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EDITORIAL

Welcome to the 2020 edition of N.M.A.M.I.T Annual Research Journal!

The COVID – 19 pandemic has affected the way we work, the way we think, and the way we function. It has taught us that whatever work we do, must be carried out efficiently with the least possible wastage of resources. The implications of that in the use of smart technology, modeling methods, robotics, and artificial intelligence, will take on a humongous role in the future years to come. All primary areas of interest to humans such as agriculture, health, manufacturing, etc. will have to be used extensively to ensure the efficient use of resources. This issue of NMAMIT research journal is a special issue covering the selected papers from National Conference on Electronics, Communication and Computing Technology (NCECCT-20) organized by the Department of Electronics & Communication Engineering and a couple of other papers mainly dealing with the use of technology for specific areas of human endeavor such as agriculture, robotics, health sector, etc. I hope this journal will be very informative for the readers and should shed some light on some of the important issues related to human involvement.

Happy Reading!

Dr. Sudesh Bekal

N.M.A.M.I.T.

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Comparative Analysis of Fusion Methods for Multimodal Brain Tumor Images

Ardra Raj[1#], Nischitha[2#], Hafsa Mehar Taj[3#], Manik Sherikar[4#] and Sijith Cyriac[5#]

[#] *Department of Electronics and Communication Engineering, Mangalore Institute of Technology and Engineering, Badaga Mijar, Moodabidre, Mangaluru, Karnataka, India*

[1]abhijnanu14@gmail.com
[2]abhilashavkd@gmail.com
[3]jenniferdsouza87@nitte.edu.in

***Abstract* — Medical image fusion is a process of merging multiple images from single or multi imaging modalities to enhance the imaging qualities and to lower the redundancy and randomness. In order to improve the diagnosis and assessment of the medical problem using multimodal images. The proposed work is focused on multimodal images and its analysis using various fusion algorithms. In this fusion work of multimodal images like Magnetic Resonance Imaging (MRI), Positron Emission Tomography (PET) and Computed Tomography (CT), of Glioblastoma Multiform and Acoustics Neuroma is carried out using Discrete Wavelet Transform (DWT), Laplacian Pyramid Transform (LPT) and Dual Tree Complex Wavelet Transform (DTCWT) fusion rule. The fusion performance is examined using several quality matrices like Standard Deviation (SD), Fusion Factor (FF), Entropy, Structural Similarity Index (SSI), Root Mean Square Error (RMSE) and Peak Signal to Noise Ratio (PSNR).**

***Keywords* — Laplacian Pyramid Transform; Dual Tree Complex Wavelet Transform; Discrete Wavelet Transform; Entropy; Fusion Factor; Structural Similarity Index; Standard Deviation; Peak Signal to Noise Ratio; Root Mean Square Error.**

I. INTRODUCTION

Brain Tumor is the abnormal growth of cells. It can be categorized as benign and malignant. Acoustics Neuroma is used as the benign disease and Glioblastoma Multiforme is used as malignant disease. Benign diseases do not consume nearby tissue or spread to different parts of the body therefore they are non-cancerous. The malignant tumors are cancerous as the cells can grow and spread.

The fusion of multimodal images such as CT, MRI and PET are utilized for the detection and diagnosis of the tumor. Image fusion is the process of blending two or more composite images to get the most clear fused image. The objective of the image fusion is to bring out the data of the images at each pixel area without disturbing the image's pixel relationships. The main advantage of image fusion is that instead of storing different modality images we can decrease the storage space and cost by storing Single fused image. For instance, doctor make inconsistent decisions due to their different experience on the diagnosis of multimodal images. To put forward the most precise diagnosis it is essential to obtain the productive automatic image fusion system. Thus, the work load of the doctors can be decreased and the efficiency of diagnosis can be developed.

II. PROPOSED METHODOLOGY

The most apt method for medical image fusion and diagnosis is the fusion methods and it also plays an important role. Image fusion is a procedure of blending the essential information from a cluster of images into a solo image, in which the obtained fused image will be more explanatory and absolute than any of the input images.

The Figure 1 shows the overview of the system which mainly involves 6 stages, which includes different multimodal images which join the input images by applying image fusion transforms to acquire the fused images. The images are put along in inverse fusion transform to create the coefficients once fusion volume coefficients are established. The image is obtained into spatial domain through inverse transform. The features are drawn out from the fused image and the performance of fusion is studied by comparing various features.

