. 1: Block Diagram of Proposed System

Following is the working:

1. Flow rate sensor and Ultrasonic level sensor will measure the data and feed to Arduino Microcontroller

2. Arduino will measure the analogue value and convert to digital

3. The digital value will be transmitted to PC and displayed in real time

4. This data will also be recorded in database

5. The database can be opened to view the details of the recordings

6. The screen can be used to view the real time data

VI. DESIGN DETAILS
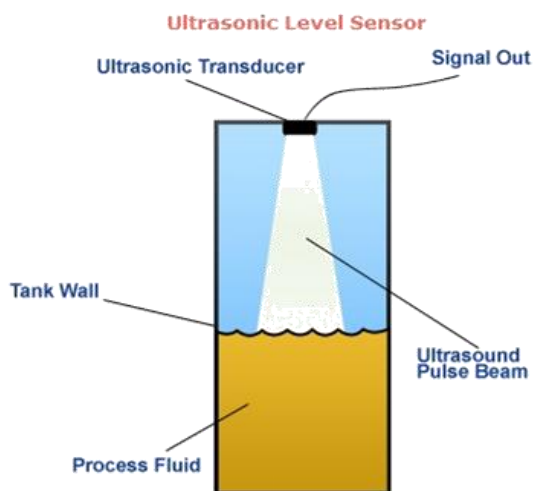
Fig. 2: Working of Ultrasonic Sensor

In this updated design, the fuel level sensor is located at the top of the fuel container in a way that it sends the sound waves in burst form in downward direction to the liquid present in the tank under the measurement. As soon as the sound waves hit the surface of the fluid, the waves which were directed towards the fluid get reflected and returned back to the sensor. The time taken by the waves to return back is proportional to the distance between the electric sensor and the fluid in the tank. The time duration is measured by the ultrasonic sensor which then further is used to calculate the level of fluid in the tank. The speed of the sound waves can sometimes be altered or affected due to variations in temperature for which appropriate compensations is needed to be provided in the sensor design. In general, the medium over the fluid's surface is air. However, one can use a blanket of nitrogen or any other vapour as an alternative.

VII. EXPECTED RESULTS

The proposed project work has aimed for developing a feasible cost automation technique to measure the fluid level and its quantity. We can achieve least possible error and maximum accuracy in the measurement. We are designing a system which accurately and digitally displays the exact level of liquid/petrol inside the liquid container. Thus, it is an efficient way to reduce the petrol thefts occurring at various fuel filling stations

VIII. CONCLUSION

Human race is developing new technologies day by day, for many purposes such as entertainment, health care, engineering and many more. But with advancements comes a demerit side of the technologies which are supposed to be put in use for good. Many applications look small, but have a huge application in real-time systems. One of this is the proposed system. Usually, vehicles show the level of fuel using a pointer against numbers. But there is no precise data available about the amount of fuel filled. You can see the level while filling the fuel, but one cannot blindly trust any gas station meter, since it can be altered as well. For this, the proposed system is the best solution. It not only shows the level of fuel in your vehicle in precise digits, but also is a very reliable system on which, the customer can trust. The proposed system will make sure that how much amount of fuel is exactly deposited to avoid loss of amount of money. System implementation will be done by using flow sensor and mobile. Through this, we can obtain good mileage of the vehicle.

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Tracking Quality of Healthcare Services

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Abstract—**Health systems in India are grappling with the effects of existing communicable and non-communicable means to cater to the needs of the people. Lack of adequate progress on these underlying social determinants of health has been acknowledged as a glaring failure of public healthcare system. The government is providing various services and funds for the betterment of the medical sector in the rural areas. But the resources provided reach in a scarce quantity to these areas of requirement. In order to keep track of the services provided and improvement being done, very few services are available and they are seldom being used. Providing a service that can efficiently do the functions and help the government in a better way is the aim of this system. Taking timely feedbacks and providing the necessary services to the patients on the feedback obtained will be the functions of this system. Evaluation of the data collected through feedbacks will help the government in betterment of the economically poor society.**

Keywords—*Feedback System ; Android ; Patient ; Doctor ; Interactive Feedback ; Medical .*

I. INTRODUCTION

Medical centres are unable to maintain the accurate data record of the patients(100%) during the feedback process.

The main motto to take up this problem is to cater to each and every need of the patient as well as monitor his/her health from the time he/she first visits the hospital till he/she totally recovers. Additional attention and adequate support to ensure faster recovery is not possible as there is a poor communication channel/link between the doctor and the patient after the check-up. Due to insufficient data obtained in the form of feedback, the government and the NGOs are unable to do the necessary improvements required in this field. According to the statistics, feedback from merely 5-10% of the patients is collected monthly from any of the government aided medical centres. Course of medication prescribed to patients is seldom monitored.The staff is neglected in terms of their behaviour and supportiveness towards the needs of the patients.

Though the government is providing various facilities free of cost, there is hardly any evidence whether the facilities are being utilised properly. No proper medium is available for the patients through which they can give their feedback about their experiences and suggestions/complaints.

II. BACKGROUND AND RELATED WORKS

A. Android OS

Android is a mobile operating system developed by Google, based on a modified version of the Linux kernel and other open source software and designed primarily for touchscreen mobile devices such as smartphones and tablets. In addition, Google has further developed Android TV for televisions, Android Auto for cars, and Android Wear for wrist watches, each with a specialized user interface. Variants of Android are also used on game consoles, digital cameras, PCs and other electronics.

Android has been the best-selling OS worldwide on smartphones since 2011 and on tablets since 2013. As of May 2017, it has over two billion monthly active users, the largest installed base of any operating system, and as of 2017, the Google Play store features over 3.5 million apps.

B. Android Applications

Applications ("apps"), which extend the functionality of devices, are written using the Android software development kit (SDK) and, often, the Java programming language.

The SDK includes a comprehensive set of development tools, including a debugger, software libraries, a handset emulator based on QEMU, documentation, sample code, and tutorials. Initially, Google's supported integrated development environment (IDE) was Eclipse using the Android Development Tools (ADT) plugin; in December 2014, Google released Android Studio, based on IntelliJ IDEA, as its primary IDE for Android application development.

C. SQLite

SQLite is an in-process library that implements a self-contained, serverless, zero-configuration, transactional SQL database engine. SQLite is an embedded SQL database engine. Unlike most other SQL databases, SQLite does not have a separate server process.

SQLite is a compact library. With all features enabled, the library size can be less than 500 KB, depending on the target platform and compiler optimization settings. SQLite is ACID-compliant and implements most of the SQL standard, using a dynamically and weakly typed SQL syntax that does not guarantee the domain integrity.

D. Related works

A few years ago Penn Medicine University undertook a project for collecting patient feedback and acting on it. Initially they took real-time feedback from patients being tended at the Vascular department of the institute.

After two weeks they introduced an SMS option for patients by distributing a card at check-in. During each test, administrative and frontline staff reviewed feedback within 24 hours and responded to concerns promptly.

Over a course of four weeks over a 1000 patients were engaged in the feedback activity with around 20 reporting as "poor".[1]

III. ANALYSIS AND DESIGN

A. System Structure Chart

Fig. 1 illustrates the system's work flow from the point the patient enters the clinic to the point his data is being stored in the database regarding the improvement in his health, personal details, time taken for recovery, etc. It covers the following stages: (i) Registration (ii) 1st Feedback (iii) Checking Inventory (iv) Daily Medicine Reminders (v) 2nd Feedback (vi) Further Feedbacks (vii) Storage of Data

The system aims at capturing maximum feedback. Also taking into consideration the condition of the patient at the time of arrival the following steps have been decided. Registration process is to collect all the general information about the patient. After visiting the doctor the patient gives his/her 1st feedback, called reaction feedback.

The patient will receive timely medicine reminders based upon the prescription given to them by the doctor. As the shortest duration of any prescription is about 3 days, the next feedback, i.e. 2nd Feedback is captured after 3 days of visit to the doctor. If the prescription continues after this, the feedback is captured every alternate day after this.
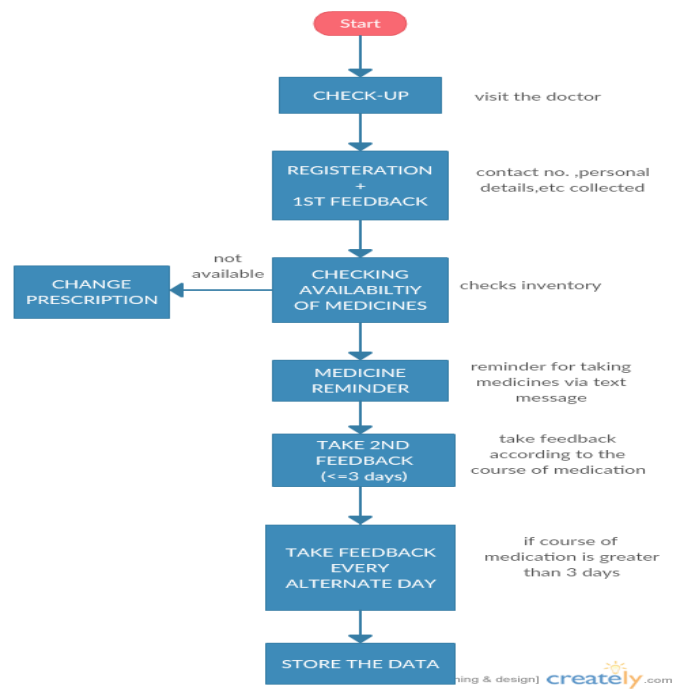
Figure 1.System Flowchart

IV. IMPLEMENTATION AND SETTINGS

A. Hardware and Software Specifications.

The feedback app is implemented on Android OS using android java and compile the packages and dependencies using Gradle.

User's phone should be running Android version 4.4 Kitkat or above as the app uses the ART(Android Runtime) introduced with the said version as default.

As for the hardware specifications it requires an android device with at least a dual core processor and 512 MB of RAM. For the suite to run smoothly,it is recommended that the phone have 1GB of RAM and a Qualcomm Snapdragon 400 or higher processor.

The data that is being collected from the staff, doctors and patients and is stored in the database in a tabular form. There are various tables created for storing personal details, feedback 1, feedback 2 , doctor prescription. All the tables are in relational format. The data being entered is stored in sqlite if no internet is available. When internet connectivity is available the data from local database i.e. sqlite is stored in the mysql database.

TABLE 1.HARDWARE AND SOFTWARE SPECIFICATIONS

Device	Hardware and Software Specifications
Android Phone	● Android v.4.4 or above

	● 512 MB RAM or above ● Snapdragon 400 or above
Target audience	● Any clinic

B. System Implementation.

1.Registration

First thing we are doing in application, is registering the clinic. For that we are considering its:

• Location
• Contact number
• E-mail
• Address

After registering the clinic we would be registering the doctors and staff of that clinic we will be considering attributes like:

• Name
• Address
• Email
• Phone No
• Date of Birth
• Gender
• Blood Group

Once we are done with registering the clinic and doctors, our app is ready for using in clinic and registering
the patient.

2.Unique Identification Number

It is quite difficult to uniquely identify the clinics, doctor and patients, which leads to ambiguity while storing the data. Also we need UNIQUE IDENTIFICATION NUMBER to search and find any particular record. So, for this purpose of UIN, we will be recording the date and time (upto seconds) when the clinic, doctor and patient is registered. And, this date & time is reformatted and used as the Unique Identification Number.

3.Initial Feedback

Now, as the user is registered and UIN is generated, after the check-up from the doctor patient have to fill the first feedback just after that, in clinic itself. To maintain the link of user and their feedbacks, they must enter their UIN, from that it will fetch user details from database. The feedback is reaction based feedback, we have inculcated four reactions:

• Wow
• Ok/Like
• Sad/Poor
• Angry/Worst

Each of these reaction is given a value.
For example,
Wow - 5,
Ok/Like - 3,
Sad/Poor - 1,
Angry/Worst - 0.

The selection of these reactions will lead to entering of numeric values in the database tables. Therefore overall experience will be calculated considering these values.

V. IMPLEMENTATION RESULTS

A. Main Menu

This is the main menu of app which features 4 module: Clinic Page, Doctor Page, Admin Page And Feedback page.
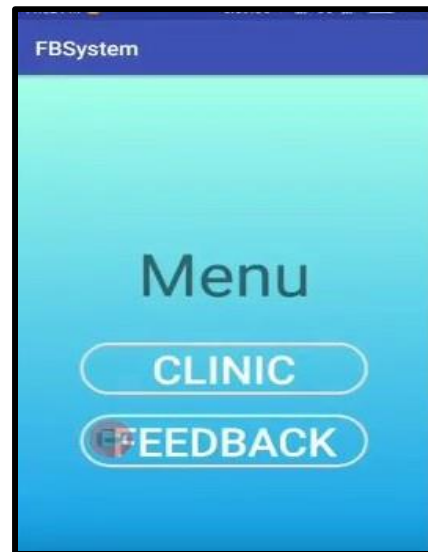
Figure 2.Screen output of main menu

B. Registration

This module have 3 sub modules where firstly the clinic is registered by Admin. Then, doctors related to that clinic is registered. Further, patients are registered upon their arrival.
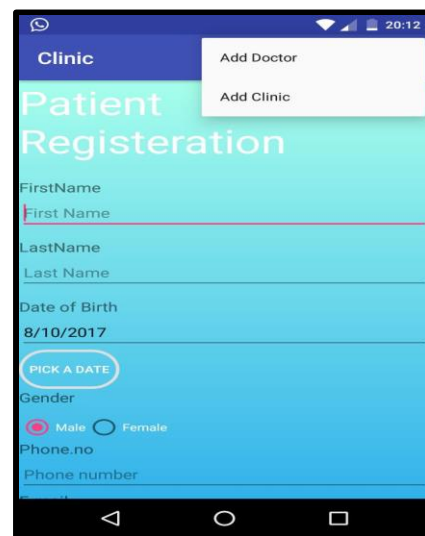
Figure 3.Screen output of Patient Registration

C. Unique ID Generation

In this module a unique identification number is generated for every patient, doctor and clinic upon registration.
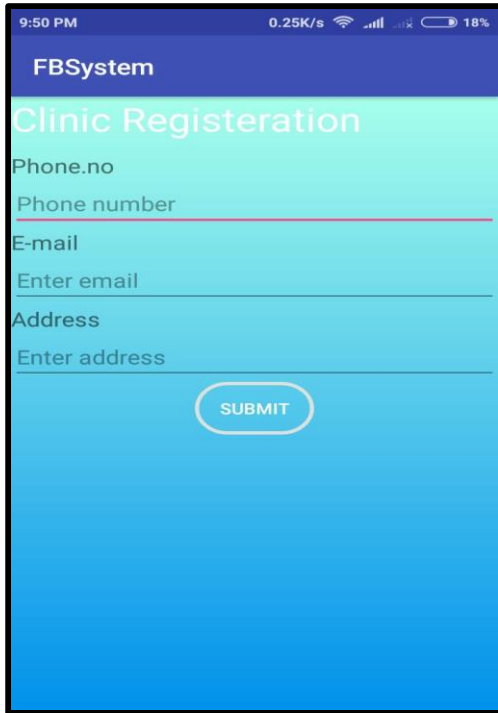
Figure 4.Screen output of Clinic Registration
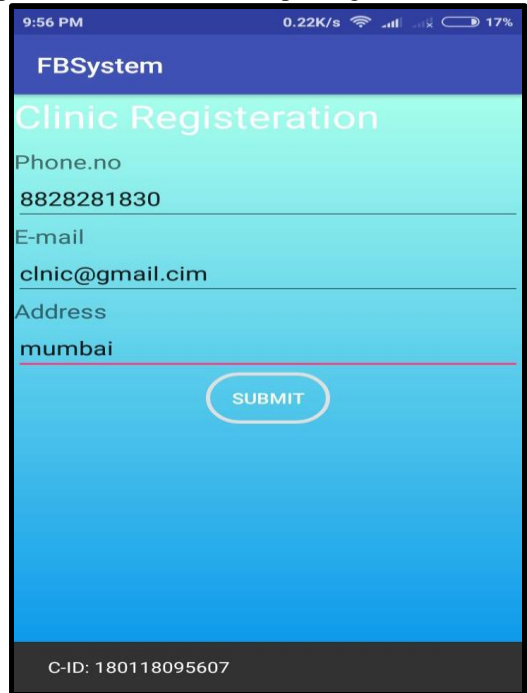
Figure 6.Screen Output of C-ID generation

Figure 5.Screen output of Doctor Registration
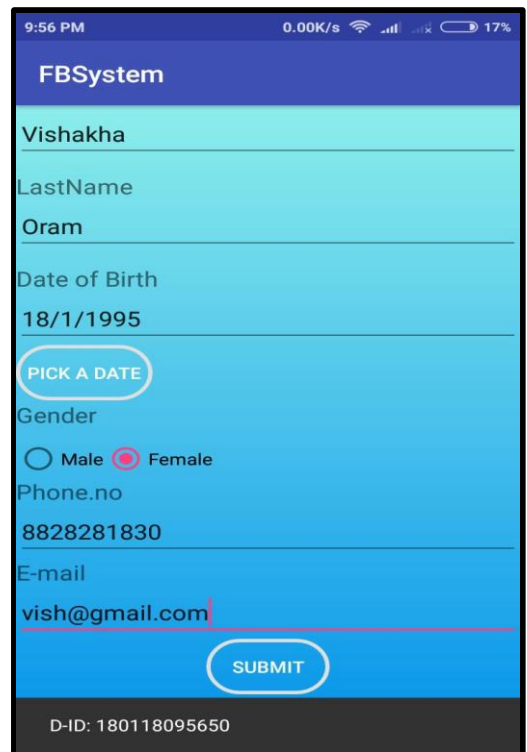
Figure 7.Screen output of D-Id Generation
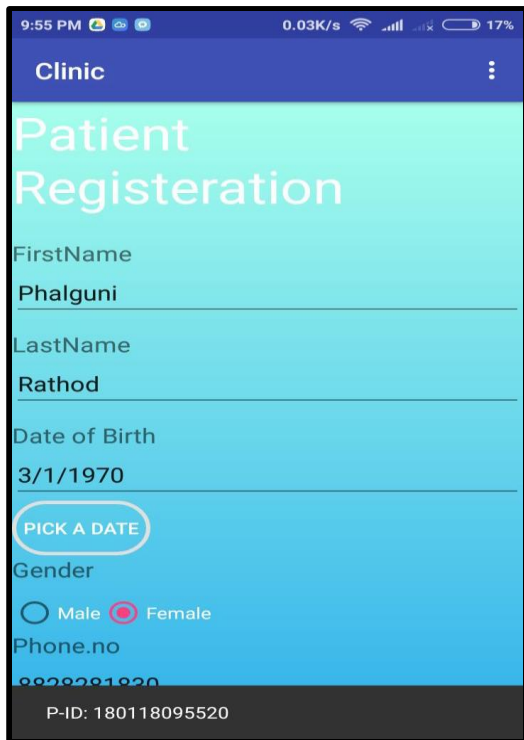
Figure 9. Screen output of feedback form

VI. Conclusion and future work

The to-be system aims at overcoming the problem of improper data management of feedbacks and which facilitates easy SMS based feedback and health monitoring system. The system can analyze the data and can give priority to user's opinion. The future scope of this projects will involve following activities: similar application on other platforms like Apple and Windows, API connections with various application for more ease of use.

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Figure 8.Screen output of P-ID Generation

D. Reaction Based Feedback

In this module, feedback of patient is taken immediately after doctor's checkup. User have to give reaction for every question asked in feedback form.

Rubber Viscosity Variation Reduction Using Advanced Predictive Analytics

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Abstract—**Manufacturing industries are always trying to reduce waste and variability in their production processes and dramatically improve product quality and yield (the amount of output per unit of input). One such industry is of Tyre or Rubber. Manufacturers of tyres face wastage and losses due to large variability in rubber viscosity during manufacturing. This work tries to identify the controllable factors which affect the rubber viscosity during manufacturing using principal component analysis, correlation and varimax rotation. It then attempts to create a predictive model for viscosity using multivariate linear regression. The performance of the model was tested and had a good accuracy. This model was then used to identify the range for the factors to construct a control system such that the viscosity was well within specified limits.**

Keywords—Tyre Manufacturing; Viscosity; Predictive Modelling; Regression; Correlation; Principal Component Analysis (PCA); Varimax Rotation; GRG Non Linear Equation Solver, Range Optimization.

I. INTRODUCTION

Tyre production process is a complex process. It can be broadly divided into the sequence: (1) reception of raw materials → (2) compounding → (3) mixing → (4) inspection of mix → (5) extrusion/calendering → (6) vulcanizing → (7) finishing/inspection. Rather than functioning in isolation, however, the steps in this sequence interact with one another. Briefly, in the first step, the raw materials mainly include natural rubber, synthetic rubber, carbon black, silica, resins and oil, chemical adhesives, sulphur, elastomers, accelerators, anti-oxidants, anti-ozonants, extenders, vulcanizers, pigments, plasticizer, and reinforcing agents. The second step of compounding is the operation of selecting the ingredients to be mixed in a batch of rubber depending up on the intended use of the tyre. The objective may be to optimize performance, to maximize traction in both wet and dry condition, or to achieve superior rolling resistance etc. of the tyre. The third step of mixing of the raw ingredients is done using Banburry Mixer. The aim of mixing is to produce a product that has the ingredients dispersed and distributed sufficiently thoroughly that will process satisfactorily in the next process, cure efficiently and give the required properties for the end application. The fourth step of extrusion is a process used to create objects of a fixed cross-sectional profile. Here, unvulcanized rubber is pushed through a die of the desired cross-section. The fifth step of vulcanizing is done to harden the rubber object by treating it with sulphur at a high temperature. And finally in the sixth step, the rubber object is inspected and finishing is done before shipping.

A. Mixing

It is one of the most critical step of rubber processing. The mixing process outcome happens through multiple stages. Polymer and chemicals are added in multiple stages in the Banbury mixer to get a required compound with specific properties. Depending on quality of tyre to be produced (supreme, mid, low), acceptable ranges for viscosity are specified. Any rubber with viscosity out of specified range is either waste or need to be used in a relatively lower quality rubber. The mixing process outcome is measured through a sampling process of Minimum Viscosity (MV) and the objective is to get consistent Minimum Viscosity with minimum deviation, as any large deviation in the minimum viscosity in any of the stages has an impact on the subsequent stages. Typically, 10% of the batches are sampled randomly for measurement, as measuring viscosity using Mooney Viscometer (Apparatus used to measure viscosity) is a time taking process. It is practically infeasible to have measurements for all batches. Since the Mixing process requires deciding the recipe / formulation which includes raw material-age, raw-material quantity and the interaction for various compounds with sequence, the time, speeds, pressures, temperatures controlling the minimum viscosity within a specified range across the stages is a challenge. It is desirable to know viscosity measurements for all batches correctly before mixing them into the next stage so that wastage is avoided and desired viscosity is obtained within specified limit.

II. RELATED RESEARCH

In order to understand and identify the factors that affect the rubber mixing process and viscosity we went through the work of H. Kondo [3], M. Bousmina [8]et al and Wan Idris Wan Yaacob [9] which were mainly based on physical interaction of the mixer blades and chemical analysis of the additives mixed with the rubber during manufacturing. However, to identify the significant factors from within the collected data surveys of Sorzano et al [1] and Girish Chandrashekar et al [2] were helpful. A good example of factor selection using filter method based on correlation (Girish Chandrashekar et al [2]) and dimensionality reduction using PCA rotation (Sorzano et al [1]) is the work of Bashir HA[6]. Similar approach is used in this paper. Also, many studies that have proposed mathematical or computational models for rubber viscosity variation control during manufacturing, have proposed models which are complex and involve uncontrollable parameters to control the process. For instance, in M. Bratina [5] et al have used neural networks to create a closed loop control system for mixing rubber compounds in internal mixers using uncontrollable parameters

like torque, energy as input to control rotor speed of the mixer. Similarly, L. P. Specht[7] et al only created a predictive model for asphalt rubber viscosity using neural networks based on experimental data. Xiankui Zeng [4] et al created a linear regression based predictive model for viscosity of rubber manufactured on the open mill. As these studies did not create easy to use and parsimonious models for internal mixers like Banburry, to automatically control mixing of rubber in large industries, we intend to make a simple model based on only controllable parameters to handle viscosity such that it is well within specified limit for producing tyres.

III. METHODOLOGY:

The methodology mainly involves creation of predictive model by identifying controllable factors which cause variation in viscosity and then creating a control system which controls these factors such that there is reduction in variation of viscosity. The major steps are -

- Data Collection.
- Factor Selection.
- Model Construction.
- Model Testing.
- Model Equation Solving & Simulation
- Controller Design

A. Data Collection

Predictive models use historical data from previously completed processes to establish mathematical relationships capable of generating estimates for outputs of future processes using their inputs.

A major step of data collection is to select the sample size. In a very general sense, the best way to ensure predictive power in regression is to use a sufficiently large sample size. The data required for the analysis should be available and reasonably accurate. Data correctness, completeness, consistency needs to be ensured.

B. Factor Selection

Developing a parametric model requires a careful selection of the factors that have predictive relationships to the target or response variable (here viscosity). These factors should be identified among more than one hundred candidate factors, which influence during the mixing process. After reviewing previously published research and considering the requirements, it was decided to consider only controllable variables as possible predictors or factors for viscosity. However, due to large number of controllable variables still further selection was required to be done. Similar to the approach in Bashir HA [6] following steps were done to select the factors -

- Generation of the correlation coefficient matrix;
- Extraction of the initial factors using the PCA method;
- Optimization of the initial factors using varimax rotation technique.

- Calculation of absolute product of factor loadings and correlation.
- Selection of variable with maximum product as a predictor.

C. Model Construction

Having identified the predictor variables, regression was performed to get the equation for the model. However, based on significance testing (t test / two-tailed test) variables were further dropped to get the best predictive model with most important predictor variables. In significance testing, p-value for each term tests the null hypothesis that the coefficient is equal to zero (no effect). A low p-value (< 0.05) indicates that you can reject the null hypothesis. In other words, a predictor that has a low p-value is likely to be a meaningful addition to your model because changes in the predictor's value are related to changes in the response variable. Conversely, a larger (insignificant) p-value suggests that changes in the predictor are not associated with the changes in the response variable. Thus, regression was again performed using only significant variables to obtain the model equation.

D. Model Testing

There are a number of objective criteria that can be used for the evaluation of a model. The most widely used criteria include the mean magnitude of relative error (MMRE) and the coefficient of multiple determination (R^2). These criteria are often in disagreement and there is no general acceptance of any specific one. We have also used mean absolute percentage error (MAPE) a slight modification of MMRE and prediction at a given level (PRED(l)) (Bashir HA [6]) to evaluate the developed predictive model.

E. Model Equation Solving & Simulation

GRG Non Linear Equation Solver was used to reduce the initial range of predictor variables such that the response variable was well within specified range. GRG stands for "Generalized Reduced Gradient". It can handle both linear and non-linear smooth functions. In its most basic form, this solver method looks at the gradient or slope of the objective function as the input values (or decision variables) change and determines that it has reached an optimum solution when the partial derivatives equal zero. The solution you obtain with this algorithm is highly dependent on the initial conditions and may not be the global optimum solution. The solver will most likely stop at the local optimum value nearest to the initial conditions (initial ranges of decision or predictor variables), giving you a solution that may or may not be optimized globally. This reduced range was further optimized using few simulations so that the standard deviation of the response variable was as per the six sigma standards.

F. Controller Design

Based on the method of control variates which is used to reduce the variance of an estimator, a control system can be designed which can be used to reduce the variation of viscosity during manufacturing by maintaining the range of factors which

are identified as predictors well within the limit obtained in the previous step.

IV. RESULTS

Due to limitation of the space results of the most significant first stage of the mixing process are described below.

A. Data Collection

Over the period of 2 years, around 10,000 observations and 117 variables were collected for the first stage. However, after data cleaning only 796 observation and 45 variables were left for further steps.

B. Factor Selection

The Pearson correlation coefficients between viscosity and other variables were calculated. Then, the principal component analysis was done on the variables excluding target variable - viscosity. This was different from Bashir HA [6] approach where he had used all variables including response variable for PCA. Based on the eigenvalue greater than or equal to 1 criterion, only 10 factors / components accounted for most of the variation which was 82.74 % of the total variation. Varimax rotation technique was applied on this initial 10 factor matrix to obtain optimized rotated matrix. After rotation, each variable was only related to one of the factors / components and each factor / component had high correlation with only a small set of variables. As shown in "TABLE I", absolute product of variable loading on each factor from rotated matrix and variable correlation coefficient with viscosity was calculated to select the variable with maximum product as predictor variable from each factor.

