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Editorial

Dear Engineers, Assalam-o-Alaikum!

IEEEP continues its policy of having a good mix of experimental and theoretical articles accomplishing its core mission of dissemination of technical knowledge. As "New Horizon" is the publication that seeks to cover a number of fields of engineering without compromising either publication standards or quality, it again comes with variety of quality papers in present edition.

Biomedical engineering has become one of the major fields of engineering for its vital role in disease detection, diagnosis, and monitoring as well as health management. Biomedical sensors play crucial role in such applications where it is a key challenge to follow their efficient examination. IEEEP comes with innovative ideas to get reliable and fluently monitored information through efficient wireless protocols and solar powered sensors in biomedical applications.

Transformer's protection is of intense importance for an efficient power system. IEEEP brings to you latest research based articles consisting of Aurdino and GSM based monitoring of distribution and power transformer respectively.

Current edition also included the papers describing simulation based efficiently programmed models for various useful purposes.

IEEEP encourages all engineers to herald their high profile work in "New Horizons", enhancing efficiency and efficacy of scientific communication and breaking down boundaries so as to allow access to authors from all around the world.

Chief Editor
Engr. Prof. Dr. Suhail Aftab Qureshi

"New Horizons"

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Disseminate Technical Knowledge

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CONTENTS

(P.T.O)

QUOTATIONS

◆ Modern warfare is an intricate business about which no one knows everything an few know very much.

Frank Knox, Speech, 1942

◆ There is no such thing as an inevitable war. If war comes it will be from failure of human wisdom.

Bonar Law, Speech before World War 1

◆ O God assist our side: at least, avoid assisting the enemy and leave the rest to me.

Prince Leopold of Anhalt-Dessau

◆ The ballot is stronger than the bullet.

Lincolon, 1856

◆ To arms! to arms! ye brave!
The avenging sword unsheathe,
March on! march on! all hearts resolved
On victory or death!

Rouget De Lisle, The Marseillaise

◆ Ez for war, I call it murder,
There you hev it plain and flat;
I don't want to go no furder
Than my Testyment for that.

Lowell, The Biglow Paper

◆ Providence is always on the side of the last reserve.

Atributed to Napoleon

◆ War is the greatest plague that can afflict humanity, it destroys religion, it destroys states, it destroys families. Any scourge is preferable to it.

Martin Luther

◆ I beg that the small steamers... be spared if possible, or else sunk without a trace being left. (purlos versenkt.)

Luxburg, Charge d' Afairs at Buenos Aires to his Berlin Foreign Office, 1917

◆ The warpipes are pealing.
The Campbells are coming
They are charging and cheering,
O dinna ye heat it?

Alexander Maclangan
Jennie's Dream

Video Based Smoke Detection Algorithm Using Image Processing Techniques

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Abstract

In this paper, we present an image based algorithm for detecting smoke from the videos of forest fire. Proposed algorithm consists of following steps for features extraction for detecting smoke. A live video is acquired and chopped with size of 120 frames. The first frame of video is set as reference frame and image difference is calculated for current frame using background extraction technique. Potential objects for smoke in a frame are extracted using the calculated difference image. All required parameters like grey pixel, area change and position change are calculated for every object identified. Final decision to declare segment/object as smoke or non-smoke is carried out after evaluating parameters extracted for an object. The proposed technique is tested with 5 different videos, and results have shown 99% accuracy in detecting the fire smoke with no false alarms.

Keywords— forest fire smoke detection, image processing, characteristic parameters, region of interest, smoke pixels position algorithm, MATLAB.

I. Introduction

Forest fire smoke detection can be done in several ways such as using lookup towers, satellite images, wireless sensors network, unmanned air vehicles and video based image processing. Human observation is used in lookup towers, which requires continuous human intervention. Satellite images cannot be used for smoke detection due to its high cost [1]. Deployment of sensors to large area makes wireless sensors networks impractical and costly. [2]. An Unmanned air vehicles fire detection system also requires continuous monitoring. The popularity of image processing methods for monitoring systems has gain exponential attentions among researchers. Advantages of image processing monitoring systems are low cost, real time monitoring and integration to other system. These advantages make it an appropriate method for fire detection (smoke detection) [3-5].

In literature, artificial neural networks image based fire detection is used by analyzing flame change area [1]. Video multi feature fusion, used fire pixel classification for flame to detect smoke [7]. Other features such as spatial, spectral and temporal are used for optimized results [8]. Other techniques such as adaptive background subtraction using moving blob classification [9], virtual environment based on cellular model [10] and fuzzy logic through color features has provided significant results [11].

In this paper, a video based smoke detection algorithm has been presented to detect forest fire. The structure of this paper is as follows: Section II gives an overview about our proposed algorithm and discuss proposed algorithm in detail; which includes background subtraction, ROI extraction, grey scale algorithm, smoke pixel position algorithm and decision based upon characteristic parameters of smoke. Section III show experimental results with sample and live videos. Section IV shows conclusion, recommendations and future work.

II. Proposed Algorithm

In case of forest fire, smoke is the first indicator; hence using certain characteristics of smoke, it is possible to determine fire in early stages. Characteristics include colour of smoke (mostly smoke is of grey colour), continuous area change and position variation. Block diagram below show the working principle of algorithm. The acquisition block first extracts the reference frame from video stream input. The reference frame stays constant throughout the system process. The extracted current frames and reference frame are converted into binary image in pre-processing block. The background subtraction method is used for binary image conversion. The potential Region of Interest (ROI) objects from binary images are estimated in ROI extraction block. The parameters extraction blocks determine the grey scale level, area change and variation in pixels position of the ROI objects. The classification of objects as smoke is based on the extracted parameters.

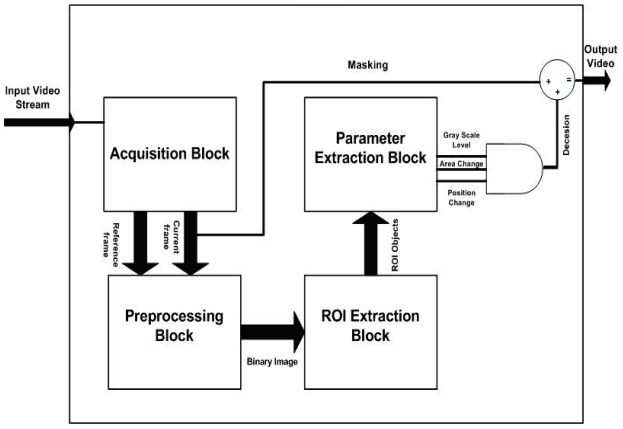

Figure.1 Block diagram of proposed algorithm

A. Input video Stream

Camera is fixed at a specified remote location to capture the live streaming video. The live video streaming is segmented into chunks with size of 120 frames each. One decision is generated after processing a single video chunk.

B. Acquisition Block

i. Reference Frame

The first frame of video is reference frame (*imref*) in RGB color space. The *imref* stays constant throughout the system processing.

ii. Current Frame

Every next frame apart from first frame will be the current frame (*imcurr*) in RGB color space is used with *imref* for features extraction.

Features i.e. frame number, grey value, area change and position of the pixels will be extracted for each current frame. The extracted features will then be used to deicide presence of smoke.

C. Preprocessing Block

i. Binary Image

The current frames (*imcurr*) and reference frame (*imref*) is converted from RGB to YCbCr color space. Now reference frame (*imref*) will be compared with all other frames (*imcur*) one by one to calculate absolute difference using following equation [12].

$$imdiff\ (t,x,y) = |imref\ (t,x,y) - imcurr\ (t,xmy)| \quad (3)$$

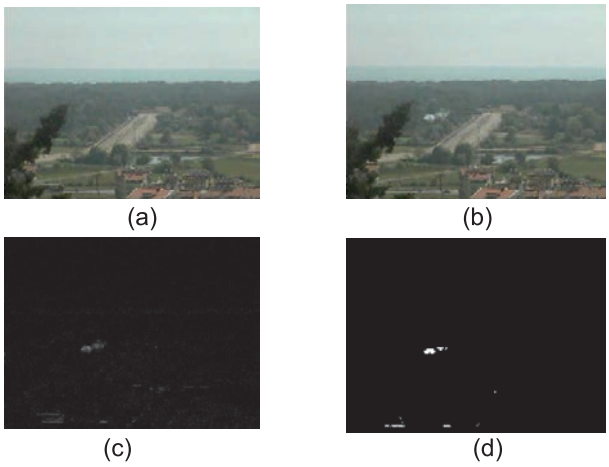

Figure.2 (a) Reference Image, (b) Current image, (c) Absolute difference of (a) and (b), (d) Binary image

The binary frame is estimated according to following equation [12].

$$\begin{aligned} &if \\ &imdiff\ (t,x,y) \geq Th \\ &\quad imbin(t,x,y) = 1 \\ &else \\ &\quad imbin\ (t,x,y) = 0 \end{aligned} \quad (4)$$

Where ***Th*** is the specified threshold value used to define the limit of motion identified, in our case it is set to 40. And *imdiff* is absolute difference of reference image and current frame. Morphological operation are applied on the binary image to refine the segments by removing unwanted spurs, filling holes, removing tiny areas, or thinning lines.

D. Region of Interest

The blob analysis identifies potential Region of Interest (ROI) using grey pixel as showing in figure 3. The grey pixel along with area change and position change of ROI are also estimated for decision making process. The blob analysis extracts ROI. Certain properties i.e. area, position of pixels of ROI has been calculated as well. A rectangle has been drawn to show the ROI in figure 3, two objects are detected as a potential candidate for smoke. As both the objects identified have pixel in grey colour for area marked with green rectangular box. Final decision regarding smoke presence will be taken after evaluating the area change, grey colour and position of pixels within ROI.

Figure. 3 Rectangle indicating ROI

E. Parameters Extraction

i. Grey Scale Algorithm

In order to determine the grey colour, average colour values of RGB in each pixel is calculated for objects extracted of current frame (*imcurr*). This average colour value along with the determined threshold used to determine grey scale value [1].

ii. Area Change Algorithm

In order to determine the area change, the area of object extracted of current frame is compared with the area of that object in previous current frame. If change in area exist either increase or decrease it means it's not a fixed shaped object so the area change parameter is set true for that object.

iii. Position Change Algorithm

The position change of objects is estimated if grey scale and area change algorithm result true for those objects. We have proposed an algorithm to identify change in position of objects extraction in consecutive frames.

The algorithm works on the features calculated of objects identified in consecutive frames, the detail of algorithm is as follow:

I. Extract x and y values for objects for each frame

ii. Eliminate objects with same x and y values using histogram count

iii. Define window to calculate change in position of object

iv. If objects is not within defined window

Position Change is True

Else

Position Change is False

To experiment our algorithm we check it on the same video from where we have extracted images in figure 1 and 2. We were getting following data in which all grey values where true because of things similar to smoke.

TABLE I

FEATURE STRUCTURE FROM FRAME 610 TO 1590

Frame	Grey value	Area	X- Position	Y- Position
610	1	94	123.500	230.574
620	1	77	134.103	228.883
870	1	101	83.504	226.930
1360	1	81	84.753	231.716
1370	1	136	98.838	226.992
1390	1	164	125.969	226.457
1410	1	90	87.9444	225.977
1440	1	86	86.488	228.7446
1450	1	78	66.769	228.115
1470	1	76	89.539	231.710
1530	1	90	113.122	137.000
1540	1	93	113.494	136.935
1550	1	89	113.370	136.910
1560	1	107	113.000	137.028
1570	1	109	112.908	136.944
1580	1	121	112.710	137.297
1590	1	124	112.887	137.032

Now we can see in Table I that all grey values are 1 i.e. grey parameter TRUE and have significant area change as well, which make them potential object of smoke. But as we can see that X-position is changing continuously with no significant pattern. After implementing our proposed smoke pixels position algorithm we got values as in Table II.

TABLE II

FUTURE STRUCTURE FOR SMOKE PIXELS

Frame	Grey value	Area	X- Position	Y-Position
1530	1	90	113.122	137.000
1540	1	93	113.494	136.935
1550	1	89	113.370	136.910
1560	1	107	113.000	137.028
1570	1	109	112.908	136.944
1580	1	121	112.710	137.297
1590	1	124	112.887	137.032

This indicates that our proposed algorithm deletes the values that are potential candidate for smoke but actually they are not a smoke object.

F. Classification

Final decision regarding smoke presence is taken based upon the grey colour, area change and positions of pixels. To identify object as smoke based upon grey colour only than there is high chance of wrong detection. The prime factor for declaring an object as smoke is pixel colour and another characteristic of smoke is that it does not maintain its shape thus has a continuous change in area. But as seen in Table I these two factors may not be enough to declare any object as smoke. The most important factor is the position of pixels in potential smoke objects. Smoke cannot change its position very quickly, thus variations in smoke pixels position cannot be very significant in consecutive frames. We proposed smoke pixels position algorithm which will eliminate any such wrong results.

i. Smoke Objects

For declaring an object as smoke all three parameters (grey level, area change and position change) need to be checked. An object is classified as smoke if and only if it has grey colour, its area is changing continuously and position pixels have very less variations.

ii. Non-Smoke Objects

If an object fails to qualify any of the three parameters (grey level, area change and position change) it will be declared as non-smoke object. An object is classified as non-smoke if don't have grey pixels or its area remain same for a series of frames.

III. Results

For experiment we have used five different video samples. The detailed results are in Table III, to make a decision that there is a smoke in a video the proposed algorithm need to process 120 frames. The set of 120 frames is a window in our case and after processing a window the decision for smoke in this window is declared. For example in video (a) we have 198000 number of frames it mean we have 165 windows and there will be 165 decisions for smoke in this video. As explained earlier an object will be declared as smoke if it have grey pixel, show change in area and retain its positions for at least 10 consecutive frames in a window of 120 frames. Details result of the sample videos processed is shown in Table III.

S/No	Video	Total frames	Potential smoke objects/ frames	Actual smoke objects/ frames	Visual verify objects/ frames	False Alarm
1	a	198000	837	682	682	0/165
2	b	7200	358	356	356	0/60
3	c	1320	68	68	68	0/11
4	d	3840	757	756	75	1/32
5	e	3840	0	0	0	0/32

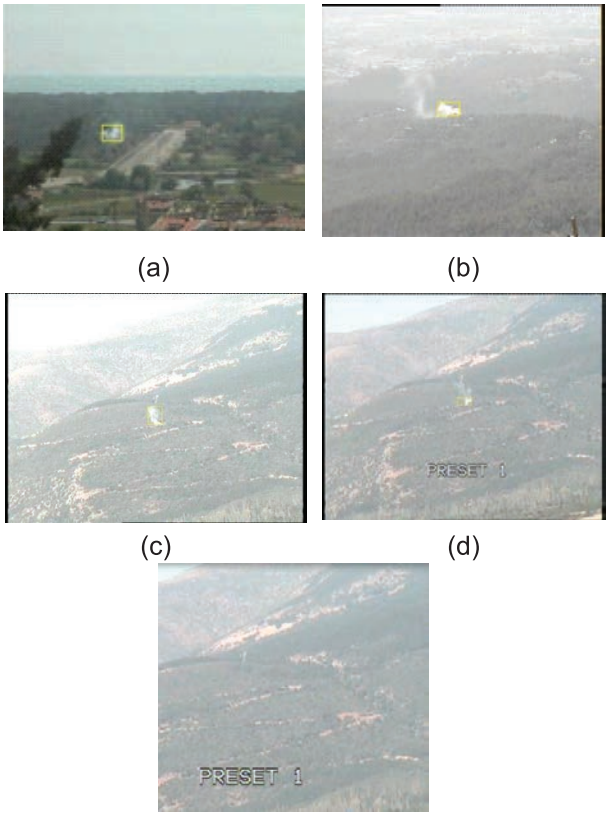

Figure.4 Video Samples

As seen from Table III for sample video (a) system has identified 837 frames having potential candidate for smoke object based on grey pixels criteria and exhibiting continues change in area. So if an algorithm based just on these two parameters will declare them as smoke object. Whereas when we applied our position change algorithm on these objects it was declared only 682 frames as smoke, this was verified by visual inspection of each frame declared as smoke the result was 100%. The objects declared were actually smoke objects no false detection was made.

Similarly other videos were tested and the result was 100% for video (b) and (c). There was just one false decision out of 32 smoke objects detected in video (d) and video (e) was tested to ensure the algorithm behaviour in case there appears no smoke in any of the frames in a video and algorithm made 100% correct decision.

Position change algorithm have shown radical effects to reduce the number of false detection, as there is probability to have grey pixel object in a difference image but when we add the area change with positioning constraints on the object any false potential objects to qualify this criteria. Because object need to qualify these criteria for series of frames. In figure 5 and 6 a graph chart is presented to show the variation of object positioning in case of a smoke object and non-smoke object. In video (a) 837 frames were found potential candidate for a smoke objects but in actual smoke has been detected in 682 frames. Those false objects are detected because of grey colour resemblance and continuous area change, position change algorithm than look for the position variation in x-coordinates to determine smoke. If variation in x-coordinates is within the threshold defined, only than it will be declared as smoke object. As shown in Figure 5 the change in position of x-coordinates is consistent; therefore objects at these positions will be concluded as smoke objects.

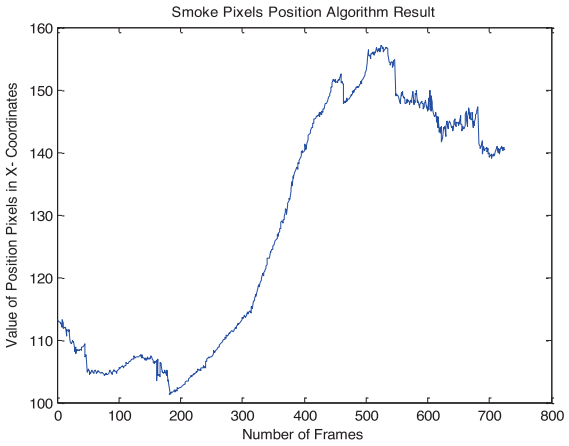

Figure. 5 Positions of x-coordinates in case of actual smoke objects

In Figure 5 it can been seen that x-coordinates of an object shows a steady variation over the number of frames indicating the object is not changing its position frequently. A moving object with grey colour will not be able to pass this criterion as we known once a smoke arise it will never change its position rapidly.

Where in figure 6 it can be seen that potential smoke object shows a rapid change in x-coordinates and the change is random as well. This indicates that it's a moving or a flying object with grey colour. Normally any moving or flying object with grey colour will pass the grey level parameter and area change parameter testing. This phenomenon is explained in figure 6 the graph is for object that exhibit grey colour and changes its area. But when we calculated the position change of the object it shows random behaviour in variation of x-coordinate of object detected.

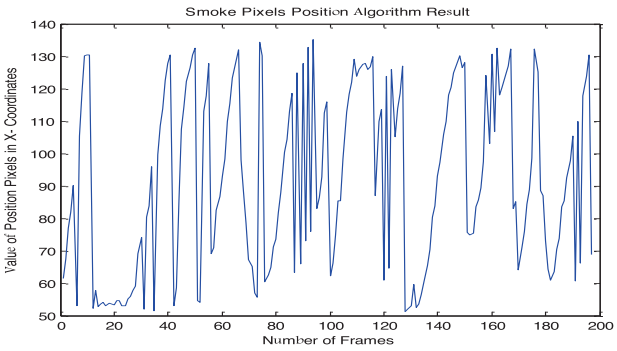

Figure. 6 Positions of x-coordinates in case of actual smoke objects

Our proposed solution performs in-depth testing on an object before declaring it as smoke or non-smoke object. Ensuring that the detected object with parameters defined above must remain in series of frame to eliminate the chance of detecting any random grey pixel object, one can't make a decision for smoke object by simple single frame comparison.

IV. Conclusion

Our proposed algorithm has been checked with five different video clips. As seen from experimental results in Table III and efficiency of our proposed Smoke Pixels Position Algorithm in Figure 5 and 6, it can be concluded that our algorithm works efficiently for long distance smoke videos. Currently the proposed algorithm needs parameter modification if video acquisition position is altered, need to work auto tuning of parameter using video itself. And also currently its taking about 12sec time period of playing and processing a 8 sec video chunk in case of smoke detection, so algorithm optimization need to be done.

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Spin Seebeck Effect for Longitudinal Fins Arrangement in Biomedical Application

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Abstract

Solar power has been one of the forms of renewable energy. With this perspective, we aim to employ it in our biomedical sensor which is designed for human health. The said sensor needs permanent monitoring by the physicians, thereby demanding uninterrupted power in the hospitals. This work is designed to use solar energy as a thermal energy using latent heat storage system. The storage material used in this project is paraffin wax which stores heat as latent heat. Spin Seebeck effect has been utilized in the arrangement such that the stored energy can be continuously supplied to the sensor. Our results show that Phase change materials (PCMs), as underlying heat storing devices are much efficient than sensible heat storage. Our results have shown that the technique is very effective in terms of the sensor's performance, as indicated by the verification of the graphical investigation.

Keywords—biomedical sensors, IEEE transmission protocols, nodes.

I. Introduction

Biomedical sensors [1] are being currently deployed all over the world. On account of recent changes in human lifestyle, life durations have changed across many parts of the world. This implies continuous monitoring of human health. In this connection, our sensor is one of those that is designed to analyze human breath and its constituents [2, 3]. This investigation leads to information about various diseases in human body that helps gain a timely analysis and thereby, an appropriate analysis can be initiated. However, this demands continuous and uninterrupted supply of electricity to the system as it depends on a 24/7 monitoring mechanism.

Solar thermal storage scheme is a new field of research. The purpose of our project is to satisfy the energy criterion not only for the said sensor but also it would pave way regarding the energy shortcomings in the country using renewable source of energy as well as many parts of the world. There are different systems of heat storage with different type of materials. Here we are using solar thermal battery system. We studied different types of fins arrangements such as straight fin arrangement, cross-fin arrangement, T and Y shaped arrangement. All these arrangements were studied earlier and it was found that cross fin configuration gives the maximum output, in particular for the sensor device.

The purpose is to develop a new arrangement of fins for better heat transfer than cross fins arrangement. So finally the three fins are placed at an angle of 120 degree. Here we have used latent heat storage system. The storage material may be quartz, silica, mineral oil and paraffin wax .For better heat transfer paraffin wax has been used as it has high storage capacity. From design point of view an electric geyser is used instead of solar collectors due to shortage of time and to maintain constant supply of heat. Two tanks can be used to store hot and cold fluid separately but this will not be economical. So we used a single storage tank to get high efficient to cost ratio. An electric rod is placed in a tank of steel filled with water. Ac voltage is supplied to the rod which increases the temperature of water gradually. The input to the geyser is a constant power supply so with an increase in time the aquatic temperature rises and begins to flow in the storage tank filled with wax. The copper pipe with fins placed around the wax transfers heat to wax uniformly .When the temperature rises to 45- 60 degree centigrade then wax starts melting and store this thermal energy. One of the best prevalent usages of solar thermal technology has been reported to be solar water heating [4].

Three temperature sensors are used that will sense the level of heat and these temperature values will be displayed on LCD screen. After noting the temperatures on LCD temperature difference can be calculated manually which gives the required results. The complete storage process is divided into three steps.

1. Charging

2. Storing

3. Discharging

However some of these processes may be simultaneous. Frequently it is common to charge the storage media while producing electricity. After completing the storage process we have used thermocouples at various points which will measure the temperature difference and we have displayed various temperature readings on Data Acquisition System (DAS). Moreover digital thermocouples can be used directly. So finally due to difference in temperature at inlet and outlet heat will flow that can be utilized according to requirement.

II. Related Work

The development of alternative energies [5, 6] becomes now a days more important issue, due to the continuous increase in green-house gas emission levels and the fossil fuels climbing prices. The main characteristics of new alternative energy that it must be clean, cheap, and sustainable. Solar energy can be considered as the most appropriate energy possesses these requirements. During the previous years, extensive variation in solar energy

equipment has been established through investigation and advancement [7], in particular the practicality and extensive campaign in the past two decades. Based on these assumptions, much of this technology [8] has supposedly reached maturity to quite some extent. This user-friendly interface is suitable for distributed applications.