The fusion rules used are Discrete Wavelet Transform, Laplacian Pyramid Transform and Dual Tree Complex Wavelet Transform.

A. Laplacian Pyramid Transform

Pyramid transformation is a group of linear transform decomposes an image into different components by multiplication with asset of transform functions. Here, input image is degraded in form of pyramids. Smoothing pyramid is the first pyramid containing the average pixel values and the difference pyramid containing the pixel differences that are edges, well known as multi resolution edge representation of the input image; these are the two types of pyramids presented in the decomposed image. The prime idea of this is to carry out a pyramid decomposition on each source image, later all these decompositions are integrated and a composite representation is

formed, which finally reconstruct the fused image by performing an inverse pyramid transform [12]. Figure 2 shows the block diagram of the LPT method.

B. Laplacian Pyramid Transform

Pyramid transformation is a group of linear transform decomposes an image into different components by multiplication with asset of transform functions. Here, input image is degraded in form of pyramids. Smoothing pyramid is the first pyramid containing the average pixel values and the difference pyramid containing the pixel differences that are edges, well known as multi resolution edge representation of

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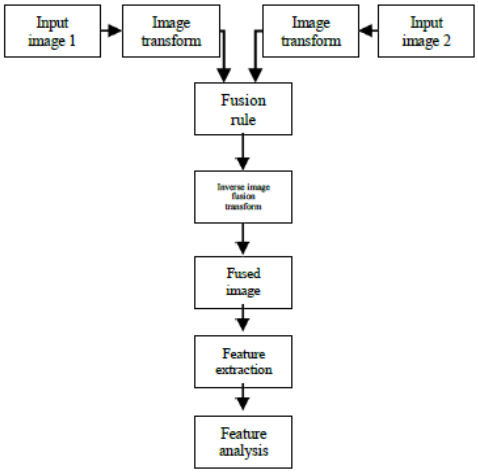


Fig. 1 Overview of the system

C. Discrete Wavelet Transform (DWT)

A mathematical tool which can detect local features in signal process is the wavelet transform. It can also be used for the multi-resolution analysis obtained by decomposing two dimensional signals as in 2D grayscale image signals into various resolution levels. This wavelet transform is tremendously used for numerous purposes such as data compression, texture analysis image fusion and feature detection [8].

DWT is a mathematical tool for the graded decomposition of an image in spatial domain. In this an image is decomposed into frequency sub bands at distinct scale from which makes the reconstruction possible. The low frequency part consists of coarse information of signal and the high frequency part consists of edge information.

2D DWT studies the image at various frequency bands by decomposing images into estimation and detailed coefficients. The Figure.2 shows three levels of decomposition of 2D image. 'HAAR' is the wavelet family used for the performance of DWT decomposition. It is real, orthogonal, symmetric, which makes DWT shift invariant [11]. The Fig. 3 shows the representation of 3 level decomposition of DWT method.

D. Dual Tree Complex Wavelet Transform (DTCWT)

The DWT improved with few additional properties is a DTCWT [15]. This technique enrolls two DWTs (Figure 4 and Fig.5, first gives the real part of the transformed coefficients, and the other provides the imaginary part.