C. Model Construction

Using the 10 variables selected model was constructed using multivariate regression. But by rejecting 5 variables with p-value > 0.05 final model was constructed as –

$3.0675 * C1412\_QTY + 3.5178 * C1621\_QTY + 1.9518 * \_10RPM\_ - 0.3873 * \_12PRESS\_ + 0.2432 * \_17PRESS\_ - 227.4$ (1)

D. Model Testing

Factor / Component	Variable	Loading	Correlation	Abs. Product
2	_13_RPM	0.9935	-0.24194	0.24036739
	_14_RPM	0.99496	-0.25387	0.252590495
	_15_RPM	0.99477	-0.25475	0.253417658
	_16_RPM	0.99104	-0.25082	0.248572653
	_17_RPM	0.99104	-0.25082	0.248572653
	_4_PRESS	0.86343	0.11577	0.099959291
	_7_PRESS	0.87066	0.11159	0.097156949
	_10_PRESS	0.86206	0.11087	0.095576592
	_16_PRESS	0.8887	0.24553	0.218202511
	_17_PRESS	0.8887	0.24553	0.218202511
3	_3_PRESS	0.77317	-0.12692	0.098130736
	_6_PRESS	0.83023	-0.02269	0.018837919
	_9_PRESS	0.54204	-0.06569	0.035606608
	_12_PRESS	0.91266	-0.11423	0.104253152
	_13_PRESS	0.91366	-0.10933	0.099890448
4	_9_PRESS	0.61785	-0.06569	0.040586567
	_3_RPM	0.9853	0.03518	0.034662854
	_4_RPM	0.96737	-0.01602	0.015497267
	_5_RPM	0.9773	0.02195	0.021451735
5	C1524_QTY	0.7879	0.0944	0.07437776
	C1552_QTY	0.58729	-0.05704	0.033499022
	C1048_QTY	0.80969	0.0441	0.035707329
	C1412_QTY	0.74382	0.16595	0.123436929
	CD491_QTY	0.6959	0.01285	0.008942315
6	_1_PRESS	0.90549	0.02941	0.026630461
7	_9_RPM	0.94269	0.05112	0.048190313
8	_7_RPM	0.82997	-0.02154	0.017877554
9	_10_RPM	0.82189	0.18498	0.152033212
10	_8_RPM	0.95967	-0.04672	0.044835782

TABLE I. FACTOR SELECTION

Factor / Component	Variable	Loading	Correlation	Abs. Product
1	C1621_QTY	-0.98563	0.27815	0.274152985
	C1540_QTY	-0.6968	0.01919	0.013371592
	_11_PRESS	0.96748	-0.28004	0.270933099
	_1_RPM	0.76575	-0.15604	0.11948763
	_2_RPM	0.73934	-0.13918	0.102901341
	_11_RPM	0.8178	-0.17586	0.143818308
	_12_RPM	0.9935	-0.24194	0.24036739

TABLE II. MODEL TESTING

Regression Model		
R-Square	0.1883	
	TRAIN DATA	TEST DATA
MAPE	5.50776089	5.628114
PRED(0.1)	85.91%	86.06%
Naive Model		
R-Square	0	
	TRAIN DATA	TEST DATA
MAPE	6.28088824	6.2286689
PRED(0.1)	82.69%	81.21%

From "TABLE II" it can be seen that the model performs better than the Naïve model and the MAPE is around 5% only. Also, PRED (0.1) > 85% that means, more than 85% of the predicted values are within 10% of their actual values.

E. Model Equation Solving & Simulation

We reduce the range of predictor variables according to the desired range of response variable using GRG Non Linear Equation Solver. The initial constraints for the predictor variables used in solver were obtained from training data. For example initial constraint for _12PRESS_ was that its value was between 0 and 100 as per the training data, but after solving the equation its range was found to be between 85 and 90 for viscosity to be between 58 and 70.

However, with respect to six sigma standard, the standard deviation in the viscosity was required to be 2 only, so that the mean viscosity was 64 and 58, 70 were 3 standard deviation away from the mean. Therefore, we had to use model simulation to further manually optimize the range of predictor variables. For simulation values for predictor variables were drawn randomly using uniform distribution from the range identified by solving the equation in previous step. "TABLE III" shows the final optimized range for predictor variables which result in the mean to be 64 and standard deviation to be 1.982.

TABLE III.   FINAL RANGES

Variable	Min.	Max.
C1621_QTY	2.3	2.4
C1412_QTY	61	63
12PRESS	86	87
17PRESS	35	37
10RPM	59.5	61.5
VISCOSITY	58	70

V.   CONCLUSION

The results clearly show us that the correlation between the predictor variables and the response variables was not much high still the method used to select variables gave us the best predictor variables. Though we have not shown the model comparison with other models, the model constructed using this approach was found to be better than the models constructed using other approaches like forward selection, backward selection, stepwise selection, ridge regression etc. Based on target variable range, optimizing the range of predictor variables using equation solver actually reduces the number of simulations and manual workload of the data scientist. The approach used here can be used by all the industries to create their specific models for product development as per their quality control requirements.

VI.   LIMITATION

The model obtained cannot be generalized. The model cannot be constructed unless there is a pattern of relationships between dependent variable and one or more factors as independent variables. In addition, the model does not take into account unusual situations. It also does not take into account uncontrollable factors which may sometime drastically affect the result. Therefore, it is only useful in a relatively constant environment.

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Widely Used Irrigation Techniques for agriculture in India

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Abstract–**Agriculture is one of the biggest resources of food in this world. Agriculture requires irrigation to be performed on a timely basis. Various irrigation techniques are practiced across the world for irrigation. Indian agriculture widely utilizes three irrigation techniques. This paper discusses and analyzes these techniques. The drawbacks of these techniques are also listed in this paper. In order to overcome the drawbacks of the widely used irrigation techniques in India, wireless sensor network (WSN) concept along with the use of web page is introduced and proposed in this paper.**

Keywords–**Agriculture, irrigation, wireless sensor network (WSN), soil moisture sensor, temperature sensor, microcontroller, Global System for Mobile Communications (GSM), General Packet Radio Service (GPRS), web page.**

I. INTRODUCTION

Mankind worldwide is majorly dependent on agriculture to fulfill his food requirement. Agriculture also has an extensive contribution in the economy of each and every country throughout the world. Besides, agriculture also serves as a source of employment and specifically in India, a considerable amount of population has undertaken agriculture as their means of earning livelihood.

II. PROCESS OF AGRICULTURE

Agriculture is a huge process. It requires a lot of time and consists of various stages. The first and the foremost important stage of agricultural process is planning, where the type of crops to be grown is decided based on different criteria. The next stage is making the agricultural field ready for sowing seeds.

A) Planning

In an agricultural field, numerous varieties of crops are grown throughout the year. Selecting the type of crops to be grown requires planning. This stage of planning is quite essential as the climatic condition of the region where the crops are to be grown should be suitable for the growth of the selected crops. All crops have different requirements for their growth and the climatic conditions play a great role in the growth of crops. That is why it becomes quite important that climatic conditions of the region are apt for the growth of crops. Based on the crop growth requirement, different varieties of crops are grown in different regions. For e.g. in the western region of India, considering the case of Maharashtra state, crops like wheat, chickpeas, cotton, sugarcane, etc. are grown in a huge quantity as the climatic conditions of Maharashtra are quite suitable for the growth of these crops.

B) Preparing the agricultural field for sowing seeds

Once the crops to be grown are selected, preparation of the agricultural field for the purpose of sowing seeds is necessary. An organization of horizontal and vertical lines is made with the help of the tractor throughout the area of field where crops are to be grown. The seeds of the crops are sowed in both the lines of the agricultural field, i.e. vertical as well as horizontal lines.

C) Irrigation

The contribution of irrigation in agriculture is the most vital contribution. Irrigation is basically providing water to the crops through pumps. Without irrigation, the crops cannot sustain their lives.

D) Using pesticides

Different kind of insects cause harm to crops. These insects affect the growth of the crops and many times even make the crops unsuitable for use. To prevent this from occurring, pesticides are used to protect the crops from the insects.

III. WIDELY USED IRRIGATION TECHNIQUES IN INDIA

In our country, water for irrigation is obtained from wells, lakes or any such water body. Besides these water sources, bore water is also used for irrigation. Pump is used as a medium to make the bore water or the water obtained from different water bodies available for irrigation. Pump is situated at a fixed position near these water bodies and using pipes and motor, water reaches to the crops at the agricultural farms. Three phase electricity is required for the motor to work. In villages of Maharashtra, where agriculture is carried out, electricity is available only for 8 hours each day. The pump switch is either kept off or on auto cut-off mode. Auto cut-off mode of the pump's switch means it works according to the availability of power supply i.e. when electricity is available, the pump will start providing water and as soon as the electricity supply is gone, the pump will stop. Pipes are attached to the pump through which water for irrigation reaches the agricultural crops. Depending on the water holding capacity of a particular crop and the availability of water, irrigation is carried out by the farmer. For example, if the farmer feels that a particular crop can survive without water for two days, so he provides that particular crop with water only after every two days and meanwhile in this gap of two days, the farmer utilizes the water for other type of crops and follows this routine of irrigation. Indian irrigation widely uses three types of irrigation techniques i.e. mud digging technique, sprinkler technique and drip irrigation technique.

A) Mud digging technique

In this technique, small sections of field are taken one at a time for irrigation. For e.g. if a section of two vertical lines consisting of the sowed crop seeds is taken for irrigation, then the surrounding mud from the horizontal lines will be dug and removed. After the irrigation process is finished, the removed mud will be again put back into place. This process shall be repeated for each line in the agricultural field consisting of crop seeds to be irrigated. This is important to be done in this irrigation technique to make way for the water to reach the place where it is actually required to reach, i.e. the soil and roots of the crops. If the water is just left into the agricultural fields without the process of digging and removing the mud before the start of irrigation and again putting it back in place after irrigation, then the water might just not reach all the crops. Few crops might remain without water. Hence to avoid this scenario, the labour work of digging and removing mud and putting it back into place is done each time during irrigation. In this technique, a large amount of water

gets wasted during irrigation, which is a major disadvantage. The significant advantage of this technique is that, the cost requirement of this technique is quite low.

B) Sprinkler technique

Another irrigation technique which is widely used in India is the sprinkler technique. In this technique, sprinklers are attached to the pipes as per the requirement. These pipes are laid across the field. On switching on the pump, the water for irrigation is provided to the crops through pipes via sprinklers. This technique requires additional pipes and sprinklers which is expensive as compared to mud digging technique but the amount of water that gets wasted in this technique is less as compared to mud digging technique. Also, the labour work required in this technique, which is the installation of additional pipes and installation of sprinklers is less, as compared to the labour work required in mud digging technique i.e. removing the mud and putting it back into place, each time during irrigation, as explained above.

C) Drip irrigation technique

For this technique, pipes are laid across the whole field, wherever it is required. Holes are made at regular intervals throughout the length of the pipe. When the pump is switched on, water through the holes of the pipes reaches the crops for irrigation. This technique increases the cost of irrigation due to requirement of additional pipes but the wastage of water in this irrigation technique as compared to the other two techniques i.e. mud digging technique and sprinkler technique is very less. Besides, the pipes once purchased, have long durability and do not need to be replaced for a very long time. The labour work requirement in this technique i.e. installation of additional pipes, is the least amount of labour work to be done as compared to other two techniques of irrigation.

Among these three irrigation techniques, drip irrigation technique seems to be a superior technique as it provides advantages over the other two techniques. Drip irrigation has the least amount of water wastage as compared to other two techniques and the labour work requirement in this technique is also very less. Although it has the drawback of high cost due to requirement of additional pipes but, as explained earlier, the pipes have long durability and it does not require replacement till a very long time. So, its drawback of having high cost can be neglected. Table I below shows the comparison of pros and cons of mud digging, drip and sprinkler irrigation techniques.

TABLE I. COMPARISON OF PROS AND CONS OF WIDELY USED IRRIGATION TECHNIQUES IN INDIA

Widely used irrigation techniques in India	Pros	Cons
Mud digging	Low cost	Requires a lot of labour work and a large amount of water is wasted
Sprinkler	Doesn't require much labour work	Cost is high and water wastage also takes place
Drip	Water wastage is very less compared to other two techniques and also the labour work is very less	Cost is high

IV. CASE STUDIES OF MUD DIGGING, DRIP AND SPRINKLER IRRIGATION TECHNIQUES WITH RESULTS

In order to get a better understanding of mud digging, drip and sprinkler irrigation techniques, let us consider their case studies with results. Mahatma Phule Krishi Vidyapeeth at Rahuri in Maharashtra state conducted a study on drip irrigation. They grew five different types of crops using drip irrigation method and mud digging method and compared their results with each other. The mud digging technique of irrigation is also called as traditional technique or traditional method.

Table II shows the types of crops grown at Rahuri, the amount of water applied in centimetre (cm) using the traditional as well as drip irrigation method and yield of crop in quantity per hectare (q/ha) using both the irrigation methods i.e. tradtional and drip irrigation. Also the table shows water use efficiency (W.U.E) in kilogram per hectare per centimetre (kg/ha/cm). Along with this, the water saved by using drip irrigation and increase in yield of crops in terms of percentage using drip irrigation as compared to the traditional irrigation method is given in this table. In this study, for the drip irrigation system used, a pressure of 0.5 kg/cm is applied in the laterals of the drip system. From the results seen in above table II, it is clearly evident that for all the different types of crops grown in this study, around 30 to 60 percentage

of water is saved using drip irrigation as compared to the traditional or mud digging method of irrigation. The yield of the crops also increased for about five to twenty four percent for different crops grown at Rahuri using drip irrigation method as compared to the traditional irrigation method. Thus, on basis of this case study and their associated results, it can be rightly stated that, drip irrigation is more beneficial than the mud digging irrigation method.

TABLE II. WATER APPLIED, YIELD, WATER USE EFFICIENCY (W.U.E) AS INFLUENCED BY DIFFERENT METHODS OF IRRIGATION FOR DIFFERENT CROPS AT RAHURI

S. No.	Crop	Water applied in cm		Yield (q/ha)		W.U.E. (Kg/ha/cm)		Water saving by drip over traditional method (%)	Increase in yield by drip over traditional method (%)
		Traditional method	Drip method	Traditional method	Drip method	Traditional method	Drip method		
1	2	3	4	5	6	7	8	9	10
1.	Cotton	89.53	42.00	22.55	28.46	25.19	67.76	53.00	26.0
2.	Lady's finger	219.86	113.32	189.02	203.41	85.97	179.50	55.00	8.0
3.	Tomato	29.70	20.84	164.00	171.86	552.19	824.66	27.0	5.0
4.	Brinjal	90.00	42.00	28.00	28.00	31.11	66.67	55.8	-
5.	Sugarcane	231.00	162.20	1,220.90	1,464.10	5,285.3	9,026.51	30.0	10.0

Source: Indian National Committee on Irrigation and Drainage (INCID), 1994 [12].

To understand sprinkler irrigation method more clearly let us consider the case study of sprinkler irrigation.

TABLE III. PERCENTAGE INCREASE IN YIELD OF DIFFERENT CROPS USING SPRINKLER AND DRIP IRRIGATION

S.NO.	Crop	Sprinkler	Drip
1.	Coconut	14	29
2.	Coffee	17	39
3.	Sugarcane	11	20
4.	Vegetables	9-30	20-80

Source: A.H.Padhye, Proceedings of International Congress on The Use of Plastics in Agriculture, 1989 [13].

A survey was carried out at all India basis for comparing the sprinkler and drip irrigation method. As seen in results from above table III, the increase in yield of crops in terms of percentage in the case of drip irrigation is almost double as compared to sprinkler irrigation. Hence, drip irrigation can evidently be considered as a superior irrigation technique as compared to mud digging and sprinkler irrigation technique.

V. DRAWBACKS OF CURRENT IRRIGATION TECHNIQUES USED IN INDIA

A) Water gets wasted on a large scale during irrigation.

B) Crops receive water based on farmer's estimation, observation and understanding and not according to their actual requirement.

C) Labour work is required.

VI. INTRODUCTION OF WIRELESS SENSOR NETWORK (WSN) BASED IRRIGATION TECHNIQUE USING WEB PAGE

To overcome the drawbacks of current irrigation technique used in India, WSN conept along with web page can be introduced into agriculture. As explained above, among the three widely used irrigation techniques in India, drip irrigation seems to be a superior irrigation technique due to its advantages over the other two irrigation techniques i.e. mud digging technique and sprinkler technique. Although this technique seems to be superior to the other two techniques, it still requires improvement, so that water wastage can be completely eliminated. In order to improve the existing drip irrigation technique, this technique should be used with the proposed system.

The proposed system constitutes of three sections. Wireless sensor section (WSS) is the first section, wireless controller section (WCS) is the second section, while the receiver section is the third section. The block diagram of WCS, WSS and receiver section is as shown below in fig. 1, fig. 2 and fig. 3 respectively. The agricultural site, where the crops are grown shall consist of the WSS. The WSS consists of solar panel, temperature sensor, soil moisture sensor microcontroller and Global System for Mobile Communications (GSM) module. The WCS consists of solar panel, relay, motor, Global System for Mobile Communications/General Packet Radio Service (GSM/GPRS) module and microcontroller. The receiver section constitutes of GPS/GPRS module, a PC or laptop with internet connection.

A) Use of WSN in agriculture

The soil moisture content and the temperature of the soil will be sensed using FC-28 soil moisture sensor and DS18B20 temperature sensor. The sensor data will be transmitted using GSM SIM300 configuration of GSM module. The GSM/GPPRS module SIM900A will receive the data at the WCS and will give the data as input to the microcontroller. ARM7 LPC2148 microcontroller shall be implemented in this proposed system. The reason behind using temperature sensor and soil moisture sensor is to

sense the soil moisture content and temperature of the crops in real time. Threshold values for the sensor shall be programmed in the microcontroller. The role of solar panel will be to provide power supply to the WCS. GSM/GPRS module shall send the sensor values and alert message regarding the start of irrigation process via short message service (SMS) to the farmer.

B) Role of web page

The information that will be sent via SMS, will also be displayed on the web page through the internet connection. Besides, the sensor values shall regularly be updated on the web page. The web page will enable real-time continuous monitoring of the sensor values. When the threshold value of the sensor will be reached, the relay shall give an indication signal to the motor to start the pump.
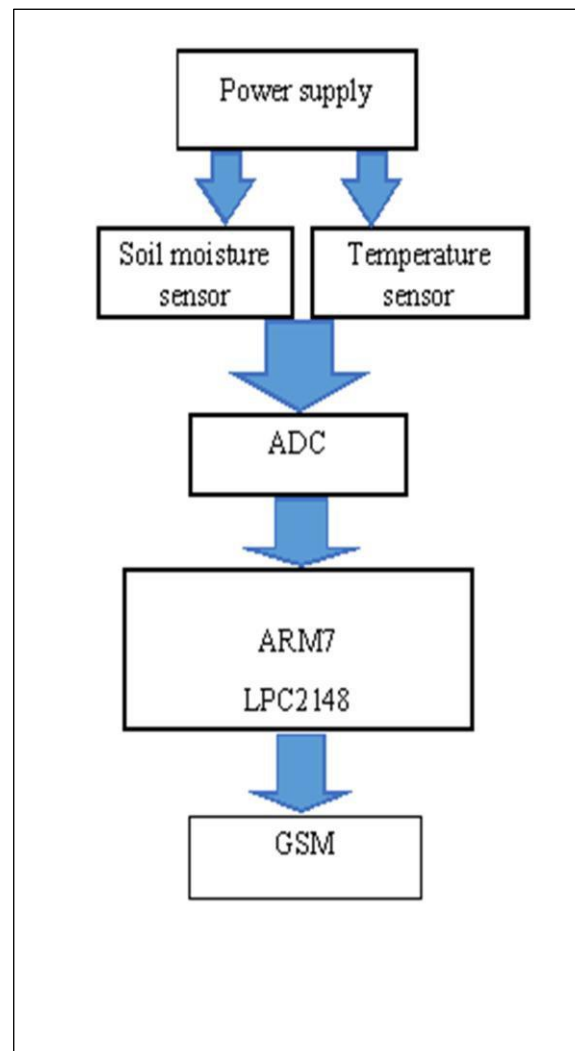
Fig. 1. Block diagram of WSS.
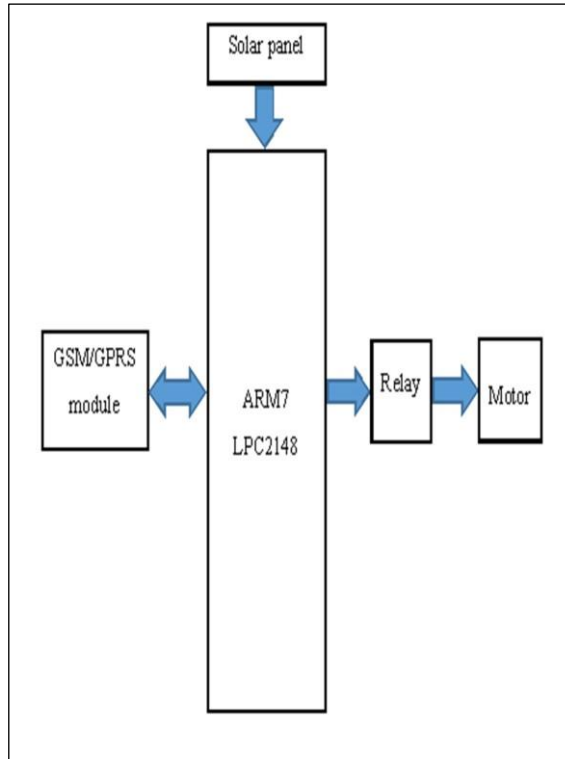
Fig. 2. Block diagram of WCS.
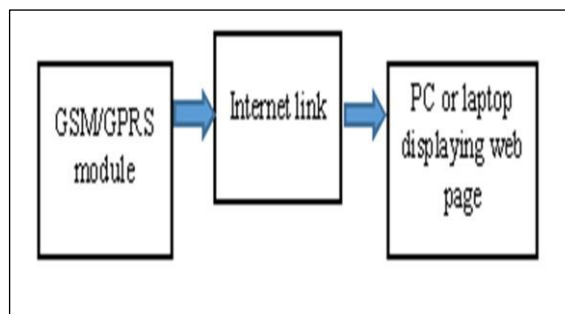
Fig.3. Block diagram of receiver unit.

VII) ADVANTAGES OF WSN BASED IRRIGATION TECHNIQUE USING WEBPAGE

A) Irrigation will be performed automatically based on the based sensor value.

B) Irrigation can also be started by just sending a short message service (SMS).

C) Parameters of crops i.e. soil moisture and temperature values can be continuously monitored through web page.

VIII. CONCLUSION

The widely used irrigation techniques in Indian agriculture have certain drawbacks. Due to presence of drawbacks, these techniques do not seem to be the best suitable techniques to be used for irrigation in agriculture. The proposed concept of WSN along with the use of web page showcases enormous benefits over the currently used techniques for irrigation in Indian agriculture. The proposed system shall overcome all the drawbacks of the irrigation techniques used at present in India.

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MOBILE APPLICATION FOR VOLUNTEER MANAGEMENT USING COLLABORATIVE FILTERING TECHNIQUE

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Abstract—**As per companies act it is mandatory for any organisation to plough back 2% of their profit for betterment of society. Due to this a large number of volunteers are engaged in different CSR activities. The problem that is being faced is that management is not up to the mark when events are to be conducted. The solution that we propose is an end to end real time application with modules that will notify volunteers about upcoming events, volunteers can log their attendance through the app, check locations using maps incorporated in the app and also provide feedback for the events attended. Collaborative Filtering engines are more versatile, in the sense that they can be applied to any domain, and with some care could also provide cross-domain recommendations. Collaborative engines need item metadata, so they require domain modeling and their extension to different domains is an issue. And hence any and every data of volunteer available would be compared to other volunteers using collaborative filtering and specific events will be recommended to the volunteers in the application developed.**

Keywords—Collaborative Filtering; Data Mining; Recommendations; Volunteer (key words)

I. INTRODUCTION

Data mining is used for finding and computing patterns in large sets of data. The main aim of data mining is to extract information that is useful from data sets and structure it for further use[9]. Collaborative Filtering(CF) is used by recommender systems and is used for making automatic predictions about interest of users by collecting likes, dislikes and preferences of many users[10]. In general sense collaborative filtering is the process of filtering or sorting information using methods which involve collaboration of multiple agents, viewpoints, data sources etc. Hence we propose use of Collaborative filtering to solve the proposed problem.

II. LITERATURE REVIEW

The statistical data mentioned on CSR portal of organizations like TCS states that volunteers invested their 58,362 hours in volunteering different activities that reached 57,90,604 beneficiaries[12]. TCS has made 42 global partners and spent Rs 51.39 crores on 22 key global programmes.[12]

Whenever a CSR activity like cleaning a lake, teaching students or awareness events takes place a lot of volunteers are needed. To manage them via manual attendance sheets and tracking their records manually would create a lot of wastage of time and energy. If a system that notifies volunteers of upcoming events, log their time spent in volunteering and ask them for their feedback for how the event could be more successful and also show the images and data related to previous events can be developed it would boost the morale of volunteers and also help the organizations to manage the volunteers by generating annual participation records.

In recommendation system collaborative filtering is a widely accepted approach for recommendation generation[1]. Some of the popular websites that use collaborative filtering are www.amazon.com, www.technorati.com and www.flickr.com[11]. Collaborative filtering systems recommend items based on similarity measures between users

and items. This approach is based on the ideology that similar users prefer similar items and uses tags as the implicit data used for recommendation generation. An interesting direction for encouraging tagging in a "Recommendation System" approach is where a user uses the metadata in the form of content or a word to define its interest in item(s)[11].

The existing technologies available in market are either android applications or websites. They either serve volunteering purposes or administrative purposes.[13] Volunteering purposes means that volunteers can find events related to their choices and then they attend it on their will. Administrative solutions means that the data related to events are processed and stored in database for future purposes. There is no application existing in market that links both volunteering and administrative modules together. The current features and modules of existing applications are as follows:

(1) Administrative Analysis

(2) Tracking or Analysis of Volunteers

(3) Attendance based recommendation

(4) eg:E-volunteer, LocalCoordinators[13]

III. PROPOSED METHODOLOGY

The proposed methodology for this project is explained as follows: There are two modules one for the volunteers, let us call them Users. Another for people managing volunteers, let them be called as Admins. The users will give inputs like comments, images, and suggestions on previous events. The Admins would notify the volunteers about the upcoming events and track their attendance for the same. The Users would also be provided with graphical participation data on yearly basis by using the Graph API for android and also volunteers would be notified about the events of their specific interests based on their participation records. Besides these facilities we would like to add some features like goal setting and tracking and badge popups as rewards after achieving the goals. For tracking the attendances we would be using the Google location API to avoid manual attendance. The web application will be used to track attendance, problem correction like attendance not marked, if any and analysis purpose by the Admins to take required actions. Now from all the data that would be gathered we will use collaborative filtering technique to recommend various events to the volunteers registered with the app.
The modules included in the project are:

1.Modules for Volunteer:
   (a) Registration and Login
   (b) Checking updated events
   (c) Registering for an event
   (d) Logging attendance using app
   (e) Checking locations using inbuilt map
   (f) Providing Feedback of Events

2.Modules for Admin:
   (a) Check volunteer registrations
   (b) Update & Remove events
   (c) Notify using Firebase
   (d) Check attendances recorded for any event
   (e) Check Feedbacks for events happened
   (f) Checking output of recommender system

A.   Data Structure
The data structure we propose consists of two lists: an event list, and user list. Event list plays a role of indexing by using event ids.. For each event user list stores pairs of volunteers their preferences of events and feedbacks for events attended. For a target user proposed method finds similar volunteers efficiently by using this data structure. First it identifies the data of user list of target volunteer. Then we find the volunteers with similar data in user list. Finally it computes similarities of target volunteer to volunteers retrieved from user list.

B.   Algorithm
The simple algorithm we use for design of recommender system is as explained below:

Algorithm: To calculate R

Input: U, E

Output: R

1: for i= 1 to U.length():

2:      for each j in E:

3:          S(i)=Euclidean_distance(Ui,Ej)

4:      end

5: end

6: sort_similarity(S)

7: top_n=S.get(n)

8: R= Recommend(Ui, E)

Figure 1: Algorithm

U: Set of users in data set with information like name, email, mobile number, location, preferences, feedbacks of events attended previously.

Ui: i'th instance of U

E: Events

T: Threshold value

S: Set denoting similarity between the users in dataset and Q.

A list of n best events for a volunteer is accumulated based on profiles in U having similarity higher than threshold value.

The formula for Euclidean distance is given below:

$$d(\mathbf{p}, \mathbf{q}) = d(\mathbf{q}, \mathbf{p}) = \sqrt{(q_1 - p_1)^2 + (q_2 - p_2)^2 + \cdots + (q_n - p_n)^2}$$

$$= \sqrt{\sum_{i=1}^{n}(q_i - p_i)^2}.$$

Where p, q are two different vectors containing data from user list and event list as described in Data Structures section i.e III-A . Euclidean distance between p and q is denoted by d.

Now, in our problem the event recommended to a volunteer depends on the events he/she has prefered to volunteer in, thus in this scenario 2 volunteers would be most similar if the distance between them were least (i.e. similar values in all attributes) and similarly 2 volunteers would be very dissimilar if the difference in the magnitude was huge.

Thus, it can be easily inferred from the above definition, the Euclidean distance metric fits our problem perfectly.