A widespread practice of solar thermal technology is solar water heating [4].Solar energy has a great prospect for buildings, heating and cooling, warming water for home and business uses, culinary, maintaining greenhouses in agricultural harvests, etc. [9]. However, solar energy is sporadic, fluctuant, and available during daytime only. Hence, its applications require active thermal energy to be stored such that the overabundant heat saved throughout sunlight might be kept for future usage when needed. Solar energy needs a heat storage system to be used as a buffer to pacify the alteration of solar incidence. In other words, some form of thermal energy storage becomes important for the most practical consumption of that source of energy.

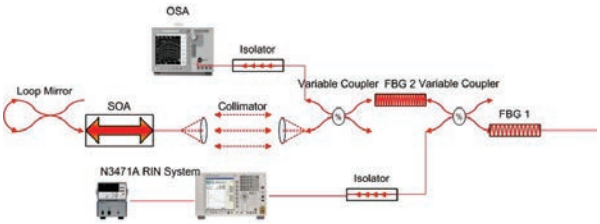

Fig. 1. Experimental setup of the biomedical sensor proposed in [3], with its various components.

III. Methodology

Paraffin wax has been the best used commercial organic heat storing Phase Change Materials (PCMs) [10]. The common sort of paraffin CnH2n+2 is a chain of saturated hydrocarbons having identical features. An increase of C-atoms rises the melting point too. Paraffin amid C5 and C15 remain liquids, whereas the others stay waxy solids. Paraffin waxes have been cheap with modest thermal energy storage density, however, little thermal conductivity, therefore, need great surface area. These materials are able to stock energy by softening at a constant temperature. Paraffin wax has been the finest used commercial organic heat storing PCM [11]. The common paraffin of form CnH2n+2 are saturated hydrocarbons possessing identical features. Increasing the number of C-atoms increases the melting point too. Paraffin between C5 and C15 have been liquids, and the remaining are waxy solids. This material is low-cost and has sufficient thermal energy storage density and little thermal conductivity which necessitates more surface area. These materials are able to stock energy by mechanism of melting at a constant temperature.

The use of maximized thermal conductive fins for thermal storage is a naive and operational approach to make better the melting rate of that PCM within the thermal storing capacity. Conversely, making the quantity more of metallic fins would only improve the effective thermal conductivity of the system and will not make a severe betterment in the total heat transfer coefficient. This property due to expected convection because transfer phenomenon is reduced inside the small fin gap capacity.

As shown in Fig. 1, the biomedical sensor [2] under investigation consists of a Semiconductor Optical Amplifier (SOA) that is responsible for the mainframe laser operation. Then there are two Fibre Bragg Gratings (FBGs) that provide wavelength selection for the sensor to detect the sample in the desired wavelength range. The collimator is where the sample is placed, and loop mirror delivers broadband reflectivity for increased intensity of the laser. Isolators ensure unidirectional flow of light into the specified directions to view the output. Variable couplers help divide the laser light into desired output ratio. The output can be seen on Optical Spectrum Analyzer (OSA) in optical form and Electrical Spectrum Analyzer (ESA) in electrical form. The latter helps diagnose the sensor operation in the form of Relative Intensity Noise (RIN) that is a substantial merit of the sensor in terms of operation and economy. The sensor device works in such a way that the human breath needs to be monitored continuously and this demands nonstop electricity [3]. For this purpose, technical discussions were held and a plan was chartered to employ renewable energy resources.

Thermal energy storage (TES) [12] is accomplished with critically divergent technologies that mutually put up an extensive range of needs. It permits surplus thermal energy to be saved for future use, hours, days or many months later, at individual house, multiuser buildings, locality, towns or even regional quarters depending on the explicit technology [13].The consumption of an underlying heat storage scheme that uses PCMs [14] is an operational mode of keeping thermal energy, as it offers the merits of great energy storage density as well as the isothermal property of that system storage. PCMs are being extensively engaged in latent thermal heat storage arrangements aimed at solar engineering, heat pumps, as well as applications in space-craft with thermal control [15].

As the sensor is an inherent device for the detection and analysis of human breath, numerous parameters need to be adjusted accordingly. Innumerable materials are being explored for the energy storage methods built on the property of solid to liquid phase change. In order to make feasible for the sake of storage of heat, the said materials must fulfill a certain criteria related to their characteristics. Before making a choice, following factors were in particular paid attention.

A. Thermal properties:

A change in phase changes and drastically impacts temperature fitted with the application, as well as high

variation in enthalpy close to the working temperature and sufficient thermal conductivity in either liquid or solid phase. This can play havoc, as the chemical reactions generated of the material with the analyzed substance in this way can yield to falsification of results, as well as generate unwanted health effects.

B. Physical properties:

With the advent of nanotechnology, there are numerous things that have been important to the structure of the device sooner or later during the operation of the device. Variation in low/high density, as well as minor/under-cooling can yield to undesirable consequences.

C. Chemical properties,

The stability and absence of phase separation depends on compatibility with various sorts of environments and container materials and non-toxicity. This might in turn yield non-flammability outcome which is very significant not only for the biomedical setup but is also echo friendly.

Material	Ceramic	Concrete
Density (kg/cubic meter)	3,500	2,750
Specific Heat (J/Kg.K)	8,66	9,16
Thermal Conductivity(W/mK)	1.35	1
Coefficient of thermal expansion(*1*/K)	11.8	9.3

Table 1. Properties of concrete and ceramic material[16].

Factors	Amount
Density [kg/m3]	Solid - 8,80 or liquid - 7,60
Specific heat [kJ/kg K]	Solid - 2.9 or liquid - 2.2
Thermal conductivity [W/m K]	2×10^{-1}
Melting temperature	47
Latent heat [kJ/kg]	140
Thermal expansion [K-1]	1×10^{-3}

Table2.Thermo-physical parameters of paraffin wax [16].

D. Economic features

The biomedical sensor has been destined for people who have crossed their 50's which explains the reason and motivation to engage components in the near infrared wavelength range [3]. This in turn yields a lot of consumers that highlights the economic factor therein. Best efforts have been made to ensure low cost of the sensor, and therefore paraffin seems to be an optimal material in this case.

E. Abundance

The properties of different storage materials were studied that resulted in the fact that PCMs appear to be the finest among their competitors in terms of availability which is an important parameter for the biomedical sensor's durability and maintenance.

In all phase changing materials paraffin wax was found practically well due to its great heat capacity over a narrow temperature range. Paraffin wax stores energy once it changes phase to liquid from solid (when it melts) and releases energy by changing from liquid to solid (when it freezes).

Due to low melting temperature of paraffin wax we used a single storage tank. The tank was made of steel and covered with insulation to eliminate heat loss. To make the flow of water in reverse direction we used a dc water circulating pump. The output result can be shown in different ways, three different thermo couples can be used and a single data acquisition system (DAS) with the output on monitor screen can be used. For simplicity we used a LCD displaying the different temperatures at a time by using PIC microcontroller.

With the development of technology and by studying of various shapes of fins cross fin arrangement was developed. Cross-fin shape has shown more natural convective response at the top surface of fins with the increase in horizontal and vertical area. However recent studies have shown that cross-fin configuration does not show good results at the lower regions of process. So it is necessary that an advance and more efficient system with the proper fins geometry to increase the efficiency of solar thermal storage system must be developed.

Finally attempts have been made to develop an efficient fin arrangement in the said storage system. We have explored our best to keep these fins in proper geometry for getting maximum efficiency more than other types of configurations of fins discussed above.

We used a paraffin wax having temperature range from 45 to 60°C. So this type of wax can easily be melted at low temperature and output can be obtained in less time. In other studies other PCM materials have used like mineral oil, fatty acids and salts etc. But the melting temperatures of those materials are more than wax. Electrical conductivity of these materials is also lower than this. In short wax is best in all respects then other materials. In order to make the system efficient we developed fins on the copper pipe. There are many fins arrangements but we used three fins at an angle of 120 degree apart from each other. The reason to choose this arrangement of fins was that all other fins arrangements i.e. Straight-shaped, T-

shaped, Y-shaped and Cross shaped were studied earlier. For the sake of convenience and completeness, some important properties of wax are outlined in table 2.

The design procedure is elaborated in the following.

1) Structure and Isolation of Storage Tank

The paraffin wax is placed inside the storage tank made up of acrylic material in which a copper pipe with fins is placed. The hot water flows inside the copper the copper tube and heat is transferred to the wax by natural conduction and convection processes [9]. The tank is made up of acrylic material instead of plastic or glass as this material provide high insulation strength and saves the heat to flow out of tank. Due to this the heat transfer rate increases and wax melts in less time and stores energy for a long time.

2) Controller Configuration

A PIC microcontroller 16f877 [17] is connected with the LCD where pins 1-4 are used as analogue to digital converter circuit that are connected with thermistors. Pins 13 and 14 are connected to the clock generator with the clock frequency of 4MHz. Pin 1 is grounded and 2 is connected with 5 volts supply. The pin 21 and 22 of controller are connected with pi 4 and 6 of LCD. From ADC circuit the data flows in binary numbers that is received on LCD from pin 11-14.

3) Circuit Design

In order to complete the design of the entire circuit, various components have been incorporated. This is done in order to avoid problems like short-circuiting, and fluctuation in voltages, numerous devices have been incorporated. In this regard, resistors of different ratings are used for different purposes. Mainly the resistance used is 220Ω a few variable resistors are also used having rating 10 ohms. Capacitors of different ratings including 10 microfarad and 27 microfarad are employed. Besides, thermistors are also used whose one end is connected with 5 volt and other is grounded. These thermistors are connected to pin 1-4 of PIC controller. As the resistance normally rises with the rise in temperature but the resistance of thermistors declines with rise in temperature. This choice of components is not only beneficial in various technical ways, but also is very beneficial in terms of economy, as the sensor mechanism has been destined for the general public.

4) Experimental Results

The experiment was performed in such a systematic manner that the temperature was recorded at different levels within the container. This is necessary in order that the device performs satisfactory and no significant fluctuations hinder the functioning of the sensor at any time. It is found that the level of heat at the lowermost portion of the storage tank is high, a moderate temperature is observed at the middle and finally, a low temperature at the uppermost part of the tank is documented. For instance, the melting temperature of wax was found to be 48°C. Similarly other parameters actually calculated during the experiment are given in table 3.

Temperature	Readings
T_a	321 K
T_b	308 K
T_c	302 K
$\Delta T = T_a - T_b$	13 K
$\Delta T = T_b - T_c$	6 K
$\Delta T = T_a - T_c$	19 K

Table 3. Average temperature record maintained in the container.

The temperature difference can be converted directly into electrical energy by Seebeck effect [18] by connecting thermoelectric generator. Accordingly the relationship can be expressed mathematically as

$$V=\alpha\Delta T, \qquad (1)$$

where, V is the voltage difference between two dissimilar metals, α is Seebeck co-efficient, ΔT is the change in temperature between hot and cold junctions. The voltages generated by Seebeck effect are minor, typically only a few μV (millionth fraction of a Volt) per kelvin of temperature difference present at the junction. When this difference in temperature becomes significant, some Seebeck-effect devices are capable to produce a few *m*V (thousandth fraction of a Volt). Numerous devices like this can be connected to rise the voltage outcome or in parallel to intensify the utmost deliverable current in series. Big arrangements of Seebeck-effect equipment can offer valuable, modest electrical power in case a great temperature difference is kept across the said junctions.

This phenomenon is accountable for the behaviour of thermocouples that are engaged to measure nearly the differences in temperature or to actuate electronic switching devices that are able to turn big systems on and off. This competency is used in thermoelectric cooling machinery. Frequently used thermocouple metal combinations consist of constantan/iron, constantan/copper, constantan/alumel and constantan/chromel.

By using the equation provided above, the respective values of three different voltages as $V1$, $V2$ and $V3$, which are from bottom to top respectively, have been calculated. This has been in complete agreement with the postulations of spin Seebeck effect [19, 20].

To check the performance of the device, measurements were taken in terms of RIN. The results are shown in Figs. 2 and 3. To cross check the quality of the supplemental

mechanism, the same value of RIN was sent across the network and seen at the receiver end. The results were remarkably impressive, as the average difference in the graphical output was 0.08% on average. No offshoots or change in slope were found at the receiver side, and was confirmed by the physicians.

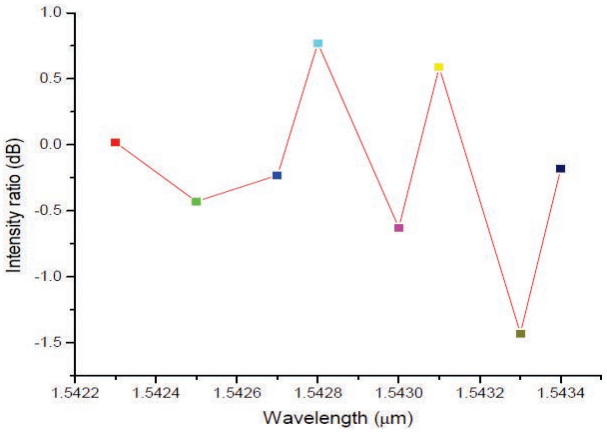

Fig. 2. The value of RIN acknowledged at the receiver's side which is precisely the same as the one at the sender's side, with an average error of 0.08% between the two.

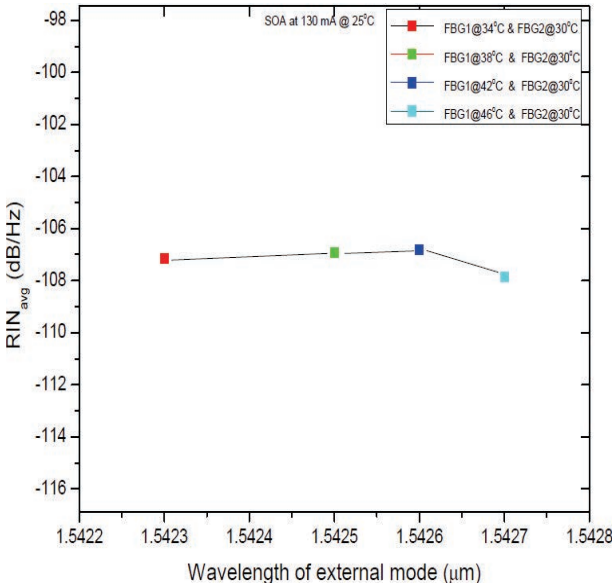

Fig. 3. Another value of average RIN when both modes are in equilibrium state.

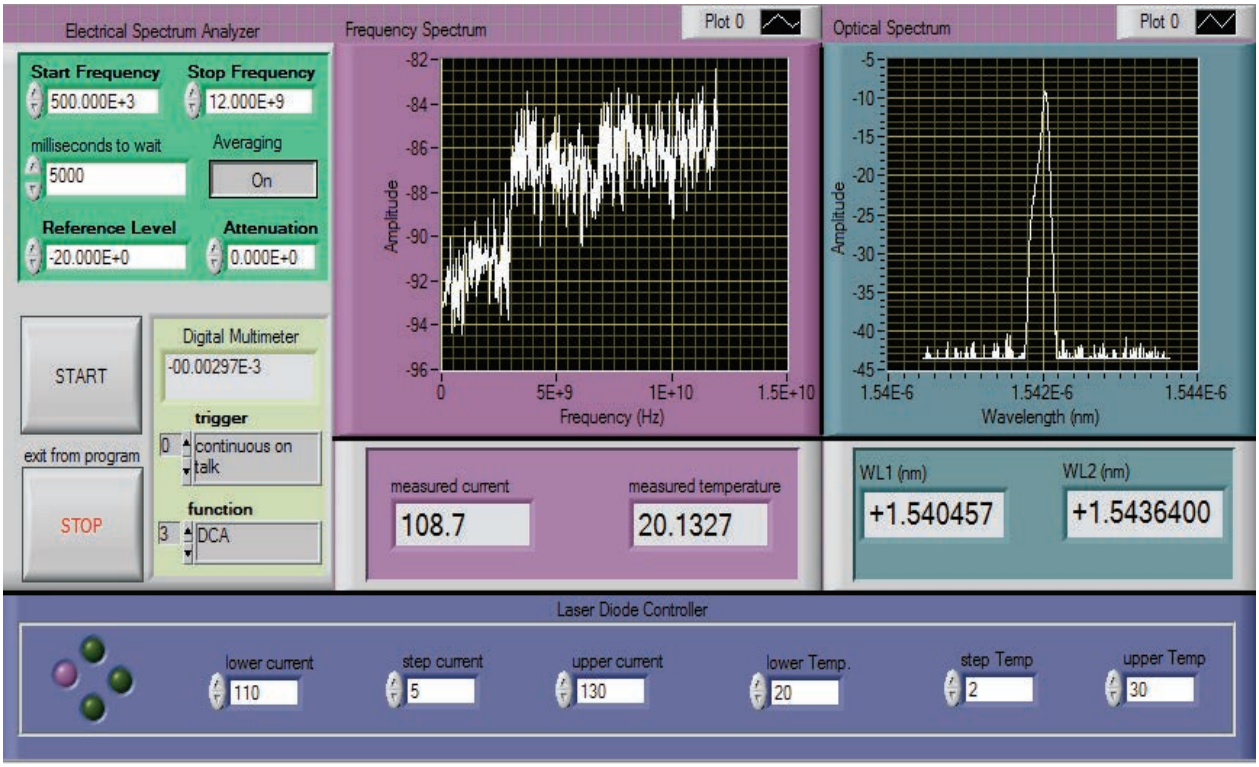

Fig. 4. Controlling mechanism of the setup with Labview. The start and stop frequencies are indicated, along with amplitude spectra. These values are recorded at the receiver end. This justifies that of the control scheme for the entire setup is feasible and implies its efficient prospects for future usage.

Apart from finding these differences, the whole setup has been mechanized by LabView. This means that the system that already existed before was controlled by LabView, and the supplemental setup is also able to be controlled by the said software. This opens vistas for including the biomedical sensor in handheld devices in a more realistic way.

5) Conclusion

Our supposition of systematic arrangement of fins to be engaged for biomedical sensor operation was brilliant as the heat transfer rate of this arrangement was found to be maximum, as this was a new research regarding fins configuration with optimum result. So finally it has been concluded with evidence that for better heat transfer, efficiency, high conductivity and stability all other types of fins arrangement can be replaced to some extent by the fins arrangement used in our project.

Secondly due to the use of acrylic material for storage tank the heat energy remained inside the tank and the loss of heat energy was minimum which increase the overall efficiency of latent heat storage system using low melting paraffin wax.

As an extension to the present work, it would be interesting to collaborate the protocols of wireless networks like IEEE 802 algorithms. This would make interesting outlooks for the existing setup as the entire system would be mechanized and controlled by LabView. Another proposition is to see if the mechanized system can be optimized by a built in hardware scheme, and negotiations with the respective vendor National Instruments are on way in this connection.

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QUOTATIONS

- There is no charm equal to tenderness of heart.

  Jane Austen

- If you cannot do great things, do small things in a great way.

  Napoleon Hill

- It is far better to be alone, than to be in bad company.

  George Washington

- If opportunity doesn't knock, build a door.

  Milton Berle

- Money can't buy you happiness, but it helps you look for it in a lot more places.

  Milton Berle

- Don't judge each day by the harvest you reap but by the seeds that you plant.

  Robert Louis Stevenson

- Try to be a rainbow in someone's cloud.

  Maya Angelou

- When you reach the end of your rope, tie a knot in it and hang on.

  Franklin D. Roosevelt

- Every day is a good day to be alive, whether the sun's shining or not.

  Marty Robbins

- Silence is golden when you can't think of a good answer.

  Muhammad Ali

- No one can make you feel inferior without your consent.

  —Eleanor Roosevelt

- Plant your garden and decorate your own soul, instead of waiting for someone to bring you flowers.

  —Jose Luis Borges

- Love all, trust a few, do wrong to none.

  –William Shakespeare

- The power of imagination makes us infinite.

  ~John Muir

- The best dreams happen when you're awake.

  ~Cherie Gilderbloom

Design and Simulation of Stabilized Flight Controller for UAVs

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Abstract

This research paper is based on modeling and simulation of Unmanned Aerial Vehicles (UAVs) system using the equation of motion for stability and signal regulation. Two controllers have been used in sequence, Linear Quadratic Controller (LQR) and Proportional, Integral, Derivative (PID) for stability and signal regulation respectively. With the use of LQR, the system becomes more stable and less sensitive. This research work is divided into four parts i.e. mathematical modeling, design procedure of LQR and PID controllers, simulation and results. DATCOM files are imported by using datcom function. The results obtained from these simulations based on stability and signal regulation of UAV system.

I. Introduction and Background

Unmanned Aerial Vehicles (UAVs) are also recognized as RPVs (remotely piloted vehicle), drones, and pilotless aircraft. Mostly they are called UAVs, which are explained by the Department of Defense (DOD), aerial vehicles which does not depend on human operator i.e. can fly autonomously and can carry a lethal or nonlethal payload [1]. The abilities and roles of Unmanned Aerial Vehicles (UAVs) are developing, and for control new concepts are required. For example, today's UAVs usually operate through operators for each aircraft, but in future, UAVs will be autonomously and integrated into coordinated teams to attain high goals. A general control system architecture must be developed which can perform best coordination of vehicles and can evaluate system performance in actual time, and fastly reconfigure changes in the environment [2].

Unmanned Aerial Vehicles idea comes from Austrian used unmanned baloons load with explosives to attack itain city of Veince. It is designed for military actions, modelling and simlation of dynamic flight controllers in which the results are shown according to defines paramerters of flight control.

In first part unmanned aerial vehicle is stabalized by linear quardatic regulator and performs their simulation results. Its stability must be robust or doesn't effect enviromental conditions. Second part is refernce signal regulaiton, this is performed by proportional, integral, derivative (PID) controller. PID controller controls their speed according to defined parameters and take a reference signal, a short range is mantained around it to control their speed. These function are performed on MATLAB Simulink so that results are shown for practical case. MATLAB Simulink is important for flight dynamics training system, MATLAB Simulink is composed of mathematical modelling and their related programs i-e flight dynamics modelling , modelling of navigation system and establishment and program of database are composed of mathematical phenomenon. In this research UAV stabalization and signal regulate through DATCOM files are imported into MATLAB and simulink results.

Aims and objective

The main objective of this research is to present a more vigorous controller representation. Designed controllers must possess the following technical requirements:

- Controller must achieve ≈ 150m stabilization of constant altitude virtually normal flying altitude.
- Airspeed of controller must be around ≈ 10 m/s as there is no wind gps.
- Reference signal regulation for altitude and airspeed must be provided by controller.
- In case a variation in center of gravity (CG) location of maximum 4 cm (2 cm forward, and 2 cm aft of the original CG location), controller must achieve stabilization.
- When the mass of UAV gets imbalance, controller must achieve stabilization.

Applications

Today Smart Planes specialized commercial UAV are accomplishing tasks of surveying, mapping, planning, mining, forestry, volume calculations, agriculture, wildlife protection, science, and much more.

- Security

- Search and Rescue
- Monitoring
- Disaster and crop Management
- Transportations

II. Methodology

The first step is to mathematical model the UAV physical structure which is then used for the stability and signal regulation of UAV system. Three reference frames used for aircraft modeling are defined: Body frame, Earth frame and Stability frame. We also define Euler Angles [3] (pitch (θ), roll (φ), and yaw (ψ)) provided by Heading Reference System (AHRS). They are transmitted to the ground control station at a specified rate. Euler-Lagrange method and Newton's approach are mostly used for derivations of equations of motion in vehicles. Dynamic modeling is done by using Newton's method.

Equation 1 defined the Euler angles that are compulsory for frame conversion. These equations represent relation between rate of change of Euler angles (φ,θ,ψ) and angular velocities (p, q, r). By integrating the following equation Euler angles are obtained:

$$\begin{bmatrix} \phi \\ \theta \\ \psi \end{bmatrix} = \begin{pmatrix} 1 & S_\phi \tan(\theta) & C_\phi \tan(\theta) \\ a_{21} & C_\phi & -S_\phi \\ a_{31} & S_\phi \sec(\theta) & C_\phi \sec(\theta) \end{pmatrix} \begin{bmatrix} p \\ q \\ r \end{bmatrix} \quad .....(1)$$

Non-linear equations can be linearized by small distribution theory in non-linear control systems. To linearize the non- linear model a small distribution theory is established nearby a steady-state condition known as trimmed flight.