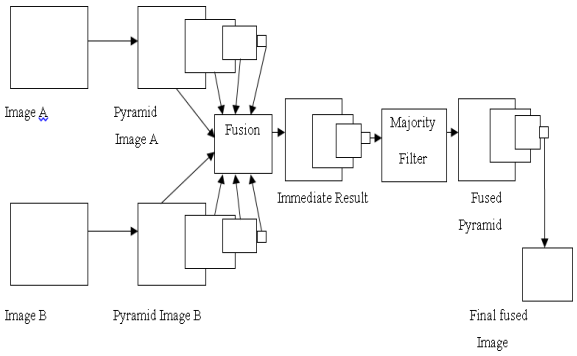


Fig. 2 Block Scheme of the Laplacian Pyramid Transform

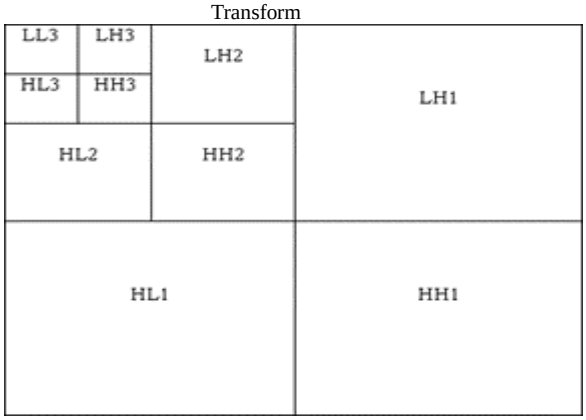


Fig. 3 Representation of 3-level decomposition of DWT [11]

DTCWT methods decompose the noisy signal into two sub-spaces i.e., low and high-frequency band [11]. A current transform is procured called dual-tree complex wavelet transform (DTCWT) by clubbing the coefficients of two DWTs into complex valued coefficients. Better directional selectivity, near

shift- invariance are some characteristics properties included in this new transform, that are very important for signal processing.

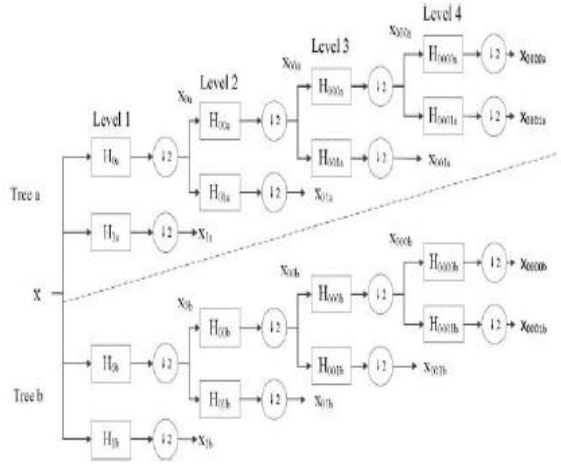


Fig. 4 Levels decomposition block of DTCWT [15]

A complex valued scaling function and a complex- valued wavelet are two parts representing DTCWT. The complex-valued wavelet and the complex scaling function is described as following.

$$\psi_c(t) = \psi_r(t) + j\psi_i(t) \qquad (1)$$

where, $\psi_r(t)$ and $j\ \psi_i(t)$ are the real and imaginary (or even and odd) respectively. The shift error in the modified DTCWT can be significantly narrowed by compensating the two DWT coefficients into phases. The domination of the DTCWT is also disclosed due to the slowly varying localization window and the high overall frequency of the DTCWT.

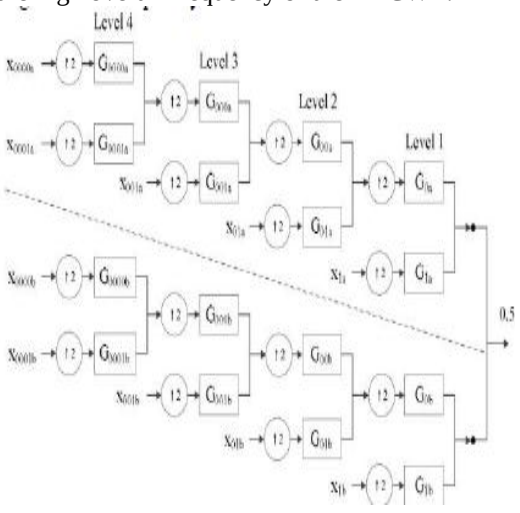


Fig. 5 Levels reconstruct block of DTCWT [15]

III. PERFORMANCE METRICS

The image degradation level is measured using quality. The performance metrics considered here is Entropy, SD, FF, SSI, PSNR and RMSE. The detailed content of a fused image is represented by the Entropy. SD contributes the dissimilar estimation of a fused image. FF gives the degree of dependency in the middle of the input image and the fused image. A quality assessment index ranges between +1 to -1, where +1 shows the fused and the input images are similar, is the Structural Similarity Index. PSNR quantitatively assess the error between the source images and the fused image. The error measured by RMSE is a percentage of mean intensity of the original image.

IV. RESULTS AND DISCUSSIONS

Estimations have been supervised for various images of size 256x256. The database of a person is acquired from "Brain atlas". MATLAB R2018a software carries out the simulation.