C. Use Case Diagram

The use case diagram for the volunteer application and admin application (volunteer app is an android application and admin app is a web app) is as shown below:
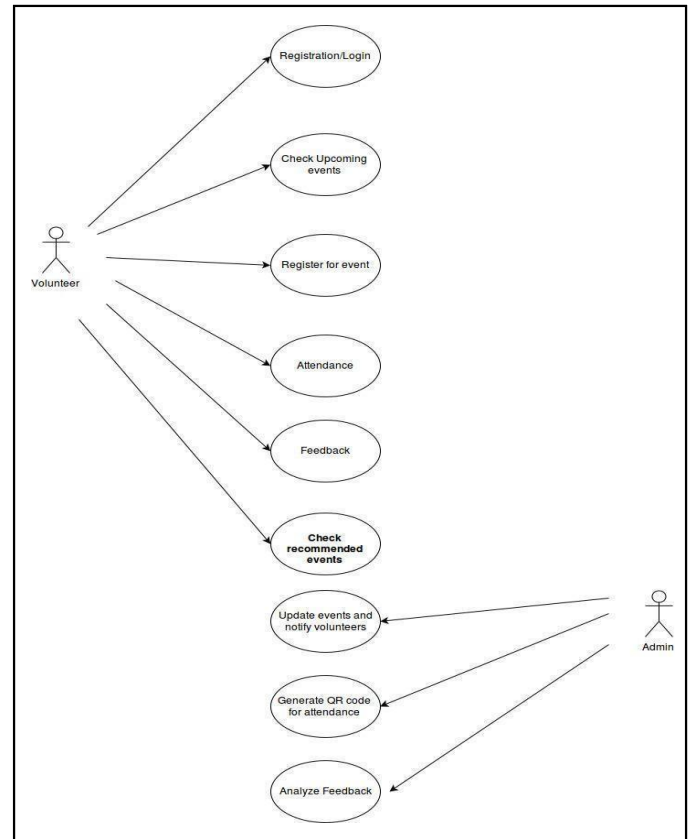
Figure 2: System Use case diagram

The use case diagram shown above displays two user i.e volunteer and admin. The activities that can be performed by volunteer and admin are shown by connecting the users to activities.

IV. RESEARCH CHALLENGES

A. User Cold-Start problem
When a new user enters in the system, he has rated no or only few items so it becomes very difficult to find similar users and therefore, degrades the quality of recommendations[7].

B. Item Cold-Start problem
When new item arrives in the system, less number of users have experienced or rated that item[7]. When less rating data are available, CF approaches fails to predict the similarity between items. This is a cold-start for new items as rating for new items cannot be predicted and therefore, system will not be able to recommend new items till some people have rated it[2].

C. Sparsity
Collaborative filtering approaches depend solely on rating database whether to predict similarity between user/item or to train a model[7]. Most of the items are experienced by only a few users therefore, user-item matrix formed is extremely

sparse due to insufficient rating data which makes algorithms inefficient to measure similarity between users[3]. One of the reasons for sparsity is huge item-to-user ratio.

D. Scalability

As system gets mature with time, number of users and items increases, leads to millions of ratings which results in slow computations and degrades the quality of recommendation system[7].

VI. CONCLUSION

The application we are developing is a generalised and customizable application as we have used simple principles and easily modifiable code work. It can be used by any college committee, office department or any college department. Hence due to simple architecture the app can be taken to any imaginable levels. The recommendation engine part using collaborative filtering can also be used at any platform where maintaining user interest is must in organization or groups. Collaborative Filtering engine works best when the user space is large and hence we propose to increase accuracy of the recommendations considering large amount of data and multiple attributes of user.

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Automated System for Malaria Parasite Detection

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Abstract-- **The traditional method involves detection of malaria under microscope which takes few hours and also highly trained professionals. The proposed method involves detection of malarial parasite by using segmentation and morphological operations. The feature extraction of all the blood cells present in the smear will take a long time. In this paper, k-means algorithm is used for segmentation and we apply feature extraction only to the infected cells and obtained results to detect malarial parasite faster. The proposed automated system for Malaria Parasite detection is implemented in MATLAB to provide the count of malaria parasite infected cells. The total number of malaria infected RBCs are counted and calculated in percent with respect to total number of RBCs present in a blood smear. Watershed algorithm is also used for segmentation.**

Keywords-- **Malaria parasite, segmentation, infected cells, RBC .**

I. INTRODUCTION

Malaria is responsible for nearly one million deaths worldwide in a year according to WHO. Majority deaths occur in Africa. This happens because of the poor environmental conditions that are suitable for breeding mosquitoes. Automation is needed in this area to obtain the results faster and to avoid human error. The automated detection involves various stages as image acquisition, preprocessing, segmentation, feature extraction, morphological operations.

II. LITERATURE REVIEW

The detection of malaria stages is studied[1]. The detection of malaria parasite is done using forward curvelet transform[2]. The feature extraction is done for preprocessed blood smears and clusters are formed by grouping into classes as infected and non infected malaria parasites[3]. The concept of artificial neural network can be applied for detection of malaria parasite[4]. Ncut algorithm is also studied[5]. The various edge detection operators are also studied[6]. Various image segmentation techniques with their advantages and disadvantages are studied[7]. Two algorithms are implemented together which are binarzation and morphological operations. Also color based segmentation is done[8]. For implementation of Normalized Cut algorithm, FGPA based architecture is used[9].

III. PROPOSED SYSTEM

The flow diagram of the proposed system is shown below in Fig 1. The various stages in the proposed system are image acquisition, preprocessing of blood smears, segmentation using watershed feature extraction and morphological operations. The preprocessing is done using filtering. The blood smears are preprocessed and used for segmentation.

Segmentation is performed on the preprocessed image. Algorithms like k-means, watershed can be used to perform this operation. Depending on various colors present in the image, formation of clusters can be done since the non-infected cells are of purple color but the infected cells are of blue color.

Sobel operator is a gradient edge detector can also be used for thresholding. The watershed algorithm is used for the segmentation of foreground cells from background in the image.
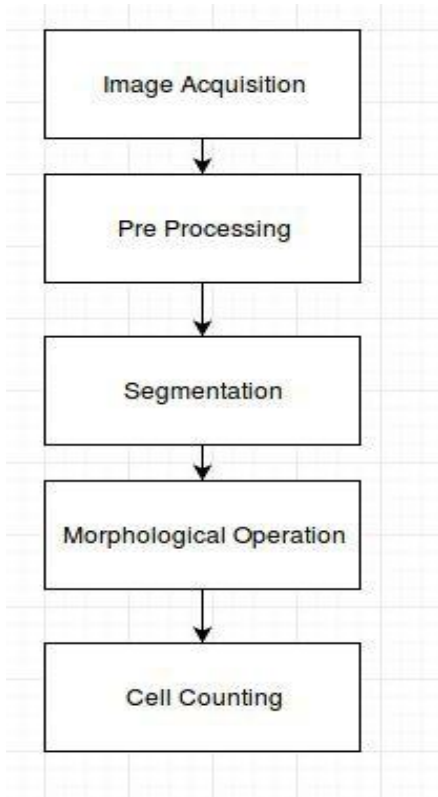
Fig. 1. Flow Diagram of Proposed Methodology

Once malaria parasite is detected, morphological operations are applied to achieve accuracy. Then area opening, gradient masking and dilation is performed on the image. Also, to detect and count all the cells of the image holes filling is performed. Also, adaptive histogram is performed. And finally the masked image is obtained for analysis and detection of the image. As per the experiments it is concluded that most of the pixels within the parasite region have threshold less than 130.

Finally, counting of total RBC's and infected cells is performed. Analysis is done, based on the count of number of cells. If the infected cells are detected, result is positive else negative. Also, based on the shape, analysis is performed.

IV. IMPLEMENTATION

The proposed system has been implemented using MATLAB.The standard database for the system is build using the images taken from CDC [10]. The system flow is shown in Fig. 2
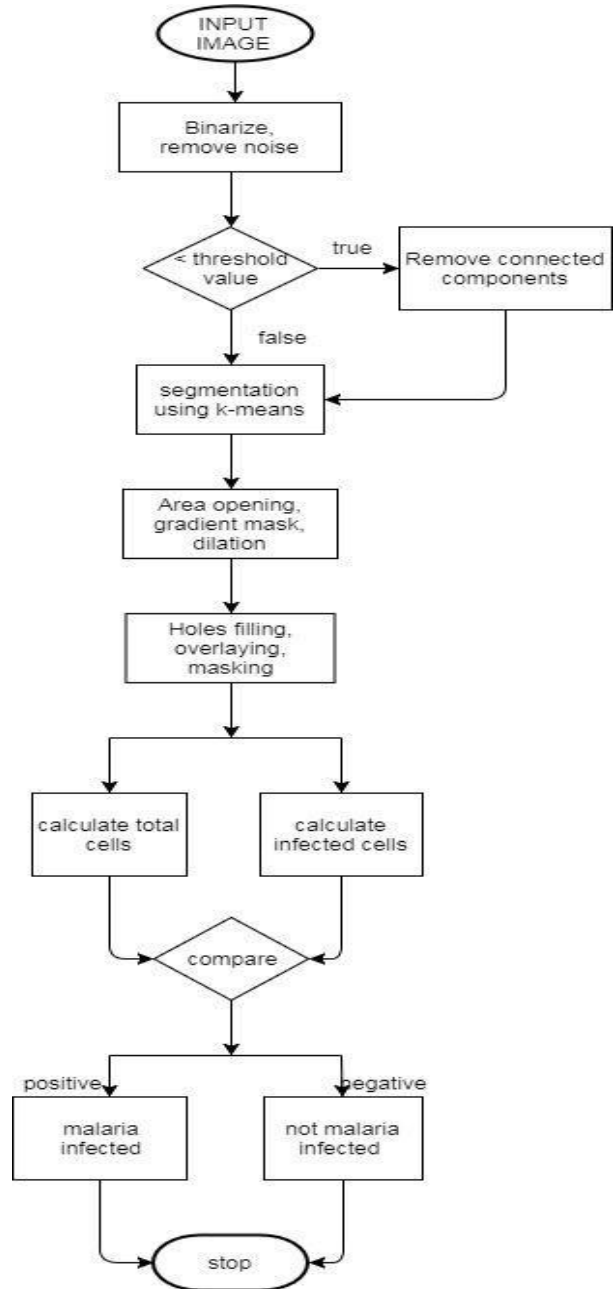
Fig. 2. Flow chart of the proposed methodology

A. Algorithm:
The steps are given below for this proposed algorithm.

Step 1: Stained blood smear images are taken as input from Centre for Disease Control website.

Step 2: Binarize the image and remove the noise using median filter.

Step 3: Remove all connected components (objects) that have fewer than a threshold of pixels from the binary image.

Step 4: Images are segmented by using K-means and watershed algorithm.

Step 5: Area opening, gradient mask and dilation is performed on the image.

Step 6: Holes are filled and adaptive histogram is performed.

Step 7: Image is masked.

Step 8: Total number of cells and infected cells are counted.

Step 9: Malaria is detected, if infected cells are present.

V. RESULT

The image results are displayed for the proposed method. The input images are shown in Fig. 3 and Fig. 11. Fig. 4 and Fig. 12 are the results of preprocessing with different stages as RGB to grayscale conversion, median filtering and histogram equalization for respective input images. Fig. 5a and Fig. 13a represent blue plane extraction of the preprocessed image whereas Fig. 5b and Fig. 13b are the results of the purple cells extraction which helps us to find the infected cells. Fig. 6 and Fig. 14 are the output images after noise removal and intensity adjustment needed for the segmentation. Fig. 7 and Fig. 15 are the output images of segmentation using k-means with the clusters. Fig. 8 and Fig. 16 are the output images of segmentation using Watershed algorithm .Fig. 9 , Fig. 10, Fig. 17, Fig. 18 are the output images of morphological operations where we perform area opening, gradient mask, dilation, holes filling and adaptive histogram. After which number of total cells and infected cells is calculated and shown in table 1.
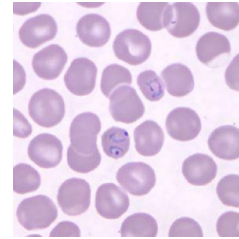
Fig. 3. Input Image 1

Fig. 4.a. Grayscale Image, b.Filtered Image, c.Histogramed Image

Fig. 5.a. Extraction-1, b. Extraction-2
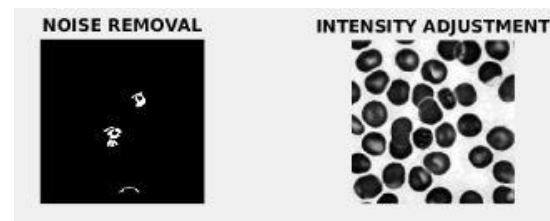
Fig. 6.a. Noise removal, b. Intensity adjustment
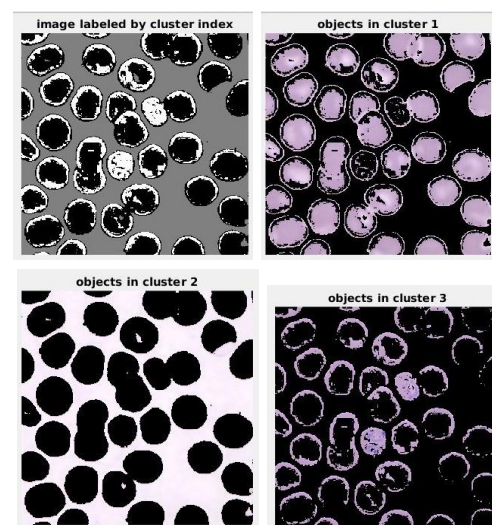
Fig. 7.a. Segmentation using k-means, b. Cluster-1, c. Cluster-2, d . Cluster-3
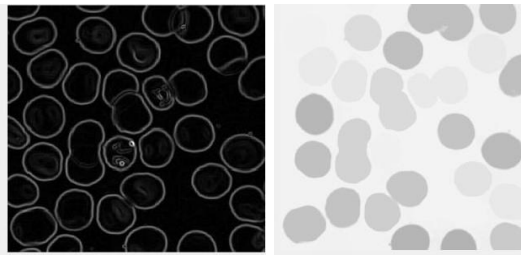
Fig. 8.Segmentation using Watershed

Fig. 9.a. Area opening, b.Gradient mask, c.Dilation
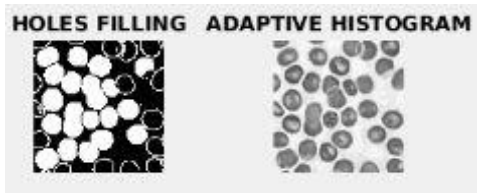
Fig. 10 a. Holes filling, b. Adaptive histogram
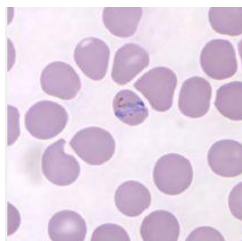
Fig. 11. Input Image 2
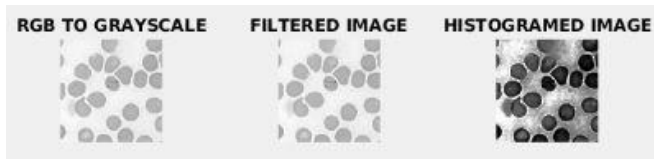
Fig. 12.a. Grayscale Image, b.Filtered Image, c.Histogramed Image
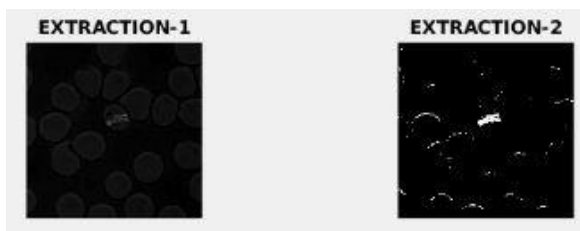
Fig. 13.a. Extraction-1, b. Extraction-2
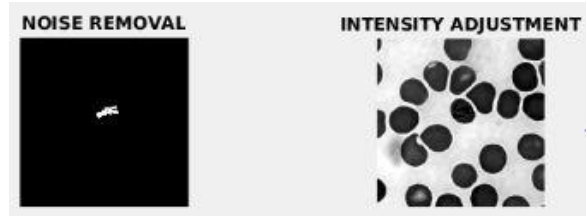
Fig. 14.a. Noise removal, b.Intensity adjustment
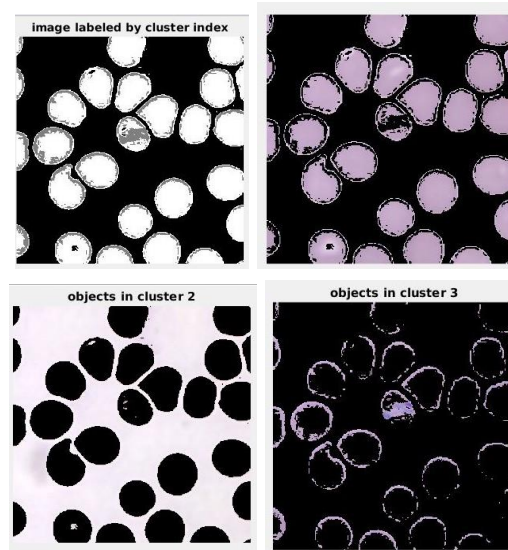
Fig. 15.a. Segmentation using k-means, b. Cluster-1, c. Cluster-2, d . Cluster-3
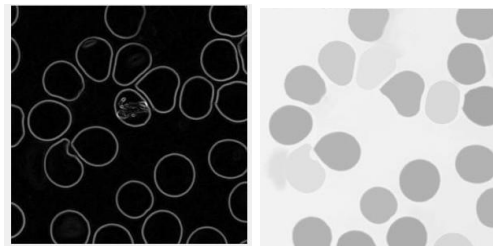
Fig. 16 .Segmentation using Watershed

Fig. 17.a. Area opening, b. Gradient mask, c. Dilation

Fig. 18.a. Holes filling, b. Adaptive histogram

Table 1. Result Analysis

	Input 1	Input 2
Percentage of infected RBCs	22.22%	14.28%
Number of total RBC count	14	12

As table 1 shows percentage of infected RBCs, malaria parasite is detected for given image.

VI. CONCLUSION

Automated system for malaria parasite detection is successfully implemented in MATLAB. The standard database of blood smears is input to the proposed system. The malarial parasite infected cells are detected. It also provides count for infected RBCs. The detection of malaria parasite is done using k-means algorithm for segmentation and features are extracted only for infected cells. The image results are displayed. The percentage of infected cells is also calculated. The result of segmentation using watershed algorithm is also displayed. In future, automated malaria parasite detection algorithm using watershed algorithm will be implemented and results will be compared with the present method.

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Learning Aid For Autistic Children

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Abstract—**Autism or Autism spectrum disorder(ASD) are terms related to the mental condition that affects the neurological development of the brain. The word 'spectrum' refers to a range of conditions that are found in people diagnosed with it. Symptoms of autism are seen from early childhood. They could be difficulties in social interaction, communication, having repetitive behaviors, less attention span and hyperactivity. There is no specific cure for autism but there are medications which can help them to improve, such as certain therapies and medical interventions. Also, autistic children are attracted to technology such as mobile gadgets. Such technology could help them in learning certain things that they are not able to learn so easily. So, with proper guidance of parents or therapists, children would be able to learn various concepts at their own pace. Making it entertaining, this technology can be useful in the treatment of autistic children. So, the aim of the project is to develop a phone application which could help autistic children in learning new concepts. The project would aim to cover as many challenges as possible faced by them and try to provide solutions that would benefit them. The application would work on Android devices.**

Keywords—**Autism, Autism Spectrum Disorder, ASD, Disability, Learning Aid, Mobile Application.**

I. INTRODUCTION

Autism, or autism spectrum disorder, [1]refers to a range of conditions characterized by challenges with social skills, repetitive behaviors, speech and nonverbal communication, as well as by unique strengths and differences. Some of the individuals with the autism have extraordinary skills in visual abilities, music, academics and many more. Many autistic people pride themselves about viewing the world in their own fascinating ways. But there are many who have severe disability, cannot live independently and require special attention. Approximately, 25 percent of the people having Autism spectrum disorder are verbally weak but are able to learn other ways to communicate.

The aim of this project is to improve the lives of those having Autism spectrum disorder. ASD is an early childhood disorder. Parents are not able to detect that in the early stage. If found in the earlier stages, it could be beneficial for the children. Some developmental delays associated with ASD can be identified and addressed even earlier. The project aims to help autistic 'children' in their early stages. It is meant to address the considerable changes in communication, education and cognition so that it could help them in the future.

Before developing solutions for their problems it is first important to know what problems they are facing in detail. So some of the issues and challenges faced by the autistic children are as follows :

- Difficulties with social communication and social interaction.
- Repetitive patterns of behaviour, interests or activities.
- Cognitive problems such as difficulties with attention and concentration.
- Frustration due to the ignorance by other people and their prejudice against autism.
- Developmental condition such as attention deficit hyperactivity disorder, dyspraxia and epilepsy.
- Mental health problems such as anxiety, depression and obsessive compulsions.
- Sensory problems such as hearing and sound sensitivity, visual disturbances.
- Not able to maintain relationships with others.
- Not able to find right school or type of education.

It is important that they be provided with interventions that can help them. These problems can be worked on and their impact can be reduced significantly. Therefore, the

proposed application includes modules that will help in improving all the problems faced by them described above.

This paper is partitioned in four chapters. The first being the introduction itself. The second chapter explains about technologies related to this project. The third chapter explains the proposed system for the learning aid in detail. The fourth chapter is the last chapter of this paper which concludes the topic along with the references.

II. Previous Works

There are several systems that are available which serve a similar purpose as the proposed project. But there are various drawbacks each of them face. The existing systems are as follows :

- Teaching Aid Software :

It is a computer software that aims to develop various attributes of autistic children with the help of various modules such as learning alphabets, words and sentences. Also, teaches mathematical concepts with the help of various games.

- Autiaid :

It is also a learning mobile application for autistic children. It has three modules: scheduling, monitoring and gaming. Scheduling prepares the schedules for the children, monitoring helps to keep track of the progress and gaming contains various games that help in developing skills.

- Educational Games for Kids :

It is an android based application which has several games for teaching the kids things like alphabets, numbers, relationships, colours etc. The disadvantage of this system is that it might work fine for other kids but autistic children may find it a little difficult to cope up with.

- Animal Memory :

It is a classical tile game which helps in improving the memory of the kids. It uses attractive and vibrant images of animals and also helps in recognition and matching for the kids.

- Autism iHelp :

It is a teaching aid which proves helpful in vocabulary teaching and speech therapy. It is developed due to the need for specific language intervention tools for children with autism.

- Touch Emotions :

It is an application which focuses on teaching different kinds of human emotions with the help of images and a voice over. The disadvantage of this system is that the voice over does not depict the emotion represented through the images accurately.

III. Proposed System

Learning Aid for Autistic Students is a mobile application that will make learning easy and fun for the kids. We propose an educational app that would help the autistic children not only in improving their skills but also eliminating their disability. It is designed specifically for the autistic students, keeping in mind their requirements and needs. The app would be developed Android devices. It is an integrated solution which would be developed using Android Studio.

There are many systems that are made for autistic children to help the learn and improve. But only few of them are mobile apps. There are many advantages of mobile applications over desktop applications such as :

- Android phones can be carried anywhere.
- Easy to use.
- They are cheap in compared to desktop devices.

There will be two modules. The first module is 'Learn' module. Basically, it would help the children in learning. It would contain many sub-modules that would aim to teach various basic educational concepts. These sub-modules would focus on improving their special education which would involve games that would teach them basics like alphabets, numbers, colors, fruits, vegetables, transport, etc. Also, it would help them understand various day-to-day things. It would also concentrate on improving the social skills of the kids.

The second module is the 'Play' module. It would contain games and tests that would help the children to practice what they learned in the 'Learn' module. These games include matching alphabets, counting numbers, naming colors, animals, fruits, currency, guessing time by looking at the clock and many more. Also, contains certain games that will help them recognize human emotions and thus clearing their confusion regarding human emotions which is a big hurdle in their communication mechanism. These modules would also help the children on improving their memory and cognition.

Also the user will have the facility to choose the lessons he wishes to take first and also to select the levels of difficulties for the tests which would be available for each module. There would also be provisions that would help the parents and teachers to tack the progress of their wards.
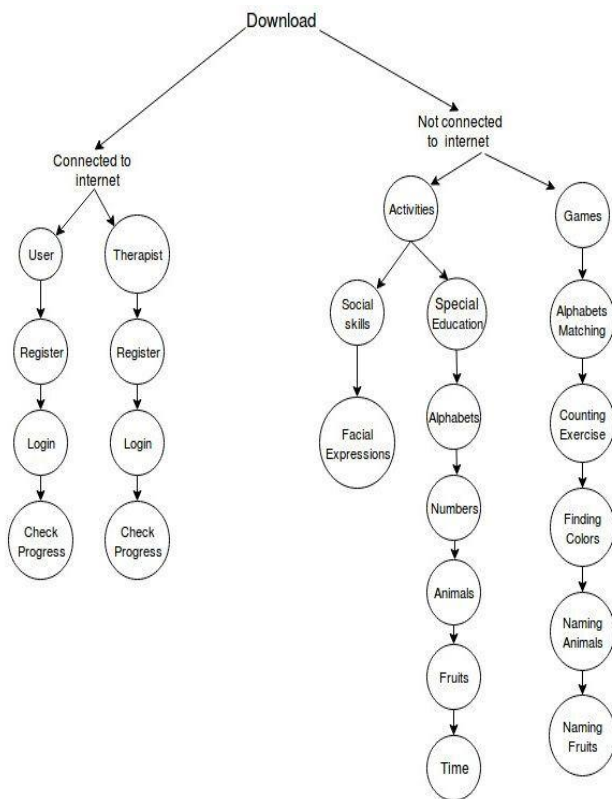
Fig(1) : Flow of System

Autistic children are not able to understand many thing they see. So, considering such facts the modules will me designed in such a way that it will be easy to understand and easy to use. The app design would be colorful so that it would attract the children. Also, the complexity of the app would be minimum so that the children won't get confused and are able to focus properly.

To make the app, Android Studio will be used. XML(eXtensible Markup Language) will be used to design the app. The core of the app will be written in Java programming language. Various designs and photos will be made using certain photo-editing softwares.

The flow of the system would be as shown in the fig(1) and the use case diagram as shown in the fig(2).

The proposed system would try to overcome and eliminate all the disadvantages and the limitations of the existing systems specified above. Thus, it may be suitable for use by parents at home and also by the doctors or therapists in the treatments.

IV. CONCLUSION

The project aims to develop most of the attributes of autistic children like speaking, reading, attention, focusing, listening, understanding and comprehension through various interactive modules. This project might prove useful for many autistic children making learning a fun activity for them. Children will be able to learn at their own pace. Also it would help the teachers, therapists and the parents to keep a track of the child's progress in various fields through the integrated system. The system being a mobile application would easy to use, manage and can be carried to any place. Also it would not require any sort of external support. The use of internet would also not be compulsory for use of the system. Thus making it useful even for the people who have no access to the internet.
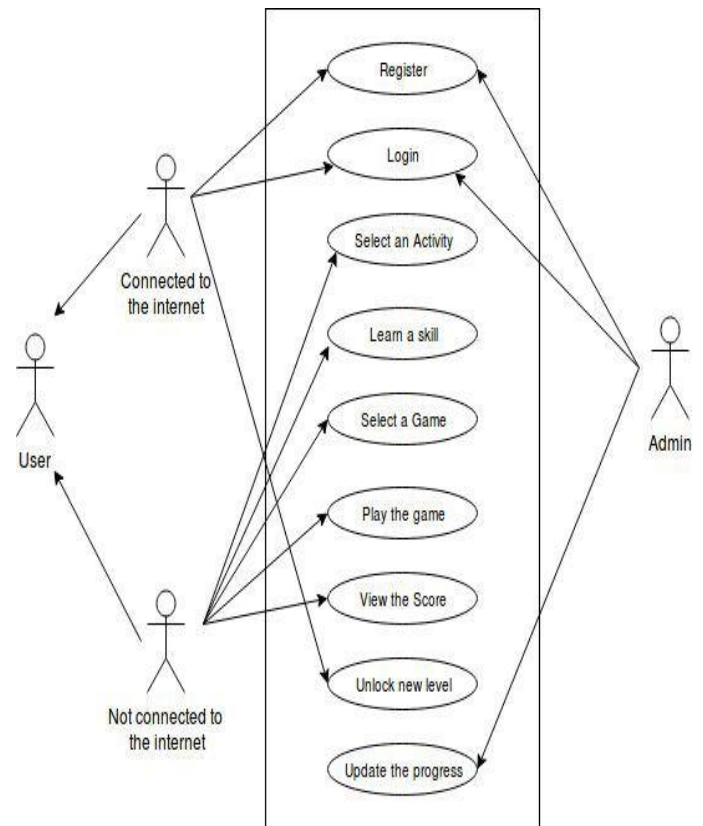
Fig(2) : Use case diagram

Information Technology for her guidance in developing the project.

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Tourist Guide with intelligent chatbox

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Abstract—Tourism is imminent across the globe. A lot of new technologies are developed to augment the advancement of tourism. This augmented technology helps to get rid of divergent opinion and provides updated information for different places. The use of technology aims to contribute and make it feasible for tourists to get point of interest(POI) within the vicinity, access path between locations and intelligent chat box. Chatbox solves user queries related to POI. Chatbox makes tourist guide unique and efficient.

Keywords—Chat Box, Mashup, POI, Tourist Guide

I. INTRODUCTION

Travel & Tourism is an important metier, whose rapid growth influences the economy of the country. The conventional ways to reach end users are magazine, newspaper and advertisements. These are static and may not create a profound impact on end users. In recent days, the penetration rate of mobile and internet is very high, so building an application using these two will reach to the maximum people around the globe. Even though accessibility of internet is very high, obtaining required information is a tedious task. This is the motivational factor to visualize the concept of Tourist Guide.