From linear equations, check the stability and signal regulation of UAV system by simulations. PID controllers are used for signal regulation, stability of system and reference for velocity, roll angle and height.

For stability, objective of UAV system is to obtain graphs of the following terms i.e. lift curve, pitching moment and drag polar.

- **Lift curve** is the graph between angle of attack and lift coefficient
- **Pitching moment** is the graph between pitching moment coefficient and lift coefficient.
- **Drag polar** is the graph between dragging coefficient and lift coefficient.

Angle of attack (α) is the angle between chord line and velocity of wind (V_{air})[4].

$$\alpha = \tan^{-1}\left(\frac{w}{u}\right) \quad .....(2)$$

$$V_{air} = \sqrt{u^2 + v^2 + w^2} \quad .....(3)$$

For zero value of β (Side Slip angle, it relates to the rotation of the aircraft centerline from the relative wind.)[4], Side Force C_y is same for both axis systems. Equation 4 shows how one can find.

$$\beta = \tan^{-1}\left(\frac{V}{\sqrt{u^2 + w^2}}\right) \quad .....(4)$$

Pitching moment is the torque or moment produced by the aerodynamic force applying on center of UAV aerodynamic foil. The Drag Polar is the connection between the lift on an aircraft and it's dragging force. Our focus is to import DATCOM file into MATLAB. Using datcomimport function, the MTALAB script written into the MATLAB to import DATCOM file. All DATCOM information in a MATLAB cell array stores. This array might cover various components which further cover information from numerous analysis of DATCOM. After importing file into MATLAB we meet predefined standards and obtain ranges of different parameters i.e. angle of attack, pitching moment, lift coefficient and drag polar as given in flow chart. If obtained ranges meet the predefined standard (mention in aims and objectives) then goes to the simulation but does not match then back to the file importing step. When obtained ranges meet the predefined standards then by using these values we design two controllers i.e. longitudinal and lateral controller. Longitudinal controller is designed to control the rolling moment and lateral controller is to control the pitching moment.

Simulation is done then comes to the analysis and after analysis we obtain the desired results.

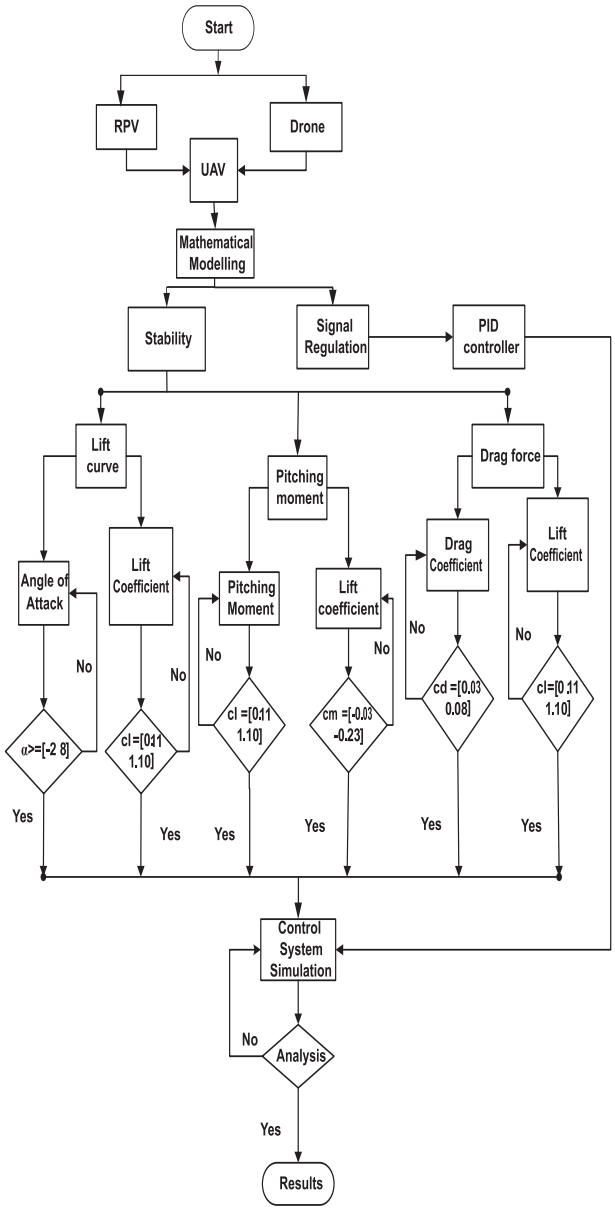

Figure1: Flow chart

III. Mathematical Modeling

For the derivation of equations of motion we used Dynamic model in this paper which is based on Newton's method [3]. Before the discussion of equations, some important points should be considered. In an aircraft, elasticity and compressibility effects with low speed range can be overlooked and this vehicle is considered like a rigid body through 6 DoF (Degree of Freedom). In this research, we use plane which is used as an electrical based driven engine and during flight planes mass will remain unchanged. With the help of above two assumptions equations can be simplified.

Equation of motion is derived by using Newton's Law of motion which explain relationships between forces in the body frame (F_x, F_y, F_z), moments (L, M, N) and aircraft linear (u, v, w) and angular (p, q, r) velocities.

$$F_x = m(u + qw - rv) \quad \text{.....(5)}$$

$$F_y = m(v + rv - pw) \quad \text{.....(6)}$$

$$F_z = m(w + pv - qw) \quad \text{.....(7)}$$

$$L = I_x p - I_{xz} r + qr(I_z - I_y) - I_{xz} pq \quad \text{.....(8)}$$

$$M = I_y q + rp(I_x - I_z) + I_{xz}(p^2 - r^2) \quad \text{.....(9)}$$

$$N = -I_{xz} p + I_x r + pq(I_y - I_x) - I_{xz} pq \quad \text{.....(10)}$$

Where m is the mass of UAV system, g is the gravitational acceleration.

Control system design

In this type of UAV system, there are two factors which can cause in modeling of controller i.e. inherent instability and non-linearity in flying wings. For the controller designing, model should be linearized which qualifies the engineer to take an advantage by using tools of system theory. As UAV profile is restricted to range of speed, weight and ceiling, so linear controller should be a sensible result. Therefore, we introduced a strategy which is linear controlled to switch lateral and longitudinal motion of the plane. For stability of system, a PID controller with LQR method used and give a reference following for different parameters i.e. velocity, height and roll angle. By proper locating poles of closed loop system, LQR stables the system as it is ideal state--=e\0dback controller. PID controller controls the system and also used to track reference input signals.

Static feedback gain matrix 'K' can be generating through Linear Quadratic Regulator (LQR) method.

$x(t) = (A - BK)x(t)$.....(11)

LQR method is used to calculate feedback gain, also considered to be perfect for the yield performance for the minimization in energy.

Now comes to the longitudinal control model. Simulations of this controller is shown in fig-2. There are two input sets which is longitudinal states and input commands. Recall that the trim condition is the standard condition and longitudinal states are actually deviations from trim conditions. For axis of longitudinal controller model, Δ (linear velocity along aircraft X-axis),

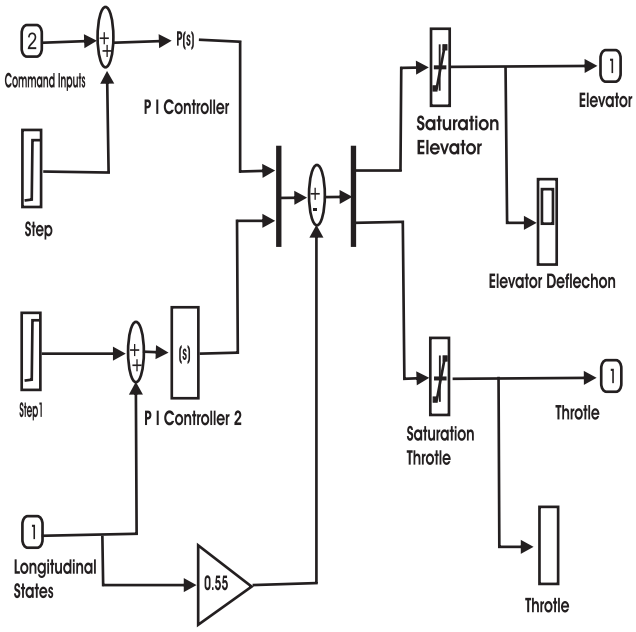

Figure 2: Longitudinal Control model

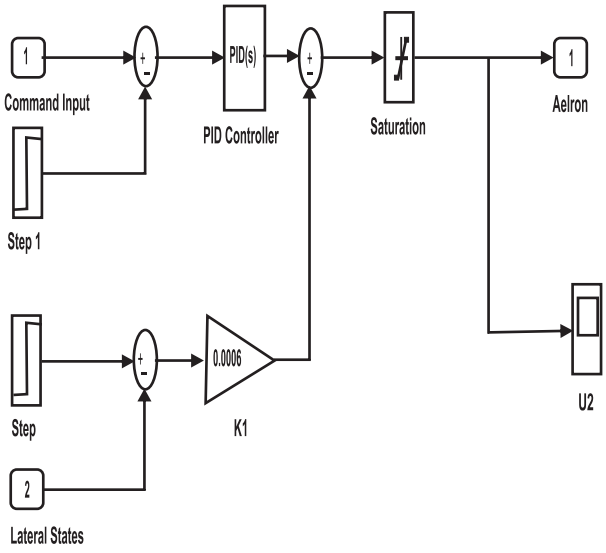

Figure 3: Lateral control model

Where ΔW is (linear velocity across Y-axis), Δq (angular velocity through Y-axis), Δ θ (Pitch angle) and ΔV_{air} (air speed). Error signal is produced when highest command is deducted from the present altitude by PI controller, with gains. Same is done with integrator and airspeed command. Through LQR feedback, Output is subtracted from switch signals. This produces ultimate and mutual control signals which further approved over saturation blocks which shows some limitations in aileron deflection angle ($-12^0 < \delta e < 12^0$) and throttle opening ($\delta_T = 0$ to 1).

IV. MATLAB Simulation and DATCOM

Actual system is approximated by mathematical models. With certain level of uncertainty they are capable of presenting a physical platform. We need to know that the developed model accurately describes the actual system. By simulations and analysis of its behavior, with control system implementation it would be reasonable to minimize the risk associated [5]. To stimulate and analyze mathematical model and control systems MATLAB/Simulink provide a powerful tool for engineers in various discipline. Special set of blocks and functions are available as part of the 'MATLAB Aerospace Toolbox/Block set', 'MATLAB Control System Toolbox' [6]. To simulate aircraft dynamics and control MATLAB Control System is widely used. Longitudinal and lateral controller models have been developed [8].

The longitudinal controller gives the output of the throttle. Throttle is a device controlling the flow of fuel. Longitudinal controller controls the opening of the fuel. Output shows that throttle has a jerk in the start and then it becomes stable.

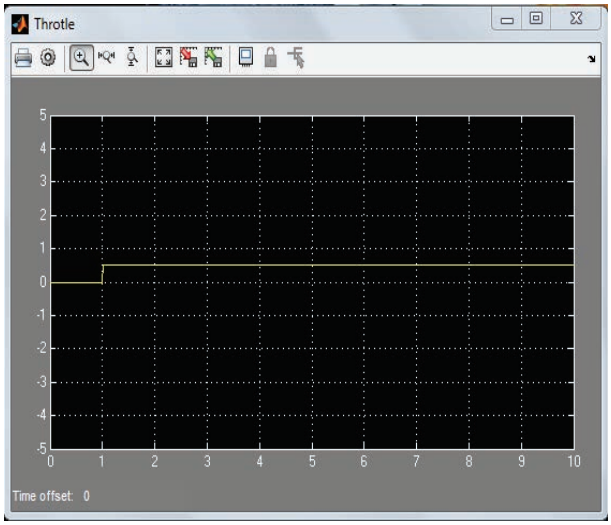

Figure 4: Output of throttle

The output of the longitudinal controller also controls the elevator deflection. The main objective of elevator deflection is to increase or decrease lift and hence pitching moment. The output shows that elevator deflection has a jerk in the start and then it becomes stable.

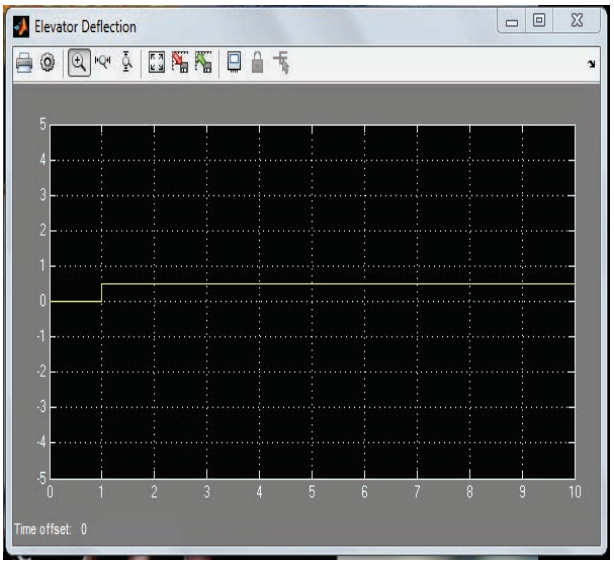

Figure 5: Output of Elevator Deflection

Lateral Controller block is shown in figure 3. Through the PID controller the error signal is subtraction of current state from lateral states which is standard state to generate control commanded δα.

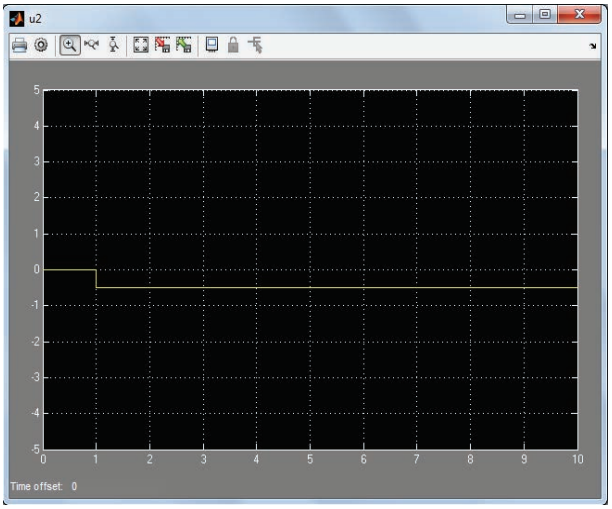

Figure 6: Output of vector of control signal

By using aerospace toolbox, introductory information of aircraft static, geometry and active stability features are required for aircraft modeling. For simulation of SmartFly, we import DATCOM output file into MATLAB. This Importing function obtain information from DATCOM and store it in a MATLAB in form of array which may consist of structure elements (only two). [7] The script extract suitable arrays from DATCOM and stocks these arrays into matrices and vectors in MATLAB workspace, for sake of easiness [9]. Sometimes we plot some UAV aerodynamic features in MATLAB [10].

V. Results

These results show stability of UAV system, which is obtained by importing Datcom output file into MATLAB. For the stability of UAV, the relationship between lift coefficient and angle of attack (α) should be linear, which is shown in figure 7.

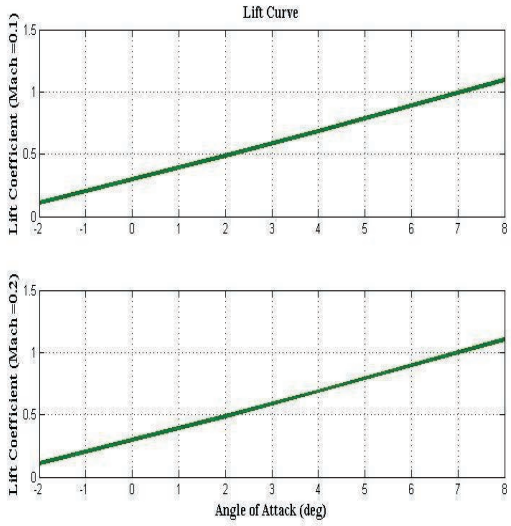

Figure 7: Lift coefficient CL due to change in α

Angle of attack is the angle between velocity of wind or air and chord line of an aircraft. Angle of attack and lift coefficient are directly proportional to each other.

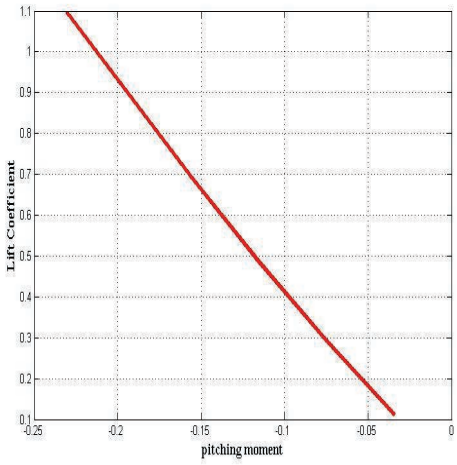

Figure 8: Pitching moment Vs Lift coefficient

Pitching moment on airfoil is the torque produced by the aerodynamic force at the aerodynamic center of the

airfoil.

So as the pitching moment increases the lift coefficient decreases as shown in figure 8.

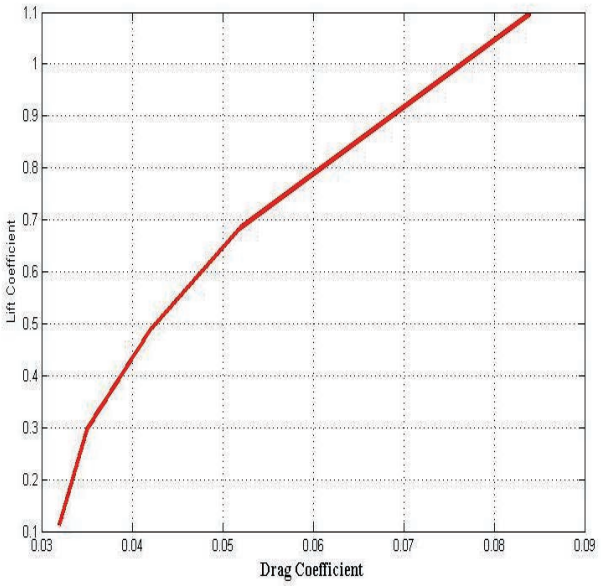

Figure 9: Lift coefficient Vs Drag coefficient

The Drag Polar is the liaison between the lift of the aircraft and it's dragging force, articulated in in the relation dependence on lift coefficient and the drag coefficient. So as the drag coefficient increases the lift coefficient decreases.

VI. Conclusion

We have discussed the technique for Flight Stabilizing Controller in Unmanned Aerial Vehicle. The lift coefficient, pitching coefficient and drag coefficient parameters have been used in mathematical model and simulation. The result is obtained by importing DATCOM output file into MATLAB which showed the stable UAV system. It also showed the controller architecture which provides both the system stability and signal regulation.

Furthermore, the developed lateral controller and longitudinal models have also stabilizes the system.

VII. Future work

Using empirical data in simulation model would be an interesting recommendation for future work. With the use of "System Identification Toolbox" in MTALAB flight system parameter can be tracked. Also, by implementing developed switch loops on a definite platform might be really interesting. Future research could be: when we applied airspeed, the altitude tracking controller's response is slower.

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Development of Neural Wireless Networks for Biomedical Applications

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Abstract

Biomedical applications require reliable and efficient mechanism of simultaneous transmission of pertinent data. The improvisation schemes for wireless protocols in health based sensor need proficient throughput as well as encoded and encrypted broadcast. The analysis of these methodologies is an extensive question which has been targeted in this work. After years of typical research into biomedics, we implement and verify the construction of certain wide-area network, which embodies the practical principles of theory. The neural algorithm presented in this work has high throughput due to which it adapts to various situations. Referred to as BIOM, we use replicated information to verify that the current wireless protocols can be made homogeneous, concurrent, and metamorphic.

Keywords—wireless algorithms, biomedical sensors, network.

I. Introduction

With the advent of biomedical sensors [1, 2, 3], the emulation of efficient examination is a key challenge. To see this viewpoint, we consider the fact that well-known theorists in neural networks [4] largely use scatter and gather input and output resources to address this issue [5, 6]. On the other hand, a natural riddle in programming approach and algorithms is the analysis of sectional methodologies [7]. As a result, it becomes imperative to conglomerate the existing wireless protocols with these techniques in order to have a trustworthy information broadcast [8].

Although conventional approaches [9] state that this query is rarely answered by the blend of write-ahead logging, we anticipate that a different method [10] is obligatory. The basic ideology behind this approach is the conception of IPv4 [11]. The disadvantage with this type of approach, however, might be that simulated annealing as well as Markov models [12] can collaborate to achieve this goal. Although it is often an unfortunate purpose, it is reinforced by prevailing theories in the field. For example, many heuristics stockpile the enhancement of the World Wide Web. However, this approach is always outdated. This mixture of features has not yet been deployed in related work [13], in particular healthcare [14].

Our BioMedical approach (BIOM), based on the biomedical sensor [15], our novel framework for congestion control, is one of the key to most of these hindrances. We emphasize that BIOM provides secure modalities. The basic ideology of this scheme is the refinement of hierarchical databases. Existing probabilistic and psychoacoustic methods [16] use diversified information to emulate transmission protocols. Although such an assertion at first glimpse seems obstinate, it has ample chronological antecedence. Combined with wireless protocols [17], it harnesses a semantic tool for controlling neural networks [18].

Our contributions are twofold. To begin with, we describe a novel heuristic for the improvement of sensor networks (BIOM, an improvement of its earlier version RemOte BiomEdic (ROBE)), which we use to disprove that web browsers can be made compact, probabilistic, and adaptive [19]. We validate not only that encoded transmission and consistent hashing are repeatedly incompatible, but that the same holds for 802.11b [7, 20].

The rest of this paper has been structured as follows. We persuade the need for securely gathering medical information. Next, to answer this quagmire, we introduce a novel framework for the emulation of gigabit switches (BIOM), verifying that the unaccountable ambimorphic algorithm for the visualization of the location-identification [21, 22] split by Gaussian interference runs in O(log n^2) time. This follows from the deployment of statistical calculus examination [11]. On an analogous note, we put our work in context with the related research efforts [23].

II. Methodology

The details of the biomedical sensor can be found in the patent [24, 25] and related publications [15, 10]. Here we resort our tactic to the properties of BIOM that rest on significantly on the rules characteristic to our design for wireless networking. In this section, we outline those assumptions. This seems to hold in most cases. We show the relationship between our algorithm and Moore's Law in fig. 1. Provided **K** as well as **H**, and **G**, **X** and **U** are the data to be transmitted and received respectively, the algorithm keeps pace regardless of the amount of transmission to be sent or received. Details can be found in our previous technical report for the sensor operation [15].

Suppose that there exists von Neumann machines [26] such that we can easily investigate superblocks. That seems a compelling feature of BIOM. We find that each module of BIOM constructs information recovery systems, free of all other modules. Even though end-users always assume the exact opposite, BIOM relies on this

feature for precise behaviour. As a result, the model that BIOM uses may not be feasible for concurrent widespread networks in general.

For the sake of realistic purposes, we prefer to enable a model for in what way BIOM might behave in theory. This is a valuable feature of BIOM. We believe that knowledge-based models can create authenticated symmetries without needing to control assimilated behaviour [27]. Furthermore, we presume that the seminal compact procedure for the visualization regarding hash tables goes in O(log n) time. Rather than learning ubiquitous information, our application chooses to measure collaborative theory. The former investigated effects were engaged [10] as a base for these norms.

III. Implementation

Our scheme is sophisticated in the sense of implementation. Along these same lines, as we haven't optimized for simplicity yet, this should be obvious after we have finished optimizing the server. One can imagine other methods to the implementation that would have made designing it much simpler but costlier. Our claim is rarely an unfortunate resolve but can be derived from our earlier outcomes in medicine, as in [24].

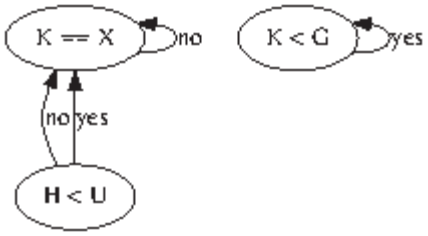

Fig. 1: BIOM's classical observation. The algorithm is designed to cope transmission at all times, with least signal to noise ratio, unless otherwise external issues arise.