The Figure 6(a) and 6(b) shows the input image set 1 CT and PET images of Glioblastoma Multiforme. CT and MRI of Acoustic Neuroma are another set of images shown in Figure 7(c) and 7(d).

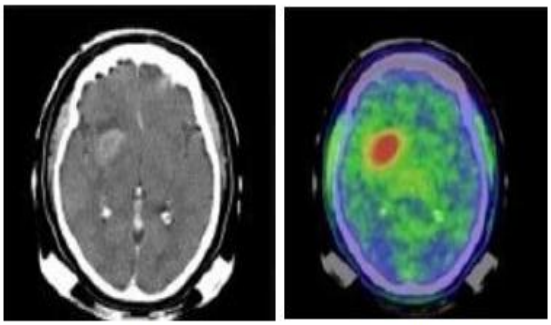


Fig. 6 Input image set 1 (a) CT of Glioblastoma Multiforme (b) PET of Glioblastoma Multiofrme

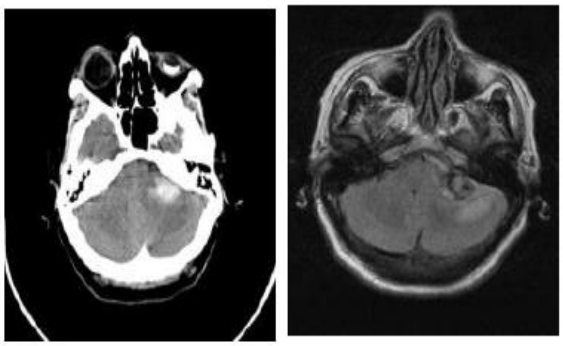
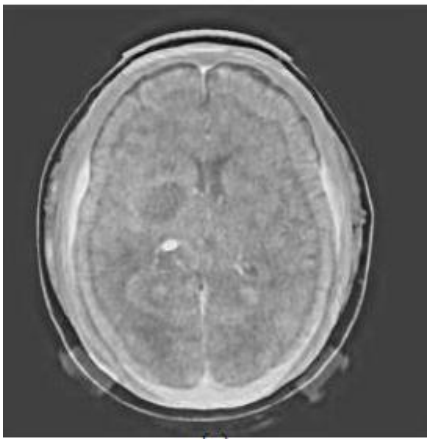
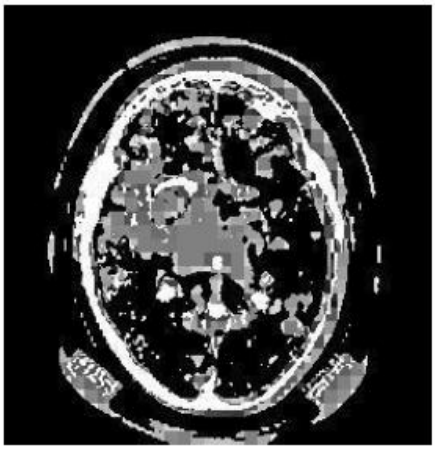


Figure 7: Input image set 2 (a) CT of Acoustic Neuroma (b) MRI of Acoustic Neuroma

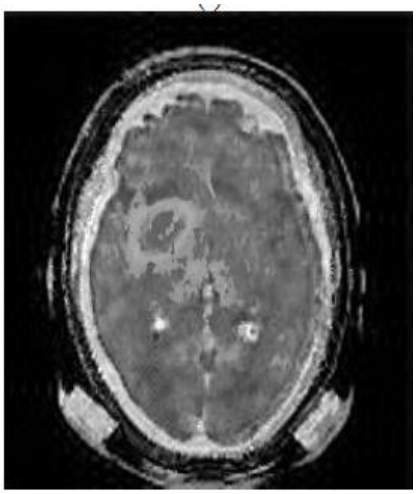
The input data set 1 and fused images are obtained as in Figure 8(e), 8(f) and 8(g) by applying DTCWT, DWT, and LPT method respectively.