Today, Mobile phones have become an essential part of our lives. "Smart" has become a rather colloquial term in marketing of mobile phones and gadgets. Smartness is usually closely related to enhancing the usability by implementing technologies. Mobile phones do more than just making calls and come with much functionality. A global positioning system (GPS) is one of them. From navigating new cities to locating missing people, GPS devices have progressed since being introduced to the world.

The GPS system uses two important parameter to get accurate location of person i.e. latitude and longitude. Global navigation makes use of latitude and longitude lines to pinpoint the user's location. Map API is used to display the location. Map API uses mashup technology to get all the locations around it. A mashup is a web Application or Web page uses functionality from two or more sources to generate a new service. Mashups are done via Web services or public APIs. Google Places API is used to get all the locations in a particular vicinity. It stores information in JSON format. The information stored in Places API includes Name, Latitude, Longitude, Type of Location, Ratings of the location etc. It uses a API key in order to access the places around it.

Tourist Guide will also have a personal assistant which is built using machine learning. Nowadays, there are a lot of open-source software libraries for machine learning. However tensorflow stands apart from the competition. Tensorflow is an open-source software library that is used for machine learning in different tasks. It can be a structure for establishing and training neural networks for the purpose of identifying or deciphering patterns as well as correlations. Apart from that, it is employed in research or production in google. It is a bit similar to human learning or reasoning.

Tourist guide is location based application. It helps users get information like traffic analysis, distance to be travelled. It also solves user's queries related to a specific location. There are various applications available but there are certain limitation in those applications. We are also working towards making our application intelligent. The Tourist guide application empowers users to get information on the go. The implementation, technologies used and work flow of the application will be explained in the further sections.

For tourism sector, many mobile applications are available which are helpful for tourists. These applications only help to

show the information about places and to do advance booking for the tour. But the problem with these applications is that they are not efficient, not able to show information when the tourist is travelling. Tourist need to use different applications for booking cabs. Doubts related to places can't be solved in existing applications. If tourist has some queries then they have to search it on internet.

II. Literature Survey

The proposed system involves guiding of tourist with the help of an android application which is available to the tourist on the move. The tourist also is provided with an assistant using artificial intelligence to solve the tourist's queries. In this section we will discuss the existing applications and papers that will help us to refine our application keeping in mind the previous attempts made.
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A. Related Work

The main objective of this paper is not only to provide updated information to tourist but also give the concise information about places. To pioneer the Tourist Guide various technologies has been used. These are referred from the work which had done previously.

The Mashup server is used to display the various web pages in combined form. The request is sent to the mashup server when user access web pages which will activate GPS[2]. The current location of user identified by GPS and end users information is received by mashup server[1]. Mashup server is used to analyze the users information which is stored in database to obtain the users preferences requirement. GPS is obligatory to add a timer to web page, that it is able to upgrade users geographical information to the mashup server within time. This is Google Map based application, which starts with simple map. In Google map, Overlays are used to represent the point of interest, lines denoting areas, routes or other relevant information about location on map. Controls are used to zoom in and zoom out the map and move the map effectively. Google map API provides many services like Geocoding which returns a current location on map, directions with detailed route instructions which takes user from one location to another[2]. Google map server mark the users current location on the map. The nearest attractions, hotels, restaurants are marked on map because mashup server integrates all information based on the map. The mobile phone cursor moves to marked on map and shows the relevant information of the marked point. All these information is send by mahsup server to the mobile device. The results are displayed on the mobile device[1]. REST API is used as communication protocol to link data or content[4]. REST API helps in retrieving the appropriate data from the trusted websites and gives information to the users about the location at which tourist reached.

III. Technologies

Before you begin to format your paper, first write and save the content as a separate text file. Keep your text and graphic files separate until after the text has been formatted and styled. Do not use hard tabs, and limit use of hard returns to only one return at the end of a paragraph. Do not add any kind of pagination anywhere in the paper. Do not number text heads-the template will do that for you.

Finally, complete content and organizational editing before formatting. Please take note of the following items when proofreading spelling and grammar:

A. GPS

It is the global positioning system used to track device's location and do the operations accordingly. It is essential in tourism based application or web apps in order to give the response according to the device location. Internet connection enhances the usage of GPS.

B. Mashup

A Mashup can be defined as the technology which is used to take input from various other websites and show it as a combination of all the information in one page. Mashup is used in this paper by integrating it will Google Map API. This API takes input from various different places in Google and produces the final output in a small Map fragment. It requires API key in order to retrieve the result of the required output. The Mashup is also required to obtain various visualisation of the map content given in the fragment.

C. Google Map API

The Google Maps API allows the developers to embed Google Maps on their web apps or mobile applications. The functionalities of the API can be accessed by either Javascript(web apps) or Java(mobile application) language. This API consists of over 50 languages and map across the globe. It uses REST API to collect the data from different websites. We can customise the maps and can use it in hybrid view as well as in 45 degree perspective view. The Hybrid view includes roadmap, satellite, terrain views. It reflects the user interface of the maps shown as final output. The 45 degree perspective view is supported by satellite as well as hybrid view. if the zoom operation is performed by the user at 45 degree rotation map results in altering the perspective view.

D. Places API

PLACES API is used Connect users with information about millions of places. The Place API allow to build application where users can search and received detailed information for places. This places are retrieved in JSON format. some others details retrieved are place icon, opening hours, closing hours, vicinity, ratings, reviews and many more. These places are retrieved taking latitude and longitude as input. The places divided in Places API are of particular types which includes restaurant, place of interest, health, geocode etc. It can also help in getting the street view of particular place. It uses RESTful API in order to retrieve the locations in JSON format.

E. Heatmap API

Heatmap is used for the distribution and relative intensity of data points on map which will be easy to understand the users. Instead of placing market at each location on the map, Heat map uses color to represent the distribution of data. Heat maps show such places where people are tapping the most. The main purpose of Heat maps are to assist you in making your

app more intuitive and user friendly, and as a result more engaging.

IV. PROPOSED SYSTEM

Tourist Guide is a large complex system. To make the application, a modular approach is the best option. The application is broken down into modules. Each module is made independent of the other. These modules have been discussed in next section.

A. Location Retrieval Module

The equations are an exception to the prescribed specifications of this template. You will need to determine whether or not your equation should be typed using either the Times New Roman or the Symbol font (please no other font). To create multileveled equations, it may be necessary to treat the equation as a graphic and insert it into the text after your paper is styled.

B. Traffic Analysis Module

It deals with the use of Google Maps Android Heatmap Utility which is the library used for traffic analysis. It's being used for measuring the traffic details of a particular location

C. Cab Module

OLA cab is being integrated in the application which allows the users to select the means of transport in order to travel from one place to another. This gives options like carpooling for the tourists in order to reduce cost.

D. Places Retrieval Module

The place retrieval module uses PLACES API which helps in retrieving the appropriate data which includes rating, place name, reviews of the place etc. The places at certain vicinity are being shown in android activity.

E. Personal Assistant Module

This module is made by Tensorflow using Python. Several neurons is being created and questions will be analysed in about 50/100 iterations depending on the complexity of the question. The best possible answer will be given to the user and the information which is required to provide the answer is wikipedia information. It is trained by conversation which is created as training data set. This is also trai ed by queries related to the locations.

V. USE CASE

Tourist Guide application is aimed to developed keeping in mind the problems of tourist. This application should be easy to use for the tourist. The Fig.1, shows the flow of the system and the working of each user and use cases of the system. The system has the different use cases which has different working.
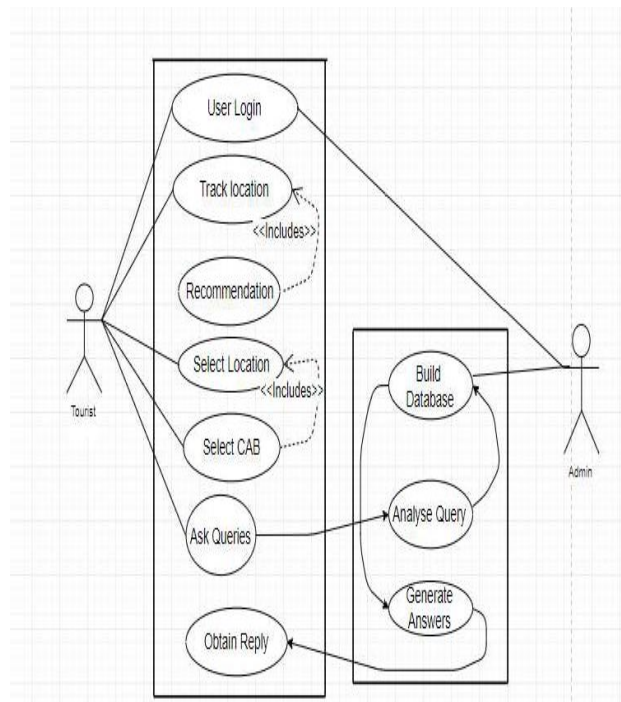
Fig.1. Tourist Guide Use Case Diagram

VI. WORK FLOW

The application is developed to provide proper guidance to the tourist for better understanding of tourists attraction. Application helps tourist to take correct decision while selecting the places. The problem which is shown in existing system that tourist are not able to get the information about the places while travelling. Tourist should be able to receive information about places not only travelling but also reaching at destination too. Therefore, to overcome this problem the mobile application is being developed. The working of Tourist Guide Application is given below.
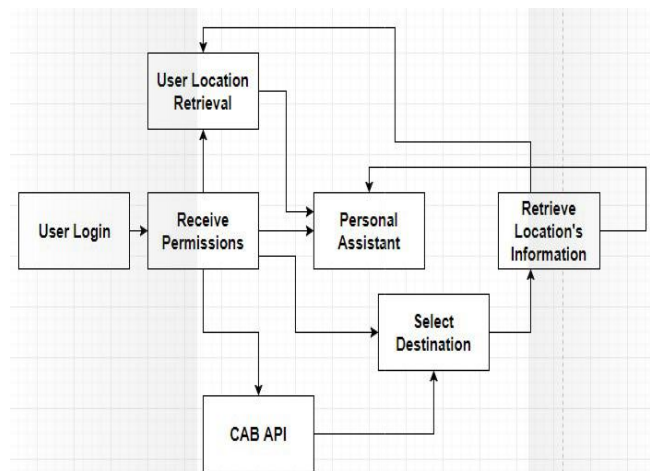
Fig. 2. Tourist Guide Block Diagram

A. Use Case Description

- USER LOGIN: Basic information of the user which includes the country from which they belong and other details are taken for authentication.

- PERMISSIONS: The user is asked for permissions to help guide the user more efficiently.

- LOCATION TRACKING: Once the user location is tracked the request is send to mashup server. Google map API is able mark the user's current location. The Mash up server fetches the information about current location and provides recommendation for the places within certain radius. The locations are retrieved on basis the of the reviews and ratings given by people who have visited earlier.

- CAB BOOKING: The user can select places which he/she wants to explore. For users, OLA API is provided in Tourist guide application. There is no need to use different application for just book a cab to travel. All features related to OLA cab are achieved in Tourist Guide application

- TRAFFIC ANALYSIS: The application shows the efficient path to travel by calculating the minimum distance to travel and analyzing the traffic on the same route between the source location and destination selected by the user.

- User is able to receive the information in the form of notification on the application about places which are coming on the route while travelling in.

- QUERY SOLVING: Personal assistant helps users to solve their queries. The best possible answer is being given, of the question asked by the user. It uses back propagation algorithm to solve the queries.

VII. OUTPUT

The tourist guide is developed using Android studio and Python IDE There are various activities involved in creating the application.

Fig. 3. User's Location retrieval

Fig. 3 depicts the retrieval of user's location[7,9]. It tracks the location using GPS as explained in above paper. It needs to get user's permission in order to retrieve the location

Fig. 4. Places around user

Fig. 4 depicts the retrieved restaurants in 5 km vicinity which is having ratings above 3.7[6]. It gives best restaurants around the user. To retrieve the best places in a state places with Point of interest tag is selected from the JSON data retrieved by Google places API
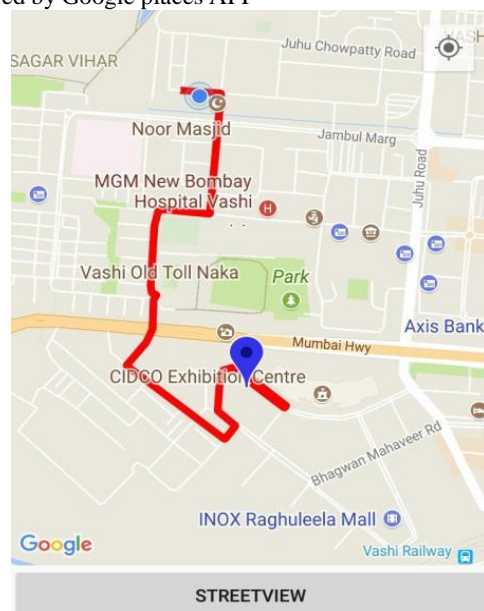
Fig.5. Path to target location

Fig. 5 depicts the shortest path from user's location to the place selected[8]. It uses heatmap API for traffic analysis in order to show the most optimum path[5].

Another part of the application shows the path from one location to another. It is done based on shortest path and traffic analysis. For traffic analysis heatmap API is used.

It also shows the Chatbox trained by neural network. It requires more than one million queries from a dataset to train the neural network. The 1 layered neural network is formed.

VIII. RESULT

The output of this paper depicts that it will solve many problems faced by the users. One such problem is, it is a cost effective solution. User's do not need to hire the guide every time they visit a location. The Environmental constraint is taken into consideration too as user's do not need to purchase tourist guide books for getting the information.

IX. CONCLUSION

This paper presents the tourist guide application and its various functionalities. Tourist Guide has several advantages over the current applications. It provides features which are not present in the current applications. It tracks user's location, recommends the nearest tourist places within certain radius and suggests the efficient path by calculating the distance between two places and performing traffic analysis. Intelligent chatbox helps to solve user's queries related to places. It also acts as a personal assistant of the user. Tourist Guide has a cab api through which the user's can book cabs hence save their time. In all, Tourist Guide is a very efficient application which will help ease the life of the tourists.

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Analysis of Various Parameters Tested at Onset of Labor

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Abstract—**In Maternity Care, a quick decision has to be made about the most suitable delivery type for the expected to be mother in labor. This study identifies obstetric and pregnancy factors that can be used to predict the most appropriate delivery technique, through the induction of data mining models using data gathered from hospital. This paper considers individual's specific risk factors such as BP and Cervical length of expecting mother, fetus position in womb, fetal heart rate, while recommending the normal or C-section delivery. Using Naive Bayes classification algorithm, the mode of delivery can be determined in case of emergency. This paper gives monitoring and data analysis of all parameters that are tested in the normal labor delivery process and predicting complications in the normal delivery, if any.**

Keywords—**Naive Bays Classification, Cardiotocography, Fetal Heart Rate, occiput presentation, Cervical length.**

I. INTRODUCTION

Labor and delivery are continuously monitored to collect data set. The objective of this paper is to predict the mode of delivery based on few specific parameters identified to help women in being mentally and financially prepared with few predefined parameters related to pregnancy, based on this system determines the delivery type using Naïve Bays classification [1]. For predicting the normal delivery time and continuous monitoring of mother and fetus, few parameters are tested in medical fields [2].

1.1 Parameters tested at the time of delivery
Some crucial parameters are to be tested at the time of normal delivery:

   a. Heartbeat of fetus
   b. Blood Pressure of expecting mother
   c. Cervix length of expecting mother
   d. Fetus position in womb

a. The Heartbeat of fetus
In most cases, fetal heart rate is monitored during labor to see fetus status and to identify potential problems ahead of time. Electronic Fetal Monitoring(EFM) is currently used to monitor almost all women in hospitals. Labor and delivery are monitored electronically with sensors that measure and record maternal uterine pressure (UP) and fetal heart rate (FHR), a is referred to as cardiotocography (CTG). The standard range for a full term baby's heart rate during labor is between 110 and 160 beats per minute (bpm). Higher or lower rates can be a sign fetus is having trouble coping with labor, depending on a number of factors. If the baseline rate is less than 110bpm, it is called bradycardia (abnormally slow heart rate) and if FHR

are greater than 160bpm it is called tachycardia (abnormally high slow rate).

b. Blood Pressure of expecting mother
Normal blood pressure of a person is usually somewhere close to 120/80 mm Hg. Blood pressure between 140/90 and 149/99 mmHg is called Mildly high, between 150/100 and 159/109 mmHg is called Moderately high and of 160/110 mmHg or higher is called severely high blood pressure. If the BP of mother is not in normal range then there are various risks to mother as well as fetus. Few risks to mother are as follows:

a. An increased chance of having a stroke.
b. Damage to kidneys and liver.
c. An increased risk of blood clotting problems.
d. An increased risk of severe bleeding from placenta.
 If developed pre-eclampsia, then it can cause serious damage to organs, including brain and kidneys.

 The risks to fetus are as follows:
a. An increased chance of poor growth.
b. An increased chance of premature birth.

c. Cervix length of expecting mother
Normal cervical length measures 4 to 5 cm when woman is not pregnant. During a normal pregnancy, the cervix remains firm, long, and closed until late in the third trimester. It usually starts to soften, shorten (efface) and open up (dilate) as body prepares itself for labor. Normally, in the late second and early third trimester the cervical length measures anywhere between 3 cm to 3.5 cm (30-35mm) and decreases progressively as the pregnancy advances, in preparation for labor. When cervical length is less than 2.2 cm (abnormal), women are not in progress to deliver normally. Normal cervix length should be10 cm at the time of delivery.

d. Fetus position in womb
The most common and abnormal combination of fetus position are as follows:
a. Cephalic Presentation
b. Occiput-posterior Presentation:
c. Brow Presentation
d. Breech Presentation
e. Shoulder Presentation
a. Cephalic presentation
The normal position of a fetus is facing rearward (toward the woman's back) with the face and body angled to one side and the neck flexed, and presentation is head first. Figure 1 shows the normal position of fetus in mother's womb.

Fig. 1 Normal Fetus Positions

Figure 2 shows the abnormal position and presentation of fetus in mother's womb.
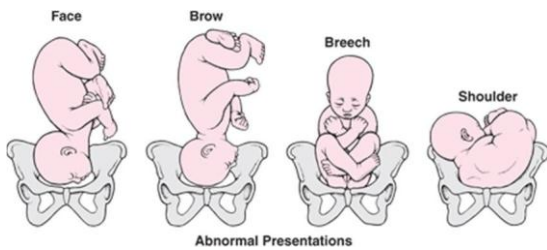
Fig. 2 Abnormal Fetus Presentation

b. Occiput posterior presentation

In the occiput posterior presentation (sunny-side up), the fetus is head first but is facing up (toward the mother's abdomen). It is the most common abnormal position or presentation. When a fetus faces forward, the neck is often straightened rather than bent, and the head requires more space to pass through the birth canal. Delivery by a vacuum extractor or forceps or cesarean delivery may be necessary.

c. Brow Presentation

If your baby is in a brow presentation, this means the largest area of head will be trying to fit through your pelvis during birth. Brow presentation usually happens when baby's neck and head are slightly extended (deflexed), as if baby is looking up.

d. Breech presentation

The buttocks or sometimes the feet present first. Breech presentation occurs in 3 to 4% of full-term deliveries. When delivered vaginally, babies that present buttocks first are more likely to be injured than those that present head first. Such injuries may find before, during, or after birth. The baby may even die. Complications are less likely when breech presentation is detected before labor or delivery .Sometimes the doctor can turn the fetus to present head first by pressing on the woman's abdomen before labor begins, usually after 36 weeks of pregnancy. However, if labor begins and the fetus is in breech presentation, problems may occur.

e. Shoulder Presentation

Shoulder presentation is an abnormal position of the fetus at the time of delivery. In this, the fetus lies transversely so that its vertebral column lies perpendicular to the maternal position of spine. So, the part that enters the birth canal will be the trunk or shoulder. In spite of some deviations in the

positioning of the fetus, the doctor may try for vaginal birth only if the baby's head, or buttock, or feet are at the bottom. Hence, the vaginal birth will be unthinkable for the mother and she has unquestionably to undergo a C-section.

The decision for usage of forceps or a vacuum assistance is guided by the indication for an instrumented delivery and the clinician's experience [3].

II. LITERATURE SURVEY

2.1 Pregnancy period tests & devices

Various devices are used to monitor the wellness of fetus and mother as listed & explained below:

a. Ultra scan

As shown in Figure 3, an ultrasound scan sends sound waves through womb (uterus). These waves bounce off the baby as echoes. The echoes are turned into an image on a screen that shows fetal position and movements. Hard tissues such as bone, reflect the sound waves and make the biggest echoes. It includes white in the image and soft tissues as grey. Fluids such as the amniotic fluid surrounding the baby appear as black. This is because the sound waves go through with no echoes. A first-trimester scan will test that baby's heart is beating and also look at the basic examination of baby's head, abdominal wall, and limbs.

Fig.3 Ultrasound Scan

b. Doppler Ultrasound

A Doppler is a form of ultrasound scan that helps to assess baby's health [4]. It measures the blood flow in different parts of fetal body, such as umbilical cord, brain, and heart. This helps to show whether fetal is getting all the oxygen and nutrients needs via the placenta. The transducer sends out sound waves, which bounces off the blood flow to fetal body through the cord as well as his blood circulation system. This creates an image on a display which shows how the blood is flowing. This is shown in Figure 3.
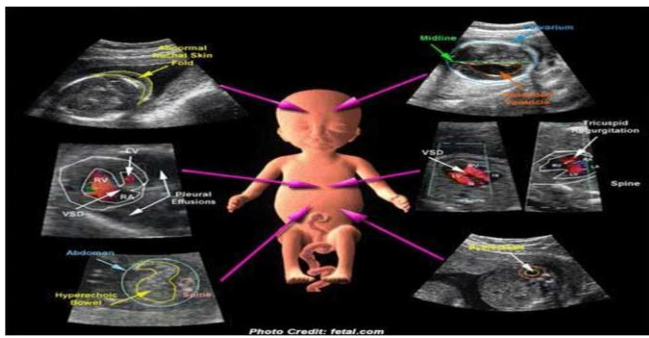
Fig.3 Doppler Ultra Scan

c. CT Scan

A doctor or physician may order a Computerized tomography (CT) scan of the fetus to formulate detailed pictures and analyze the internal structure. Computerized Tomography (CT) scanning is useful to get a very detailed 3D image of certain parts of the body. The same is shown in Figure 4.
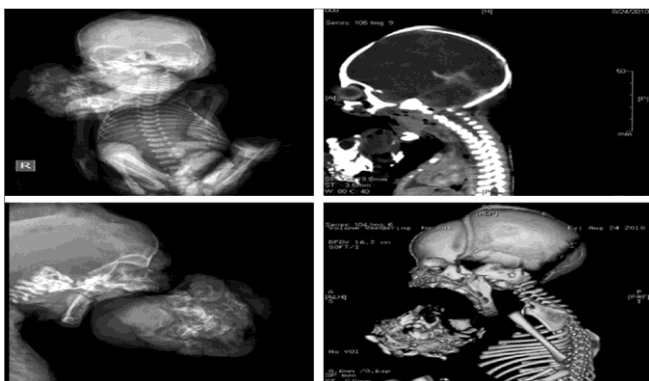
Fig. 4 CT Scan

d. Stethoscope

External Electronic Fetal monitoring can be done by listening to baby's heartbeat with a special stethoscope. External monitoring is done using two flat devices known as sensors held in place with elastic belts on belly. One sensor makes use of reflected sound waves i.e. ultrasound to keep track of fetal heart rate. The other sensor measures the strength and duration of uterine contractions. The sensors are connected to a machine to keep the track of information. External monitoring is used for a non-stress test which records baby's heart rate while baby is moving and not moving. A non-stress test may be combined with a fetal ultrasound to evaluate the amount of amniotic fluid. External monitoring is also made for a contraction stress test, which records changes in baby's heart rate when to have uterine contractions. It may be done to check on fetal health during a non-stress test. It may help to predict whether the baby can handle the stress of labor and vaginal delivery.

e. Telemetry

External monitoring can also be done remotely called as telemetry, without need to be connected by wires to a machine. At some places, the sensors send the information

about the fetal heart rate and uterine contractions to a remote monitor. Remote monitoring allows to walk around freely. The position of the heart rate monitor changes periodically to adjust to the movement of baby. For a non-stress test, the sensors are placed on belly of the labor. It is asked to push a button on the machine every time baby moves or have a contraction. Fetal heart rate is recorded and compared to the record of movement or contractions.

f. Electrode with a wire & tube

Internal fetal monitoring is done only after cervix has dilated to at least 2 centimeters (cm) and amniotic sac has ruptured. Once started, internal monitoring is done continuously. A thin wire (electrode) is guided through vagina and cervix and attached to baby's scalp. A small tube is also inserted through vagina to attach a device to monitors the contractions inside uterus. The electrode and the tube are attached with wires to a recording device to record of fetal heart rate as well as the strength and duration of uterine contractions.

g.. Monitors

Monitors are used to detect the baby's heart rate and length and frequency of the contractions. There are even monitors that allow patients to walk around while it keeps track of the heart rate and contractions. Figure 5 shows the same.
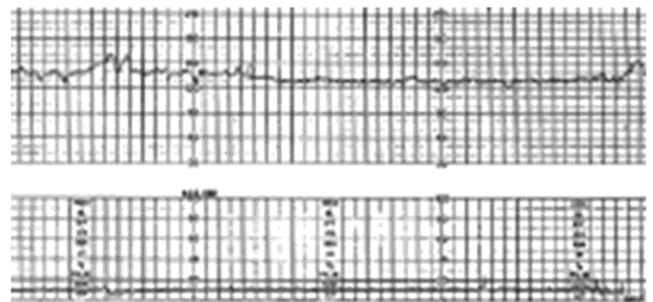
Fig. 5 Monitor

h. Delivery assistance (operative vaginal delivery) It is hand held metal instrument with blade extensions that are applied to each side of the fetal head part for delivery process. The traction force of the blades helps to aids in neonate delivery as shown in Figure 6.

Fig. 6 Operative Vaginal Delivery

i. Forceps The Use of forceps has decreased over the past several decades. The indications for forceps are included in prolonged second stage of labor or ineffective maternal push power. The presenting part needs to be at +2 station part before forceps should be applied to the labor for the delivery [5]. If the presenting part is at higher station, abdominal delivery should

be chosen into consideration of the labor for the process. Forceps use is mainly associated with less fetal hematoma formation and quick delivery times are compared with vacuum assist lacerations. Forceps is associated with lower risk of maternal bleeding condition and better choice that the mother is able to deliver vaginally in subsequent pregnancies. The device is shown in Figure 7.

Fig. 7 Forcep

j. Vacuum

Vacuum consists of a suction cup that is attached to the fetal head part to assist with extraction. Tractional pressure is updated by a negative pressure handle system. Types include metal cup vacuums, plastic cup vacuums, and a mushroom-shaped vacuum cup that uses the advantages of the metal and plastic designs. It is used during emergency delivery because of fetal distress, poor maternal push power, or checks for maternal medical conditions that contraindicate strong pushing. The same is shown in Figure 8.

Fig. 8 Vacuum

k. Axis traction device for delivery forceps

This device is light, simple in construction, having only three parts, and very easy to apply to any forceps handle when axis traction is required. It prevents the lock of the forceps from slipping and at the same time does not hinder the forceps blades from being opened or closed at the wish of the operator. The handle alone is sufficient for most of the axis traction cases, but when a great amount of traction is required a "T" or cross-bar can be attached through the slot in the lower end. The same is shown in Figure 9

Fig. 9 Axis Traction for Delivery Forceps

l. Cusco's self-retaining bivalve vaginal speculum

Cusco vaginal speculum can be used to carry out an endoscopy. The speculum is placed inside the vaginal opening of the woman which helps the surgeon to perform the required endoscopic process**.** This process usually involves the female reproductive system and the genitourinary system which is why the vaginal opening must be expanded for the process to be conducted efficiently. The same is shown in Figure 10.

Fig.10 Cusco self-retaining bivalve vaginal speculum

III. SYSTEM DESIGN AND IMPLEMENTATION

Our system deals with predicting the mode of delivery for a woman in labor depending on various parameters. The system then determines the delivery mode whether normal or c-section using Naive Bayes classification [4,5,6]. The system architecture is shown in Figure 11.
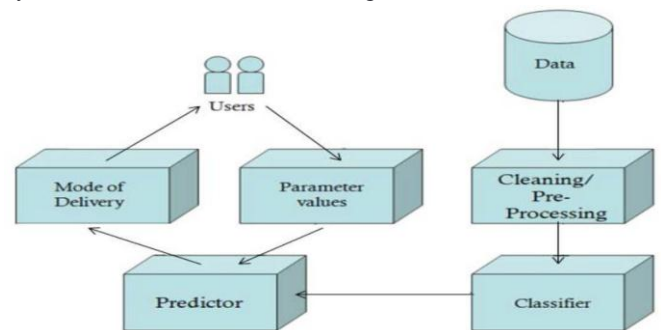
Fig.11 System Architecture

Various module of System architecture are as follows:

i. Selection of Classifier

The prediction of normal or c-section will be done with the help of data mining classification technique based on naive bayes theorem. The set of all classes (C) available, , and the item with attributes so using Naive Bayes classification algorithm, we can predict the class C to which X belongs, based on the similarity of the attributes of X and items of that class. For this, the posterior probability P (C|X) is given by equation i. below.

$$P(c \mid X) = P(x_1 \mid c) \times P(x_2 \mid c) \times \cdots \times P(x_n \mid c) \times P(c)$$

where P(X/C) is the conditional probability of X given C.