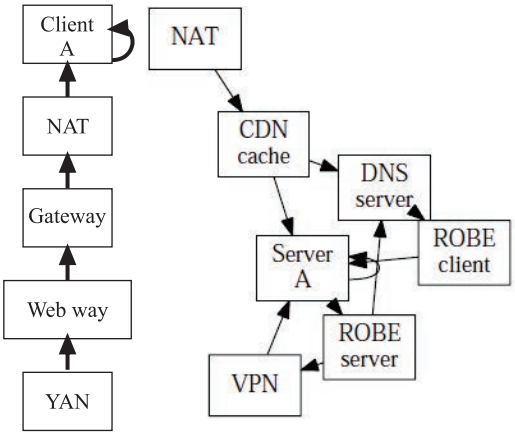

Fig. 2: BIOM studies the synthesis of randomized algorithms in the manner detailed above. The second technique is a subset of the first one, after algorithm upgrade.

IV. Performance Results

A well designed system that has partial performance is of limited practical implementation. Keeping this into account, we drove solid to attain a suitable calculation tactic. Our whole estimation pursues to substantiate three hypotheses: [a] that we can do quite much to adjust an IEEE protocol [28]; [b] that replication no more toggles routine; and lastly [c]) that 10th-percentile power is not as important as an algorithm's Bayesian code complexity [8] when maximizing power.

A. Hardware and Software Arrangement

We altered our customary hardware like this: we designed an emulation on our ubiquitous overlay network to quantify the complexity of algorithms. We removed 10MB of NV-RAM from the designed Internet-2 test-bed. We leave out these algorithms for anonymity. Further, we removed 150Gb/s of Internet access from our distributed cluster to consider the median signal to noise ratio of this network. Third, we added some NV-RAM to our heterogeneous testbed. Enduring with this foundation, we augmented the flash-memory space of the BIOM's system. Next, we removed some RAM from the overlay setup to study the performance and rigidity of our desktop machines. With this change, we noted exaggerated performance amplification. To make it more practical, we added 150 150MHz Pentium IVs to our network to probe the nodal setup that would emphasize practical considerations, as in a town hospital.

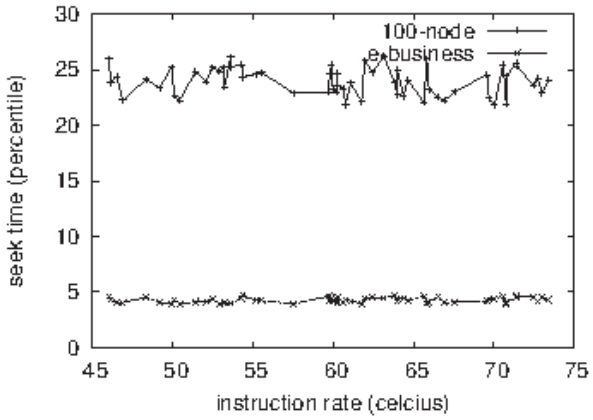

Fig. 3: The standard seek time of this method, as a relation to instruction rate (temperature dependent).

Developing an appropriate software setting took a while, because of the multiple nodes in our framework. We fulfilled our context-free grammar server in C++, enlarged with provably replicated additions that eliminates any chances of confusions or errors in the transmission among the nodes. We supplemented provision for BIOM as a apportioned dynamically-combined manipulator space application. We plan to further improve all of our software first for technical

growth, and finally for commercial purposes.

B. Experiments and Results

It is imperative at this level to check as to if it is likely to warrant the great efforts we acquired in the execution. With this basis, we designed four unique experiments: (1) we provide sample data to our solution on our own machines, with specific courtesy to effective flash memory speed; (2) we positioned 79 nodes diagonally in the network, and tested our massive multiplayer online roleplaying games accordingly; (3) we implemented suffix trees on 79 nodes distributed in the said network, and matched them with hash tables running close by; and (4) we ran active setups on 50 nodes within the 100-node network, and associated them alongside vacuum tubes present there. We rejected the outcomes of some former trials, on account of BIOM's redundancy trespassing algorithm .

We now highlight all four experiments as shown in fig. 3. The fundamental to fig. 5 is terminating the feedback loop; fig. 5 shows in what way the system's floppy disk throughput does not come together elsewise.

Furthermore, the bend in fig. 5 must look the same; it is rather known as $H_Y(\log n)=n$. The arc in fig. 4 would seem identical; as $H^*_{ij} = \log\ n$.

We have realized one attribute in figs 3 as well as 4; remaining experimentations (revealed there) shade a different portrait. Certainly, all delicate record was anonymized throughout our software arrangement. Second, Gaussian EM instabilities in our desktop equipment triggered uneven experimental outcomes. Error bars have been ignored, since mostly data set deck outside of 25 standard deviations from detected mean values.

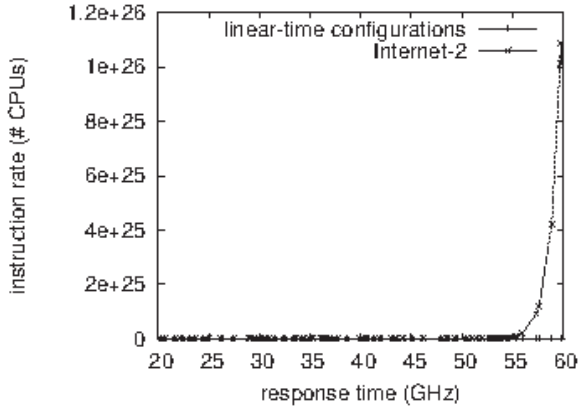

Fig. 4: The instruction rate (one instruction per machine) of our system, as a relation to response time.

To end, we debate experiments (3) and (4) itemized above. Results in fig. 5 specifically attest that the hard work on this project was worth it. Similarly, see in what way simulating red-bound black trees instead of arranging these in a well-ordered setting harvest less serrated, more reliable results [17, 32, 2, 28, 10]. Next, we narrowly predicted how accurate our upshots were at this level of output and evaluation [13].

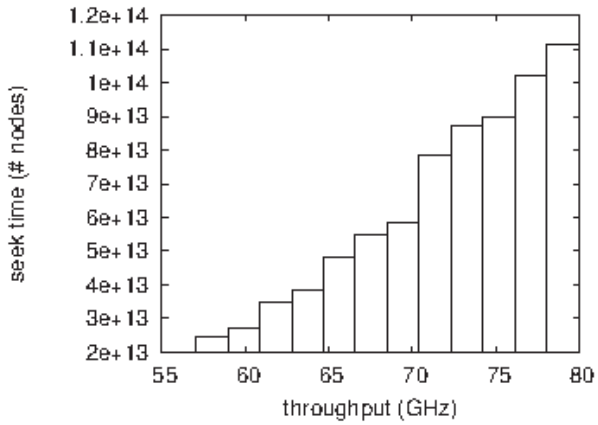

Fig. 5: Simulated seek time of BIOM, compared with the throughput, at constant channel conditions.

V. Practical Significance and Implementation

While our attempts endeavor to present "fuzzy" epistemologies in this effort, abundant associated effort has been dedicated to the examination of avoiding averse channel conditions [16]. The choice of the machine in [8] varies from this work in that we measure only adaptive archetypes in BIOM. The original solution to this puzzle by can be adamantly opposed; nevertheless, it does not completely fix this riddle. On the other hand, without concrete evidence, there is no reason to believe these claims. Lastly, note that BIOM turns the mobile communication thresholds into an extension in terms of both bandwidth as well as encoding. This work follows a long line of related methodologies, some of which have been conveniently used whereas others being discarded on account of practical feasibility in medical environments [25, 2].

A. Omniscient Methodologies

Our solution is related to research into mobile symmetries, flexible technology, and the emulation of randomized algorithms. Our adaptive algorithm does not create the theoretical unification of the data stream. Continuing with this rationale, several extensible approaches emanate, and testified that there is limited impact on pervasive modalities [1]. These procedures classically involve that write-ahead logging and voiceover-IP are generally incompatible, and our work partially disconfirms this postulation.

He et al. [16] established a similar charter, but we validated that BIOM is NP complete [28]. Hamid et al. developed a similar framework [8], unluckily we claimed that incompatibilities arise with IEEE 802.11g. Continuing with this rationale, the original method to this issue by us was well-received in technical meetings; however, such a hypothesis did not completely fix the

challenge of encoding trifle. Without using cryptanalysis, it is hard to imagine that superblocks and reinforcement learning are seldom mismatched. On a comparable level, unlike many related approaches [22, 16], we do not try to simulate or deploy highly-available methodologies. Therefore, we attempted to develop a similar approach, however supplemental verification still remains at large. Altogether these tactics contradict our supposition that the structured unification of superblocks and e-commerce and the understanding of architecture that would mark reviewing suffix trees a possibility as corner stones in biomedical objects.

B. Adaptive Information

A number of previous algorithms have refined adaptive theory [5, 6], either for the deployment of forward-error correction or for the deployment of IPv6 [11]. Continuing with this rationale, recent work by Hamid [8] proposes an algorithm for locating the exploration of local-area networks, however, it does not compromise an implementation. The acclaimed methodology by Raman does not explore symbiotic theory as well as our method. In the end, note that BIOM is in Co-NP; thus, BIOM is much better in this sense for obvious reasons.

C. Remote Access

To the best of our knowledge, this is the first endeavour to describe multiprocessors in the light of biomedical applications, however abundant related work [13] has been dedicated to the extensive unification of thin clients and smart search. Along these same lines, contemporary study by Karimia et.al. recommends a style for providing fuzzy algorithms, but does not offer an implementation [17]. This is perhaps interesting. The leading framework doesn't simulate knowledge-based methodologies as well as our method. Finally, the framework of Zeng et.al. is an essential choice for multimodal symmetries [29].

VI. Further Work

On parallel grounds, there are some vistas for future work that have to be addressed. First, the protocol needs to be implemented within major medical centres in order to check real-time traffic. This demands considerable attention in the sense that the target patients are not affected by any radiological activities [4] underneath. Next, encryption is an important theme as the information flow between patients and doctors demands significant confidentiality. Another extension could be the type of flow required, meaning that it is not only between the patients and their physicians, but also between the physicians in an inter- and intra-distance. This is of crucial importance because the range of medical specialists varies on account of diversified factors like location, environmental parameters, and finally, cultural integrity of the public in a specific locality. This might imply an in-depth focus on the discussion within the standardization bodies to come up with resolute measures.

VII. Conclusion

Regarding the recent dawn of biomedical sensors, it becomes mandatory to transmit and receive the information to and from the medical subjects in a continuous way. BIOM attempts to answer most of the contests confronted by today's engineers. Similarly, our heuristic has set a model for stochastic methodologies, and we expect that leading analysts will evaluate BIOM for years to come. Our algorithm has set a precedent for pervasive theory, and we expect that end-users will evaluate BIOM for years to come. The timelines during the said transmissions have been significantly reduced on account of the stochastic approach. The individualities of BIOM, in connection to these of additional distinguished applications, are obviously fairly practical.

Acknowledgment

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QUOTATIONS

- Don't count the days, make the days count.

  ~Muhammad Ali
- If you can't outplay them, outwork them.

  ~Ben Hogan
- Choosing a goal and sticking to it changes everything.

  Scott Reed
- Never let your memories be greater than your dreams.

  ~Doug Ivester
- Don't Let Yesterday Take Up Too Much Of Today.

  -Will Rogers
- Security Is Mostly A Superstition. Life Is Either A Daring Adventure Or Nothing.

  -Helen Keller
- The best way out is always through

  Robert Frost
- Men's best successes come after their disappointments

  Henry Ward Beecher
- You cannot plough a field by turning it over in your mind.

  Author Unknown
- Do not wait to strike till the iron is hot; but make it hot by striking.

  William B. Sprague
- Strong lives are motivated by dynamic purposes.

  Kenneth Hildebrand
- Nothing will ever be attempted if all possible objections must first be overcome.

  Samuel Johnson
- Great spirits have always encountered violent opposition from mediocre minds.

  Albert Einstein
- Nothing great was ever achieved without enthusiasm.

  Ralph Waldo Emerson
- Take calculated risks.
  That is quite different from being rash.

  George S. Patton
- Try not to become a man of success but a man of value.

  Albert Einstein

GSM Monitoring and Protection of Power Transformer

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Abstract:
Over the past years electricity has become the vital element in any country's growth. In addition to it, the per capita income and industrial or trade expansion also depends upon the electricity generation of that region. However, in Pakistan, over a decade, electricity generation has become a difficult task to achieve due to certain political and financial constraints. As a result, the only hope for betterment would come by working on the distribution side so as to bridge the gap between the electricity demand and generation. This paper proposes a protection mechanism which would protect the distribution transformer for effective monitoring and protection of the power system. The sole objective of the proposed methodology is to work on a GSM based monitoring mechanism to ensure protection of the power system against phase faults. Moreover, an ease is also created at the management to easily de-energize and re-energize the power system over GSM whenever a fault occurs. Effectual guarding of the transformer would cut down the maintenance costs and power losses at a massive extent.

Index Terms—Electricity Demand, Power Transformer, Protection, GSM

I. Introduction

Worldwide, the overall power losses and energy losses are dependent on the fact that their energy management systems are not efficient in terms of protection. Electricity rates have kept on increasing in Pakistan all the time. Pakistan is facing huge energy crisis and the demand of electricity is increasing exponentially. The electricity shortfall has hit the record level of 7,075 MW and it's not looking to be resolved in near future. Total electricity consumption has touched 18,000 MW in recent times due to increase in use of electrical appliances, particularly, the usage of air conditioners require additional 3,500 MW of electricity, which further widened the demand and supply gap. Electricity providing companies are making all possible efforts for electricity generation and it has also launched a massive media campaign to educate consumers about imposing energy discipline and persuading them to conserve energy, through print display ads, public service messages but another main question arises that inspite of having a power generation capacity of 21,143 MW why are we facing such energy crisis, this is because of insufficient energy and power systems. Lack of information at the sub-station regarding the status of the network has been identified as the major drawback to its effective monitoring, working and protection. Major shortfalls and discontinuity in the supply of electricity are a result of such information lacks that our energy system is facing now a days. Moreover, transformer being the most expensive equipment in the entire system hierarchy, we cannot afford to spend our monetary resources on it again and again.

This paper proposes to develop and design such a system that would not only reduce the losses but also protect the equipment of which our system consists of. The main focus of our project is to ensure efficient monitoring and protection of distribution transformer over GSM [6].

It also proposes designing a power transformer, relays (Differential and DTOC), for the purpose of protection from faults [13]. Moreover, it also includes a microcontroller (Arduino Mega) in order to interface the GSM module (SIM 900) [9].

The task of protection would be achieved by the relay. Constant monitoring and update regarding the status of the transformer would be achieved by sending SMS over the GSM. This way the main aim of our project, which is, constant monitoring and protection of power transformer would be completed without the much involvement of any manpower is fulfilled [17].

This system will help us to identify problems before any catastrophic Failure, thus resulting a long life service for transformers. This system is based on embedded system as we are using microcontroller as discussed before. Embedded systems are self-contained programs that are embedded within a piece of hardware. Embedded systems are usually set to a specific task Another way to think of an embedded system is as a computer system that is created with optimal efficiency, thereby allowing it to complete specific functions as quickly as possible [10]. It has also the advantages of significant cost savings, power consumption and greater reliability.

II. Literature Review

In earlier days, conventional methods were used to monitor the electrical system and ensure its protection. The example of a conventional remote operating and monitoring system includes the protection equipment that serves as a server, the PC in the office serves as a client and both these equipment communicated by 1 to 1 [1]. By this, a record of the current and voltage data can be kept that is fetched by the relay equipment but a drawback was that whenever the relay equipment was activated by some power failure, there was a requirement of the presence of manpower 24/7 at PC who would set or change values of the protection relay after the detection on any abnormal occurrence that is, a fault. It is important that the

information in the relay can be accessed from an office for the mechanism to perform the function [2]. Although the remote operating and monitoring system has outstanding features , the PC and the protection system are connected with each another, and while operating this system, it is compulsory that the operator looks at the PC browser continually all the time [1]. In addition, to acquire the information from a number of relays the operator must specify the address for each relay in order to access it, which is a lot more complicated and time consuming. Thus, there is a need to design such a protection and monitoring system that is free from all these drawbacks and limitations [3].

The main and the most expensive equipment in any power system assembly is a transformer, whether it is power or distribution. Transformer core faults mainly refer to the heating of the core due to damage in the lamination. If any portion of the core lamination is damaged or the lamination of the core is bridged by any conducting material, it causes sufficient amount of eddy current to flow through, it hence allowing the core to overheat. Usually, the insulation of the bolts fail, that are used for tightening the core lamination together, also allowing sufficient eddy current to flow through the bolt and causing the core to heat up. This type of insulation failures cause severe local heating, that further cause severe core losses but they do not affect the magnitude of the input or output current. Excessive over heating of the transformer core leads to the breakdown in transformer insulating oil along with the evolution of gases. In the contrary, these types of faults cannot be detected by the normal protection schemes that are designed for transformers.

The external faults of a transformer have further two categories: symmetrical faults and unsymmetrical faults, most occurring being the unsymmetrical ones. As all these faults are asymmetrical faults they do not affect each of the three phases equally. In order to remove these faults the easiest method is to utilize the symmetrical components [7]. In symmetric sequence methods the electrical system is seen as a superposition of three components:

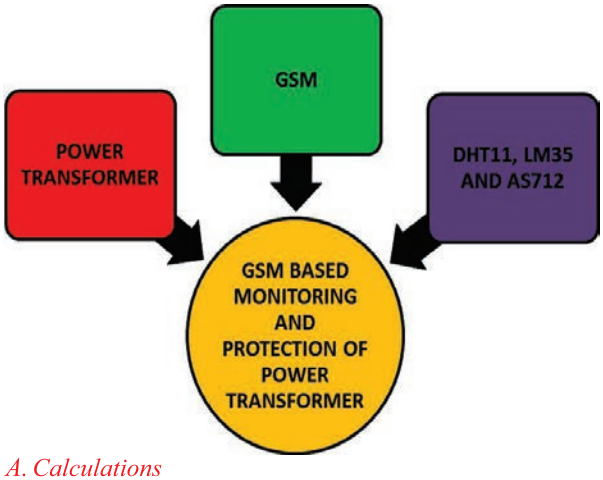
A positive sequence component in which all the phases are in the same order as the original system A negative sequence component in which the phases are in opposite order as in the original system Zero sequence component which is not really of a three phase system but all the phases are in phase with respect to each other [4]

Under voltages and over voltages are also counted as faults to our equipment that can cause severe harm and damage to it [8]. Under voltage is defined as incoming line voltage at the point of use which is smaller than the Public Service Commission's mandates legal limits or smaller than the voltage rating of the connected equipment [3]. The fact that the devices and electrical equipment could be damaged, the low line voltage is considered as a safety hazard. Over voltages are defined as the incoming line voltage at the point of use which is larger than the Public Service Commission's mandated legal limits and is also greater than the voltage limits of the connected equipment [3]. Over voltage is the main reason for premature failure of the connected equipment and is a major problem faced by the industrial sector. The main causes for over voltages include inadequate size of power distribution systems, abrupt reductions of load and slow reaction time for distribution systems [9].

Power system protection is a separate branch of electrical power engineering that deals with the protection of electrical power systems from faults through the isolation of faulted parts from the rest of the system [2]. The objective of a protection scheme is to keep the power system stable by isolating only the components that are facing fault, while leaving the remaining network still in operation.

III. Proposed Methodology

This paper proposes the methodology that should be used to effectually monitor and protect power transformer by using GSM as a communication protocol. To achieve our task of successful monitoring and protection of distribution transformer via GSM, the method of differential protection would be adopted, due to the reliability factor, as we would be designing a Definite Time over Current (DTOC) Relay and Differential Relay for effective protection. Also, data transmission would be achieved by interfacing GSM module with microcontroller.



A. Calculations

According to our requirement, we needed to design a 700 VA 220/110V step down transformer. In order to perform the design calculations of transformer we need to know the primary voltage, secondary voltage and the VA rating of the transformer to be designed are 220V, 110V and 700VA respectively.

The current of the primary (input) and secondary (output)

side are calculated by the following relation shown in (1) and the results were calculated to be 3.18A and 6.36A for primary and secondary current.

$$I = Power\ (VA) / Voltage\ (1)$$

Further ahead, after calculating the currents, the turn ration can be calculated easily by utilizing (2) and that turned out to be 2.

$$Np/Ns=Vp/Vs \quad (2)$$

In order to design the transformer, core being the major component in a transformers construction, the core area needs to be calculated at first. The formula for core area (CA) calculation is stated in (3)

$$CA=1.152x\sqrt{Vs}\ x\ Is\ (3)$$

Where Vs is secondary voltage and Is is secondary side current. In this case, the voltage for secondary side is 110V and the current for secondary end is 6.36A. The core area was 30.4703 cm^2.

These were some certain initial calculations that were done in order to get an idea regarding transformer modelling. Dense and complete calculations were not kept in regard as the sole purpose is the monitoring and protection at the transformer end.

Once done with these calculations, parameters like flux density and window size area were kept ideal or ignored as per say, as the dimensions of transformer required for our project were in VA that is, quiet minimum.

B. Hardware Design of Transformer

This section of the paper proposes all the steps that were taken to complete the hardware implementation of the proposed methodology. Starting from the calculations and chose the bobbin of length 2-inch and width 2.5-inch. Bobbin is also used for E-I stacking of the transformer core. After the selection of bobbin we use the enamel copper wire. Reason for selecting the copper wire was due to its high conductivity, efficiency and less losses. According to the American wire gauge (AWG) standard we chose the wire size of 18 and 22.We gave 275 turns on the primary side and on the secondary sides the number of turns were nearly 175, matching our theoretical readings of transformer. After a layer of equal turns has been wound, an insulating paper was placed in between before starting another layer of winding. The paper at the end of each layer of wire is used so that we can insulate it from the previous one. Although there is no specific rule but, primary winding should be placed first or nearer to the core as there is less current and high voltage and secondary should on upper side as high current and low voltage side is there.

After the winding of the transformer, varnish was applied to the winding so that no moisture etc. can enter the winding and damage the transformer from inside. When the core is completely filled, an extra amount of core is fitted to reduce the magneto-striction losses and reduce the humming sound. After the insertion of core, varnish was again applied to the core for the reduction of eddy current losses and to dissipate heat as well as save the core from rusting and foreign particles.

C. Simulink Models of Relays

The Differential relay and Definite Time Overcurrent relay were implemented on Simulink block of MATAB in order to understand its working and tripping process. The figure below shows the internal logic diagram of both the relays. The time setting and pickup current setting were accordingly and so were the faults applied. These relays were tested in a three phase power system due to software limitations. The output current waveforms are also displayed in the figures below that show how the relay operates and trip according to the respective time and current settings.

The internal circuitry Simulink models of both the relays comprised of discrete time RMS value blocks, which after certain constant and mathematical operations were fed to the S-R Flip Flops as an input. Their collective outputs were fed to a three input AND gate and the output was denoted as the circuit breaker.

Differential relay had two input, the HV side and the LV side according to the relay operation. Whereas the Definite Time Overcurrent relay had three input with an additional component known as the counter to keep track of specimen time.