(a)



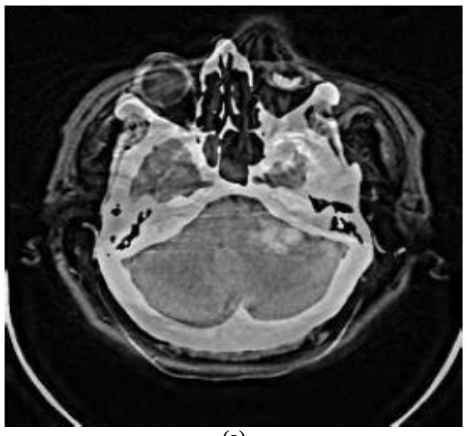
(b)



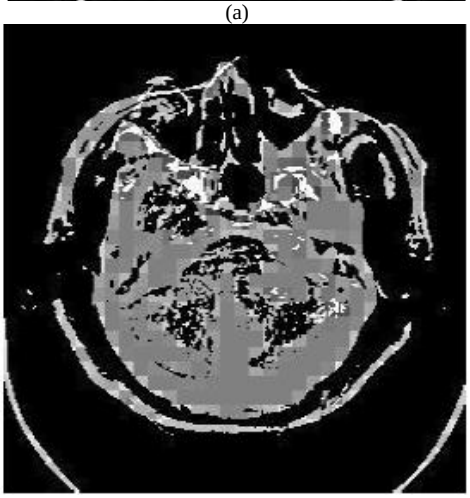
(c)

Fig. 8 Output of image set 1 (a) DTCWT (b) DWT (c) LPT

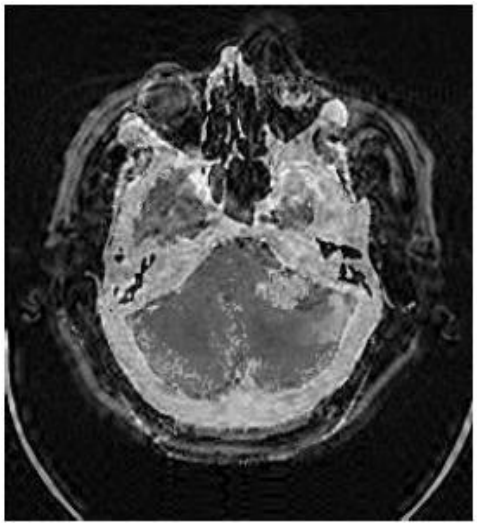
The input data set 2 and fused images are obtained as in Figure 9(h), 9(i) and 9(j) by the application of DTCWT, DWT, and LPT method respectively.



(a)



(b)



(c)

Fig. 9 Output of image set 2 (a) DTCWT (b) DWT (c) LPT

The fused image is analyzed by its performance metrics like SD, FF, SSI, Entropy, RMSE and PSNR as expressed in Table 1 analyze the performance of fused images.

TABLE 1
STATISTICAL ANALYSIS OF FUSION METHODS

Data Sets	Metrics	DWT	DTCWT	LPT
Image Set 1	Entropy	6.3106	15.89	5.7626
	SD	0.4059	0.2679	13
	FF	0.4484	0.5394	0.4159
	SSI	0.9890	0.9927	0.9894
	PSNR	56.7011	62.1248	59.2784
	RMSE	0.3728	0.1997	0.2771
Image Set 2	Entropy	5.7626	16	15.88
	SD	0.3477	0.2590	11.9806
	FF	0.4277	0.5724	0.3760
	SSI	0.9988	0.9989	0.9985
	PSNR	64.4506	65.7608	64.7773
	RMSE	0.1528	0.1314	0.1471

The Figures 10, 11, 12, 13, 14 and 15 show the statistical view of the performance metrics of the methods.