Equation I

ii. Pre-Processing and Cleaning of the input data set

After eliminating some record for which the parameters are missing or incorrect values, the ultimate data set should obtained each containing 4 parameters.   After selecting the parameters, the numeric values were converted into categories like – LOW, HIGH, and NORMAL for simplifying the classification process.

iii. lassification and Prediction

Classification is a two step-model. First step is division of data into training set used for predicting relations and testing data set used for assessing the strength and accuracy of the relations predicted. In the next step, the training set is used to build the classifier model and the testing set is used to validate the model built. The goal is to classify the mode of delivery as NORMAL or NOT_NORMAL based on the known attributes. The second class consists of all other delivery types like Caesarean (C-section), vacuum delivery, forceps delivery etc. The user inputs values of all the 4 parameters to the classification algorithm. After processing, the predictor determines whether a normal delivery is possible or not.

IV.   RESULT

Result of parameter comparison is shown using various tables below. The normal and abnormal values of all required parameters to be tested for verifying expected mother status in labor and fetus condition, exactly before delivery process are shown in tables I below. It also discusses the necessary action to be taken by expecting mother in labor and expert doctor opinion. Table II to Table VI shows comparison of various parameters against each other for predicting normal or caesarean delivery depending on the complications involved. Computing the results with naïve bayes classifier the system acts like a predictor tool, allowing the users to enter values of the specified parameters and giving the most likely mode of delivery as the output.

IV. CONCLUSION

The proposed system helps to monitor the health condition of pregnant women at regular intervals. The sensor-based hand held device predicts the mode of delivery as normal or c-section. It also determines the mode of delivery by monitoring values of various parameters need to be tested against each other to decide on normal or c-section delivery.

V. FUTURESCOPE

In future the device can be improved by allowing users to contribute to all medically relevant parameter values. The device can be made full proof to work on many more parameters giving accurate result and early prediction for delivery mode. The system would also be modified further to obtain associations and possible anomalies for better analysis and medical care of the fetus & expected mother.

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TABLE I Parameter Values

BP of mother (mm Hg)		Fetus Heart Rate(bpm)		Cervix length of mother(cm)		Position of fetus in womb	
	Classifier Prediction		Classifier Prediction		Classifier Prediction		Classifier Prediction
115/75 (Accurate value)	Need not to worry	110-160 (Normal)	Need not to worry	10cm	Fully dilated	Cephalic presentation	Best position. Can wait for normal delivery
140/90 to 149/99 (Mildly High BP)	Doctor try to maintain normal BP of mother	<110 Bradycardia	It is not usually a problem	0cm	Closed	Occipito-posterior	labor may be long and slow, with bouts of contractions starting and stopping
150/100 to 159/109 (Moderately high BP)	Doctor try to maintain normal BP of mother otherwise preeclampsia	<100 Bradycardia	Sign of fetal distress.	<2.2cm	Short cervix length.	Breech	Not ideal for delivery.
Above 160/110 (Severely high BP)	Preeclampsia which is at high risk of placental abruption	>160 Tachycardia	It is not always a sign of fatal distress	<1.5cm	C-section is necessary	Left Shoulder Presentation	Chance for a prolapsed cord
90/60 (Borderline low BP)	The normal drop in BP typically does not cause any problems	>180 Tachycardia	Sign of foetus distress.	3.0 cm to 3.5 cm	Normal	Back Down Position	Baby can be pushed into the right position.
60/40 (Mild low BP)	Greater risk of stillbirth relative to normotensive pregnancies. Need close care and treatment	+FHR >15 bpm, lasting >15s but <10 min Accelerations	Doctor may need to induce accelerations.	4-5	Anterior position	Right shoulder presentation	Require a C-section.
50/33 (Extremely low BP)	A severe drop in blood pressure can result in organ damage.	-FHR >15 bpm, lasting >15 s but <10 min Deceleration	It can be a problem C-section is needed	5+	Baby is ready to come out	Brow Presentation	Doctor may recommend caesarean

Table II shows the comparison of BP of mother with cervical length of mother and the prediction accordingly

TABLE II BP of Mother with Cervical Length of Mother

BP of mother	Cervix length of mother	Classifier Prediction
115/75 (normal)	10cm	Cervix is fully dilated
115/75 (normal)	5+	Baby is ready to come out
115/75 (normal)	>2.2 cm	Doctors try to open the cervix
>140/90 (mild high BP)	10cm	Need not to worry. Continuous monitoring is required
>140/90 (mild high BP)	5+	Need not to worry. Continuous monitoring is required
>140/90 (mild high BP)	>2.2 cm	Doctors try to open the cervix
150/100 to 159/109 (Moderate high BP)	10cm	Need not to worry but careful attention is needed to BP
150/100 to 159/109 (Moderate high BP)	5+	Need not to worry but careful attention is needed to BP
150/100 to 159/109 (Moderate high BP)	>2.2 cm	Doctor may advised to go under c-section
Above 160/110 (Severely high BP)	10cm	Doctor tries everything possible to maintain normal BP. If not controlled then caesarean
Above 160/110 (Severely high BP)	5+	Doctor tries everything possible to maintain normal BP. If not controlled then caesarean
Above 160/110 (Severely high BP)	>2.2 cm	Probably caesarean
50/33 (Extremely low BP)	10cm	Doctor tries everything possible to maintain normal BP. If not controlled then caesarean
50/33 (Extremely low BP)	5+	Doctor tries everything possible to maintain normal BP. If not controlled then caesarean
50/33 (Extremely low BP)	>2.2 cm	Probably caesarean

Table III shows the comparison of Blood pressure (BP) of mother with Heart Beat of fetus(FHR) and prediction accordingly.

TABLE III BP of Mother with FHR of Fetus

BP of mother	Heartbeat of fetus	Classifier Prediction
115/75(normal)	110-160 (normal)	Happy outcome for both expect other risk factors.
115/75(normal)	<110 (bradycardia)	Healthcare provider will run further tests and take any appropriate action necessary to regulate FHR.
115/75(normal)	>160 (tachycardia)	If the baby's heart rate is consistently high, your doctor may prescribe you medication that is passed through the placenta to the baby to help regulate the heartbeat.
>140/90 (mild high BP)	110-160 (normal)	If your blood pressure remains mildly to moderately raised and you do not develop pre-eclampsia then the risk is low
>140/90(mild high BP)	<110 bradycardia	If your blood pressure remains mildly to moderately raised and you do not develop pre-eclampsia then the risk is low but bradycardia may be a problem it is below 100 BPM, especially if there are other abnormal heart rate patterns, such as poor beat-to-beat variability. continuously assess expectant mothers with preeclampsia and monitor FHR.
>140/90(mild high BP)	>160 tachycardia	High blood pressure and tachycardia can be dangerous. Continuously assess expectant mothers with preeclampsia and monitor FHR.
150/100 to 159/109(Moderate high BP)	110-160(normal)	A woman with mild-to-moderate hypertension could develop severe hypertension if not managed correctly
150/100 to 159/109(Moderate high BP)	<110 bradycardia	If your blood pressure remains mildly to moderately raised and you do not develop pre-eclampsia then the risk is low but bradycardia may be a problem it is below 100 BPM , especially if there are other abnormal heart rate patterns, such as poor beat-to-beat variability. continuously assess expectant mothers with preeclampsia and monitor FHR.
150/100 to 159/109(Moderate high BP)	>160 (tachycardia)	If your blood pressure remains mildly to moderately raised and you do not develop pre-eclampsia then the risk is low but tachycardia may be a problem if it is greater than 180.
Above 160/110(Severely high BP)	110-160(normal)	It may develop Preeclampsia which can cause serious complications both in the mother and the baby if left untreated.
Above 160/110(Severely high BP)	<110 bradycardia	Doctor may preferred to go under caesarean
Above160/110 (Severely high BP)	>160 tachycardia	Doctor may preferred to go under caesarean
50/33 (Extremely low BP)	110-160(normal)	The normal drop in BP typically does not cause any problems but a severe drop in blood pressure can result in organ damage such as stroke, kidney failure, and heart attack
50/33 (Extremely low BP)	<110 bradycardia	Doctor may preferred to go under caesarean
50/33 (Extremely low BP)	>160 tachycardia	Doctor may preferred to go under caesarean

Table IV shows BP of mother with fetus position in womb and prediction accordingly

TABLE IV BP of Mother with Fetus Position

BP of mother	Fetus position in womb	Classifier Prediction
115/75(normal)	cephalic presentation	Both are safe
115/75(normal)	occipito-posterior, Brow presentation	Delivery by a vacuum extractor or forceps or caesarean delivery may be necessary.
115/75(normal)	Breech presentation, Shoulder presentation	Sometimes the doctor can turn the Fetus to present head first by pressing on the woman's abdomen otherwise caesarean delivery is preferred
>140/90 (mild high BP)	cephalic presentation	Doctor tries to control BP
>140/90 (mild high BP)	occipital-posterior, Brow presentation	Delivery by a vacuum extractor or forceps or caesarean delivery may be necessary
>140/90 (mild high BP)	Breech presentation, Shoulder presentation	Sometimes the doctor can turn the fetus to present head first by pressing on the woman's abdomen otherwise caesarean delivery is preferred
150/100 to 159/109(Moderate high BP)	cephalic presentation	Doctor tries to control BP
150/100 to 159/109(Moderate high BP)	occipital-posterior, Brow presentation	Delivery by a vacuum extractor or forceps or caesarean delivery
150/100 to 159/109(Moderate high BP)	Breech presentation, Shoulder presentation	Sometimes the doctor can turn the Fetus to present head first by pressing on the woman's abdomen otherwise caesarean delivery is preferred
Above 160/110(Severely high BP)	cephalic presentation	Doctor tries to control BP otherwise caesarean is preferred
Above 160/110(Severely high BP)	occipital-posterior, Brow presentation	Delivery by a vacuum extractor or forceps or caesarean delivery may be necessary
Above 160/110(Severely high BP)	Breech presentation, Shoulder presentation	Sometimes the doctor can turn the fetus to present head first by pressing on the woman's abdomen otherwise caesarean delivery is preferred
50/33 (Extremely low BP)	cephalic presentation	Doctor tries to control BP otherwise caesarean is preferred
50/33 (Extremely low BP)	occipital-posterior, Brow presentation	Delivery by a vacuum extractor or forceps or caesarean delivery may be necessary
50/33 (Extremely low BP)	Breech presentation, Shoulder presentation	Sometimes the doctor can turn the fetus to present head first by pressing on the woman's abdomen otherwise caesarean delivery is preferred

Table V shows comparison of BP of mother ,cervix length of mother and Fetal heart rate and prediction accordingly.

TABLE V BP of Mother, Fetus Position in Womb and Cervix Length

BP of Mother	FHR	Cervix length	Classifier Prediction
115/75(normal)	110-160 (normal)	10cm	Both are safe. normal delivery is possible
115/75(normal)	<110 (bradycardia)	5+	FHR need to be monitored continuously
115/75(normal)	>160 (tachycardia)	>2.2 cm	FHR need to be monitored continuously and doctors try to open the cervix. If not managed then caesarean is possible
>140/90 (mild high BP)	**110-160 (normal)**	**10cm**	**Both are safe. normal delivery is possible**
>140/90 (mild high BP)	<110 (bradycardia)	5+	FHR need to be monitored continuously
>140/90 (mild high BP)	>160 (tachycardia)	>2.2 cm	FHR need to be monitored continuously and doctors try to open the cervix. If not managed then caesarean is possible
150/100 to 159/109(Moderate high BP)	110-160 (normal)	10cm	Both are safe. normal delivery is possible
150/100 to 159/109(Moderate high BP)	<110 (bradycardia)	5+	FHR need to be monitored continuously
150/100 to 159/109(Moderate high BP)	>160 (tachycardia)	>2.2 cm	FHR need to be monitored continuously and doctors try to open the cervix. If not managed then caesarean is possible
Above 160/110(Severely high BP)	110-160 (normal)	10cm	Doctor tries to control BP otherwise caesarean is preferred
Above 160/110(Severely high BP)	<110 (bradycardia)	5+	Doctor tries to control BP otherwise caesarean is preferred
Above 160/110(Severely high BP)	>160 (tachycardia)	>2.2 cm	Doctor advised to go under c-section
50/33 (Extremely low BP)	110-160 (normal)	10cm	Doctor tries to control BP otherwise caesarean is preferred
50/33 (Extremely low BP)	<110 (bradycardia)	5+	Doctor tries to control BP otherwise caesarean is preferred
50/33 (Extremely low BP)	>160 (tachycardia)	>2.2 cm	Doctor advised to go under c-section

Table VI shows comparison of BP of mother, Fetal heart rate, Cervix length of mother and Fetus position in womb and prediction accordingly.

TABLE VI   BP of Mother, FHR ,Cervix Length of Mother and Fetus Position in Womb

BP of Mother	FHR	Cervix length	Fetes position in womb	Classifier Prediction
115/75(normal)	110-160 (normal)	10cm	cephalic presentation	Baby is ready to come out
115/75(normal)	<110 (bradycardia)	5+	occipito-posterior, Brow presentation	Delivery by a vacuum extractor or forceps or caesarean
115/75(normal)	>160 (tachycardia)	>2.2 cm	Breech presentation, Shoulder presentation	Doctor can turn the fetus to present head first by pressing on the woman's abdomen otherwise caesarean delivery
>140/90 (mild high BP)	110-160 (normal)	10cm	cephalic presentation	Doctor tries to control BP
>140/90 (mild high BP)	<110 (bradycardia)	5+	occipito-posterior, Brow presentation	Delivery by a vacuum extractor or forceps or caesarean delivery
>140/90 (mild high BP)	>160 (tachycardia)	>2.2 cm	Breech presentation, Shoulder presentation	Doctor can turn the fetus to present head first by pressing on the woman's abdomen otherwise caesarean delivery
150/100 to 159/109(Moderate high BP)	110-160 (normal)	10cm	cephalic presentation	Doctor tries to control BP
150/100 to 159/109(Moderate high BP)	<110 (bradycardia)	5+	occipito-posterior, Brow presentation	Delivery by a vacuum extractor or forceps or caesarean delivery
150/100 to 159/109(Moderate high BP)	>160 (tachycardia)	>2.2 cm	Breech presentation, Shoulder presentation	Doctor can turn the fetus to present head first by pressing on the woman's abdomen otherwise caesarean delivery
Above 160/110(Severely high BP)	110-160 (normal)	10cm	cephalic presentation	Doctor tries to control BP
Above 160/110(Severely high BP)	<110 (bradycardia)	5+	occipito-posterior, Brow presentation	Delivery by a vacuum extractor or forceps or caesarean delivery may be necessary
Above 160/110(Severely high BP)	>160 (tachycardia)	>2.2 cm	Breech presentation, Shoulder presentation	Doctor can turn the fetus to present head first by pressing on the woman's abdomen otherwise caesarean
50/33 (Extremely low BP)	110-160 (normal)	10cm	cephalic presentation	Doctor tries to control BP
50/33 (Extremely low BP)	<110 (bradycardia)	5+	occipito-posterior, Brow presentation	Delivery by a vacuum extractor or forceps or caesarean delivery
50/33 (Extremely low BP)	>160 (tachycardia)	>2.2 cm	Breech presentation, Shoulder presentation	Doctor can turn the fetus to present head first by pressing on the woman's abdomen otherwise caesarean delivery

Short-Term Household Load Forecasting using Neural Networks and Support Vector Regression

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Abstract—**Short-term load forecasting (STLF) for a single house is a complex process due to the uncertain and varying occupants' behavior. However, it is nowadays receiving increasing attention as it can contribute to the efficient operation of future smart-grids. Accurate knowledge about the next-step load of a house will enable a utility to make a decision about controlling appliances to match the demand to the supply. This paper presents the very first results of a comparative study between the performances of multi-layer feed-forward neural network (MLNN), support vector regression (SVR) and elman recurrent neural network (ERNN) for the one-step ahead quarter hourly, daily and daily peak power demand forecasting for a house in France based on actual energy/power meter measurements. MLNN was found to have superior performances than ERNN and SVR, with mean absolute percentage errors varying in the range 2.34 % to 9.03 %. The MLNN models therefore have a huge potential to be implemented in actual residential STLF cases where a large dataset of power measurements is available.**

Keywords—Short-term load forecasting; Residential load; neural network; Support Vector Regression

I. INTRODUCTION

Short-term load forecasting (STLF) is the prediction of electricity demand over periods of up to a week ahead, and is useful for the efficient operation of power systems. For instance, it is used to make the supply match the load demand, to manage system reserves, and to calculate the varying price of electricity. Aggregated load forecasting for large geographical regions such as an entire country is well established. However, limited research has been carried out on load forecasting of individual houses [1], which is challenging due to noisy and volatile data [2]. Future smart-grids will include significant integration of distributed energy resources so that STLF at a disaggregated level will be necessary for efficient grid operation. This will necessitate the installation of smart meters at individual houses. These meters will offer fast and reliable communication of more detailed information to utilities with minimal human intervention. The measured data can be used to predict the next-step load of individual houses by using several techniques, which will make utilities and electricity network

operators more efficient. For instance, knowing the future load accurately can help formulate the time-of-use electricity tariffs to make better use of the existing grid infrastructure. Moreover, appliances can easily be controlled to match the electricity demand of houses to the availability of renewable energy.

STLF at the local level has been useful in numerous state-of-the-art applications including demand side management [3] and electric vehicle integration [4]. Limited research has been carried out on the comparison of different artificial intelligence (AI)-based techniques for residential STLF. Seven different machine learning algorithms were evaluated in [5] to predict the next hour building energy consumption, based on measurements having a resolution of 15 minutes. The results showed that support vector regression (SVR) performed better than multi-layer feed-forward neural network (MLNN) and the lowest achieved mean absolute percentage error (MAPE) was 16.11 %. Moreover, it was shown that the inclusion of the actual previous energy consumption information in the model improves its forecasting accuracy. MLNN and support vector machines were used to predict a house's load for the next 24 hours in [6], based on previous energy consumption and internal temperature information, and both provided reasonable forecasting accuracies. Based on their results, the authors stressed out that load forecasting on individual household level is a complex task. MLNN was used as model without any weather variable input to predict the hourly and daily energy usage of households in Portugal [7]. For 46 households analyzed, the daily energy consumption forecasting had a maximum and average MAPE of 18.1 % and 4.2 % respectively. For 2 particular houses, the hourly energy demand forecasting had MAPE varying between 10.0 % and 23.5 %.

In this paper, we investigated the use of a household's metered actual electrical parameters to develop models for the next quarter hourly, next day and next day peak load forecasting by employing MLNN, elman recurrent neural network (ERNN) and SVR AI methods without the use of weather data. The rest of this paper is organized as follows: Section II describes the methodology adopted in this work, section III provides the results and their discussions, and section IV eventually concludes the paper.

II.   METHODOLOGY

A. Dataset preprocessing

Measured electricity consumption at 1-minute resolution for a house located in Clamart, France was obtained from the UCI Machine Learning Repository [8]. The dataset contained a total of 2,075,259 measurements for the years 2006-2010 and had 9 attributes namely the date and time, mains voltage, global current intensity, global active and reactive powers, and 3 sub-metering measurements for different groups of loads. The arithmetic sum of the 3 sub-meterings was determined and was labelled 'METER'. The raw data was aggregated by finding the median over 15 minutes for the quarter-hourly STLF and over 24 hours for the daily STLF. Median was used for aggregation as mean is sensitive to outliers. For the daily peak STLF, the maximum load for each day was retrieved. For the quarter-hourly aggregated data, missing values were discarded. For the daily data, the missing values were estimated by finding the average of the two values immediately before and immediately after the unavailable values [9]. The multiplicative decomposition model [10] was employed to break down the power time series into four components using (1),

$$Y(t) = T(t) * C(t) * S(t) * I(t) \qquad (1)$$

Where $Y(t)$ is the time series data, $T(t)$ is the trend component, $C(t)$ is the cyclic component, $S(t)$ is the seasonal component and $I(t)$ is the irregular component. The centered moving average (CMA) which is free from noise was calculated using (2),

$$CMA_k = T(t) * C(t) \qquad (2)$$

where k is the seasonal frequency which was chosen after a test to determine if seasonality existed in the power consumption associated with that particular frequency [9].

B. Quarter hourly STLF model

A seasonal frequency selected for the CMA was 24, as the seasonal pattern was found to repeat itself every 6 hours [9]. The selected inputs to the model were the 15-minutes aggregated power consumption, current intensity and METER [9], the CMA for quarter-hourly pattern and the hour type, which is any integer between 1 and 24 inclusive. Fig. 1 shows the aggregated power and the corresponding CMA for a small part of the dataset
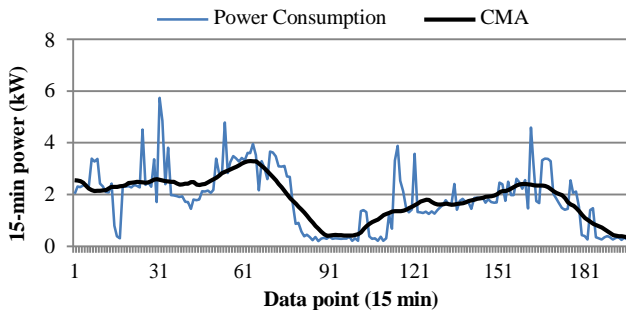
Fig. 1. Aggregated power (15 min) and CMA

C. Daily STLF model

A seasonal frequency of 7 was selected as the pattern was found to repeat itself every week. The selected inputs to the model were the 15-minutes aggregated power consumption, current intensity and METER, the CMA for daily pattern and day type, which is any integer between 1 and 7. Fig. 2 shows the aggregated power and the CMA for the entire data set, whereby the yearly pattern is clearly visible.
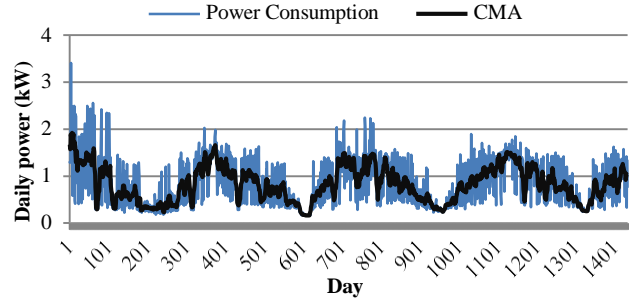
Fig. 2. Aggregated power (24 hours) and CMA

D. Daily peak STLF model

A seasonal frequency of 7 was selected. The inputs to the model were the 15-min aggregated power consumption, current intensity and METER, the CMA for daily peak pattern and day type. Fig. 3 shows the peak power and the CMA for the entire dataset.
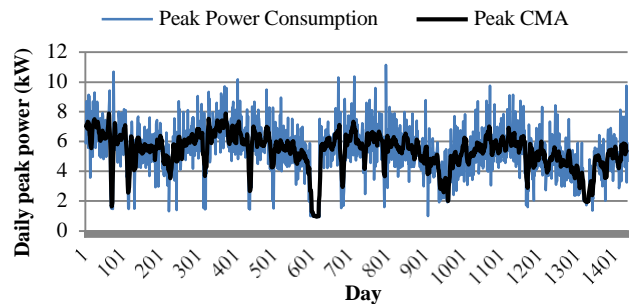
Fig. 3. Daily peak power and CMA

E. Correlation Analysis

Autocorrelation was computed to determine the number of past power consumption observations to be input to the model for the forecasting. Cross-correlation was subsequently performed to determine the number of previous observations for the other input parameters with respect to the power consumption [9]. For the quarter hourly STLF, it was found that all 5 inputs were important, and that the immediate past 20 observations for each input were required. For the daily and daily peak STLF, it was found that the METER and day type inputs were not useful, and that the immediate past 7 observations are required.

F. Models training, validation and testing

The datasets for the different scenarios were divided into the training, validation and testing subsets as described in TABLE I, TABLE II and TABLE III.

TABLE I. DATA FOR QUARTER HOURLY MODEL [9]

Dataset	Percentage	Start date	End date
Training	65	17.12.2006	03.07.2009
Validation	18	04.07.2009	19.03.2010
Testing	17	20.03.2010	26.11.2010

TABLE II. DATA FOR THE DAILY MODEL [9]

Dataset	Percentage	Start date	End date
Training	80	20.12.2006	09.02.2010
Validation	10.03	10.02.2010	03.07.2010
Testing	9.97	04.07.2010	23.11.2010

TABLE III. DATA FOR THE DAILY PEAK MODEL [9]

Dataset	Percentage	Start date	End date
Training	80	20.12.2006	09.02.2010
Validation	10.03	10.02.2010	03.07.2010
Testing	7.39	04.07.2010	17.10.2010

A solid theoretical background on neural networks (MLNN and ERNN) is provided in [11], and a good introduction to SVR is provided in [12]. Cross-validation method was employed to avoid overfitting for the MLNN and ERNN models. No cross-validation was employed for the SVR as the epsilon of the ε-tube of a SVR was by default sufficiently large (0.1) to avoid overfitting [13]. After the SVR training, the validation set was used for testing to verify if overfitting occurred. For the MLNN and ERNN, 100 input neurons were used for the quarter-hourly model and 21 neurons were used for both the daily and peak daily models [9]. The inputs were normalized. Only one hidden layer was used as it was enough for a good generalization. The optimal quantity of the hidden layer neurons was found through trial and error, by starting with a high number of neurons [9]. The weights were initialized using the Nguyen-Widrow algorithm. The resilient backpropagation learning algorithm was used as it is more efficient and faster than the standard backpropagation algorithm. The neural networks were assessed with different initial and maximum weight update values in order to achieve the least training and validation errors, and batch update process was employed [9]. For the MLNN, linear activation functions were used for the input neurons, while the hidden and output neurons had logistic sigmoid activation functions. The ERNN hidden layer neurons had logistic sigmoid activation functions while the output, input and context layer neurons had the linear activation function. The neural networks were trained five times through multithreading in order to ensure a global or a good local minimum. The same normalized inputs were applied for the SVR in which the radial basis kernel function was used. The ratio of the cost of error parameter, C, to the gamma parameter, γ, was varied from 10 to 1000. The MAPE (3) metric was used to evaluate the performances of the different configurations of MLNN, ERNN and SVR.

$$MAPE = \frac{100}{n} \sum_{i=1}^{n} \left| \frac{y_i - \hat{y}_i}{y_i} \right| \qquad (3)$$

Where n is the quantity of observation points in a dataset, $\hat{y}$ is the forecasted value and y_i is the true value. Equations of the regression lines (4) of the training and validation data sets were verified to determine if overfitting occurred.

$$Predicted = (Gradient)Real + Intercept \qquad (4)$$

G. Software and Computing Platform

The simulations were carried out using the version 3.3.0 of Encog machine learning framework with JAVA programming. The version 3.3 Common Math and version 1.0.19 JFreeChart libraries were used to perform the regression analysis and to produce the graphical display of results [9]. The NetBeans IDE 8.1 was used to implement the codes. RStudio 0.99.903 alongside R programming and Ms Office Excel 2007 were employed to preprocess the data. Simulations were run on Core i7, 3.40Ghz processors with 8 GB RAM.

III. RESULTS AND DISCUSSION

Only the most important results are presented in this section.

A. Quarter hourly STLF

The number of hidden neurons for the MLNN were varied from 80 to 20 and it was found that 40 hidden neurons performed the best. The initial and maximum weight update values were 0.5 and 80 respectively. The number of hidden neurons for the ERNN was varied from 50 to 20, with the latter producing the best performance. Several combinations of initial and maximum weight update values were tested and it was found that the best performance was obtained for initial and maximum values of 0.0001 and 0.001 respectively. For the SVR, the best performance was obtained with C and γ set to 85 and 0.085 respectively. The training MAPE, validation MAPE, and regression analysis are shown in TABLE IV.

TABLE IV. Quarter hourly STLF training results

		MLNN	ERNN	SVR
Training	MAPE (%)	9.42	39.47	14.8
	Gradient	0.901	0.729	0.883
	Intercept	0.019	0.051	0.035
Validation	MAPE (%)	9.07	36.68	14.2
	Gradient	0.899	0.740	0.882
	Intercept	0.019	0.049	0.035

The regression analyses conclude that no overfitting occurred for all the 3 models, given that gradients and intercepts for the training and validation phases are very close. Fig. 4 shows the predicted and actual load by MLNN for the period 1st October 2010 (00:00) to 3rd October 2010 (23:00). It is clearly visible that the model can accurately predict the load. Fig. 5 and Fig. 6 show the forecasting results for ERNN and SVR respectively. It can be seen that their performances are poor compared to the MLNN.

B. Daily STLF

MLNN performed the best with 60 hidden neurons. The initial and maximum weight update values were 0.0001 and 0.001 respectively. ERNN performed the best with 10 neurons. The initial and maximum weight update values were 0.000001 and 0.00001 respectively. For the SVR, the best performance

occurred with C and γ set to 40 and 0.04 respectively. The training MAPE, validation MAPE, and regression analysis are shown in TABLE V. It can be deduced that no overfitting occurred.