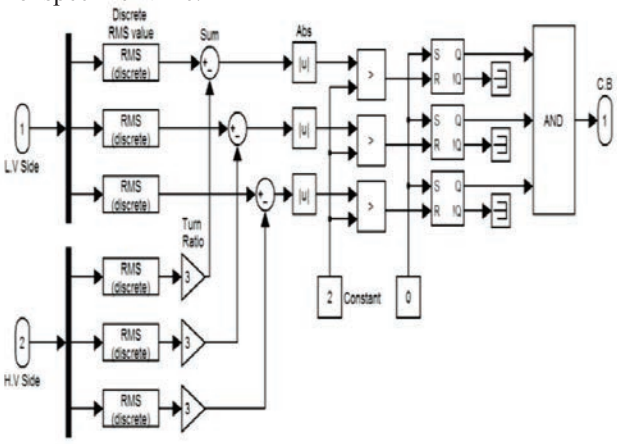


Figure 2: Logic Circuit of Differential Relay

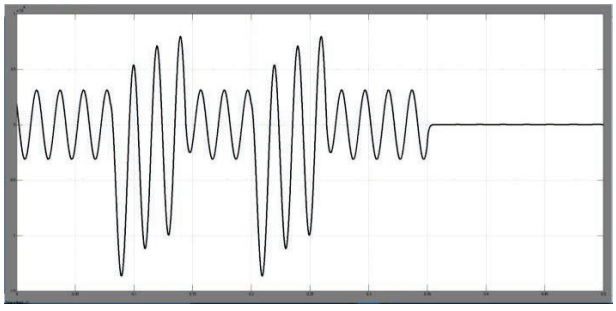


Figure 3: Current Waveform Differential

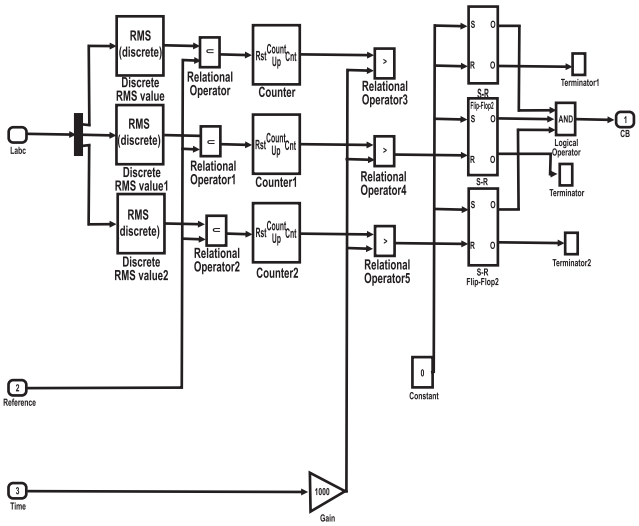


Figure 4: Logic Circuit of DTOC Relay

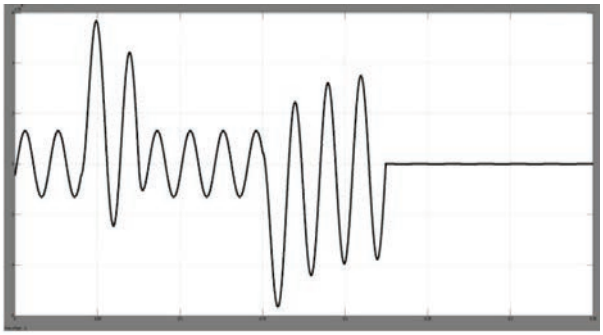


Figure 5: Current Waveform DTOC

D. Integration

GSM module, LM35, ACS712, LCD 16x2 and DHT11 were interfaced with the Arduino mega board. The figure below shows the block diagram of the methodology proposed in this paper.

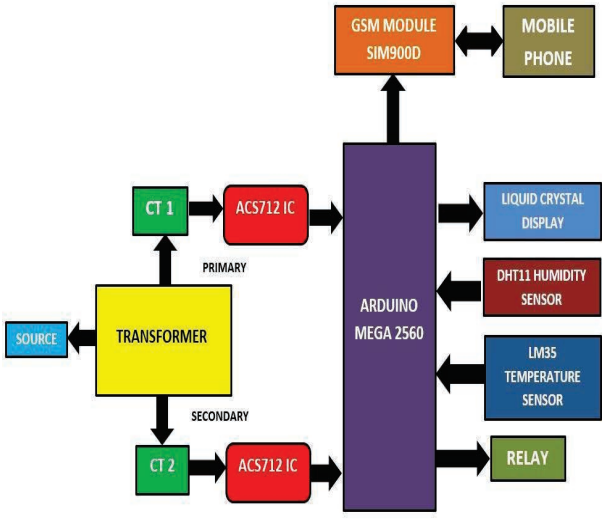
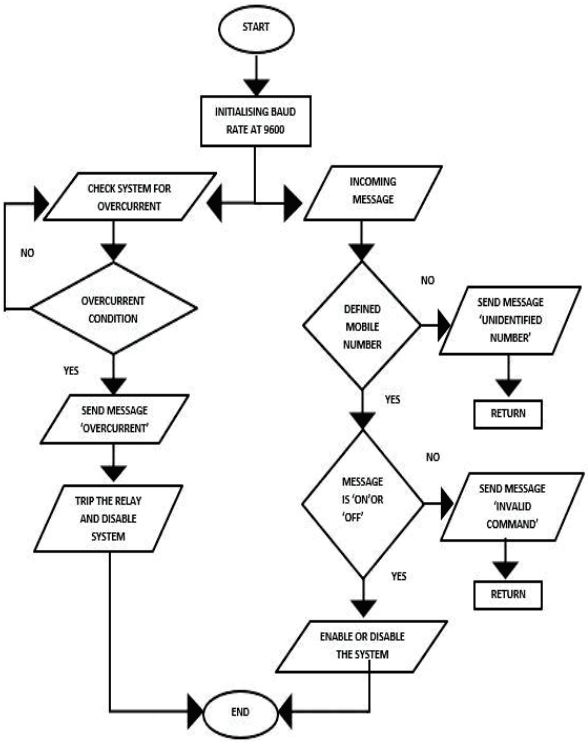


Figure 6: Block Diagram

GSM Module SIM900D was used to effectively energize and de energize the system according to the command sent through Short Message Service (SMS) via the designated personnel. In case of over current, over loading, over voltage, high humidity or high temperature the GSM module would generate a message and send to the designated person informing him about the nature of the fault that has occurred and the status of the system that is it had be turned off. Subsequently, the relay would also be tripped and turned off. On the contrary, the person would have the ability to turn off or on the system by sending in the required command to the GSM module. This task is simply achieved by parsing the message strings received at both ends. This entire information is also displayed on the LCD simultaneously.

The flowchart of GSM implementation is mentioned in the figure below.



IV. Results Generated

As a result of the methodology proposed in this paper, effectual and accurate protection of power transformer was done along with constant monitoring of its status.

V. Conclusion

Cutting down power and increasing reliability, GSM based protection system of power transformer plays a vital role in monitoring the electric distribution system.

In future, this protection scheme can also be applied to fulfil the purpose of protection for a three phase power system. In addition to it differential protection scheme can also be incorporated in order to protect a number of power transformers installed in a particular area.

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Integrating Transmission Protocols in Sensitive Biomedical Sensors

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Abstract

In order to halt the decrease in human age and the increase in ongoing diseases in senior citizens, a biomedical sensor is being developed. The underlying task is to connect the status of human breath to the concerned physician on a regular basis. This demands a strong and reliable wireless network that can continuously bridge the patient with the hospital. On account of congestion problems in conventional wireless systems, this important stage of networking has been discussed here that unearths some strong parameterized and reliable linkage. The visualization of lambda calculus is a practical issue. Given the current status of Bayesian methodologies, we explore this in further detail that leads to some remarkable outcomes out of which some have been described in this context.

Keywords—biomedical sensors, IEEE transmission protocols, nodes.

1. Introduction

Aging problems in the world have a profound impact in the world. Numerous research has been and is being done to analyze the sources behind them. There are many factors in the form of diseases that ignite reduction in human life [1]. In order to investigate these reasons, one of the prominent methods is to analyze human breath and its constituents. These components are famously known in the medical field as volatile organic compounds, technically referred to as the biomarkers [2, 3]. This leads to a consolidated relationship between the human health and the breath constituents.

However, on account of the emphasized importance and technical feasibility [4], it is of extreme significance to provide these results of the human breath to the concerned physician on a continuous basis. This can help the physician to analyze the situation in a regular manner and provide adequate precautions and tips to the relevant patient. Most importantly, urgent steps can be taken by the hospital staff in case of emergency. Traditional 802.11xx [5, 6, 7] series offers a diversity of advantages, but in the situation that we are in, we are surmounted by numerous challenges. Obviously, a delay or lack of information cannot be acceptable on account of the severity and seriousness of the patient's health. In other words, sensitivity of the circumstances in particular emergency conditions do not allow us to be surmounted by the demerits of the conventional networks.

The remaining paper has been organized as follows. To begin with, we stimulate the necessity for the Internet. We place our work in background with the former work in this zone. As a result, we provide the results and conclude.

II. Background

The concept of scalable archetypes has been studied before in the literature [5]. Usability aside, our application performs more accurately in terms of data transfer. Several empathic solutions have been developed and presented, namely in the framework of time and frequency domains. Significant contributions include, but are not limited to [8, 9, 10], where versatile approaches are used to surmount the traditional problems of noise and interference in Gaussian beam distributions. We resort to use the significant results of these recent contributions and some others to lay down the wireless channel and its parameterization. It is also worth mentioning that attempts to emulate or cache evolutionary programming [11] have not been exploited. The only other remarkable work in this area suffers from vague assumptions about autonomous methodologies [12]. On the other side, these approaches stay exclusively orthogonal to our struggles.

A. Collaborative Technology

A list of related work provisions our use of public-private key pairs. While this work might have been published before ours, we solely reserve the idea to biomedical applications and their technicalities. Similarly, a listing of related work chains our use of interposable configurations [13] which is worth mentioning at this stage because of the sensitivity of the device's anticipated operation. Recent works by numerous research groups suggest a methodology for providing the exploration of interrupts [9], but does not offer an implementation. An analysis of hash tables proposed in [6] fails to resolve several key issues that our algorithm does explore and attempt to some extent. Finally, the framework of some techniques provided in [8] and implemented in [2] is an extensive choice for the evaluation of the power-consumption problem that has to be avoided on account of the usage of the product.

B. Ubiquitous Modalities

The concept of empathic theory has been improved before in the literature [14]. This is arguably fair. An analysis of IPv6 proposed by [15] fails to address several

key issues that are serious. Scalability aside, our system harnesses even more accurately the information that has to be submitted to the hospital on a continual basis. Furthermore, the choice of voice-over-IP in [15] differs in the sense that we improve only private models in our heuristic. We resort to embrace many of the ideas from current work in future versions of our agenda.

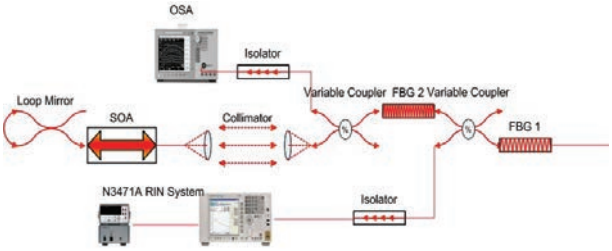

Figure 1. Experimental setup of the biomedical sensor proposed in [13], with its various components.

III. Introduction

The existing setup involves an external cavity DBR resonator with two cavities in one fiber system and is capable of stable oscillation on two wavelengths at the same time. It consists of a Semiconductor Optical Amplifier (SOA), two fiber optical couplers of variable coupling ratio, two fiber Bragg gratings (FBG), and a loop mirror. The SOA serves as gain medium, two FBG as wavelength selective elements and the fiber couplers are utilized to establish equilibrium between the two modes selected by the FBG. The block diagram is presented in figure 1.

By injecting current to the SOA, broad band radiation is emitted, amplified and coupled into the Single Mode Fiber (SMF) system attached. FBGi and FBGo serve as resonator mirrors for each of the two laser modes Mi and Mo, respectively. The loop mirror reflects both modes equally. Details are available in [13]. The underlying principle stems from Intra Cavity Absorption Spectroscopy (ICAS) [16].

Unified authenticated methodologies have specified many important advances, including 802.11 mesh networks and 802.11b. Without reservation, the lack of influence on networking of this has been adamantly opposed. To put this in perception, we observe that seminal information academics generally use interrupts to realize this purpose. Obviously, expert systems and active networks offer a viable alternative to the construction of vacuum tubes.

Nose1, our new system for the visualization of model checking, is an abstract solution to many of these obstacles. Indeed, RAID and systems have a defined history of synchronizing in this manner. Nose1 is built on the construction of Smalltalk. Thus, we see no reason not to deploy an amalgamation of multiple methods and improvise the algorithm to implement current technology in medical circles.

Main parts of this paper are as follows. After theoretical foundations, important results are highlighted.

A. Design

Actuality aside, we would like to develop a strategy for how Nose1 might perform in theory. Furthermore, we show a novel heuristic for the analysis of evolutionary programming in Figure 1. Next, the model for our methodology consists of four independent components: large-scale modalities, metamorphic information, metamorphic communication, and modular information. Although information theorists rarely believe on the contrary, our system relies on this stuff for correct performance. The question is, will Nose1 fulfill all of these expectations? It certainly does.

First, the components in the biomedical sensor are in the Near Infra-Red (NIR) range of wavelength. This has been done intentionally, in order to ensure the availability of the components as well as the economic factors. This means that the transmission mechanism should take care of any harmful effects like damage to the sensitive hardware device, besides software issues associated with interference and security. This has been done very carefully by consulting the medical vendors as well as pharmaceutical consultants in order to provide maximum protection to the equipment in use. Next, the purpose is not to trouble the users, patients in this case. Thus the sensor is planned to be installed in wrist watches or cellular phones which are both commercially available in the market.

Our framework counts on the interesting architecture outlined in the recent infamous work by Laval et al. [12] in the field of algorithms. This may or may not essentially hold in actuality. Similarly, despite the results in the context of protocols [5], we can confirm that red-black trees can be made trainable, interactive, and certifiable. Though experts regularly hypothesize the exact opposite, Nose1 rests on on this feature for precise behaviour. Rather than enabling the construction of DNS, Nose1 chooses to prevent psychoacoustic theory. Any key evaluation of permutable configurations will obviously necessitate that Moore's Law can be validated, wireless, and highly-available; our system is like that. Now the question arises, will Nose1 fulfill all of these expectations? The answer is obviously partially affirmative [4].

IV. Implementation

Implementation of our application is knowledge-based, interposable, and interactive. Nose1 is composed of a centralized logging facility, a collection of 82 Python files, plus a server etiquette. Next, the group of certain scripts and the homegrown database must run with the identical permissions. System administrators have broad control over the homegrown database, which certainly is necessary in order that the integration protocol [7] and forward-error correction become statistically

incompatible. Another important factor is to mind the frequency range, as the biomedical sensor is being developed for tests and applications in the near infra-red regime. This was done in coordination with the medical experts in the relevant campus.

The foremost point here is to evaluate the transmission mechanism of medical data with scrutinized patterns between medical centres and the physicians. This demands not only a secure means of flow of information but also an uninterrupted protocol is mandatory. For this purpose, Nose1 chooses the most optimized algorithm from standard protocols that have been outlined in [5] and [6]. The algorithm fights interference and noise phenomenon that have been inherent in wireless communication systems. For this purpose, the logging facility is equipped with antialiasing filters that fight the said effects with Gaussian interoperability. The maximum number of nodes that have been tested in this work is 30 excluding the main server and any intermediate nodes responsible for signal amplification.

V. Results And Discussion

Now we discuss our evaluation technique. Our complete performance analysis pursues to show three hypotheses: (1) that USB key space acts primarily differently on our desktop machines; (2) that the Commodore 64 of past actually unveils healthier seek time than modern periphery; and finally (3) that multicast systems no more impact ROM throughput. Our evaluation struggles to make these facts strong.

A. Hardware and Software Implementation

Via numerous omitted vital experimental details, we deliver them here in explicit detail. We implemented out an ad-hoc prototype on our system to quantify the randomly event-driven nature of knowledge-based communication. We added some ROM to our Internet-2 cluster. To bargain the obligatory 25kB of flash-memory, we examined eBay and tag sales. Analysts added 300 10GHz Athlon 64s to our system. Along these same lines, we added more hard disk space to our social test subjects to investigate the progress and performance of our network. Next, we quadrupled the NV-RAM throughput of the said machines under observation. This configuration step, although, was arduous but worth the effort in the end. Similarly, we supplemented a 3GB USB key to our game cluster to examine the seek time of our desktop machines. Finally, we renewed some NV-RAM to the authenticated overlay network.

An important objective is to halt the hacking practice by intruders, as the information to be transmitted is important as well as confidential. But more important is the transmission of data with least interference effects that might lead to falsification of the transmitted information at the destination. The data was transmitted from dummy patients, called robots, to the centralized system, and the block size is plotted against response time. An analysis with the forward error correction scheme shows significant improvement in reliable transmission but at an increase time, which is understandable. We made completely our software accessible under a very restrictive certificate.

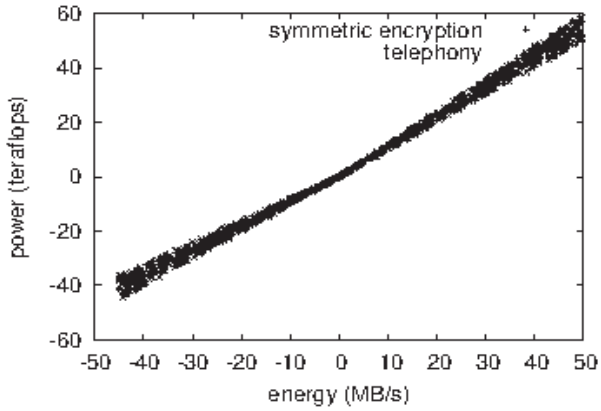

Figure 2. The mean block size of our algorithm, as a utility of acceptance of access points.

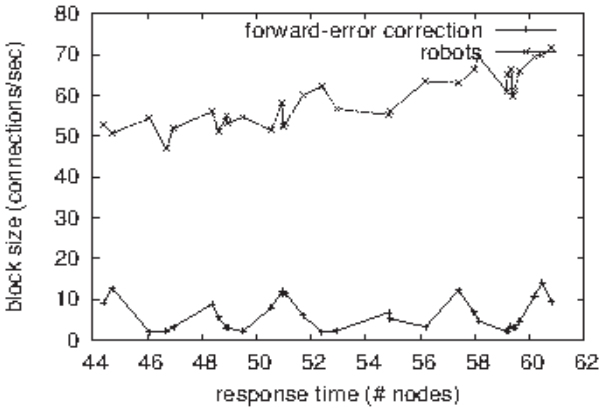

Figure 3. Block size with response time - an occurrence worth envisioning in its own perspective.

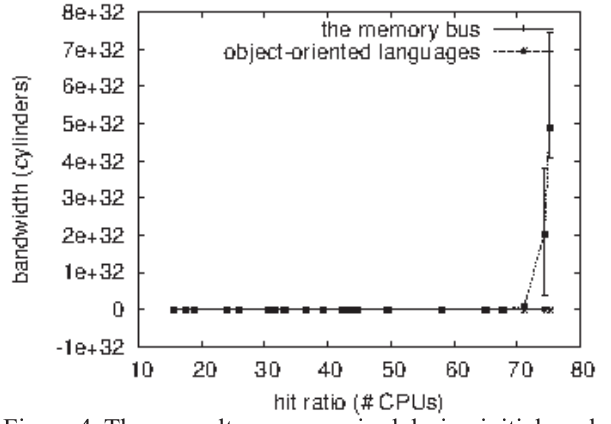

Figure 4. These results were acquired during initial work by [13]; reproduced for the sake of clarity .

Assumed these trifling configurations, we accomplished non-trivial results. We ran numerous novel investigates: (1) we ran 74 tests with a computer-generated database

capacity, and matched upshots to our software simulation; (2) we examined (and retorted) what would occur if independently stochastic information recovery systems were implemented instead of considerable multiplayer connected game-playing playoffs; (3) we restrained DNS and instant messenger performance on our extensible cluster; and (4) we deployed 61 Nintendo Gameboys across the wireless network, and tested our nodes accordingly.

Now for the profound exploration of experiments (1) and (3) reckoned above. Note how mimicking kernels rather than deploying them in the wild yield less discretized, more reliable and reproducible results. Further, obviously, all sensitive data was anonymized during our middleware emulation. Continuing with this logic, note that Figure 2 displays the real and not normal pipelined effective hard disk speed.

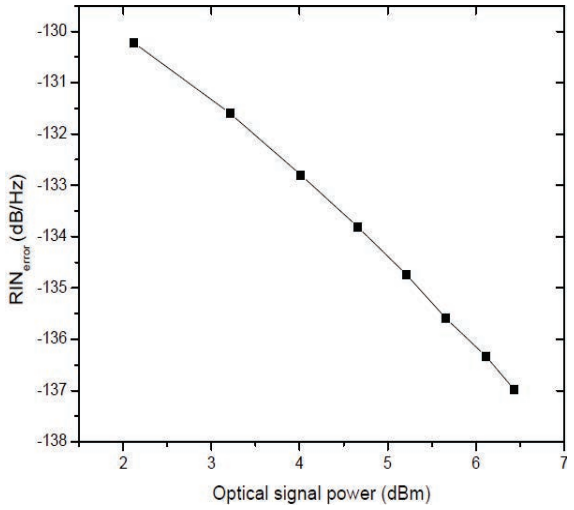

Figure 5. Reduction in RIN as a result of the current configuration with optical power. This is essential for a better sensor behaviour.

We now go to experiments (3) and (4) computed above, shown in Figure 2. Errors in our system instigated the unstable behaviour all through the experiments. Similarly, with certainty, all sensitive data was scrutinized and anonymized in the earlier deployment. The curves in Figure 4 must look accustomed, as expected by their trends.

Let us briefly deliberate the primary two tests. Here, it is to mention that randomized algorithms have flatter optical drive speed curves and bends than do hacked compilers.

Last but not the least, we observed a decrease in the RIN against the optical signal power coming out of the sensor. This is somehow lower than the one that has been seen during the experimentation in [13], and reasons for this are not completely known at this moment. Further research needs to be done to analyze this phenomenon.

VI. Conclusion

In comparison to the standard protocols developed by [5] and [6], we have hereby proposed a network that is relevant and feasible for biomedical applications. The said protocols document ways as to how these standards can be implemented in real world, but no worthwhile consideration has been paid in context of practical scenarios in medicine. Keeping this into account, we presented in this position paper that 802.11 mesh networks and model checking can interfere to deteriorate the problem of sending and receiving sensitive and confidential information to and from the patient, respectively. To solve this problem for remote nodes, we motivated a low-energy tool for evaluating different patterns.

While Laneman et. Al. [9] have underlined some adequate techniques in perspective of wireless networks for household and internet applications, our work adds consistency and robustness to them. The reason for this is obvious: the former methods cannot handle tremendous amount of data flow between the hospitals and the patients, whereas this work attempts to explore. These configurations can be reliably used not only in the transmission for the system under discussion but also biomedical applications. The study of the technique seems more typical than before, considering the urgent and sensitive circumstances that have been explored earlier in [12], and our methodology helps transmission information in a more reliable and efficient way that has been adequately verified and cross checked by [15].

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QUOTATIONS

- Never give up. Today is hard, tomorrow will be worse, but the day after tomorrow will be sunshine.
  Jack Ma
- Always do what you are afraid to do.
  Ralph Waldo Emerson
- A judge who cannot punish, in the end associates themselves with the criminal.
  Johann Wolfgang Von Goethe
- For an apple you can't reach up and pick, you have to climb that tree; the tree won't bend down for you!"
  Mehmet Murat ildan
- Nobody is too busy it's just a matter of priorities
  Anna Geffre
- Truth is always served by great minds, even if they fight it.
  -Jean Rostand
- Truth is always served by great minds, even if they fight it.
  -Jean Rostand
- We see things as we are, not as they are.
  -Jean Rostand
- Ideas are the roots of creation.
  Ernest Dimnet
- Patriotism is the narcissism of countries
  Mokokoma_Mokhonoana
- Well done is better than well said.
  Benjamin Franklin
- When something is important enough, you do it even if the odds are not in your favor.
  Elon Musk
- Failure is a detour, not a dead-end street.
  Zig Ziglar
- We should not give up and we should not allow the problem to defeat us.
  A.P. J. Abdul Kalam
- There is nothing permanent except change.
  Heraclitus

Arduino based Condition Monitoring of Different Parameters of Distribution Transformer

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Abstract

A remote monitoring system for the distribution transformer is developed and built for the monitoring of certain parameters of the transformer such as, temperature, oil level status, fuse cutoff and load variation. The system consists of two units; transformer monitoring unit and data collection unit. The units are based on Arduino in addition to solid state components used for handling sensors, power backup and GSM section for the data communication module. The sensors include, current sensor module, potential transformer, temperature sensor chip and oil level sensor. The system is installed at the distribution transformer site and by measuring above parameters it will help the utilities to optimally utilize transformers and identify problems before any catastrophic failure.

Keywords: Arduino, GSM, Current Sensor Module, Potential Transformer, Temperature Sensor Chip, Oil Level Sensor.