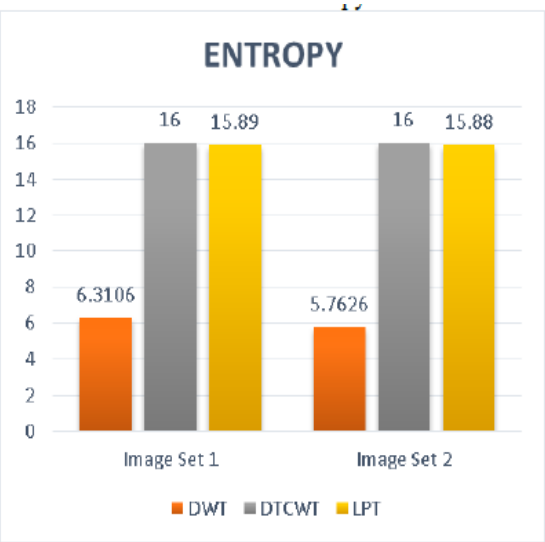


Fig. 10 Entropy

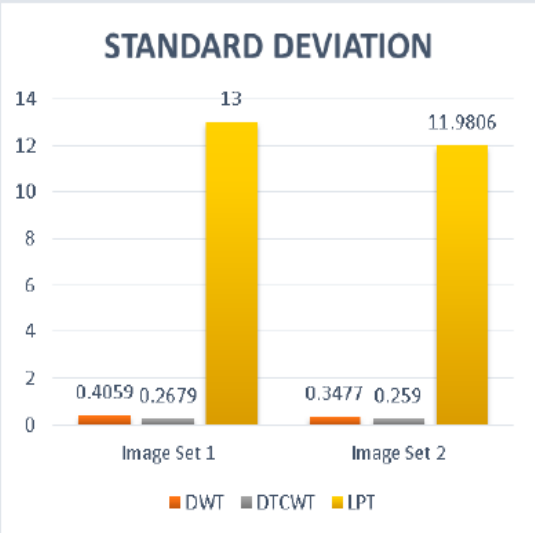


Fig. 11 Standard Deviation

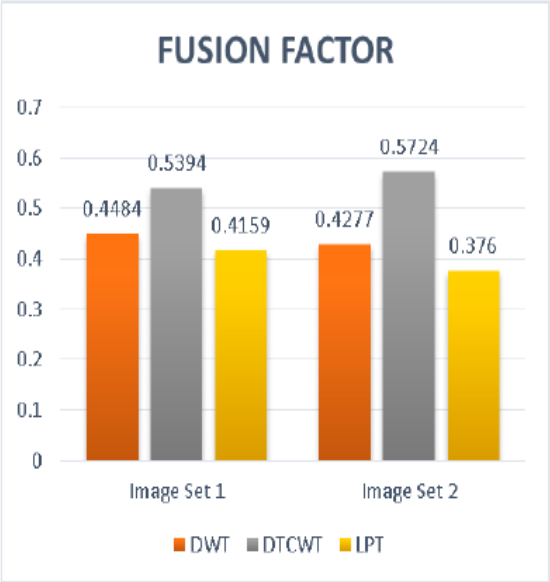


Fig. 12 Fusion Factor

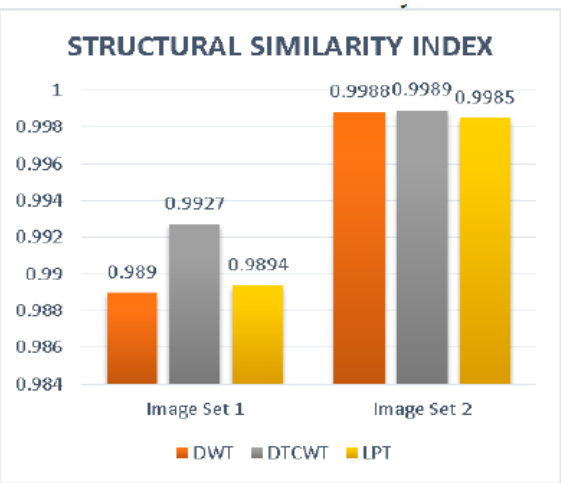


Fig. 13 Structural Similarity Index

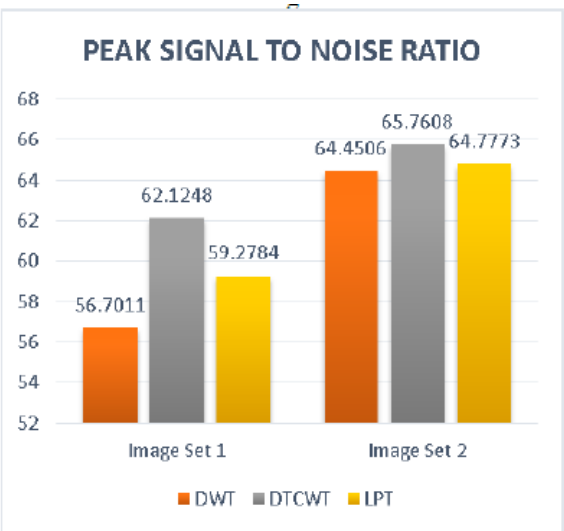


Fig. 14 Peak Signal to Noise Ratio

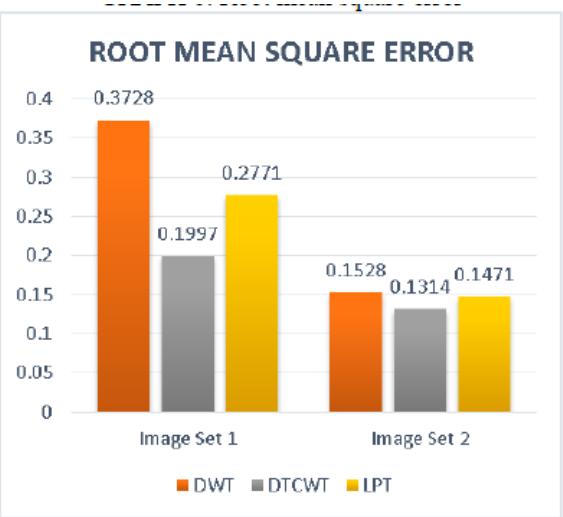


Fig. 15 Root Mean Square Error

V. Conclusion

This paper is a representation of fusion of various modality images using DWT, DTCWT and LPT fusion method. Various performance metrics are considered to carry out comparative analyses. The DTCWT fusion method indicates high information content where all the performance are high. Therefore, from the comparative analysis of fusion methods prove that for the particular datasets given DTCWT fusion method gives the best results.

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Agricultural Robot for Seeding and Farming

Shravya[1#], Raghavendra H Naik[2#], Anupama B[3#], Puvana V[4#], Jagadeesh Gali[5#]
[#] Dept. of E&CE, NMAMIT, Nitte , Karkala, Udupi, Affliated to VTU, Belagavi, India 574110

[1]shravyaspoojary13@gmail.com
[2]rhnaik678@gmail.com
[3]anupamaece@nitte.edu.in
[4]puvanapooja@yahoo.com
[5]jagadeesh5578@gmail.com

***Abstract*—Innovations in the agriculture field is becoming an important task because of increasing demand on quality of agriculture products and lack of labours in rural farming areas. One of the basic operation in the agriculture field is seed sowing. Sowing seeds manually is very time consuming and costly. The proposed system helps the farmers to advance seed sowing techniques. Precision agriculture concept is one of the emerging technologies in robotics field of agriculture sector. The aim of precision agriculture is to advance farming techniques by reducing the time and energy required for performing repetitive tasks and to increase the crop yield. Precision agriculture