TABLE V. Daily STLF training results

		MLNN	ERNN	SVR
Training	MAPE (%)	3.22	12.13	14.33
	Gradient	0.99	0.857	0.741
	Intercept	0.003	0.0377	0.0785
Validation	MAPE (%)	2.65	10.85	12.5
	Gradient	0.989	0.8113	0.677
	Intercept	0.0026	0.0621	0.0969
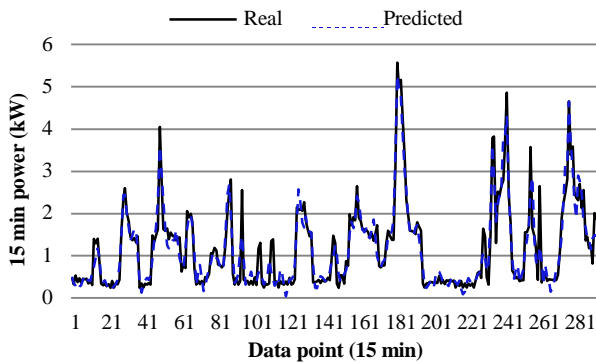
Fig. 4. Quarter hourly MLNN predicted and real load
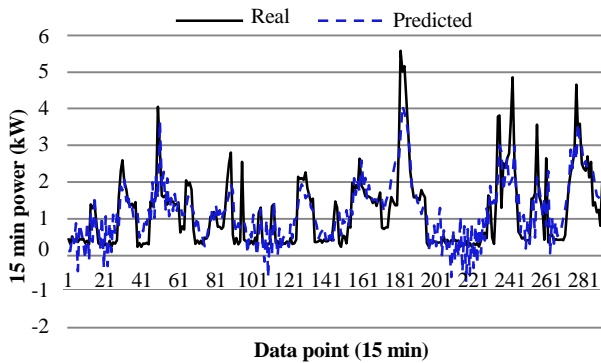
Fig. 5. Quarter hourly ERNN predicted and real load
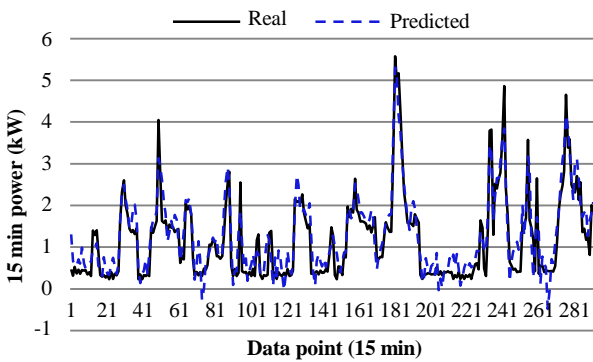
Fig. 6. Quarter hourly SVR predicted and real load

Fig. 7 shows MLNN accurately predicted and actual load by MLNN for the period 11th July 2010 to 23rd November 2010. Fig. 8 and Fig. 9 show the forecasting results for ERNN and SVR respectively. It can be seen that their performances are poor compared to the MLNN.
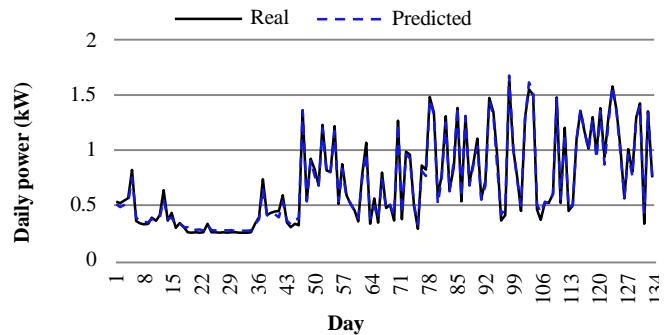
Fig. 7. Daily MLNN predicted and real load
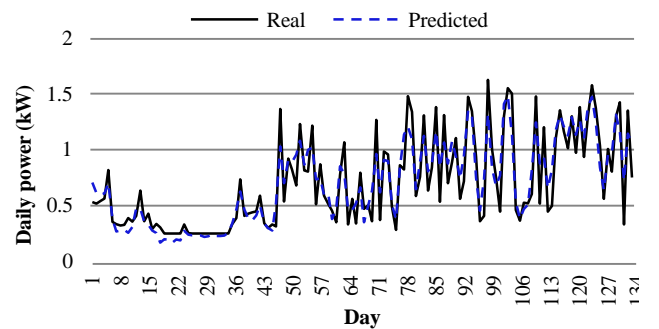
Fig. 8. Daily ERNN predicted and real load
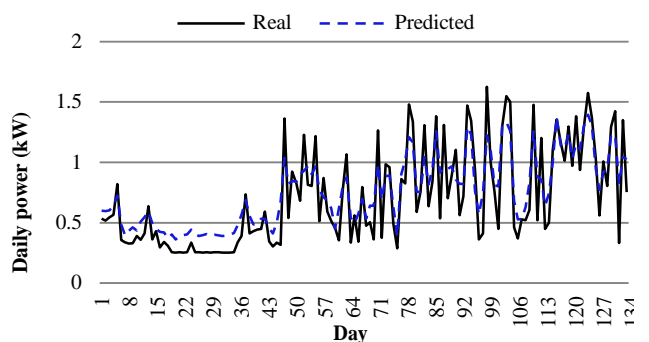
Fig. 9. Daily SVR predicted and real load

C. Daily peak STLF

MLNN performed the best with 70 hidden neurons. The initial and maximum weight update values were 0.0001 and 0.001 respectively. ERNN performed the best with 20 neurons. The initial and maximum weight update values were 0.000001 and 0.00001 respectively. For the SVR, the best performance was obtained with C and γ set to 50 and 0.05 respectively. The training MAPE, validation MAPE, and regression analysis are shown in TABLE VI. It can be deduced that no overfitting occurred. Fig. 10 shows the predicted and actual load by MLNN for the period 11th July 2010 to 17th October 2010, whereby it is visible that the model has a good prediction accuracy. Fig. 11 and Fig. 12 show the forecasting results for ERNN and SVR respectively. It can be seen that their performances are poor compared to the MLNN.

TABLE VI. Daily peak STLF training results

		MLNN	ERNN	SVR
Training	MAPE (%)	1.82	11.91	7.63
	Gradient	0.988	0.755	0.838
	Intercept	0.0054	0.1067	0.0750
Validation	MAPE (%)	1.78	10.22	8.39
	Gradient	1.006	0.636	0.741
	Intercept	-0.0016	0.1413	0.1056
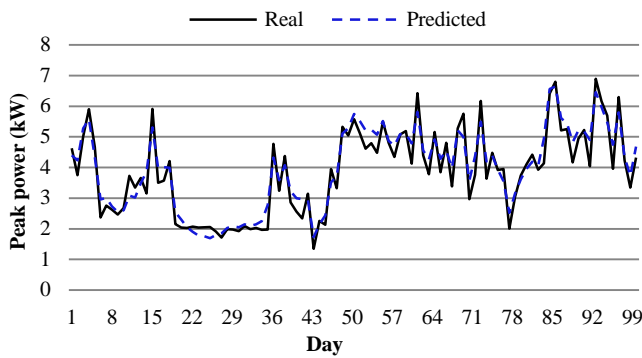
Fig. 10. Daily peak MLNN predicted and real load
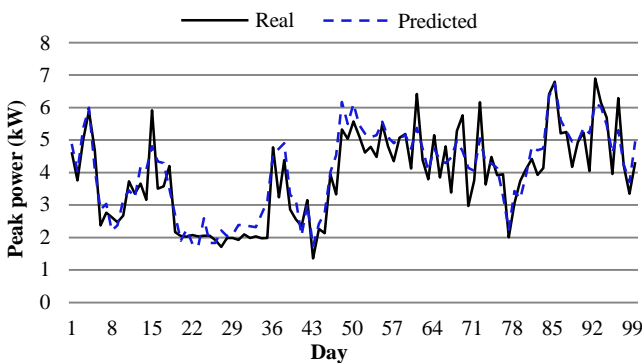
Fig. 11. Daily peak ERNN predicted and real load
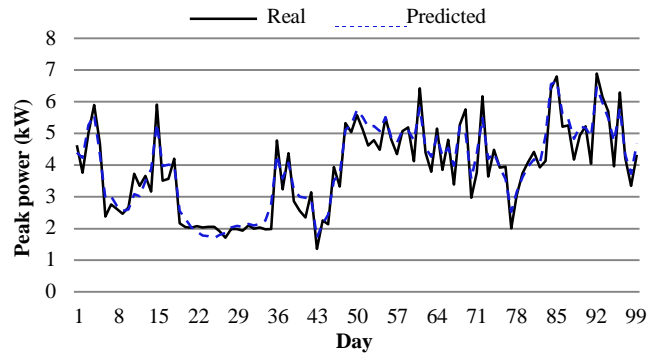
Fig. 12. Daily peak SVR predicted and real load

D. Comparison between models

Fig. 13 compares the performances of the models by the MAPE. It can be observed that MLNN has a superior performance for all the STLF scenarios. Moreover, it can be deduced that the models perform the best when predicting the daily peak load and the worst when forecasting the quarter-hourly load, except for SVR, which performs the worst for the daily STLF.
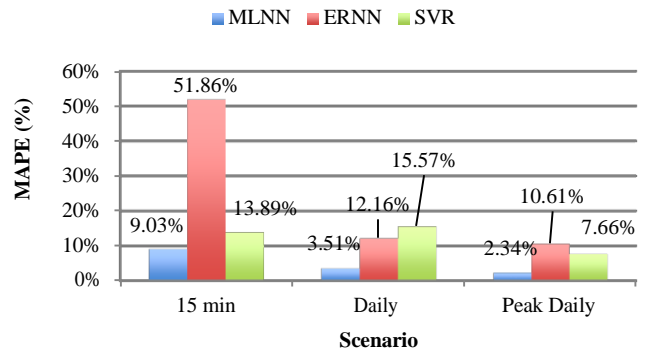
Fig. 13. Comparison of MAPE

Fig. 14 compares the performances of the models by their training times. It can be deduced that both SVR and MLNN take an excessively long time when large amounts of data are used for the training. The training of ERNN on the other hand, lasted for about 10 times less, but the testing phase yielded a poor MAPE.
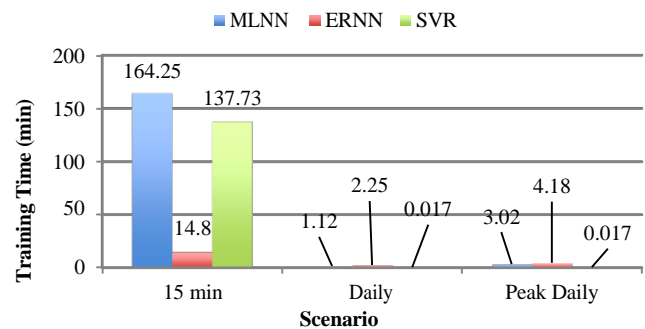
Fig. 14. Comparison of model training time

For the daily and daily peak STLF, all the models, particularly MLNN and SVR, have relatively much lower training times as compared to the quarter hourly models, due to lesser amount of training data. Moreover, SVR took about 200 times shorter for the training as compared to MLNN and ERNN for the peak load scenario. The high training time for the quarter hourly MLNN model does not limit its real application because once training has been accomplished, the system can quickly provide accurate forecasts for the next step load.

IV. CONCLUSION

This paper presented the very first comparison between MLNN, ERNN, and SVR for the STLF of the next-step ahead quarter hourly, daily, daily peak electrical load forecasting for a house based on actual energy/power meter measurements. It was found that the MLNN model has very good forecasting accuracies based on the selected input data, with MAPE as low as 2.34 %. The model has a great potential to be implemented for houses equipped with smart meters and where only a few years' measurements are available. SVR and ERNN performed acceptably for the daily peak STLF with the MAPE varying in the range of 7.66 % - 15.57 %. A future study will involve comparing other AI techniques as well as different combinations of inputs, for several scenarios of STLF including quarter hourly, half hourly, hourly, daily, peak daily, weekly and peak weakly. A thorough investigation shall be carried out on all the variable parameters of the different AI techniques.

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The Fractional Fourier Transform in Signal Processing as a modern tool

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Abstract—**The Fractional Fourier Transform is the generalization of the classical Fourier Transform and was introduced many years ago in mathematics literature. The original purpose of Fractional Fourier Transform is to solve the differential equation in quantum mechanics problems in optics. Most of the applications of Fractional Fourier Transform in optics.It depends on a parameterα and can be interpreted as rotation by an angle α in the time frequency plane or decomposition of the signal in terms of chirps. It is also used in digital domain. Because of its simple and of beautiful properties in time – frequency plane, there are many new applications waiting for signal processing.**

Keywords—:   Fractional Fourier Transform, signal processing and analysis.

I. INTRODUCTION

Fractional Fourier transform is depend on fraction calculus and is more generalized form of calculus, unlike the integer order calculus where operation are centered mainly at the integers ,fractional calculus consider every real number where v>0. The meaning and application of this new type of calculus are quite comparable to those of the ordinary calculus, especially whenv>0 gets closer and closer to certain integers. The first fractional operator will introduce the fractional integral which is a generalization of the n-tuple in iterated integral to any real order and any nth iterated integral as a single integral.

Although the idea of fractional calculus was born more than 300 year ago, only recently has serious effort has been dedicated to it study, still, ordinary calculus much more familiars, and more preferred, may be because of its application are more apparent. However we believe that in addition to opening our minds to braches of thought by filling the gap of ordinary calculus, fractional calculus has the potential of presenting intriguing and useful application in future.

II. Contents

The fourth power of 3 is defined as 3^4, but $3^{3.5}= 3^{7/2} =\sqrt{3^7}$ may be defined in this manner.

The first and the second derivatives of the function f(x) as df(x)/dx andd^2f(x)/d$x^2 = (\frac{d}{dx})^2$f(x)

Now what is the 2.5^{th} derivative of a function? Let F(u) denote FT(Fourier Transform) of f(x).

The F.T. of the nth derivative of the f(x) be given by$(i2\pi u)^n$ F(u) , for any positive integer n.

Generalizingthis property by replacing n with real order a andtake it as the ath derivative of f(x), thus we can find d^af(x)/dx^a , the a^{th}derivative of f(x) and the inverse F.T. of $(i2\pi u)^a$ F(u). Both of these will deal with the fraction ofan operation performed on an entity, rather than fractions of the entity itself.

Let T be the transformation and describing T as following
T{f(x)} = F(u)

Where f and F are the two functions with variables x and u, respectively, where F is a T transform . thus we can also consider one new transform as

$$T^{\alpha}\{f(x)\} = F_d(u)$$

WhereT^{α} , the α-order fractional T transform, and the parameter α is called the 'fractional order' and this kind of Transform is called "fractional transform", which satisfies the following conditions

BOUNDARY $T^0\{f(x)\} = f(u)$
CONDITIONS $T^1\{f(x)\} = F(u)$.

Additive Property: $T^{\beta}\{T^{\alpha}\{f(x)\}\}=T^{\beta+\alpha}\{f(x)\}$

As we know the two functions f and F are F.T. pair if

$$F(v)= \int_{-\infty}^{+\infty} f(x)\exp (-i2\pi vx)dx$$

&
$f(x) = \int_{-\infty}^{+\infty} F(v) \exp (i2\pi vx)dv$

Which reduce to operator notation as F= £{f} where £ denotes

the conventional F.T. Thus$£^2\{f(x)\} = f(-x)$; $£^4\{f(x)\} = f(x)$.

Thus the notation $£^{\alpha}$ means doing the £ for α times.

The F.T. by expressing it in terms of these Eigen functions as following

$$f(x) = \sum_{n=0}^{\infty} A_n\psi_n(x)$$

$A_n = \int_{-\infty}^{+\infty} \Psi_n(x) f(x)dx$

$£ \{f(x)\} =\sum_{n=0}^{\infty} A_n e^{-in\pi/2}\psi_n(x)$

The α^{th}order Fractional Fourier Transform give the same Eigen functions as the F.T., but its Eigen value are the αth power of the Eigen values of the ordinary F.T.

The Fractional operator of order α may be defined through Eigen functions of the Conventional Fourier operator as

$$£^{\alpha}\{\psi_n(x)\} = e^{-i\alpha n\pi/2}\psi_n(n)$$

If the operator be linear, the fractional transform of an arbitrary function may be expected as

$$\{£^{\alpha}[f(x)]\}(x) = \sum_{n=0}^{\infty} A_n e^{-\alpha n\pi/2}\psi_n(x)$$

Thus, we have the following essential properties:

(1) The FFT operation is Linear.

(2) The first-order Transform '£' corresponds to the Conventional F.T. £ and the zeroth-order transform $£^0$, ie. doing no transform.

(3) The fractional operator is additive $£^{\beta}£^{\alpha} =£^{\alpha+}$

FRCTIONAL FT. OF SOME SIGNALS

SIGNAL	Fr FT with order $\emptyset$
$\partial(t-\tau)$	$\sqrt{\dfrac{1 - jcot\emptyset}{2}} \cdot e^{j(\frac{\tau^2+u^2}{2})cot\emptyset} \cdot e^{-jcosec(\emptyset\tau u)}$
$e^{-j(at^2+bt+c)}$	$\sqrt{\dfrac{1 - jcot\emptyset}{j.2a - jcot\emptyset}} \cdot e^{\frac{j(2acot\emptyset-1)u^2}{2(cot\emptyset-2a)}} \cdot e^{\frac{-j(b\,cosec\emptyset)}{cot\emptyset-2a}} \cdot e^{\frac{-j(b^2)}{2(cot\emptyset-2a)}} - j$
1	$\sqrt{1 + jtan\emptyset} \cdot e^{-(\frac{ju^2 tan\emptyset}{2})}$
$\cos(vt)$	$\sqrt{1 + jtan\emptyset} \cdot e^{\frac{-j(u^2+v^2)tan\emptyset}{2}} \cdot \cos(uvsec\emptyset)$
$\sin(vt)$	$\sqrt{1 + jtan\emptyset} \cdot e^{\frac{-j(u^2+v^2)tan\emptyset}{2}} \cdot \sin(uvsec\emptyset)$

We have introduced some relations between them, which are quite important because many applications are based on them. The first FRFT have several applications in the area of Optics and Signal Processing, which leads to generalization of notation of space or time and frequency domain which are central concepts of Signal processing. The generalization of F.T , Fr. F.T in a useful tool for Signal Processing. Since the flexibility of Fr. F.T is better than conventional F.T., many problems that cannot be solved well by Conventional F.T. are solved here. It has many applications in the solutions of Differential Equation, Optical Beam Propagation and Spherical mirror resonators, Optical Diffraction theory, Optical Signal Processing, Signal Detectors and finds other relation between Fr. F.T. and other signal representation.

III.   FUTURE SCOPE

Using ideas of ordinary calculus we can differentiate a function

$f(x) = x$ to the 1st or nth order and we can also established a mean or some potential application of the results and we can differentiate the same function to $1/2$th order. Better still, can be established a mean of some potential application of the results?

We may not achieve that through ordinary calculus but we may through fractional calculus –a more generalised form of calculus.

We know how to solve some fractional order differial equation using the Laplacetransform, we can solve these problem using both the integer and fractional order operations.

They fractional matrix function $K_{v,v}(At^v)$ which we computed

using extended Putzeralogrithim and defined as

$K_{v,v}(At^v) = t^{v-1}E_{v,v}(At^v)$, where $E_{v,v}(At^v)$ is the

matrix Mittag – Leffler function .

We would like to consider in the future extending the ideas specially rounding the above matrix function and again this idea can be extended to any n×n matrix.

IV.   CONCLUSION

We have introduce two different form of fractional derivative ,the Riemann Liouville and caputo forms and examine some basic properties of each . We can solve some simple fractional differential equation leading up to the fractional damped harmonic oscillator problems here we have used the concept of fractional derivatives, fractional integration and using application of Laplace transform also. Here given the concept of fractional calculus by Riemann Liouville concept of fractional integral and derivative at some fractional differentialequations with an emphasis of the Laplace transform of the fractional integral and derivatives

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REMOVAL OF HEAVY METALS FROM EFFLUENT OF METAL PLATING INDUSTRY BY ADSORBENT PREPARED FROM PEANUT SHELL

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Abstract
This study deals with the adsorption of Fe and Ni from Metal Plating Industry Effluent by using peanut husk as prepared adsorbent .Batch adsorption studies were studied to optimize the effect of various parameters such as adsorbent doze (gm), initial (pH_o), contact time, initial concentration for the removal of Nickel and Iron. The maximum removal of Nickel was found to be (75.5 % at pH 3.5) and that of Iron was found to be (80 % at 3.5 pH) when using peanut husk. The sludge can be simply filtered and dried and can be used as a fuel in a boiler furnace and in incineration thus its heating value can be recovered.

Keywords: Heavy Metal, Metal Plating Industry (MPI), Iron, Nickel

INTRODUCTION

Industrial progress is positive indication to improve human life. Metal plating industries take appropriate place. Due to these industries environment is suffering from the effects of pollution. Heavy metals such as Ni, Fe etc are unpleasantly affecting our ecosystem due to their toxicological and physiological effects in environment. When these metals, are present in excess limit then it can be a serious health hazard which can create many disturbance in human beings and to the animals and cause water pollution if discharged in water receiving bodies. [1]. Basic reason for heavy metal pollution is due to metal-plating, battery manufacturing, mining and metallurgical engineering. [2]. The main heavy metals which cause metal ion pollution are Fe, Ni, Cr, Pb, Cd etc. Iron and Nickel are toxic pollutants which causes serious problems in

environment and human health. When accumulated at high levels of Iron and Nickel, can generate serious problems and when concentration reaches 0.1 mg/g body weight, it can ultimately become serious [3].

HEAVY METAL FOUND IN WASTEWATER

Heavy metals found in wastewater include Fe, Ni, Cr, Pb etc. These metals, when found in sufficient concentrations, can be detrimental to human health as well as the environment. There are various conventional methods for the removal the heavy metals from MPE such as chemical precipitation, filtration, ion exchange, evaporation, reverse osmosis, solvent extraction, and electrochemical treatment and membrane technologies [4]. It has been seen that these methods are quite expensive and high sludge generation. [5]. Therefore it became a challenge for opting new technique for efficient metal removal from water and wastewater. With reference to other conventional methods adsorption method has found to be most convenient method due to its simplicity and high efficiency, as well as the availability of a wide range of adsorbents. The most common used adsorbent is Activated carbon for the removal of heavy metals from MPE. But due to its higher cost and loss during the regeneration restrict its applications.

ELECTROPLATING INDUSTRIES

Electroplating is the method of a metal coating to a metallic or other conducting surface by an electrochemical process. The article to be plated (the work) is made the cathode (negative electrode) of an electrolysis cell through which a direct electric current is passed. The article is immersed in an aqueous solution (the bath) containing the required metal in an

oxidised form, either as an aquated cation or as a complex ion. The anode is usually a bar of the metal being plated. During electrolysis metal is deposited on to the work and metal from the bar dissolves:

$Mz(aq) + ze^- \rightarrow M(s)$ at cathode

$M(s) \rightarrow Mz+ (aq) + ze$ at anode
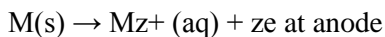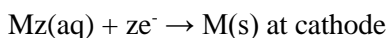
Faraday's laws of electrolysis govern the amount of metal deposited. Mathematically Faraday's laws of electrolysis can be written as:

$Q \propto zm/M$

$Q = It = zFn$

where Q is the charged passed, I is the current passed, t is the time the current is passed, z is the change in oxidation state, m and M are the mass and molar mass respectively of oxidised or reduced species, F is the Faraday constant (96485 $C.mol^{-1}$, the charge of one mole of electrons), and n is the amount of substance oxidised or reduced.

MATERIALS AND METHODS

Raw material

Groundnut shell was used as a basic raw material, for the preparation of prepared activated carbon. Groundnut shell was properly washed to remove any mud, etc., dried and then ground to a particle size of 2 mm for the further process of carbonization. Operating condition for preparation of powdered activated carbon

Condition	Temperature (^{o}C)	Duration (Min.)
Charring condition	400	30
Chemical activation condition	650	15

Preparation of adsorbent

The groundnut was carbonized in an electric furnace by carbonization. Adsorbent was prepared by keeping adsorbent in a stainless steel apparatus and carbonized at 400°C for 30 min in a muffle furnace followed by chemical activation by impregnating with $ZnCl_2$ for 24 h at a 1.55 $ZnCl_2$/char ratio and dried at 100±30°C. The dried and impregnated adsorbent material was carbonized at 650°C for 15 min. The final product was finally dried and sieved to obtain a particular particle size.

RESULT AND DISCUSSION

Effect of agitation time

Agitation time is surrogate parameter for heavy metal removal from MPE as reported by several authors [9,10]. Therefore, the determination of rate of metal adsorption by Peanut husk from 100 ml (at 10, 20, 50, 100 mgL^{-1}), the solution was analysed for residual metal at different time intervals. Results of effect of the agitation time on Iron (III) at 105 ppm by Peanut husk adsorbent are shown Figure 1. shows the effect of agitation time on Iron (105 ppm) and Nickel (95ppm) by Peanut husk adsorbent.
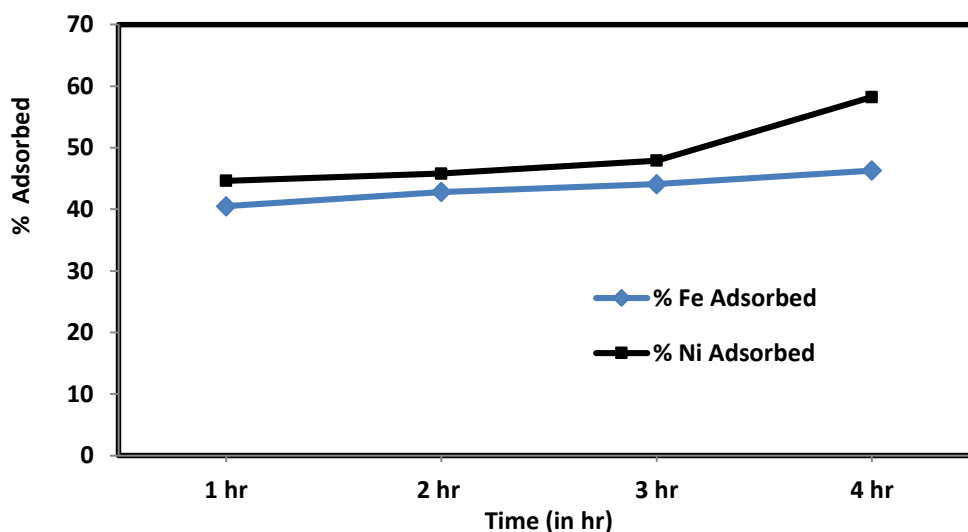
Figure 1 Effect of agitation on adsorption of heavy metal using Peanut husk as an adsorbent.

Effect of pH

To pH of the solution plays a wide role in adsorption process for the removal of heavy metal. During adsorption neutral pH and slightly alkaline pH was found to better thus, to determine to check the effect of pH a known volume of adsorbent is added in 100 ml of MPE. Treated effluent having Fe adsorbed of 75.4, 82.4, 67.2, 48.1, 26.1, 40.7 and 45.3 % were obtained at pH 2, pH3.5, pH5, pH6.5, pH8, pH9.5 and pH11 respectively for 360 min of agitation, while nickel adsorbed of 58.2, 80.1, 66.4, 35.8, 8.3, 22.6 and 25.6 % were obtained at pH2, pH3.5, pH5, pH6.5, pH8, pH9.5 and pH11 respectively for 240 min of agitation. Adsorbent dosages are one of the important parameter for treatment of electroplating effluent. The effect of adsorbent dosage i.e. the amount of the Peanut husk on the adsorption of metals was studied at different dosages ranging from 4 to20 gm/l. The effects of adsorbent dosage at various initial metal concentrations are presented in figure 2.
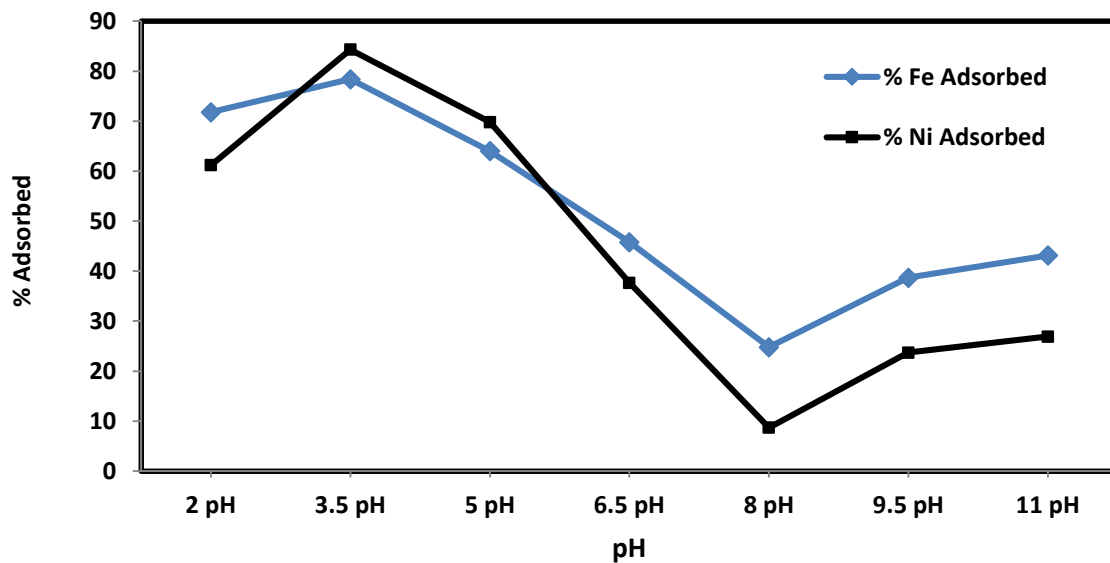
Figure 2 Effect of pH on adsorption of metal using Peanut husk as an adsorbent

Effect of Adsorbent Dosage

Adsorbent dosages are one of the important parameter for treatment of electroplating effluent. The effect of adsorbent dosage i.e. the amount of the Peanut husk on the adsorption of metals was studied at different dosages ranging from 4 to 50 gm/l. The effects of adsorbent doze at various initial metal concentrations are presented in this section.