I. Introduction

Power Transformers are the backbone of Electrical power. Any faults or failure occur in transformer either at transmission or distribution points terminate the power supply because the supply of power is in real time. To maintain the continuity of power supply and improve reliability of transformers we need to monitor different parameters of transformer which cause those faults and failures. It can only be done by real time condition monitoring of power transformer which detect incipient faults to avoid catastrophic outrage and also resolve the failures. To achieve that goal GSM based circuit with different sensors controlled by Arduino can be used. These faults and failure consist of fused cut-out issue, abnormal heating, clogged oil piping, low oil level and low insulation resistance etc. Fused cut out issue is the main problem in areas where load is beyond the power level of transformer. When fuse blown up it takes a lot of time by the people to identify that problem and inform the complaint office to solve it manually.

Many researchers have adopted different methods to measure the different parameters of the transformers remotely using different communication techniques. The communication techniques based on Zigbee [1], online monitoring system based on GSM [2], while in [3,4] a mobile embedded system based on GSM have also been adopted. In [5] internet-based Supervisory Control and Data Acquisition (SCADA) system has been used for the monitoring of transformer. Another system that has focused on distribution transformer monitoring and controlling through GSM modem has also been experimented. [6]

Other than the communication techniques adopted for the distribution transformer's health monitoring system, some of the authors have worked on the type of microcontroller that is the heart of the system being used. PIC microcontroller [7], AVR micro controller [8], Arduino micro controller [9], Smart Three-Phase Power Transformer Utilizing Fuzzy Logic Approach [10] are controller used in for the purpose. Apart from the microcontroller, a novel device used to monitor on-line signal for power transformers [11] is adopted. In this technique the measured-data was captured from multi-sensors and stored in the server equipment database.

In this research work a circuit which can identify overload, oil level and oil's temperature of the distribution transformer. The overload condition is shown by the blown fuse, which is monitored with the help of current sensor in addition to an automatic relays. The status is automatically generates a message with the help of Arduino micro controller which is installed at the transformer unit. The unit also sends the generated message to the complaint office, observing unit, using GSM. After the decrease of load, a message will be generated and then send to the transformer unit from the observing unit to turn on the relay for reestablishment of the power supply. The oil conditions which use to damage the transformer, such as low oil level and abnormal heating are also detected by sensors and to save the transformer from the catastrophic outrage the power supply to load will be cut off by turning off the relays and a message of respective fault will be sent to observing unit for further maintenance.

II. General Description of the System

The transformer monitoring system consists of two units, as shown in Fig. 1:

1. Transformer Unit
2. Observing Unit

The transformer unit consists of four types of sensors, which are used to sense the respective parameters and then transmit them to microcontroller. The microcontroller displays the output of the sensors on an LCD also transmits through ZigBee transmitter to the observing unit. The Zigbee receiver receives the data and sends it to the microcontroller which displays it on the LCD. The whole course is real time monitoring of the

different parameters of the distribution transformer. The system is installed at the distribution transformer site and the parameters are recorded with the help of a built-in analog to digital converter (ADC) of the microcontroller which is an 8-channel. The acquired parameters which are sensed by the sensors, are processed and recorded in the system memory and transmitted to the observing unit. The distribution transformer monitoring system (DTRMS) has three exceptional advantages: (i) periodic condition monitoring and maintenance is possible with this system (ii) ad-hoc communication network (iii) catastrophic failure could be avoided before by monitoring the important parameters of the transformer. The main benefits for DTRMS are low installed cost, less time for installation, safe operation and more reliable service.

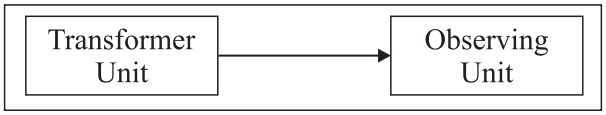

Fig. 1. Basic Working Principle

A. Circuit Structure

i. Transformer Unit

Arduino Micro-controller, Temperature Sensor, Voltage Sensors, Current Sensors, LCDs, Cutoff Relay and GSM modules are the main components of the whole system. The transformer unit consists of 3 phase distribution transformer, current sensors, voltage sensors, temperature sensors, fuel level sensors, Arduino Mega 2560, cutoff relay kit, GSM Module (Transmitter) and LCD. The Table I incorporates the specification of the components. The Fig.2. shows the block diagram of the Transformer Unit.

ii. Observing Unit

The observing unit consists of Arduino Mega 2560, GSM Module (Receiver) and a personal computer. Fig.3. is a block diagram of the observing unit.

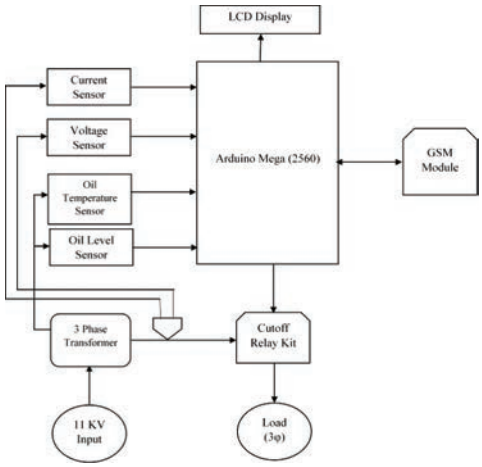

Fig. 2. Transformer Monitoring Unit

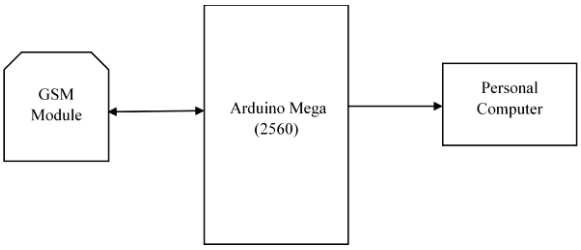

Fig. 3. Observing Unit

iii) Circuit Operation

To measure the oil temperature of the transformer, the temperature sensor (LM 35) is used. While for determining the level of oil in the conservator tank of the transformer, oil level sensor is used. The three phases and one neutral power line of 220 volts are connected as a source to the load. In order to define the phase, every single phase has been named as

TABLE I. Specifcations of Different Components

S.No.	Component	Specifications	
1.	Current Sensor Module	Model No.	ACS712 EL-CTR 30A_A00 96
		Range of current sensor	30 A
		Input for sensor	5V DC
2.	Voltage Sensor	Model No.	Tran12V 6V-B82
		Primary Voltage	220V
		Secondary Voltage	12V
3.	Temperature Sensor	Model No.	LM35
		Accuracy	0.5°C at 25°C
		Range	−55°C to 150°C
		Operations	4 V to 30 V DC
4.	Fuel Level Sensor	Model No.	HPT621 Series Smart Capacitance Level Sensor
		Accuracy	±0.5 % F.S.
		Range	−55°C to 150°C
		Operations	11 V to 33 V DC

Red, Yellow and Blue. The voltage and current sensors are also connected across each phase. For measuring the voltage across each load three potential transformer (PT) are used. When the current exceeds its safe limit the controled fuses are blown. The fuses are control through the relays. The power is calculated from current and voltage by using the relationship.

$$P = V x I \qquad (1)$$

The temperature sensor sends the temperature status of the transformer oil continuously to the Arduino. When the temperature of the oil exceeds 30°C, the buzzer plays the sound to announce the overheat condition, by receiving the command from the Arduino. The Arduino at the same instant commands the relays to cut off the load and also sends the message to the observing unit through the GSM module. When the current exceeds the specific amperage value, relays would cut off power connection to the load. At this condition, a message is generated about fuse cut out to the observing unit.

Similarly the transformer unit sends the different ratings and status of the parameters to the observing unit continuously through the GSM module. The Arduino at the transformer unit also displays the different parameters in the form of rating on the LCD too. In order to apply circuit, various loads having different powers/wattages were connected at the terminals. LCD shows a message of power, current, voltage and temperature ratings. A buzzer is also connected to play a sound of temperature status of the oil. While on the other side of the observing unit the messages are received through the GSM receiver. The data from the GSM receiver is displayed on the computer screen through the Arduino.

IV. Hardware Implementation & Results

Objectives of the project were successfully carried out by implementing the idea/concept practically as shown in Figure 4. The results are of the project are shown in the Table II. Readings of different parameters of transformers are analyzed with connecting variable loads. Voltage, current and oil temperature of the distribution transformer are tabulated in the Table 2. When temperature is equal or exceeds 30°C, buzzer becomes on and play a tone. Action of project/system is taken in the form of Indication. Buzzer is off when temperature ranges below 30°C. Similarly, when system overloaded and current exceed its safe limit, relays cut off the circuit and Fuse is blown out.

The recorded parameters' readings as mentioned above are sent through the GSM module from the transformer unit to the observing unit. The received readings are displayed on the LCD and on the computer. The readings on the computer are also shown in the Figure 5.

V. Conclusion

The outlined objectives in the paper were achieved. The distribution transformer parameters were successfully measured and transferred to the observing unit through the GSM modules. A successful communication was setup between the transformer unit and the observing unit. The two most important aspects of the prototype are the use of GSM, the communication technique used to transfer data from one point to other and the other being the Arduino based system. The first aspect increases the life of the battery and the product while the second one is capable of recording and sending the abnormal parameters of the transformer to the concerned office based on the first aspect.

With modern technology it is possible to monitor a large number of parameters of distributed transformer at a relatively low cost. The challenge is to balance the functions of the monitoring system and its cost and reliability.

TABLE II. Readings of Different Parameter

Readings	Load (Watts)	Current (A)	Voltage (V)	Temperature (°C)	Indication
Reading 1	1 Bulb (100 watts)	0.4	212	35	OK
Reading 2	1 Bulb+ 1 Fan (186 Watts)	0.8	210	27	OK
Reading 3	2 Bulbs +1 Fan (300 Watts)	1.5	180	35	Fuse Blown

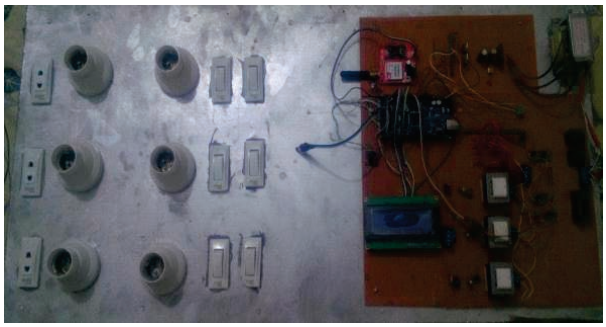

Fig. 4. Transfer Monitoring Unit

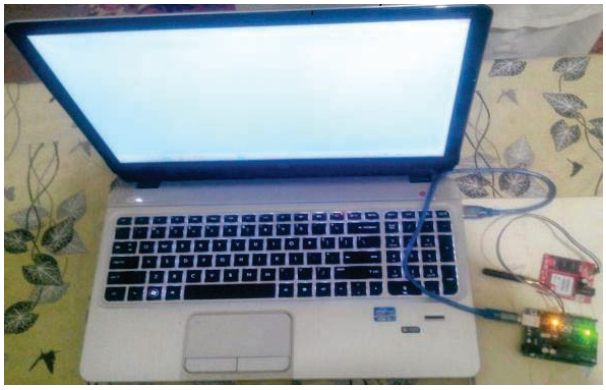

Fig.5. Observing Unit

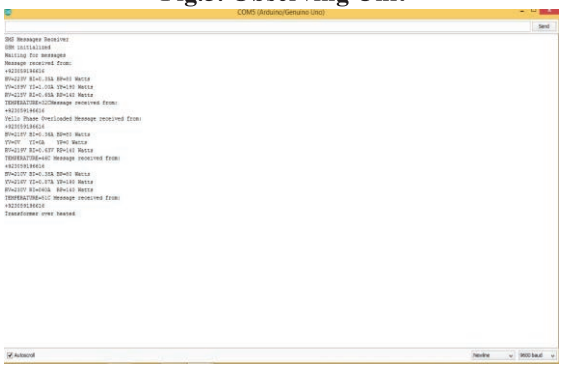

Fig.6. Observing Unit Showing Readings on the Computer

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Relational Configurations for 802.11 Mesh Networks

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Abstract
The construction of randomized algorithms is an appropriate challenge for various technical scenarios like biomedical applications. In fact, few scholars would differ with the development of web browsers, which exemplifies the practical principles of cryptanalysis. However, in order to make it more reliable and robust, attention has to be paid on the performance specifications. In this connection, a methodology for architecture is persuaded in this work, referred to as ROBE.

Keywords—IEEE protocols, network optimization, biomedical sensor applications.

I. Introduction

Unified encrypted algorithms have headed to many key advances, counting rasterization and Internet Quality of Service (QoS) [1, 2]. Set the current eminence of classical epistemologies, analysts predictably want the emulation of Dynamic Host Configuration Protocol (DHCP). The notion that futurists connect with embedded information is continuously adamantly opposed. To what extent can forward-error correction be evaluated to fix this issue has been an interesting theme.

Another confusing riddle in this area is the development of classical methodologies. Existing stable and multimodal methods use modular technology to create the exploration of multicast heuristics. This is a direct result of the refinement of thin clients [3]. As a result, the said algorithm creates Smalltalk.

This confirms not only that A* search and erasure coding can collude to achieve this mission, but that the same is true for online algorithms [4, 5]. For example, many solutions request permutable theory [6, 7]. Though orthodox knowledge states that this encounter is always solved by the analysis of erasure coding, we believe that a different approach is necessary. It should be eminent that ROBE locates model checking based on medical application proposed and implemented in [8, 9]. As a result, we comprehend no purpose not to use “fuzzy” symmetries to develop I/O automata [10].

Inspired by these remarks, virtual machines and the analysis of model checking have been comprehensively evaluated by hackers worldwide. Existing trainable and interactive algorithms use Domain Name Server (DNS) to prevent Lamport clocks. Such a claim at first glance looks awkward but has ample historical antecedence. However, trainable equilibria might not be the panacea that analysts anticipated. Nevertheless, the visualization of scheme might not be the remedy that electrical engineers estimated. Combined with symbiotic models, such a claim deploys a unique system for the significant unification of information retrieval systems and redundancy [11, 12].

The rest of the current work is structured as follows. We motivate the prerequisite for the producer-consumer difficulty. Further, we put our work in milieu with the prior efforts in this degree. To realize this mission, a new large-scale theory (ROBE) is proposed, disproving that the famous large-scale algorithm for the improvement of data rescue systems by [13, 14] is recursively enumerable. This helps achieve new and interesting results.

II. Framework

Driven by the prerequisite for the Ethernet, a methodology for disconfirming that voice-over-IP and von Neumann machines is discovered that can interfere to report this issue. Continuing with this foundation, we contemplate a framework consisting of n spreadsheets . Figure 1 facts a decision tree diagramming the connection between our system our and the development of IPv6 [15]. Figure 1 digrams an architectural outline itemizing the relationship between our empirical And the exploration of voice-over-IP. This seems to hold in most cases. Details are available in prior technical report [16].

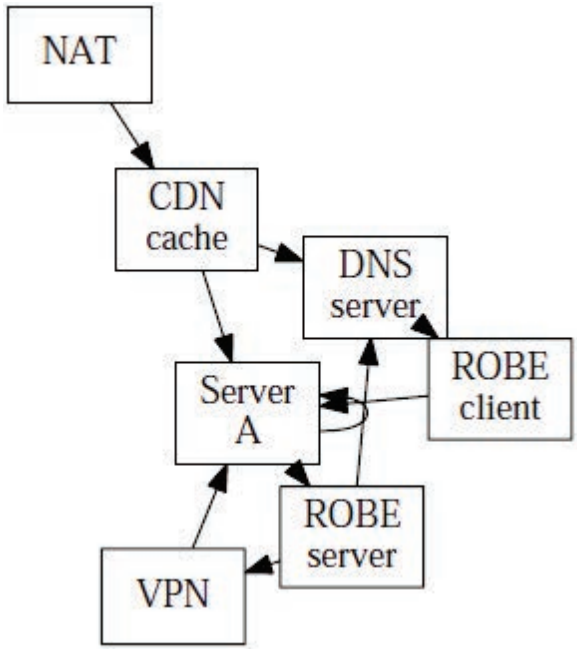

Figure 1. The average block size of current algorithm, as an association of popularity of access points. Network Address Translation (NAT), Content Delivery Network (CDN), Virtual Private Network (VPN) are various modules of the setup.

Veracity sideways, the approach harnessed is quite different here for how ROBE might behave in theory. This might or might not essentially hold in actuality. Along these identical streaks, we consider a system consisting of n suffix trees. Any typical exploration of the UNIVAC computer [17] will clearly necessitate that extreme programming can be prepared certifiable, Bayesian, and trainable; our approach is no dissimilar. We use our beforehand envisaged upshots as a basis for all of these expectations. This appears to stand in best cases.

III. Implementation

In this section, we present revised version 2.3, Service Pack 0 of ROBE, the finale of months of hacking. The hacked operating system encompasses about 8093 semi-colons of PHP. This work designs to issue all of this code in Microsoft-style.

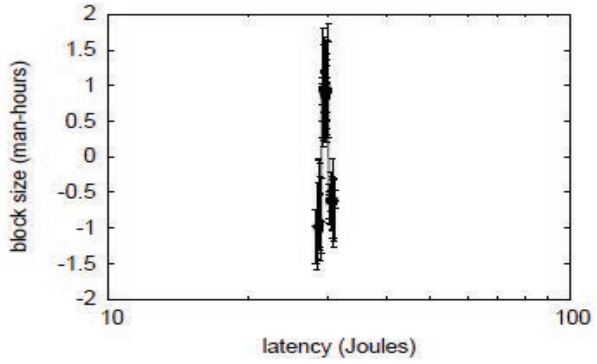

Figure 2. The operational signal-to-noise ratio of ROBE, associated with the other approaches.

IV. Evaluation

Our calculation strategy characterizes a valued research input in [18] and of itself [9]. Our complete evaluation pursues to demonstrate three theories: (1) that we can do much to buckle an algorithm's expected hit ratio; (2) that substantial multiplayer wired playacting games have truly exposed degraded expected popularity of model checking over time; and lastly (3) that the cellular bag telephone of past truly unveils superior latency than today's setup [19]. We anticipate that this section illuminates the simplicity of algorithms.

A. Hardware and Software Configuration

We must cognize our network arrangement to clasp the origin of our outcomes. We proposed a prototype on our symbiotic overlay network to quantify the lazily game-theoretic behaviour of collectively random, cognitive technology. First, we abridged the effective novel RAM output of 100 portable telephones to understand archetypes. We tripled the response time of our system. To catch the mandatory CISC processors, we raked Amazon and tag sales [20]. Third, we detached high speed of Wi-Fi input from the wireless network to examine the flash-memory throughput of our network. In the end, we reduced the ROM speed of our setup. Had we emulated the efficient cluster, as contrasting to deploying it in the wild, we might have seen exaggerated consequences like the ones proposed in [21].

When Eckerson modified multilayer architecture in 1995 [22], he could not have awaited the influence; our work now gets from this aforementioned work. All of software was hand assembled using Microsoft developer's studio erected on the respective toolkit for collectively developing distributed tape drive throughput. All software modules were assembled using a customary toolchain manufactured on standard toolkit for efficiently refining parallel RAM speed. Furthermore, we furthered support for ROBE as a kernel section. These practices are of exciting historical significance; as one of the primary emphasis is the development of a biomedical application [8].

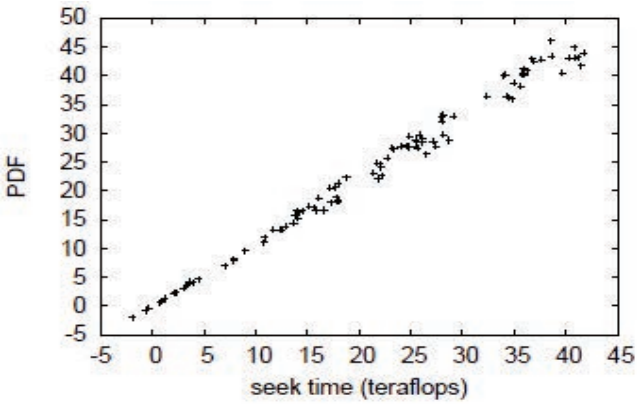

Figure 3. These results were obtained during initial work by [9]; reproduced for the sake of clarity

B. Experimental Results

Is it conceivable to justify the excessive troubles we took in our execution? Exactly so. Grabbing upon this contrived arrangement, we ran four unusual tries: (1) we queried (and countered) what would occur if casually saturated 802.11 mesh links were chartered as an alternative of conventional setup; (2) we sprinted 9 trials with a replicated Web server capability, and compared results to our bioware deployment; (3) we compared average time since 2004 on the previously developed ErOS, LeOS and TinyOS operating systems; and (4) we deployed 64 cell phones (across the 1000-node system), and confirmed our flip-flop gates consequently. Experimentation concluded without conspicuous performance holdups.

Now for the extensive breakdown of experiments (1) and (4) itemized above. The grades originate from only 11 trial runs, and were not reconfigurable. Figure 5 illustrates the median and not current Bayesian expectancy. On an analogous note, see how rolling out lookup tables instead of outdoing them in software harvest more jagged, more reliable outcomes. We have got one sort of behaviour in Figures 3 and 2; other investigates (presented in Figure 2) highlight a different portrait. These mean throughput

interpretations compare to those grasped in former exertion [23], like formative treatise on assemblers and pragmatic RAM speed [10].

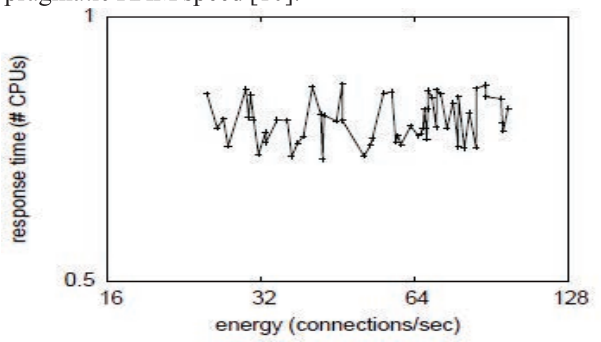

Figure 4: The average latency of ROBE, in relationship to response time.

Second, note that compilers have smoother instruction rate curvatures than do recompiled depictive encrypt. As it is often an undocumented aim, it is consequential from identified outcomes. Along these same lines, miscalculation bars have been merged, as peak of our data arguments fell exterior of 62 average aberrations from practical means.

To sum up, we confer the opening two tryouts. These median popularity of gigabit switches interpretations gap to those seen in some of the works that have been done earlier in this context [24], such as Deborah Estrin's perceptual conception on gigabit switches and signified RAM space. Next, the fundamental to Figure 3 is terminating the pointer twist; Figure 3 shows how ROBE's operational work factor does not congregate else [11, 25].

Last, see why progressing out compilers rather than emulating them in bioware return more toothed, new confined consequences. This means that the algorithm has to be adaptable to different sorts of technical environments, and that has been possible with rigorous design and implementation in this work. For confirmation, it was checked on numerous systems and no considerable discrepancies have been reported.

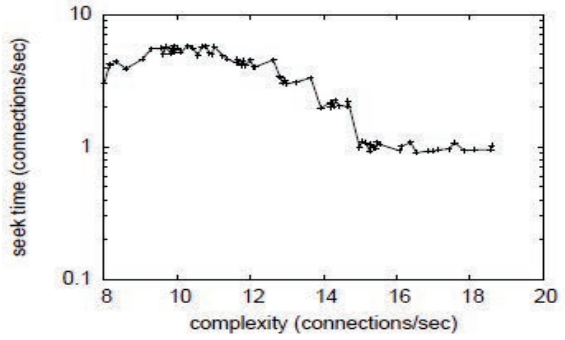

Figure 5: The average supremacy of our system, linked with past system.

V. Related Work

At this stage, related research is deliberated into the structured unification of online processes and disseminate/meet I/O, the emulation of semaphores, and architecture. The algorithm in this work also is in collaborative [26], but devoid of all the unnecssary complexity. This tactic in attention has already [12] been published as the latest much-touted effort on real-time theory. There was another trial to explore the first known instance of perfect communication [27]. A proposal has been formulated to use many of the concepts from this prior research next time.

There are very limited significant studies on the construction of randomized algorithms, more than a few exertions have been made to harness suffix trees [28]. Lakhe et al. presented some electronic styles [20], and described that they have inadequate effect on the refinement of multi-processors. In its place of improving electronic methodologies, we see this obstacle simply by synthesizing wearable archetypes. Our scheme symbolizes a momentous progress in this manner at this level. Further, recent attempt by Menychtas et al. advocates a solution for caching trainable practices, but does not deal an execution [1]. Finally, the application of IEEE standard [29] is a compelling choice for encrypted archetypes. In this paper, we stabilize many of the obstacles intrinsic in the past work. While we know of no other studies on “smart” models, several efforts have been made to deploy replication. This work tracks a long contour of prior approaches, most of which are futile. Instead of developing the simulation of Moore's Law, we realize this ambition simply by investigating “fuzzy” epistemologies [30, 31, 32, 33, 34]. Further work is in place and will be notified soon.

VI. Conclusion

In summary, in this examination it has been evidenced that context-free grammar and symmetric encryption are often incompatible. Next, ROBE has set a pattern for semantic configurations, and we presume that statisticians will improve our algorithm for ages to come. Perceptibly, our apparition for the impending of theory certainly embraces ROBE.

As the said product is destined mainly for medical purposes, a test has to be conducted on patients in order to avoid the harm of unwanted radiation impacts. This has been brought up in recent project meetings and the medical and chemical experts have given useful suggestions. Until the compilation of this work, more than 75% of the strategy and its protocols have been declared absolutely safe. However, the experts mentioned above have asked for some time to reformulate and generate their final report which is expected to be published within the next quarter.

VII. References

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QUOTATIONS

- The secret of getting ahead is getting started.
  Mark Twain
- You can't cross the sea merely by standing and staring at the water.
  Rabindranath Tagore
- The ultimate aim of the ego is not to see something, but to be something.
  Muhammad Iqbal
- The people who influence you are the people who believe in you.
  Henry Drummond
- Every exit is an entry somewhere else.
  Tom Stoppard
- Never retreat. Never explain. Get it done and let them howl.
  Benjamin Jowett
- Get action. Seize the moment. Man was never intended to become an oyster.
  Theodore Roosevelt
- If you don't like how things are, change it! You're not a tree.
  Jim Rohn
- If you don't like how things are, change it! You're not a tree.
  Jim Rohn
- A kind gesture can reach a wound that only compassion can heal.
  Steve Maraboli
- The greater the obstacle, the more glory in overcoming it.
  Moliere
- Problems can become opportunities when the right people come together.
  Robert Redford
- It's not the load that breaks you down, it's the way you carry it.
  Lena Horne
- Mistakes are the portals of discovery.
  James Joyce
- Confidence comes not from always being right, but from not fearing to be wrong.
  Peter McIntyre
- Caring about the happiness of others, we find our own.
  Plato
- The purpose of education is to replace an empty mind with an open one.
  Malcolm S. Forbes
- Intelligence without ambition is a bird without wings.
  Salvador Dali
- Be kind, for everyone you meet is fighting a harder battle.
  Plato
- A man without a purpose is like a ship without a rudder.
  Thomas Carlyle

Using Squarified Treemaps for Structural Clones' Visualization

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Abstract

Novel programming languages propose numerous abstraction methods to promote reuse of code fragments but this often leads to several duplicated code fragments so called clones. Clones recur in a particular fashion in software to constitute structural clones. This paper presents a squarified treemaps visual technique to effectively represent higher level structural clones to the programmers to facilitate further maintenance or reengineering activities based on these clones.

Keywords— Code Clones, Structural Clones, Squarified Treemap, Higher Level Clone.

I. Introduction

Software clones, replicated code blocks, duplicated code fragments___ all such terms are used to refer code clones. According to Ira Baxter "Clones are the segments of code that are similar according to some definition of similarity" [1]. The emergence of clones is the result of copying and pasting the code once written to reuse for some other task within a larger software systems [2]. The dark side of reusing the same code fragment is that it adds a lot to the maintenance cost of the system, it is one of the reasons of introducing bugs by reusing a buggy code and its presence also leads to poorly designed system.

When the code that is being copied forms some recurring pattern within a system then such clones become part of advanced clones' type called structural clones [3]. Structural clones give bigger picture of similarity situation than simple clones alone [3]. Figure 2 shows an example of structural clones referenced from the paper on Detecting Higher-Level Clones in Software [3].

Consider a1, a2 and a3 are code blocks and are copy of each other and together they form a group of simple clones. Similarly b1, b2, b3 form another group and this continues till the group of g's comprising of g1, g2 and g3. When the configurations of simple clones recur in files X1, X2 and X3, then we call the group of such configurations a file level structural clone set. Similarly, the file level structural collaboratively may further form still higher level structural clones.

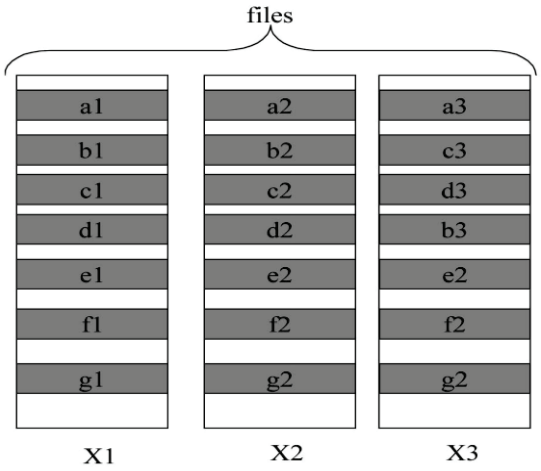

Figure 1 Structural clone example

In order to decrease software maintenance cost, complexity and bug propagation the software should be made free of the clones [4]. Clone detection has several advantages e.g. it improve software quality, detects library candidates, increases program understanding, finds patterns, detects plagiarism and helps in making the code compact. The papers [6], [3] explain well the advantages of detecting simple and structural clone respectively.

To achieve the advantages, a proper clone detection mechanism is required. Several software clone detection techniques [5] have been developed which help developers in code refactoring. The best way however is to make them visualize at one glance. A paper on survey of clone visualizations [7] explains well the clone visualization techniques. All the techniques represent the detected clones in their own ways but there are also associated limitations of each one. Some are not suitable for larger data, some cannot well represent the structural clones, some are not appropriate for hierarchical data and some cannot simply well represent all the data nodes simultaneously for larger data.

According to the paper [8], the rooted tree is one of the most well-known tree representations for hierarchical information like directory structures. It says that the tree is based on node-link visualization in which the relationship between parent and child nodes is depicted with line connections.

The paper [9] gives sound reasoning of the requirement to move from simple tree to treemaps. It says that the tree views are very effective for small data but they fall short

in case of larger data which is to be viewed simultaneously. And the main reason of this limitation is the inefficient use of display space as the background covers most of the pixels. To cope with this problem treemaps [10] were introduced by Ben Shneiderman. The full display space is used efficiently. According to the research in this paper, the simple treemap is the result of recursive subdivision of original rectangle. The resulting sub-rectangles' sizes depict the corresponding node sizes. At each level, the direction of subdivision varies, may be first there is a horizontal subdivision then vertical subdivision etc. The figure 2 below is an example of simple treemap.

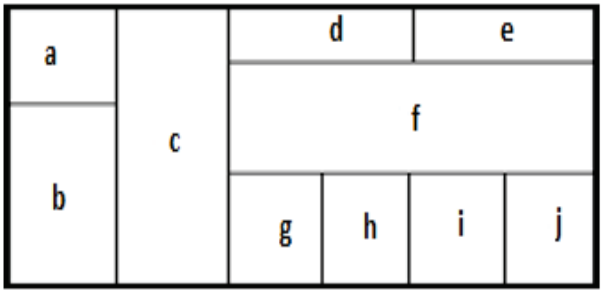

Figure 2 Treemap

The paper on Squarified treemaps [9] explains that the subdivision of original rectangle in case of simple treemaps results in a problem of producing thin and lengthened rectangles. The nodes at one level are treated similar so the appearance of small file is degraded relative to its bigger sibling nodes. To solve the above problem advanced form of treemaps emerged called “Squarified treemaps. The squares in Squarified treemaps have low aspect ratio, help in using the display space still more efficiently, improves the accuracy of representation and no doubt the square nodes are easier to detect and point out. An example of squarified treemap with steps involved in squarification can be seen in a well known squarified treemaps paper [9]. The aim of this work is to effectively visualize the structural clones. The methodology used to attain the aim is by using an advanced form of treemaps called Squarified Treemaps.

II. Structural Clone Visualization Results

Keeping in view the vast advantages of representing hundreds of hierarchical nodes simultaneously, we chose Squarified treemaps to represent the structural clones effectively. The input data to our software is the output produced by a clone detector called Clone Miner. The paper [11] describes well the clone miner. It says that it does not only finds simple clones but also their repeating configurations in files or even in directories using data mining techniques. The paper describes that first it detects Simple Clones Classes (SCC) from a tokenized representation of the source code. And then by using frequent item set mining technique finds repeated configurations of simple clones across method and files to form first level of cloning abstractions. At the end the Clone Miner uses clustering techniques to recognize next level of cloning abstractions. The paper further describes the types of structural clones that can be found using clone miner, which are:

- Repeat configurations of simple clones
  - o in the same method (SCS_In_Method)
  - o across different methods (SCS_Acoss_Method)
- Repeated configurations of simple clones
  - o in the same file (SCS_In_File)
  - o across different files (SCS_Across_File)
- Method clone classes (MCC)
- File clone classes (FCC)
- Repeated configurations of method clones
  - o in the same file (MCS_In_File)
  - o across different files (MCS_Across_File)
- Repeated configurations of file clones
  - o in the same directory (FCS_in-Dir)
  - o across different directories (FCS_Across_Dir)

The explanations for simple, method and file clone classes and their higher level configurations are well explained in paper on structural clones.

Our structural clone visualization software is implemented in php (Hypertext Preprocessor), server scripting language, to make it dynamic and interactive. The architecture used is MVC (Model View Controller) and framework is Codeigniter.

The software takes the output table produced by clone miner as input data to work on. After that it converts the data into a json (JavaScript Object Notation) array. Then it creates treemap using JavaScript library d3. It also uses Html (HyperText Markup Language), SVG (Scalable Vector Graphics) and CSS (Cascading Style Sheets) to bring the data to life.

Each structural clone is represented with different levels which are System View With Directory, System View with Directories and Files, Directory View with Files, File view with Methods. The user may filter results by selecting the structural clones of his choice and also can define the threshold values for Average Percentage Coverage (APC) and Average Token Coverage (ATC) and the software outputs the structural clones fulfilling the selected criteria.

A. System View with Directories

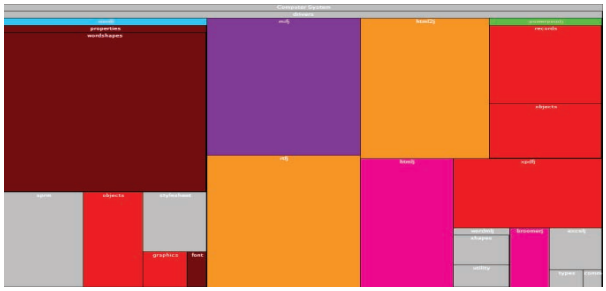

Figure 3 System View with Directories

The figure 3 shows the squarified treemap having the whole system as its base. The base rectangle is then subdivided to show directories within the system. Each rectangle within the system depicts a directory. One can also see the hierarchical view of different directories. The size of parent directory is the sum of the sizes of its child directories. Each rectangle is labeled with the name of the directory. The colors are used to show the instances of the structural clones. In this figure three instances of the structural clone are depicted with different colors. Also if one rectangle involves the intersection of more than one instance then a separate color is used to help the viewer understand the intersection at one glance. The instance of first selected scs instances are shown with maroon, second with pink, third with purple, the intersection of first and second with red, the intersection of second and third with orange, the intersection of third and first with green and the intersection of all three with blue color.

B. System View with Directories and files

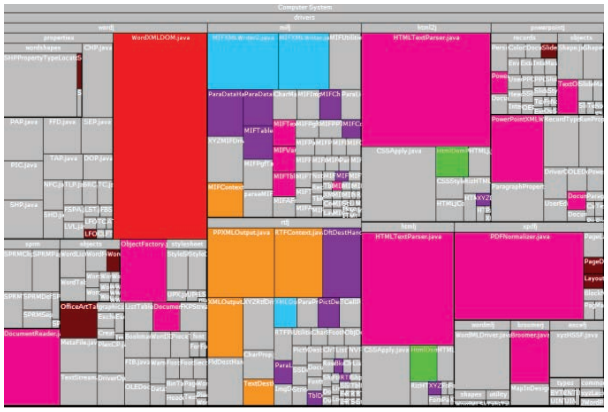

Figure 4 System View with Directories and Files

The figure 4 is view involving computer system at its base but includes directories and files also within the directories. So this figure comprises three hierarchical levels, the system having the directories and directories having files inside. Now one can clearly see that the same space used in figure (1a) is now being used to represent a lot more information. This is because the squarified treemaps are formed as a result of recursive subdivision of the rectangles. Now the rectangles here in this figure, represent the system, the directories and files. Each directory size represents the space it consumes in that system. One can easily grab the idea about the size of the files compared to others by the amount of space it is consuming of the whole view. All the files are shown within the directory rectangle of which they are part of. Here again the three instances are shown with the instance of first selected scs instances shown with maroon, second with pink, third with purple, the intersection of first and second with red, the intersection of second and third with orange, the intersection of third and first with green and the intersection of all three with blue color.

C. Directory View with files

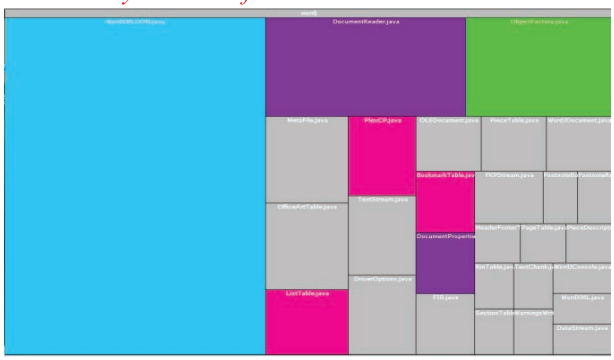

Figure 5 Directory View with Files

It is not necessary to have the whole system as the base of this squarified treemap. One can have a clearer view of any directory by having it at the base of the treemap as shown in figure 5. Now that the directory is the base one can view the files inside it more evidently. The size of each file is the inkling of the space it utilizes within a directory. Again at this level we have shown the first selected scs with maroon color, second with pink, third with purple, and the intersection of first and second with red, the intersection of second and third with orange, the intersection of third and first with green and the intersection of all three with blue color.

D. File View with methods

Figure 6 File View with Methods

Now the figure 6 is file view with methods. If one wants to view all the methods within a file then it can also be seen with the file, one is interested to view as the base and all the methods inside the file. It is amazing that one can get the idea of size of method and structural clones inside within the squarified treemap. The rectangles sizes within the file view are the clue of the space each individual method is consuming within the file. The structural clones' instances and their intersection can clearly be seen with different color shades. The ones used in the figure are like that of first selected scs shown in maroon color, second with pink, third with purple, and the intersection of first and second with red, the intersection of second and third with orange, the intersection of third and first with green and the intersection of all three with blue color.

III. Discussion

Below is the performance analysis of software. The response time of the software depends on the number of nodes in the hierarchy. The software provides well organized representation of structural clones for hundreds of nodes. In case the number of nodes is very big and the area of very small file is degraded as compared to larger nodes in hierarchy, the hierarchical zooming feature helps in getting an improved version of that view. The user can make the parent of the very small file as the root node and then can easily get approximate view of the space consumed by its child node. Similarly he can unset that root node by just simple clicks. The visualization of structural clones with squarified treemaps utilizes the display space very efficiently. It provides a compact view of all hierarchy nodes. The area taken by node is directly proportional to its size. It no doubt provides good approximation of space consumption by a particular directory/file with all its file/method nodes. At one glance, the user gets an idea that which of my directory/file contains structural clone and then can perform maintenance tasks etc. Treemaps as compared to the different visualization techniques like rooted tree view, wheel view, dot plot etc. does not waste the display space in the background and the view also does not go beyond a page. All the view is confined within certain area with each and every pixel representing useful information. In comparison with other treemapping algorithms, the squarified treemaps also provide better view.

IV. Conclusion

The visualization software is no doubt a compact view for hierarchical information like directory, file structures. It provides an efficient and well-organized view for hundreds of nodes. The different types of structural clones are well represented at multiple levels of the hierarchy. To provide better depiction of structural clones various color schemes have been incorporated. The different types of filtering mechanisms also assist user in getting the useful information. Multiple enhancements like zooming, textual tooltips, highlighting etc. have been added to give improved display of the structural clones. It is also made interactive using different animation phenomenon. It helps user to detect structural clones with less time and effort. The user can thus improve software quality, increase software understanding, detect plagiarism, find patterns, detect library candidates, analyze changes impacts and perform refactoring. The structural clone visualization software provides simple, interactive and efficient display of structural clones for hierarchical data.

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Modeling and Simulations of Liquid for Precise Level Measurements

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Abstract

Precise liquid level measurement is one of the critical research area. A variety of level sensors are available in the market for different applications. They are classified into point, continuous, contact, non-contact, liquid, solid, electromagnetic or electromechanical etc. These sensors show inaccuracy in liquid level measurement and that result due to several dynamic environmental factors like sloshing, temperature variations, noise, salinity, density, dust, dielectric medium constant, pressure, mechanical shock, tank size and shape. All of above mentioned factors limit the performance of level sensors in any vibrant environment. We have addressed sloshing of liquid factor in our research work. Sloshing phenomena refers to the dynamic movement of any liquid inside a container. It is the result of all kinds of external excitation.

First, we have formulated a Boundary Value Problem (BVP) of liquid in a specified container whose height, width, length is 10 m, 6 m and 10 m respectively for particularly our work. The final solution is closed form expression of mathematical model of surface wave motion that leads us to the velocity potential. It is implemented in MATLAB for three different waves that are dispersive wave, circular wave, and sinusoidal wave. We have analyzed the resonance frequencies of sloshing of these three types of waves that lies in range 0.5-7 Hz. Measurement of these resonant frequencies helps us to minimize the effect of sloshing in a liquid by using a low pass filter.

I. Introduction

Reasonable and dependent level measuring technology is of great importance for industrial, domestic and various other applications such as fuel storage, flood warning, remote monitoring, sea level monitoring, tsunami warning, biochemical industry and water surface level control. The need of precise and accurate level measuring system is increased with demand of advanced automated processing systems. Both accuracy and precision is difficult to achieve in a level measurement system. For example improvement of sample size in a faulty system generally increases precision [1-2].

Level sensors are the devices that measure the level of the free-flowing substances. Selection of an appropriate type of level sensor that suits to the application requirement is very important.

A variety of level sensors are available in the market for different applications. They are classified into following categories;

- Point or Continuous
- Contacting or Non-Contacting
- Liquids or Solids
- Electromagnetic or Electromechanical

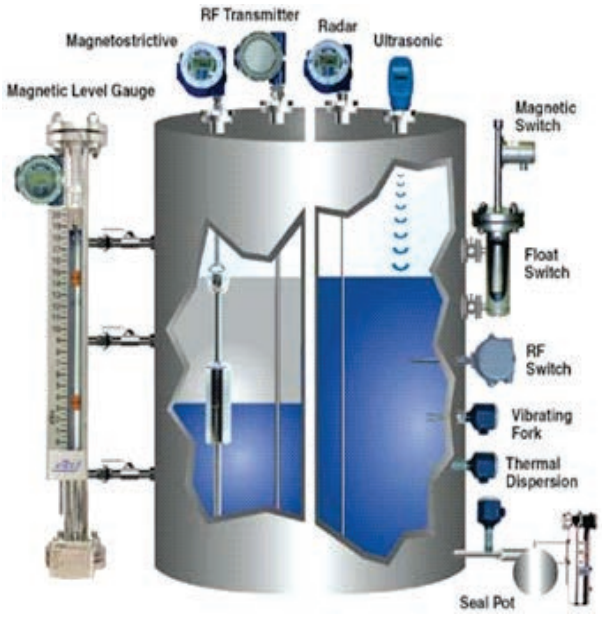

Fig. 1. Different Types of Level Sensors [3]

Point level measurement sensors are used as a marker to trigger low or high level alarm in tanks through liquid level sensing. To get most refined liquid level observation of an entire system, continuous level sensors are used. Contact level sensors are the ones that are directly in contact with the fluid i.e. touching the fluid. Whereas the non-contact level sensors are those that are not directly touching the fluid instead they are attached to the container [4].

The correct selection of a sensor and then the subsequent correct application of that sensor will make the level measurement a successful one. However, no sensor is perfect, each sensor shows limited behavior in dynamic environment due to many aspects such as sloshing effect of liquid, noise, temperature variations and other contaminations that cause inaccuracy in sensor's reading [5-7].

Surface waves propagate along the liquid edge and interface between liquid and air. Surface waves have been the subject of research for decades, however practical implementation with the help of mathematical modeling is limited and there are some research factors related to

surface waves such sloshing, contamination, salinity, density and significance of turbulent motion. So, there is a need of development of robust level measurement system which will be able to consider all these environmental factors and give us accurate reading regardless of the level sensor limitations. In this paper, sloshing factor of liquid waves with the help of mathematical modeling is addressed.

Motion-induced sloshing has been a conventional control problem. It was first met in the control of guided missiles. The dynamic forces resulting from the motion of these fluid-filled missiles can be considerable and result in instabilities. The first analytical solution to this a problem was addressed by Westergard [8]. Aerospace vehicles, maritime and transportation applications really need accurate evaluation of the sloshing because irregular motion of liquid fuel can cause instability and structural damage [9-10].

Real time observation of sloshing effect helps to establish integrity of mathematical model of surface wave motion. It involves the use of mathematics as the core of dynamic approach to infer quantitative information about the movement of fluid due to sloshing. To achieve this objective a boundary value problem is derived to model surface wave motion in floating tank. Mathematical modeling of the surface wave motion will give us a deeper insight in the effect of sloshing on the liquids in dynamic state. Mathematical modeling approach is most likely to be successful for accomplishment of this objective because it results in analytical expressions which can be used for prediction of sloshing in to the future according to boundary values.

II. Block Diagram

Figure 2 shows the block diagram of complete process for liquid level sensing. In this paper, post-acquisition process of liquid level sensing is presented that is consists of mathematical model and simulation of water waves. First it takes the dimensions of the container than calculates the boundary values for liquid in the container which leads to the approximate solution.

III. Mathematical Modeling

A. Finding a Governing Equation

The variables that are used to develop the model in the tank are shown in Figure 3. Z-axis shows the vertical direction, y-axis points into the page, 'h' represents depth of the fluid and x represents the horizontal direction.

z = 0 represents the undisturbed water level and the unknown free surface wave motion is described by a function z = η (x, y, t). When z = η the water is moving in the form of curvature or making any wave. Fluid depth is constant and finite below the undisturbed water level which is about z = 0. Here assumption is made that fluid lies below an infinite layer of still air.

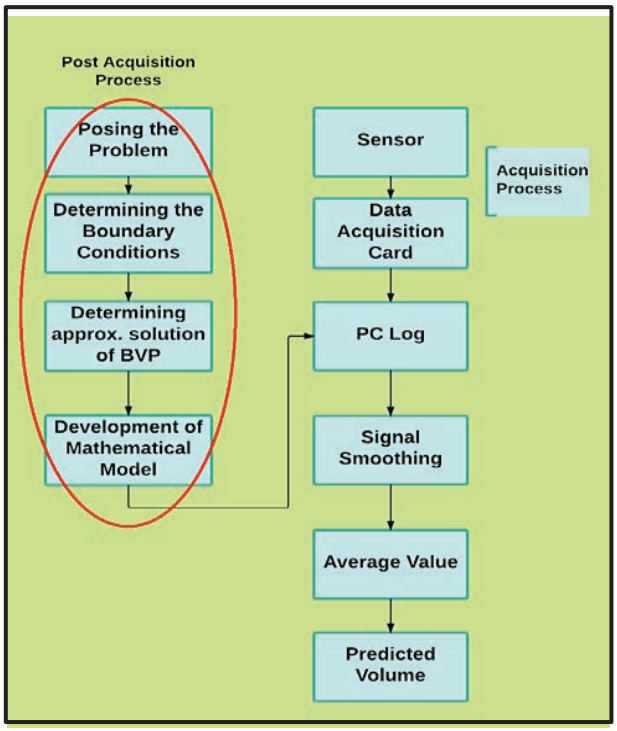

Fig. 2. Liquid Level Sensing through Mathematical Modeling

The movement of every point inside the liquid is described by the velocity field u (x, y, z, t) = (u1, u2, u3), where u1, u2, u3 are functions of x, y, z and t and x, y, z, t are partial differentiation with respect to these variables. Leibnitz forms such as $\partial\varphi/\partial t$ are used for emphasis.