Adsorption of Iron (105 ppm) and Nickel (95 ppm) by Peanut husk adsorbent at various adsorbent dosages is shown in fig 3. The amount of adsorbent dosage required for the optimum removal of the metal ions increased with increase in the initial metal ion concentration.
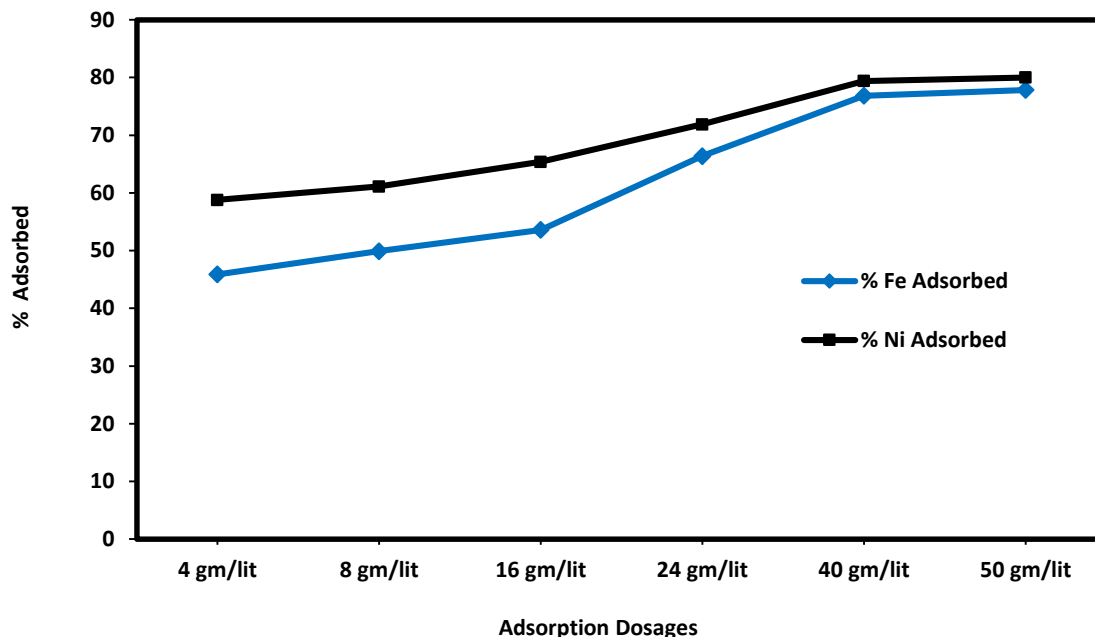
Figure 3 Effect of adsorption dosage on adsorption of metal using peanut husk as an adsorbent

CONCLUSION

From this study it has been concluded that T the peanut shell can be used as an adsorbent for the removal of iron, nickel from MPE. The maximum removal of iron and nickel was (77.85%, 79.4%) at 40gm/l. Since water also has high elution efficiency nickel, iron loaded peanut husk is unstable and has to be adsorbed off and managed carefully. The most approximate method for its disposal is to separate the spent peanut shell sludge from the aqueous solution dry it and use it as a fuel in boiler furnace etc. Spent peanut husk has high heating value to have potential use in the adsorption of iron, nickel from anodizing industry effluent.

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TQM implementation barriers in Indian certified SMEs

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Abstract—**The formalized system of ISO 9000 series enable to develop an environment to adopt advanced quality management system like TQM in order to meet the increase in quality demand from consumers and competitiveness between SMEs. This study examines the barriers in the development of TQM among ISO 9001certified SMEs in India. The empirical data was obtained from 200 certified companies of the four regions of India. The perspective barriers were analyzed using SPSS software. The key barriers in the adoption of TQM practices are resistance to change, lack of reward and recognition and lack of training while the favorable barriers are top management commitment and customer focus. The ranking of barriers provide preference to management of SMEs to attack upon in order to implement TQM.**

Keywords—TQM, ISO9001, SMEs, Barriers

I.   INTRODUCTION

Today industries are under an environment of severe competition from domestic and international organizations. The competitiveness is to meet the demand for superior quality products and services. Consequently, many organizations have been adopting simple quality aspects to advanced quality system such as ISO9001, Total quality management (TQM), six sigma etc. An organization with an effective management system is expected to be more efficient in using its resources than an organization without an effective management system [1]. So, a good quality and its management, is well recognized for its issues strongly impacting the overall performance in industries that's why, adequate quality systems are of paramount importance from competitive point of view [2].

The organizations in developing countries like India prefer to achieve competitive advantage through the effective deployment of ISO 9000 quality management system (ISO9000QMS).The certification system encourages the SMEs facing with limited resources and tremendous competitive pressure, to broaden the focus of their quality approach to TQM. Developing TQM implementation for firms in India is not easy task, where there are many factors resisting its implementation [3], but the SMEs affirmative in perceiving total quality is due to its ability to counter the major emerged challenges of cost reduction, quality improvement and delivery in time [4]. In view of the sustenance of SMEs with good quality practices it is essential to overcome the barriers. This study is an attempt to identify and evaluate the barriers in the adoption of total quality practices among the ISO9001certified Indian SMEs. The prioritization of barriers helps management to attack with optimum resources and implement TQM.

II.   LITERATURE REVIEW

A.   Quality improvement path in Indian organizations

In India the improvement of quality has been adopted through four distinct stages is shown in "Fig 1". Before 1947, India was a British colony, had very little industrial production and typically exported raw materials to the United Kingdom for processing. Very little efforts existed in improving the quality of Indian goods. Since the 1920s, a number of Indian engineering companies started industrial production and some of them established a reputation for quality products. However, there were no organized efforts to improve quality [5]. After independence, the products manufactured in Indian companies were to be used by the Indian customers. The quality had been convinced with inspection to separate the non-acceptable quality product and get through with its scrap or rework. Next came the quality control up gradation through supervised skills, written specification, measurement and standardization, the fruits of which reaped mainly by the good managed and professional firms. It is started with customers accept the quality decided by the firms and not as per their expectations as the processes are aligned according to the written specifications. In conjunction to this, many SMEs focuses on local and domestic market which confined quality as per regional standard of ISI Certification Mark (The Bureau of Indian Standards) introduced by the Government of India jointly with Quality council of India. Their products range from cosmetics to food and heavy industrial materials sporting ISI certification tags that indicate safety and assurance of certain level quality. The quality tags on products are to guarantee safe purpose for the customers to meet quality standards. This quality had been accepted by customers till SMEs in general gave quality recognition through an emphasis on quality assurance and developing quality management system practices for producing goods and services that confirm to quality as per the customer requirements. The changed situation has happened with the open market in India which gave rise selection power to customers. The Indians and SMEs are left with no option but to take quality competitively and as per the customers' expectations.
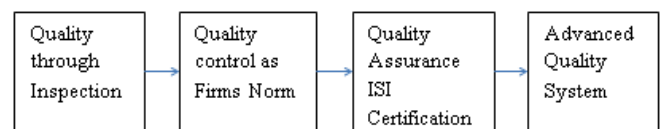

Fig. 1. Quality Improvement path in Indian Companies

The competent SMEs in India have recognized the importance of ISO certification and understand the

requirement of documentation and procedures to ensure the quality of products and services. The adoption of these certifications in some of the Indian SMEs was merely for the improvement of quality products and services rather than quality of processes [6]. The favorable fact is the process oriented culture in the MNCs consequently encouraged the quality enlightened suppliers in India to meet the required specifications and expectations of customers. In majority good firms the certification acts as a bridge between the traditional management of SMEs and a more sophisticated one. It plays a catalytic role in the adoption of new quality management tools. The department of Trade and Industry of India (1995) commented, "The ISO standard is to be viewed as a good foundation to build TQM." The upgraded ISO 9001QMS is more quality align system which provides for the further requirement of continuous improvement for the adoption of TQM.

B. Total quality management system in ISO SMEs

The ISO 9000 (International Organization for Standardization) series of international standards were first introduced in 1987 with the objective of standardizing quality management systems. A number of studies have been conducted to examine the relationship between TQM implementation and Quality Management Systems (QMS).A common argument of many of these studies is that ISO 9001 series should be the first step and then sequentially followed by TQM implementation [7]. Having realized the importance of seeking ISO certification, the organizations in India launched quality improvement process continuously. The TQM initiative in India has been moving forward under different banners but, faced by competition, demanding consumers and the needs of global customers, it has gathered momentum in the last few years. Initially it has been the manufacturing sector that has focused on TQM and has been influenced significantly by the Japanese approach to TQM [8]. Now, it has made impressive inroads in to the manufacturing and service sectors in India as demonstrated by different researchers [9], [10], [11], [12], [2].

HavingISO9001 certification means adoption of common dimensions between ISO 9001 and TQM such as process management, use of statistical tools and information and data gathering however companies that implemented and certified would still fall far short of implementing a comprehensive TQM system [13]. There exists definite number of barriers that causes lack of TQM implementation among certified SMEs are mostly true in developing countries [14].

III. METHODOLOGY

The instrument used in data collection consists of two parts – first part is profile of respondents and second part comprised of questions pertaining to barriers in TQM implementation. The 14 barriers identified for this study have most influence in the implementation of TQM. The literature base of these barriers found in the research carried out by [15] to study the TQM implementation in Indian industries and a book "Total Quality Management" by [16]. A 5- point Likert scale was employed with a score of 5=Extreme Favours; 4=Very Strong Favours; 3=Strongly Favours;2=Slightly Favours; 1=Equally Favours.

The questionnaire was pre tested with pilot study that involved 16 practitioners, 2 CEOs and 2 academicians. The modified questionnaire was mailed to more than 400 certified companies selected from the lists provided by Micro Small Medium Entrepreneur Mumbai office, directories of different industrial associations and reference companies from quality management consultancy in Nagpur. The 200 filled correct responses were used for analysis after rejecting 18 ambiguous responses.

A. Analysis and results

The analysis of respondents profile has revealed the higher (88.5 percent) of manufacturing SMEs and less (11.5 percent) of service SMEs. The respondents from these certified SMEs were the experienced (5 to 10 years) quality practitioners at middle level management - 85 percent, first level supervisor - 10.5 percent and the top level management - 4.5 percent were fewer respondents.

B. Barriers to TQM implementation

SMEs in developing countries face an abundance of external constraints due to the differences in infrastructure, social, cultural and regulatory factors and internal constraints inherent to SMEs by nature [17]. These constraints pose obstacles in the adoption of core values of TQM as they are strongly correlated. The 14 such barriers that are impediment to the development of TQM analyzed to determine the highly influencing to least influencing barriers. The mean and standard deviation method is used to decide the ranking of the barriers. The barriers with the maximum to minimum mean values are taken in ascending order of ranking are shown in TABLE I. The barrier with smallest mean value pose less obstacle compared to first rank inactual conduction of TQM practices. These barriers with their rankings aredepicted in "Fig. 2" and are discussed below.

1. Resistance to change: The certified SMEs with ISO quality management system abide to working processes and procedures which is against the dynamism requires in every organization in the implementation of TQM needs significant changes. The individual change is required to all employees from lower level to top management. The highest mean score 4.15, indicates unwillingness of staff in SMEs to come out of "comfort zone" and learn and adopt new techniques, methods and ideas oriented to customer satisfaction.

2. Lack of rewards and recognition: The second highest mean score 4.025, shows the lack of motivation to employees in TQM implementation. The management of SMEs gives less encouragement to the self motivated performing individuals by giving any incentive and reward. The reward and recognition policy is useful to develop uniform quality environment essential for TQM.

3. Lack of training: SMEs adopt very basic training to their lower level employees and managers in terms of induction training and on the job training. SMEs are less focused in providing training required to increase the skills, improve the problem solving and communication abilities.

4. Lack of effective measurement criteria: SMEs collect information related to customers, processes, employees, tests, etc. The improper collection and analysis of this information

prevents owners and managers to gauge the correct depth of quality improvement require. Even the recorded data, managers could not analyze for routine or consistent use of it to contribute to the efficiency of the overall system.

5. Lack of systems and structures for TQM activities: The documented sequential and interrelated processes deployed to implement TQM lagging the recorded effectiveness.

6. Costly consultancies and training programs: Not many SMEs seek the expert services from management consultancies which come at reasonable cost. The important criterion is consistent management according to the set parameters and practices for implementation of TQM.

7. Lack of understanding: The moderate (mean=3.8750) understanding shows moderate involvement of everyone that is from CEO to shop floor person in the process of TQM. They contribute through moderate knowledge of processes and facets of TQM since everyone in company contributes for TQM. Due to this managers unable to use proper decision making tools and techniques, changes in the systems due to fear of losing market etc. are enveloped to these SMEs in India.

8. Lack of evaluation of procedures and benchmark indices: The SMEs have moderate evaluation of the processes, services, products, customers, employees etc. that are benchmarked for improvement.

9. Training with no purpose: The continuous improvement for a job and a process as one of the tenets of TQM require training on different aspects such as employee involvement, cooperation and teamwork, problem solving and learning and statistical tools. Such purposeful training lags in Indian SMEs.

10. Lack of top management commitment: The firm's quality and cultural commitment is not clear to CEO and managers. Top management and owner of the firm are less aware, knowledgeable and committed to act as the change agent for TQM. The lack of experience and confidence in quality system implementation are mainly from the indigenous SMEs in India.

11. Lack of preparation: SMEs has moderatepreparatory contribution to TQM implementation.

12. Lack of resources: The good use of technical, human, customer, facility and other resources of the firm involve prioritization and allotment to ensure quality during production.

13. Lack of vision: Lack of vision and customer focus share the same ranking and pose less barrier to TQM implementation. The product and services are focused towards customer requirement but lag continuous improvement of processes, products and services.

14. Lack of customer focus: The minimum barrier for customer focus shows Indian SMEs have good understanding of customer needs to maintain customer satisfaction.

IV. CONCLUSION

It is apparent from this study that due to barriers the implementation of TQM practices is weak among Indian SMEs except few that are good managed and multinational SMEs. The first three major barriers are resistance to change, lack of rewards and recognition and lack of training while the last four barriers in terms of rank are lack of vision, lack of customer focus, lack of resources, lack of preparation and lack of top management commitment. The initial three barriers are related to human nature and with motivation the employees could be trained for their willing involvement into the task. The certified manufacturing and service SMEs have to overcome these barriers by severe quality practices. The implementation of TQM is viable due to the favorable practices of management commitment, resources availability and customer focus.

TABLE I. TQM BARRIERS RANKING

| Sr. no.	Barriers	Mean	Standard deviation	Rank
1.	Resistance to change (Too busy)	4.1500	0.90643	1
2.	Lack of rewards and recognition	4.0250	0.98449	2
3.	Lack of training	4.0200	0.96136	3
4.	Lack of effective measurement criteria	3.9350	0.85700	4
5.	Lack of systems and structures for TQM activities	3.9343	0.91281	5
6.	Costly consultancies, training programs	3.9200	0.90980	6
7.	Lack of understanding	3.8750	0.76963	7
8.	Lack of evaluation procedures and benchmark indices	3.8300	0.90842	8
9.	Training with no purpose	3.8250	0.97937	9
10.	Lack of top management commitment	3.7450	1.09360	10
11.	Lack of preparation	3.7400	0.90914	11
12.	Lack of resources	3.6850	1.13677	12
13.	Lack of vision	3.5050	1.11634	13
14.	Lack of customer focus	3.5050	1.19882	13
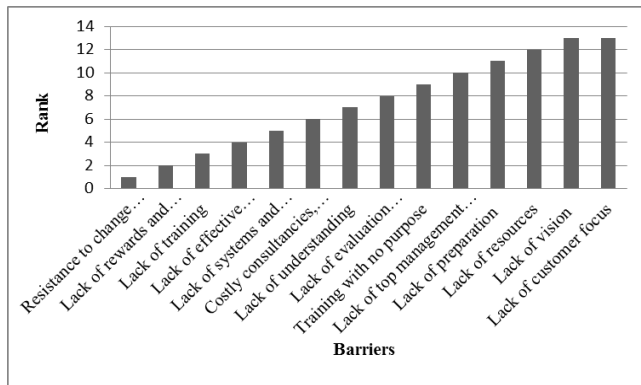
Fig.2. TQM implementation barriers ranking

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ASSESSMENT OF FEED STOCK PROPERTIES OF SEED OIL OF AMOORA ROHITUKA AND HEPTAPLEURUM VENULOSUM FOR THE BIODIESEL PRODUCTION

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Abstract—**The production of biodiesel from non edible seed oils as an alternative fuel has gained significant attention due to the predicted depletion of conventional fuels and due to environmental concerns. The seed oils of *Amoora rohituka (AR)* and *Heptapleurum venulosum* (*HV*) plant species are selected for this screening. These species yield 41.7% & 50.0% non edible oil respectively. The details of component fatty acids (CFAs) are extracted from the literature. The other necessary analytical data like iodine value, saponification value and the various parameters of biodiesel viz., cetane number, density, viscosity, flash point, lower heating value, higher heating value, cloud point, and pour point of fatty acid methyl esters (FAMEs) of AR and HV respectively are computed empirically. The biodiesel properties FAMEs of these seed oils are compared with petro-diesel. This work reports the suitability of these selected species as feedstock for the biodiesel production.**

Keywords— *Edible Seed oil, Amoora rohituka, Heptapleurum venulosum, Biodiesel, Fatty acid methyl esters*

I. INTRODUCTION

Sustainability, in essence is the development of methodologies to meet the needs of the present without compromising those of future generations. It has become a watchword for modern society, with developed and developing nations and multinational corporations promoting international research programs into sustainable food, energy, materials, and even city planning. As there is over exploitation of the non renewable fossil fuels meeting the demands of the present life style, it has become necessary to find out alternative renewable fuels.

Due to its clean emissions profile, ease of use and many other benefits, biodiesel is quickly becoming one of the fastest growing alternative fuels in the world [1]. The advantages of biodiesel comprise its domestic origin, renewability, biodegradability, higher flash point, inbuilt lubricity, higher cetane number than that of petro diesel, low viscosity, improved heating value which yield shorter ignition delay and longer combustion duration leading to low particulate emissions, reduction in emissions of CO_X, SO_X, etc.

Researchers in the recent times, are focusing on non edible seed oils for the biodiesel production to mitigate the consequences of usage of edible oils for the production of biodiesel which otherwise, would lead to adverse effect on food security [2]. There are several methods used for biodiesel production like pyrolysis, micro emulsification and transesterification. Among these, transesterification is a simple and feasible method used for the biodiesel production [3].

Transesterification is a triacylglycerol (TAG) reaction with a short chain monohydric alcohol normally at elevated temperatures in the presence of catalyst to form fatty acid alkyl esters and glycerol. Three moles of biodiesel and one of glycerol is produced for every one mole of TAG (Fig. 1).
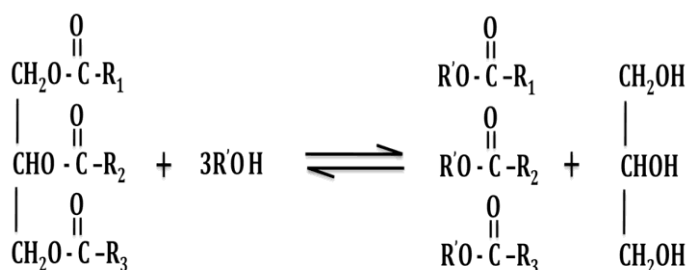
Figure 1: Transesterification reaction

II. SEEDS UNDER STUDY

A. Amoora Rohituka

Amoora rohituka, (*Aphanamixis polystachya*), is a species of tree in the family Meliaceae. It is a deciduous tree distributed all over India, Western Peninsula, Pakistan, Nepal, Bhutan, Bangladesh, Myanmar, Malaya and Srilanka. It is widely used as a medicinal plant in Ayurveda. Oil is not edible and can be used for biodiesel production. The very fine wood is used for construction and ship-making. Fruit is a single seeded pale-reddish with subglobose capsule (Fig. 2).

Figure 1: Amoora rohituka

B. *Heptapleurum Venulosum*

Heptapleurum venulosa synonym of Schefflera venulosa is a species in the genus Schefflera and belongs to the family of the Araliaceae. *Heptapleurum venulosa* is evergreen and is found in Himalayas, Punjab to Assam in India, Southern and Northern China, Malaya and Northern Burma at altitudes of 300-1800m. The tree produces five-stellate flowers (Fig. 3). The trees produce drupes. The trees prefer a half-shady to shady situation on fresh to moist soil. The substrate should be sandy loam. They tolerate temperatures only above at least 1°C.

Figure 2: Heptapleurum venulosum

III. COMPUTATIONAL ANALYSIS OF BIODIESEL PROPERTIES OF SEED OILS

The selected seed oils and the computed biodiesel properties are compared for fuel properties as per ASTM, DIN D6751 and EN 14214 standard methods.

A. Saponification value (SV) and iodine value (IV)

These parameters of the seed oils are calculated to establish their suitability for biodiesel synthesis. The SV and IV of seed oils are calculated from the equations [1] and [2] respectively based on fatty acid compositions [4].

$$SV = \sum \frac{560 \cdot A_i}{MW_i} \qquad [1]$$

$$IV = \sum \frac{254 \times N_{db} \times A_i}{MW_i} \qquad [2]$$

where, A_i is the percentage of component fatty acids, N_{db} is the number of carbon-carbon double bonds and MW_i is the molecular weight of each component.

B. Cetane number (CN)

Generally, biodiesel exhibits higher CN than conventional petro diesel and results in higher combustion efficiency. CN is significant in knowing the suitability of biodiesel. The CN of FAMEs is computed using the equation [3] and is known closely to match the experimental values [5].

$$CN_{mix} = \sum A_C \times CN_C \ [6]. \qquad [3]$$

where, CN_{mix} is the cetane number of the mixture, A_C and CN_C represent the relative amount (%) and the cetane number of the individual neat ester.

C. Higher heating value (HHV)

It is known that the processed vegetable oils used in diesel engines are the complex chemical mixtures of FAMEs. The HHV of biodiesel is calculated using equation [4] in accordance with regression model [7].

$$HHV = 49.43 - (0.015 \times IV) - (0.041 \times SV) \qquad [4]$$

D. Lower heating value (LHV)

The LHV of processed vegetable oils is estimated using equations [5] and [6] based on bond energy values of chemical structure of different FAMEs. For FAMEs,

$$LHV = 0.0109 \left(\frac{C}{O}\right)_3 - 0.3516 \left(\frac{C}{O}\right)_2 + 4.2000 \left(\frac{C}{O}\right) + 21.066 - 0.100 \, N_{db} \qquad [5]$$

$$LHV = 0.0011 \left(\frac{H}{O}\right)_3 - 0.0785 \left(\frac{H}{O}\right)_2 + 2.0409 \left(\frac{H}{O}\right) + 20.992 - 0.100 \, N_{db} \qquad [6]$$

Where, C, H & O are the number of carbons, hydrogen and oxygen respectively. N_{db} has the same meaning as stated above.

E. Density

Density is a key fuel property which directly affects the engine performance. The density values for FAMEs depend on their fatty acid composition. The density of BPME can be determined by using the equation [9]

$$\rho_i = 0.8463 + 4.9/M_i + 0.0118 \, N_{db} \qquad [7]$$

where, ρ_i, M_i and N_{db} are density, molecular weight and number of double bonds in the ith FAME respectively.

F. Viscosity

Viscosity is generally estimated as the time for a volume of liquid to flow under gravity through a calibrated glass capillary viscometer at 40 ºC. Structural features such as chain length and degree of unsaturation influence the viscosities of FAME. The viscosity of FAMEs decreases with the level of unsaturation and increases with the ester chain length. It is determined using the equation

$$V = 0.235N_c - 0.468N_{db} \ [10]. \qquad [8]$$

where, N_c is the weighted average number of carbon atoms and N_{db} is the weighted average number of double bonds present in FAMEs.

G. Flash point

Flash point is a parameter that is usually considered to determine handling, transportation and fuel storage conditions. This property is defined as the minimum temperature at which the volatile fuel flashes or ignites momentarily when in contact with a flame or spark at a pressure of 101.325kPa. It is calculated empirically using the equation

$$FP = 23.362\ N_c + 4.854\ N_{db} \quad [10]. \qquad [9]$$

Where, N_c is the weighted average number of carbon atoms and N_{db} is the weighted average number of double bonds.

H. Cold flow properties (cloud point and pour point)

Cloud point is the temperature when fuel starts forming a cloudy appearance due to the formation of solidified wax. The wax formed thickens the fuel and clogs fuel filters and injectors in engines. The methyl esters having higher degree of saturation tend to have poor cold flow properties. Cloud point is determined by the equation

$$CP = 18.134\ N_c - 0.790\ U_{FAME} \quad [10]. \qquad [10]$$

Where, N_c is the weighted average number of carbon atoms and U_{FAME} is the composition of unsaturated FAMEs in the biodiesel.

Pour point is the temperature at which the biodiesel solidifies and stops flowing and it is calculated using the equation,

$$PP = 18.880\ N_c - 1.000\ U_{FAME} \quad [10]. \qquad [11]$$

Where, N_c is the weighted average number of carbon atoms and U_{FAME} is the composition of unsaturated FAMEs in the biodiesel.

IV. RESULTS AND DISCUSSION

Biodiesel properties of seed oils of *Amoora rohituka* and *Heptapleurum venulosum* are computed based on the data from the literature (G.G. Bhat and Daulatabad, 1997). The component fatty acids (CFAs) are determined with the help of Gas Chromatography. GC MS helps in determining various chemical products regardless of water contents, polymeric emulsions, spent cake, spent catalyst, liquors, soil sample and sediments. The CFAs and other analytical values of seed oils and properties of biodiesel are depicted in Table-2 and Table-3 respectively. The computed parameters of biodiesel from both *Amoora rohituka* and *Heptapleurum venulosum* are complimentary to quality biodiesel and make them befitting candidates for the synthesis of biodiesel.

Iodine value of seed oils should not exceed 120 mg I_2 g^{-1} which best fits for both *Amoora rohituka* and *Heptapleurum venulosum* as per the limitation laid by European standard organization EN 14214 for biodiesel. There

is consistency in the SV (Table 3). This signifies that *Amoora rohituka and Heptapleurum venulosum* are ideal for the biodiesel as per the conclusion derived by Knothe (Knothe, 2008). It may be noted that higher SV infers higher proportion of fatty acids per unit mass of oil and subsequent higher proportion of FAMEs in the biodiesel. Also, because, the FAMEs are oxygenates, improved combustion efficiency and CN is expected and the values are satisfied by both the seeds under study

Density limits for FAMEs in the European EN norm are in the range of 0.860 g/cm^3− 0.900 g/cm^3. Density of FAMEs of AR and HV are 0.870 g/cm^3 and 0.875 g/cm^3 respectively which are in the range specified by EN Standards. The density values of FAMEs of AR and HV are higher than petro-diesel (Table 3), this is because of presence of unsaturated compounds mainly C18:1 and C18:2 methyl esters.

The US (ASTM D6751-08) and EN 14214 standards limit the biodiesel viscosity in the range of 1.9− 6.0 mm^2 s^{-1} and 3.5− 5.0 mm^2 s^{-1}. The calculated viscosity of AR and HV are 4.020 mm^2 s^{-1} and 3.905 mm^2 s^{-1} which seems to be lesser than that of petro-diesel (Table 3). The empirically calculated viscosity of FAMEs of *Amoora rohituka* and *Heptapleurum venulosum* meet the ASTM and EN standards.

Biodiesel standards of USA (ASTM D6751), Germany (DIN 51606) and European Organization (EN 14214) have set CN value as 47, 49 and 51 respectively (Krisnangkura, 1986). The computed values of CN for the FAMEs of seed oils of *Amoora rohituka* and *Heptapleurum venulosum* 52.2 and 54.6 respectively whereas, the CN of petro-diesel is 42.0. The empirically calculated CN value of FAMEs of *Amoora rohituka* and *Heptapleurum venulosum* meet the ASTM standards.