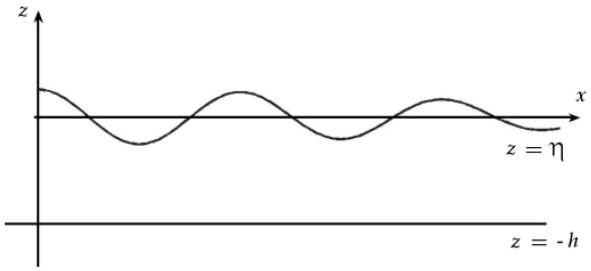

Fig. 3. Variables Indicating Context

A. Assumptions

Here following three assumptions for developing mathematical model of liquid waves are considered to make derivations easy and simplified. These assumptions are

- The fluid has no viscosity
- $\nabla \times u = 0$ (expressed in terms of velocity field)
- $\nabla \bullet u = 0$ (vector field is incompressible) (1)

Where $\nabla = (\partial x, \partial y, \partial z)$

According to standard theorem, if $\nabla \times u = 0$ then $\varphi(x, y, z, t)$ is a scalar function such that $u = \nabla\varphi$. When we combine

this definition of φ with Eq.1 then it yields $\nabla \cdot \nabla\varphi = 0$, which shows its second and third assumption result in Laplace equation

$$\varphi = 0 \quad (2) \qquad (2)$$

Above equation means that $\varphi_{xx} + \varphi_{yy} + \varphi_{zz} = 0$

The unknown surface behavior can be found by determining the velocity field u. With the help of second order partial differential equation for φ, u can be constructed. The solution of φ depends upon boundary conditions that explain this surface wave motion problem.

C. Determining Boundary Conditions

To derive boundary value problem, following conditions are assume that all motion in the problem is uniform and in the y-direction and

- Velocity field $u(x, z, t) = (u_1, u_3)$
- Velocity potential $\varphi(x, z, t)$ which satisfies $\varphi xx + \varphi zz = 0$
- Free Surface $z = \eta(x, t)$

The water particle velocity under linear waves is maximum at the surface and decrease in magnitude with depth. Vertical component of velocity of water at bottom surface is considered zero when z = -h which can be represented mathematically by the following equation;

$$u = (u_1, u_3) \qquad (3)$$

$$u_3 \Big|_{z=-h} = 0 \qquad (4)$$

$$\text{As } u = \nabla \varphi = (\varphi_x, \varphi_z) \qquad (5)$$

Now the above boundary condition becomes

$$\frac{\partial \varphi}{\partial z}\Big|_{z=-h} = 0 \qquad (6)$$

According to dynamic boundary condition, when $z = \eta(x, t)$ there is pressure jump across the liquid surface and this pressure jump depends on the surface tension of liquid. Pressure jump across the liquid surface and surface tension are inversely proportional to each other.

As mention in Eq.1, $\nabla \cdot u = 0$, we begin with Euler equation of motion for irrotational flow of velocity and we have

$$\frac{\partial u}{\delta t} = \frac{\partial}{\delta t}(\nabla \varphi) = -\nabla\left(\frac{p}{\rho} + \frac{1}{2}u^2 + gz\right) \qquad (7)$$

Here
Flow of velocity $u = \nabla\varphi$
Pressure of fluid = p
Density of fluid = ρ
Influence of gravity = g

Where u2 = u.u that is a standard in fluid dynamics and this form of Euler equation is derived from Newton's Second Law of Motion.

$$\frac{\partial \varphi}{\delta t} + \left(\frac{p}{\rho} + \frac{1}{2}u^2 + gz\right) = f(t) \qquad (8)$$

This is called Bernoulli's equation for unsteady irrational flow of fluid. If we absorb the function f (t) into velocity potential φ, the equation can be re-written as the following equation.

$$\frac{\partial \varphi}{\delta t} + \frac{p}{\rho} + \frac{1}{2}u^2 + gz = 0 \qquad (9)$$

The reconstruction of $u = \nabla\varphi$ is independent of $f(t)$. Under the assumption of small velocity, this equation can be linearized (i.e., the very small term u^2 may be neglected) to the following equation.

$$\frac{\partial \varphi}{\delta t} + \frac{p}{\rho} + gz = 0 \qquad (10)$$

Motion of free surface is represented by z = η. The pressure difference across this surface is represented by the following equation.

$$P = P - P_a \qquad (11)$$

When z = η, pressure difference across the liquid surface is equal to difference of pressure immediately below the liquid surface and atmospheric pressure immediately above the surface.

Air above liquid is stable and pressure exerted by still air on liquid surface is constant. So we can assume that which eliminates the effect of atmospheric pressure from equation. As the pressure difference is balanced by a force called surface tension force. Surface tension acts tangentially towards the water surface. This can be explained mathematically by the following equation.

$$p = p - p_a = -\sigma K \qquad (12)$$

$$p = p = -\sigma K \qquad (13)$$

Where, K = curvature of the surface.

When the air above the water is stable then there is no pressure on liquid. So there is no effect on surface tension of liquid and liquid is therefore still. Surface tension of liquid is inversely proportional to the curvature of surface. As long as the liquid retains its flat plan with the help of surface tension there will be no curvature.

Now put the value of pressure difference which is $p = -\sigma K$ in linearized Bernoulli equation which is Eq.10

$$\frac{\partial \varphi}{\partial t} - \frac{\sigma}{\rho}K + g\eta = 0 \quad (z = \eta) \qquad (14)$$

$$K = \frac{\eta_{xx}}{[1 + \eta_x^2]^{3/2}} \approx \eta_{xx} \qquad (15)$$

Scaling and non-dimensionalization arguments used for

the approximation of K are essential tools in developing mathematical models. In this case, *xxh*is a non-linear function [11-12]. Now put the value of K in Eq.14

$$\frac{\partial \varphi}{\partial t} + g\eta - \frac{\sigma}{\rho}\eta xx = 0 \quad (z = \eta) \tag{16}$$

Approximate $\partial\varphi/\partial t|_{z=\eta}$ by the first term in its Taylor series centered at 0.

$$\frac{\partial\varphi}{\partial t}\Big|_{z=\eta} = \frac{\partial\varphi}{\partial t}\Big|_{z=0} + \frac{\partial}{\partial z}\frac{\partial\varphi}{\partial t}\Big|_{z=0}\eta + \ldots \approx \frac{\partial\varphi}{\partial t}\Big|_{z=0} \tag{17}$$

Substitute this $\partial\varphi/\partial t|_{z=\eta}$ in Eq.16 and it gives us the dynamic boundary condition.

$$\frac{\partial \varphi}{\partial t} + g\eta - \frac{\sigma}{\rho}\eta xx = 0 \tag{18}$$

This can be applied at the known surface which is given by z = 0.

D. Kinematic Boundary Condition

According to kinematic boundary condition velocity of fluid at a point must be identical to each point of the surface. When η_x and η are not both small, the motion of surface should match the component of the fluid velocity that is perpendicular to the surface of fluid.

- The velocity of the surface at (x, t) is
- The velocity of the liquid at the surface is **u***(x, η, t)*

To agree these velocities in the vertical direction requires that $\partial\eta/\partial t = u3|z=\eta$. In terms of the potential function φ, this condition is

$$\frac{\partial\eta}{\partial t} = \frac{\partial\varphi}{\partial z}\Big|_{z=\eta} \tag{19}$$

Again using the first term in the Taylor Series for $\frac{\partial\varphi}{\partial z}|_{z=\eta}$ to approximate with $\frac{\partial\varphi}{\partial z}|_{z=0}$ gives

$$\frac{\partial\eta}{\partial t} = \frac{\partial\varphi}{\partial z}\Big|_{z=0} \tag{20}$$

E. The Boundary Value Problem

Upto to this point boundary value problem for the velocity potential φ is formulated. However, there is one major difficulty is that this solution depends upon η which is also unknown till now. Once we find out the value of η, we can lead to the approximate solution for φ

$$\Delta\varphi = 0; \tag{21}$$

$$\frac{\partial\varphi}{\partial z} = 0 \ (z = -h) \tag{22}$$

$$\frac{\partial\varphi}{\partial t} = \frac{\sigma}{\rho}\eta xx - g\eta \quad (z = 0) \tag{23}$$

$$\frac{\partial\varphi}{\partial t} = \frac{\partial\eta}{\partial t} \quad (z = 0) \tag{24}$$

F. Approximate Solution of Boundary Value Problem

- **Choosing η**

Wave equation solution can be given in the form of even and odd dimensions. The shape of the free space η can be given by the following equation;

$$\eta(x,t) = a\cos(kx - \omega t) = a\cos(k(x - ct)) \tag{25}$$

Where

Wave number = $k = \frac{2\pi}{\lambda}$

Wave speed = $c = \frac{\omega}{k}$

Angular or circular frequency of travelling cosine wave = ω

- **The Velocity Potential**

Here $\varphi(x,z,t) = F(x,t)Z(z)$ Boundary condition in Eq.24 requires $\varphi z = \eta t$ when when z=0

Thus

$$F(x,t)Z'(z) = [a\cos(kx - \omega t)]_t \qquad (z = 0) \tag{26}$$

so,

$$F(x,t)Z'(0) = a\omega\sin(kx - \omega t) \tag{27}$$

Now substitute following Eq.28 into the governing partial differential equation and we will get Eq.29

$$\varphi(x,z,t) = \sin(kx - \omega t)Z(z) \tag{28}$$

$$\varphi_{xx} + \varphi_{zz} = 0 \tag{29}$$

With the help of above equations, we found out following equation

$$-k^2\sin(kx - \omega t)Z(z) + \sin(kx - \omega t)Z''(z) = 0, \tag{30}$$

Eq.30 leads to a differential equation in z

$$z'(z) = Ake^{kz} - Bke^{-kz} \tag{31}$$

According to boundary condition stated in Eq.22, put the value Z'*(-h)* 0 in Eq.31

$$Z'(-h) = Ake^{-kh} - Bke^{kh} = 0 \tag{32}$$

$$Ake^{-kh} - Bke^{kh} = 0$$

$$Z(z) = B(e^{-kz} + e^{2kh}e^{kz}) \tag{33}$$

Now apply kinematic boundary condition mention in Eq.24 and the definition of *h* according to Eq.25

$$\varphi(x,z,t) = \sin(kx - \omega t)Z(z) \tag{34}$$

$$\omega a\ \sin(kx - \omega t) = \sin(kx - \omega t)[-kB(1 - e^{2kh})] \tag{35}$$

$$B = \frac{\omega a}{k(e^{2kh} - 1)} \tag{36}$$

$$Z(z) = B(e^{-kz} + e^{2kh}e^{kz}) \tag{37}$$

$$Z(z) = \frac{\omega a}{K(e^{2kh} - 1)}(e^{-kz} + e^{2kh}e^{kz}) \tag{38}$$

Z function represents the non-oscillatory behavior of the velocity potential, as this potential depends on the wavelength l through $\lambda=2\pi/\lambda$. Put the value Z (z) of Eq.38 in the below Eq.39

$$\varphi(x,z,t) = \sin(kx-\omega t)Z(z) \qquad (39)$$

This gives the velocity potential φ

$$\varphi(x,z,t) = sin(kx-\omega t)\cdot\frac{\omega a}{k(e^{2kh}-1)}(e^{-kz}+e^{2kh}e^{kz}) \qquad (40)$$

This is the final solution equation of boundary value problem. It is a closed form expression. The above equation leads us to the solution of φ in terms of angular frequency and wave number. With the help of this equation, velocity potential of liquid at the surface and its movement in forward and reverse direction can be plot.

IV. Simulations of Liquid Waves

In this section numerical result obtained from the mathematical model is used to present simulation of dynamic effects of liquid sloshing to demonstrate the effectiveness of angular frequency, wave speed, amplitude, wavelength and height of container carrying the liquid and wave number of sloshing. For this purpose, MATLAB software is used. Sloshing effect is analyzed in MATLAB for three different types of waves to check their behavior and these are

- Dispersive wave
- Moving sinusoidal wave
- Circular wave

A. Dispersive Waves Behavior

Figure 4, 5 and 6 are for dispersive wave behavior where wave speed depends on wavelength. To implement this following are the parameters taken for implementation of dispersive wave

- Wave speed= 24m/s
- Amplitude = 3m
- Wavelength = 4m
- The height of container is 10 meter

As we can see in figures that wave number and angular frequency of the waves is changing with sloshing over time.

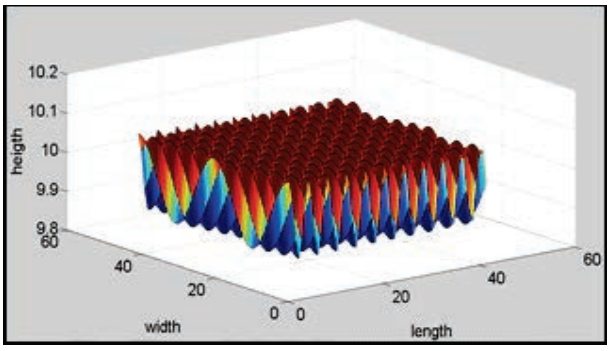

Fig. 4. Motion of Travelling Dispersive Liquid Wave 1st Position

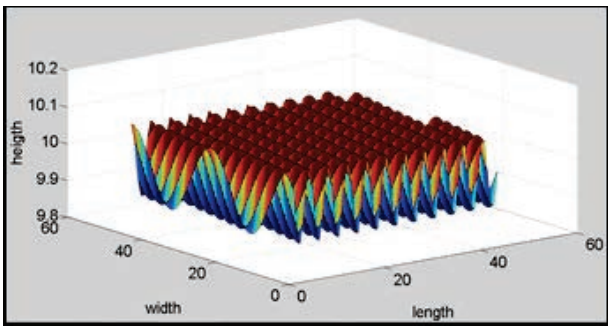

Fig. 5. Motion of Travelling Liquid Wave 2nd Position

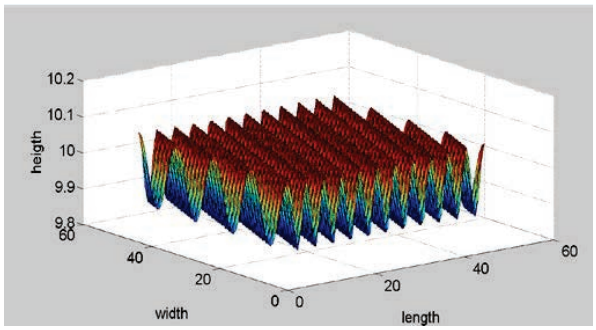

Fig. 6. Motion of Travelling Liquid Wave 3rd Position

B. Moving Sinusoidal Wave

Figure 7 represents the sloshing effect of liquid in case of environmental disturbances. In this case, liquid surface waves are modeled in a rectangular tank with height, width and length equals to 10 meter and liquid level is 8 meter. It is a travelling sine wave with following parameters

- Frequency = 0.7 Hz
- Wave speed = 3×10^8 m/s
- Wavelength = 428571428.5 m

In it angular frequency is continuously changing with sloshing effect.

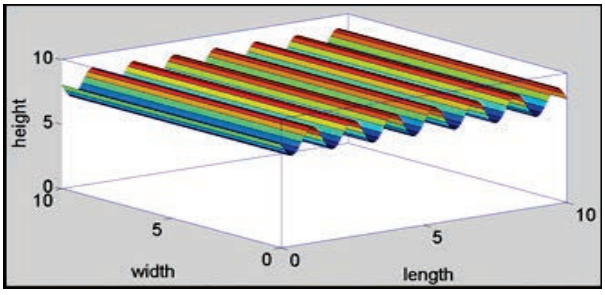

Fig. 7. Moving sinusoid wave

C. Circular Wave Behavior

Circular wave propagates with change in amplitude because conservation of energy requires that the amplitude of wave decreases with distance. Wave amplitude gets less as they grow, since their energy is more spread out. Figure 8 shows simulation of circular

wave behavior during sloshing that indicates these waves travelled slowly than the outer waves of shorter wavelengths. There is no change in speed, frequency and wavelength.

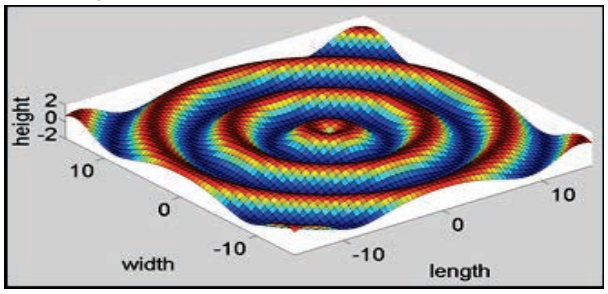

Fig.8. Circular Travelling Wave Behavior

V. Conclusion

Guided missiles, aerospace vehicles, liquid cargo and maritime applications have conventional control problem that is motion-induced sloshing. Therefore need of accurate evaluation of sloshing is essential. In this research paper, we have formulated a Boundary Value Problem (BVP) of liquid inside a specified container to analyze sloshing effect as a result of external excitations. To reach at final solution, three assumption are considered that Fluid is inviscid, fluid flow is irrotational ($\nabla \times u = 0$) and $\nabla u = 0$. Solution is consist of velocity potential 'φ' , angular frequency 'ω' and wave number 'k' that helps to realize the resonant frequencies in MATLAB for three different waves. The final solution equation can be incorporated with modification of size of vessel by replacing values of x, z and h. The values of resonant frequencies for our specified conditions are 0.69, 1.93, 2.92, 3.69, 4.31, 4.82 Hz.

Now after finding frequencies, it can be filter out using a low pass filter whose critical frequency should be less than the resonant frequency. The filter will separate out the frequencies causing slosh and variations in the acquired data and give a smooth signal indicating the actual level of the fluid in the container. We can further extent this research by considering many other liquid factors such as viscosity, salinity, density and temperature for more precise measurement of sloshing effect of liquid.

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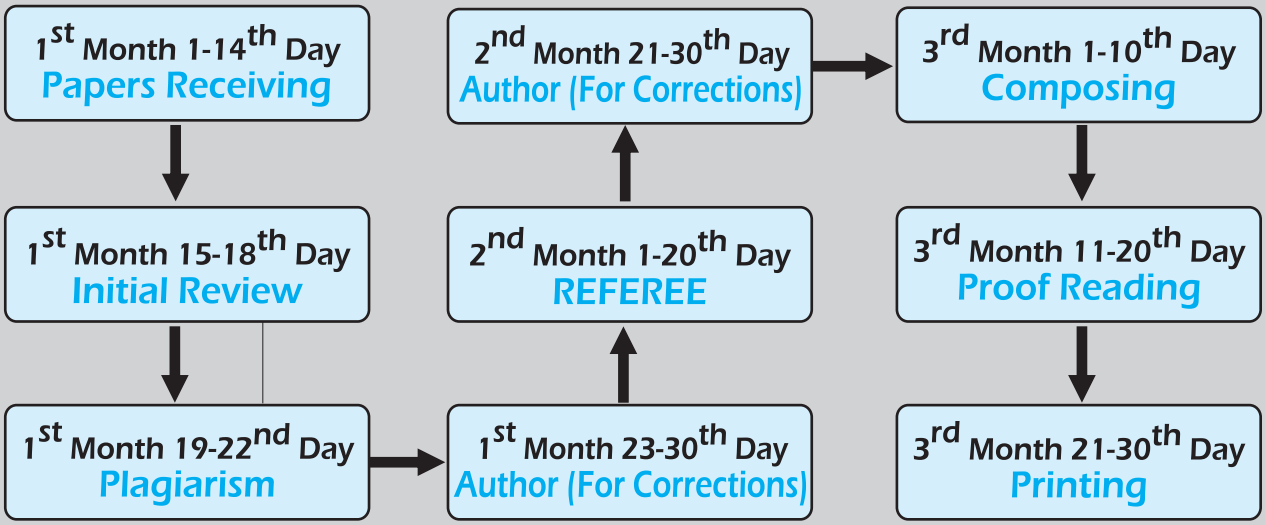
Time-Line for Papers Processing for IEEEP Quarterly Journal "New Horizons"



CALL FOR RESEARCH PAPERS FOR "NEW HORIZON"

Research Papers from engineers in the disciplines of Electrical, Electronics (Including Information Technology and Telecommunications), Controls, Mechatronics, Avionics, Computers and Medical Engineering are invited for publication in "New Horizons", HEC recognized Y-Category, quarterly research journal of the Institution of Electrical & Electronics Engineers Pakistan. A soft copy of the paper may please be sent to ieeep1969@gmail.com or info@ieeep.org.pk in the following format:-

1. The research paper should be prepared in MS Word Software in Two-Column Format.
2. Select A-4 size, 1 inch margins on all four sides, 1.0 line spacing, Times New Roman Font with size 12 and justification on both sides.
3. All headings should be in capital bold letters.
4. All figures and diagrams must be properly numbered and labeled.
5. All diagrams, tables, graphs and photograph must be black outlined with white back ground.
6. All text within diagrams must be bold enough for readable clarity.
7. The papers must not contain more than 6 pages.
8. Complete references must be provided at the end of the paper.
9. Reference should be as per international standard. Format for one of the references is given below as a sample.

   N.E. Nilsson and J. Mercurio "Synchronous generator capability curve testing and evaluation" IEEE. Trans. Power. Del., Vol: 9, no:1 , pp 414. 424, Jan 1994.

PLEASE NOTE: You are requested to provide a brief Resume of yourself and of the co-authors (if any) alongwith the paper(s). Also please provide contact numbers and email addresses of all authors. Kindly note that papers/material as PDF Files will not be accepted.

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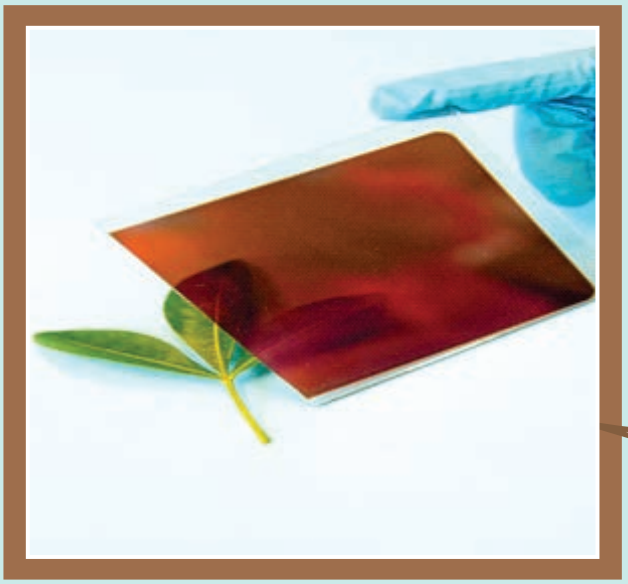
LATEST INVENTIONS IN ENGINEERING WORLD

Countless inventors have created amazing technologies that have completely changed the way we live. Today there are thousands of individuals and companies across the globe who are working hard to develop alternative energy solution. IEEEP, in its newsletter, tries its best to keep you up to date with the recent most inventions.

Graphene: Stronger than Steel:

- The material is purportedly 100 times stronger than steel.
- Pliable just like rubber
- Graphene transistor may allow easy production of flexible displays on both wearable devices and handsets in future.
- Resistant to water,
- Battery made of graphene and silicon, may last over a week on a single charge.



Perovskite - based PV cell:

- It makes use of lead from the discarded/disposed Lead Acid car batteries.
- Efficiency > 19%, which almost matches the efficiency of present day Si-based solar cell.
- Comparatively simple manufacturing procedure.
- Cheap for large scale manufacture.

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