The HHV of a fuel is a function of its carbon, hydrogen and oxygen content and it is evaluated using the equation [4]. The HHV is seen to be almost same at about 39.5 MJ kg^{-1} for the biodiesels derived from the investigated seed oils which is slightly lower than that of petrodiesel [43 MJ kg^{-1}], or petroleum [42 MJ kg^{-1}], but is higher than that of coal [32–37 MJ kg^{-1}]. The LHVs are estimated using two equations [5] and [6]. The computed LHVs of respective biodiesels are about 38.0 MJ kg^{-1}. The European Biofuels Technology Platform 2011 reported the LHV for biodiesel as 37.1 MJ kg^{-1} (Biofuels Technology Platform, 2011). This is slightly lower than the LHV of petro-diesel [43 MJ kg^{-1}]. It may be noted that heating values are a function of mainly carbon content in the fuel.

ASTM D6751 and EN 14214 fixes the minimum value of flash point at 120ºC. Flash point of AR and HV are 164.7 ºC and 166.9 ºC respectively which are higher than that of petro-diesel (Table 3). The values obtained for AR and HV meet the ASTM and EN standards.

The cloud point and pour point values of AR and HV are 8.05ºC , 6.26 ºC and 1.9 ºC, -0.021 ºC respectively which are higher than petro-diesel (Table 3).

TABLE I.   ANALYTICAL VALUES OF *AMOORA ROHITUKA* [A] AND *HEPTAPLEURUM VENULOSUM* [B] SEED OILS

Source / Seed species	AR[A]	HV[B]
% Seed oil	41.7	50.0
Molecular weight of oil (g mol^{-1})	632.3	651.4
% Total saturated fatty acids (TSFAs)	37.2	33.4
% Total unsaturated fatty acids (TUSFAs)	62.8	66.6
Saponification number (mg KOH g^{-1})	204.2	203.8
Iodine value (mg I$_2$ g^{-1})	107.1	103.3
% Component fatty acids:		
14:0 (Myristic)	-	1.2
16:0 (Palmitic)	24.8	21.4
18:0 (Stearic)	12.4	8.0
22:0 (Behanic)	-	1.1
18:1 (Oleic)	20.9	18.9
18:2 (Linoleic)	28.5	47.7
18:3 (Linolenic)	13.4	-
20:0 (Arachidic)	-	1.7

TABLE II.   COMPARISON OF PROPERTIES OF BIODIESELS EMPIRICALLY COMPUTED FOR *AMOORA ROHITUKA* AND *HEPTAPLEURUM VENULOSUM* WITH PETRODIESEL

Fuel property	(AR)	(HV)	(PD)
Density 15 °C (g/cm^3)	0.870	0.875	0.855[a]
Viscosity 40°C (mm^2 s^{-1})	4.020	3.905	3.800[a]
CN	52.2	54.6	42.0[a]
HHV (MJ kg^{-1})	39.4	39.5	46.0[a]
LHV (MJ kg^{-1})	38.1	38.1	43.1[a]
Flash point °C	164.7	166.9	60 to 80[b]
Cloud point °C	8.05	6.26	-15 to 5[b]
Pour point °C	1.9	-0.021	-35 to -15[b]

Conclusion

The FAMEs of seed oil of *Amoora rohituka* and *Heptapleurum venulosum* meet the major specifications of US biodiesel standard and European standards and can be utilized for the production of biodiesel.

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Plant Leaf Disease Detection Using Image Processing Techniques and Classification Based On Neural Networks

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Abstract: *Agriculture is the backbone of the Indian economy. Majority of population depends on it and it also contributes towards a large part of GDP. Plant leaf diseases can result in the reduction of both quality and quantity of agricultural yield. Naked eye observation is not the best way to observe minute variation in the infected part of leaf. In this paper, we are providing software solution to automate detection and classification of plant leaf diseases. In this we are using various computer vision and machine learning techniques to classify diseases & then appropriate measures can be carried out. This approach will enhance productivity of crops and increase the efficiency and accuracy of disease detection in plant leaves. It includes several steps viz. Image acquisition, image pre-processing, segmentation, features extraction and neural network based classification.*

Keywords: image processing, artificial neural networks, OTSU segmentation, co-occurence matrix, KNN classifier, feature extraction.

I.   Introduction

Plant diseases causes many significant damages and losses in crops around the world. Appropriate measures on disease identification should be introduced to prevent the problems and minimize the losses. Technical approaches using machine learning and computer vision are actively researched to achieve intelligence farming by early detection on plant disease. A mobile application is obviously desirable to aid the farmers in diagnosing what sorts of diseases a plant has. Although some similar applications exist, most of them achieve the function by submitting the image to a team of plant pathologists or expert garden advisors to get possible identification results and some advice. This paper presents the research, design and implementation of a system to automatically identify the plants diseases based on its leaf appearance using computer vision and machine learning techniques. Many studies on different segmentation, feature extraction and classification methods were done in order to find the most effective and accurate approach.

The system comprises of five main phases;performing image acquisition in image processing is always the first step in the workflow sequence because, without an image, no processing is possible. The second phase is pre-processing of input image to improve the quality of image and to remove the undesired distortion from the image. Clipping of the leaf image is performed to get the interested image region.

The third phase is to check each individual pixel to see whether it belongs to an object of interest or not. This operation is called segmentation and produces a binary image. Segmentation is the operation at the threshold between low-level image processing and image analysis. In fourth phase we calculate the texture features for the segmented infected area of the leaf.Finally, in the fifth phase; classification, extraction and comparison of the co-occurrence features is carried out and stored in the feature dataset with the help of machine learning techniques and neural networks.

II. Literature Review

Medical image processing for diagnosing disease has become popular these years, because it can not only give a rapid and reliable result to assess patients' condition, but also reduce the cost significantly in

comparison to the traditional diagnosis (Dhawan, 1990). In the past decades, image processing and pattern recognition for plant disease detection has also been an active research area. The overwhelming majority of the technique is similar. First some images are taken from the environment of study by camera. And useful features are extracted from the meaningful part segmented from the original image by some image processing technique. Afterward various classifiers should be applied as a determinant to classify the images into different categories. The segmentation and feature extraction technique of image processing technique and classification learning method are extremely vital to get a correct result. Shapes, color properties and texture based classifier are commonly used approach in the past researches.

Texture is a kind of very useful feature to discriminate the species of disease. The first time to use color texture as the feature to analyze was reported by Shearer et al. (1990) developed an algorithm to recognize cucumber anthracnose using infrared reflection features and optical filter features. However the recognition accuracy was not high enough because the color texture information was not fully utilized. Pydipati et al. (2006) reported a study to identify citrus disease using a texture based hue, saturation and intensity (HSI) feature combined with statistical algorithms, which achieves over 95% classification accuracy rate. Another method successfully recognizing rice brown spot and rice blast via color texture analysis, was developed by Sanyal & Patel (2008).

Segmentation is another important task which can affect the whole leaf disease identification.However the usual segmentation method is too slow to implement an interactive mobile

application. Mobile systems aiding to identify the plant species based on leaf photograph recognition were proposed by Agarwal et al. (2006); Belhumeur et al. (2008). The systems use shape of the leaf as the discriminator to classify the species and the photograph requires to be taken in a white background.

A white background is a somewhat controlled condition, while the leaf pictures in this project are in a complex environment with many coins, branches and different color background. Leaf segmentation in the unconstrained background is much more difficult. Some automatic segmentation on leaf images have been developed by some researcher, however none of them is completely successful with limited result. A k-means segmentation clustering the pixels into leaf and background was developed by Casanova et al. (2012). Yanikoglu et al. (2012) also experimented an approach by assuming the leaf in the centre of the image, so that the leaf color can be attained by the most clustered pixels in the centre. With the leaf color known, it is easy to segment the leaf image by a simple watershed method according to the distance to the sample leaf color.
However this method is not applied to many leafs which randomly distributed in the image. Neto et al. (2006) also develop a method to segment the leaf in unconstrained condition. At the beginning of their method, candidate pixels are selected out based on the color index and make a fragmentation on the candidate pixels. Final decision was made by sieving the convex shape on the fragments. This approach works but cannot segment all the leaves out sometimes.

III. Proposed System

Digital camera or similar devices are use to take images of leafs of different types,

and then those are used to identify the affected area in leafs. Then different types of image processing techniques are applied on them, to process those images, to get different and useful features needed for the purpose of analysing later.

Image acquisition
Image pre-processing
Image Segmentation
Feature extraction
Statistical analysis
Classification
Diagnosis Results

Fig 1. Block Diagram of proposed approach

Algorithm written below illustrates the step by step approach for the proposed image recognition and segmentation processes involved in the designing of the system:

(1)Image acquisition is the very first step that requires acquiring an image with the help of a digital camera or other camera devices.

(2)Pre-processing of input image to improve the quality of image and to remove the undesired distortion from the image. Clipping of the leaf image is performed to get the interested image region and then image smoothing is done using the smoothing filter. To increase the contrast, Image enhancement is also done.

(3)Mostly green colored pixels, in this step, are masked. In this, we computed a threshold value that is used for these pixels. Then in the following way mostly green pixels are masked: if pixel intensity of the green component is less than the pre-computed threshold value, then zero value is assigned to the red, green and blue components of the pixel.

(4)In the infected clusters, inside the boundaries, remove the masked cells.

(5)Obtain the useful segments to classify the leaf diseases. Segment the components using Otsu's method.

Otsu's Method

Otsu's method is named for Nobuyuki Otsu, who published it in IEEE Transactions on Systems, Man, and Cybernetics, vol. SMC-9, no. 1, January 1979. At this time, researchers had already explored a variety of ways to choose a threshold automatically by examining the histogram of image pixel values. The basic idea is to look for two peaks, representing foreground and background pixel values, and pick a point in between the two peaks as the threshold value. Otsu's segmentation uses grey level (L) as an input image while X is the total of x data.

(6)The input data to an algorithm will be transformed into a compact representation set of features. The input data transform into the set of feature is known as feature extraction. If the feature extraction is carefully chosen then the features will extract the relevant information from the input data.

(7)Classification of disease:

In this phase of classification, extraction and comparison of the co-occurrence features for the leaves with the corresponding feature values are stored in the feature dataset. We are going to use neural network based classification. In pattern recognition, the K-nearest neighbor algorithms (K-NN) is a method for classifying objects based on closest training examples in the feature space.

K-NN is a type of instance-based learning where the function and computation is deferred until classification. So the K-nearest neighbor algorithm is the powerful of all machine learning algorithms. The object is classified of its neighbors and being assigned to the class most common to its K nearest neighbors. Here K is an integer and if K = 1 then the object is assigned to the class of its nearest neighbour.

$$CR = \frac{No.\ of\ correctly\ classified\ text\ data}{Total\ no.\ of\ text\ data} \times 100$$

IV. Results and Analysis:

All the experiments are performed in MATLAB. The trained features are obtained from the sugarcane leaves. Each and every class is tested differently to differentiate from normal and diseased leaves. The number in a particular cell indicates that correctly classified leaves against all the conditions of the leaves. The overall accuracy using K-NN Classifier is 95%. The CR is called as classification rate. From the results it is clear that texture analysis can be used for feature extraction and also it is used to observe that normal and diseased leaves, which can be classified easily.

Classifiers	Performance Measure		
	Accuracy	Precision	Sensitivity
SVM	85%	90%	84%
KNN	91%	95%	94%

Table(1): Performance Comparison

V. Conclusion

This paper presents the research, design and implementation of a system to automatically identify the plants diseases based on its leaf appearance using computer vision and machine learning techniques. This is an efficient and accurate approach towards detection of plant diseases which will help in minimizing major production and economic losses, ensuring both quality and quantity of agricultural products and making the overall task of disease detection in plants much easier.

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Survey on Normal or C-Section Delivery Process

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Abstract— **The continuous monitoring of expected mother and fetus is the key fact about labor delivery process. Sensors can be used to measure the dilation and effacement of the cervix and also to measure the time required to deliver a child. The focus of this paper is to survey parameters that are important at the time of child birth deciding on normal or caesarean delivery.**

Keywords— ***Fetal Heart Rate, Electronic Fetal Monitoring ,Occiput-presentation, Breech presentation.***

I. INTRODUCTION

This survey paper provides monitoring and data analysis of the parameters that are important in the normal labor delivery process. Sensor based technologies can be used to monitor the labor delivery process. Labor and delivery are continuously monitored electronically with sensors that measure and record Fetal Heart Rate (FHR) which is referred as Cardiotocography (CTG). The delivery of a full-term newborn fetus refers to a gestation age of 37-42 weeks, as determined by the last menstrual period of labor or via ultra-sonographic technique and evaluation. Basically, the normal delivery process is divided into 3 stages as shown in the Figure 1 [1].
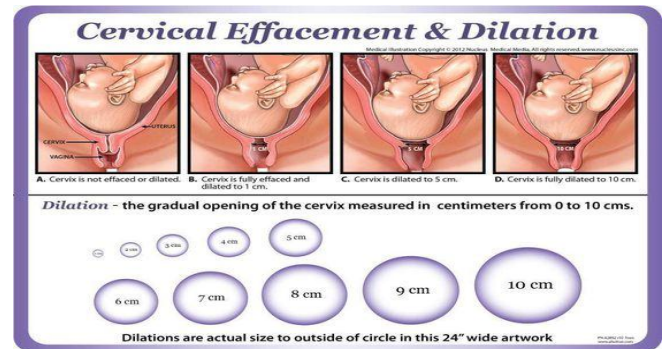

Fig.1 Stages of Normal Delivery Process

1.1. Stage 1: Dilation and Effacement of the Cervix
This stage consists of 3 phases as follows,
    a. Early or Latent phase,
    b. Active phase,
    c. Transition phase.
The same is shown in Figure 2.

Fig. 2 Dilation and Effacement of the Cervix

1.1.1 Early or Latent Phase (cervix dilates from 0 to 4 cm)
In the first phase of normal delivery process, childbirth can take 6 to 10 hours for a first-time mother. The beginning of labor happens differently in every woman. In some women, the cervix can dilate to three centimeters well before any noticeable, real contractions begin. Some women can have strong contractions that don't change their cervical dilation at all. But, in general, the early phase brings some effacement thinning and softening of the cervix and dilation to 3 centimeters over a period of hours or days. Contractions are mild and sometimes irregular, coming from 5 to 30 minutes, lasting 30 to 45 seconds. The water may break in this early phase.

1.1.2. Active Phase (cervix dilates from 4 to 7 cm)
In this phase, serious labor for baby delivery begins, and when most women begin to labor more intensely. It can last an average of three to six hours for first baby, and about half that for subsequent births. During the active phase, contractions usually come steadily, gradually increasing in intensity and frequency, from three to five minutes. Pains may be centered in the lower back, abdomen, or thighs, and they may be intense enough to make it hard for mother to talk. The mother might also experience an increased amount of pinkish or brownish discharge, or what's sometimes called a "bloody show".

1.1.3. Transition phase(cervix dilates from 8 to 10 cm)
The final phase of the first stage can last 20 minutes to two hours for fetal, and may go quite quickly in subsequent birth. Contractions during this phase are intense, spaced about one to three minutes. Sometimes fatigue, shakiness, and nausea are all common in this phase, as mother body does the hard work of reaching complete dilation and effacement. It may feel a
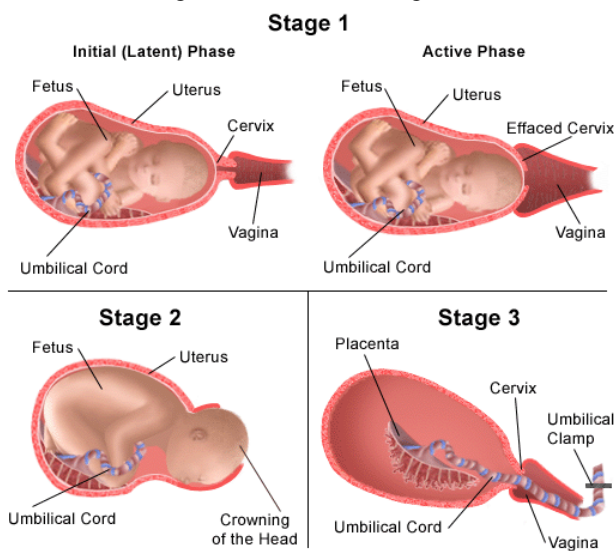
strong urge to push or bear down, along with pressure in the rectal area and stinging in the vaginal area as the fetal head moves down toward the vaginal opening.

1.2. Stage 2: Pushing and Birth

The second stage of labor is the time between full cervical dilation and delivery of the fetus. This phase mainly lasts from minutes to hours. The maximum time for the second stage mainly depends on the patient's parity and whether the labor has an epidural condition.

1.3. Stage 3: Delivery of the Placenta

The normal delivery of the placenta is the final and last stage of labor in the process; it normally occurs within 30 minutes of delivery of the newborn fetus. As the uterus contracts, a plane of separation develops at the placenta-endometrial interface. As the uterus further contracts of the labor, the placenta is expelled.

II.   LITERATURE SURVEY

For predicting the normal delivery time and monitoring of mother and fetus, few important parameters are tested through some devices and techniques are used in medical field.

2.1 Parameters tested at the time of delivery

Some crucial parameters are to be tested at the time of normal delivery:

   a.   Heartbeat of fetus
   b.   Blood Pressure of expecting mother
   c.   Cervix length of expecting mother
   d.   Fetus position in womb

2.1.1. The Heartbeat of fetus

In most cases, fetal heart rate is monitored during labor to see fetus status and to identify potential problems ahead of time. Electronic Fetal Monitoring (EFM) is currently used to monitor almost all women in hospitals which describe the heart rate variability for contraction and non-contraction intervals in forms of movement frequency in MHz Labor and delivery are monitored electronically with sensors that measure and record maternal uterine pressure (UP) and fetal heart rate (FHR), a procedure referred to as cardiotocography (CTG) [2,3]. The normal range for a full term baby's heart rate during labor is between 110 and 160 beats per minute (bpm). Higher or lower rates can be a sign fetus is having trouble coping with labor, depending on a number of factors. If the baseline rate is less than 110bpm, it is called bradycardia (abnormally slow heart rate) and if FHR are greater than 160bpm it is called tachycardia (abnormally high slow rate).

2.1.2. Blood Pressure of expecting mother

Normal blood pressure of a person is usually somewhere close to 120/80 mmHg. Blood pressure between 140/90 and 149/99 mmHg is called Mildly high, between 150/100 and 159/109 mmHg is called Moderately high and of 160/110 mmHg or higher is called severely high blood pressure. If the BP of mother is not in normal range then there are various risks to mother as well as fetus. Few risks to mother are as follows.
a. An increased chance of having a stroke.
b. Damage to kidneys and liver.
c. An increased risk of blood clotting problems.
d. An increased risk of severe bleeding from placenta. If developed pre-eclampsia, then it can cause serious damage to organs, including brain and kidneys.
The risks to fetus are as follows
a. An increased chance of poor growth.
b. An increased chance of premature birth.

2.1.3. Cervix length of expecting mother

Normal cervical length measures 4 to 5 cm when woman is not pregnant. During a normal pregnancy, the cervix remains firm, long, and closed until late in the third trimester. It usually starts to soften, shorten (efface) and open up (dilate) as body prepares itself for labor. Normally, in the late second and early third trimester, the cervical length measures anywhere between 3 cm to 3.5 cm (30-35mm) and decreases progressively as the pregnancy advances, in preparation for labor. When cervical length is less than 2.2 cm (abnormal), women are not in progress to deliver normally. Normal cervix length should be 10 cm at the time of delivery.

2.1.4. Fetus position in womb

The most common and abnormal combination of fetus position:
a. Cephalic Presentation
b. Occiput-posterior Presentation
c. Brow Presentation
d. Breech Presentation
e. Shoulder Presentation

a. Cephalic presentation

The normal position of a fetus is facing rearward (toward the woman's back) with the face and body angled to one side and the neck flexed, and presentation is head first. Figure 3 shows the normal position o fetus in mother's womb.

Fig. 3 Normal Fetus Positions

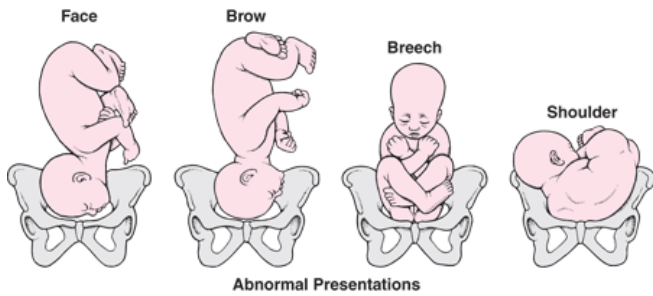Figure 4 shows the abnormal position and presentation of fetus in mother's womb.

Fig. 4 Abnormal Fetus Presentation

b. Occiput-posterior presentation
In the occiput-posterior presentation (also called sunny-side up), the fetus is head first but is facing up (toward the mother's abdomen). It is the most common abnormal position or presentation. When a fetus faces forward, the neck is often straightened rather than bent, and the head requires more space to pass through the birth canal. Delivery by a vacuum extractor or forceps or caesarean delivery may be necessary.

c. Brow Presentation
If baby is in a brow presentation, this means the largest area of fetus head will be trying to fit through mother's pelvis during birth. Brow presentation usually happens when baby's neck and head are slightly extended (deflexed), as if baby is looking up.

d. *Breech presentation*
The buttocks or sometimes the feet present first. Breech presentation occurs in 3 to 4% of full-term deliveries. When delivered vaginally, babies that present buttocks first are more likely to be injured than those that present head first. Such injuries may find before, during, or after birth. The baby may even die. Complications are less likely when breech presentation is detected before labor or delivery .Sometimes the doctor can turn the fetus to present head first by pressing on the woman's abdomen before labor begins, usually after 36 weeks of pregnancy. However, if labor begins and the fetus is in breech presentation, problems may occur.

e. Shoulder Presentation
Shoulder presentation is an abnormal position of the fetus at the time of delivery. In this, the fetus lies transversely so that its vertebral column lies perpendicular to the maternal position of spine. So, the part that enters the birth canal will be the trunk or shoulder. In spite of some deviations in the positioning of the fetus, the doctor may try for vaginal birth only if the baby's head, or buttock, or feet are at the bottom. Hence, the vaginal birth will be unthinkable for the mother and she has unquestionably to undergo a C-section.

The decision for usage of forceps or a vacuum assistance is guided by the indication for an instrumented delivery and the clinician's experience.

2.2 Pregnancy period tests & devices
Various devices are used to monitor the wellness of fetus and mother as follows:
2.2.1. Ultra scan
As shown in Figure 5, an ultrasound scan sends sound waves through womb (uterus). These waves bounce off the baby as echoes. The echoes are turned into an image on a screen that shows fetal position and movements. Hard tissues such as bone, reflect the sound waves and make the biggest echoes. It includes white in the image and soft tissues as grey. Fluids such as the amniotic fluid surrounding the baby appear as black. This is because the sound waves go through with no echoes. A first-trimester scan will test that baby's heart is beating and also look at the basic examination of baby's head, abdominal wall, and limbs.

Fig.5 Ultrasound Scan

2.2.2. Doppler Ultrasound
A Doppler is a form of ultrasound scan that helps to assess baby's health [4]. It measures the blood flow in different parts of fetal body, such as umbilical cord, brain, and heart. This helps to show whether fetal is getting all the oxygen and nutrients needs via the placenta. The transducer sends out sound waves, which bounces off the blood flow to fetal body through the cord as well as his blood circulation system. This creates an image on a display which shows how the blood is flowing. This is shown in Figure 6.

Fig.6 Doppler Ultra Scan

2.2.3. CT Scan

A doctor or physician may order a Computerized tomography (CT) scan of the fetus to formulate detailed pictures and analyze the internal structure. Computerized Tomography (CT) scanning is useful to get a very detailed 3D image of certain parts of the body. The same is shown in Figure 7.

Fig. 7 CT Scan

2.2.4. Stethoscope

External Electronic Fetal monitoring can be done by listening to baby's heartbeat with a special stethoscope. External monitoring is done using two flat devices known as sensors held in place with elastic belts on belly. One sensor makes use of reflected sound waves i.e. ultrasound to keep track of fetal heart rate. The other sensor measures the strength and duration of uterine contractions. The sensors are connected to a machine to keep the track of information. External monitoring is used for a non-stress test which records baby's heart rate while baby is moving and not moving. A non-stress test may be combined with a fetal ultrasound to evaluate the amount of amniotic fluid. External monitoring is also made for a contraction stress test, which records changes in baby's heart rate when to have uterine contractions. It may be done to check on fetal health during a non-stress test. It may help to predict whether the baby can handle the stress of labor and vaginal delivery.

2.2.5. Telemetry

External monitoring can also be done remotely called as telemetry, without need to be connected by wires to a machine. At some places, the sensors send the information about the fetal heart rate and uterine contractions to a remote monitor. Remote monitoring allows to walk around freely. The position of the heart rate monitor changes periodically to adjust to the movement of baby. For a non-stress test, the sensors are placed on belly of the labor. It is asked to push a button on the machine every time baby moves or have a contraction. Fetal heart rate is recorded and compared to the record of movement or contractions.

2.2.6. Electrode with a wire & tube

Internal fetal monitoring is done only after cervix has dilated to at least 2 centimeters (cm) and amniotic sac has ruptured. Once started, internal monitoring is done continuously. A thin wire (electrode) is guided through vagina and cervix and attached to baby's scalp. A small tube is also inserted through vagina to attach a device to monitors the contractions inside uterus. The electrode and the tube are attached with wires to a recording device to record of fetal heart rate as well as the strength and duration of uterine contractions.

2.2.7. Monitors

Monitors are used to detect the baby's heart rate and length and frequency of the contractions. There are even monitors that allow patients to walk around while it keeps track of the heart rate and contractions. Figure 8 shows the same.
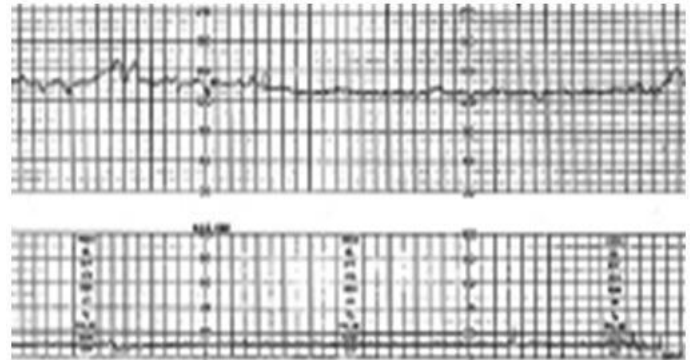

Fig. 8 Monitor

2.2.8. Delivery assistance (operative vaginal delivery)

It is hand held metal instrument with blade extensions that are applied to each side of the fetal head part for delivery process. The traction force of the blades helps to aids in neonate delivery as shown in Figure 9.

Fig. 9 Operative Vaginal Delivery

2.2.9. Forceps

The Use of forceps has decreased over the past several decades. The indications for forceps are included in prolonged second stage of labor or ineffective maternal push power. The presenting part needs to be at +2 station part before forceps should be applied to the labor for the delivery [5]. If the presenting part is at higher station, abdominal delivery should be chosen into consideration of the labor for the process. Forceps use is mainly associated with less fetal hematoma formation and quick delivery times are compared with vacuum assist lacerations. Forceps is associated with lower risk of maternal bleeding condition and better choice that the mother is able to deliver vaginally in subsequent pregnancies. The device is shown in Figure 10.

Fig. 10 Forcep

2.2.9. Vacuum

Vacuum consists of a suction cup that is attached to the fetal head part to assist with extraction. Tractional pressure is updated by a negative pressure handle system. Types include metal cup vacuums, plastic cup vacuums, and a mushroom-shaped vacuum cup that uses the advantages of the metal and plastic designs. It is used during emergency delivery because of fetal distress, poor maternal push power, or checks for maternal medical conditions that contraindicate strong pushing. The same is shown in Figure 11.

Fig.11. Vacuum

2.2.11. Axis traction device for delivery forceps

This device is light, simple in construction, having only three parts, and very easy to apply to any forceps handle when axis traction is required. It prevents the lock of the forceps from slipping and at the same time does not hinder the forceps blades from being opened or closed at the wish of the operator. The handle alone is sufficient for most of the axis traction cases, but when a great amount of traction is required a "T" or cross-bar can be attached through the slot in the lower end. The same is shown in Figure.12

Fig. 12 Axis Traction for Delivery Forceps

2.2.12. Cusco's self-retaining bivalve vaginal speculum

Cusco vaginal speculum can be used to carry out an endoscopy. The speculum is placed inside the vaginal opening of the woman which helps the surgeon to perform the required endoscopic process. This process usually involves the female reproductive system and the genitourinary system which is why the vaginal opening must be expanded for the process to be conducted efficiently. The same is shown in Figure 13.

Fig.13 Cusco self-retaining bivalve vaginal speculum

III. FUTURE SCOPE

Sensor-based hand held device can be designed to predict whether mode of delivery is normal or c-section. This device can be made full proof to work on many more parameters giving accurate result and early prediction for delivery mode.

IV. CONCLUSION

This paper gives survey of all the devices used for normal or c-section delivery and parameters tested at the time of labor. By doing detailed survey about existing devices we have came up with sensor based hand held device for predicting normal or caesarean delivery. Computing the results from sensor base hand held device this system acts like a predictor tool[6,7], allowing users to enter values of the specified parameters and giving the most likely mode of delivery as the output. Early prediction of the possibility of having either a Caesarean section or a normal delivery would be extremely useful in recommending women to take a second estimation in cases where the doctor's prediction is considerably different.

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