is also known as precision farming. This approach includes designing of robots based on certain conditions of agriculture environment in which the robot is going to work. In this paper, an autonomous agricultural robot is presented which is designed for seed sowing and watering the crops. It is a four wheeled robotic vehicle which is controlled by ESP8266 microcontroller and sensors for navigation along with DC motor for seed dropper and water pump.**

***Keywords*—Precision agriculture, Precision farming, Seed sowing, ESP8266, Infrared (IR) sensor, Ultrasonic sensor.**

I. INTRODUCTION

The seed sowing methods used earlier includes the use of animal drawn funnel and seed drill or tilling using tractor. These methods requires extra manpower, more time and energy consumption where as in tractor based drilling operations the land is exposed to high level of noise and vibration, which are detrimental to soil and work performance [2]. The rapid growth in industries forces the labours in the villages to migrate to the cities. This issue creates the labour problem for the agricultural operations. The wages for the labour is also more. These factor forces the farmers who are interested in agricultural activity to leave their land uncultivated. Robotics technology is used for different operations which are done in agriculture. An automatic machine should be designed which will be available to the farmers at a cheaper rate and sow the seeds effectively. Designing a robot for automating agricultural operations has to be done by considering two conditions which are suitable agriculture environment for the robot and precision requirement in the task over traditional methods [2].

This project is based on developing a robot which is used for sowing seeds in ploughed land. It involves the usage of sensors to detect the boundary and to check when the seed tank turns empty. Water pump is used to supply water during the seeding process.

II. METHODOLOGY

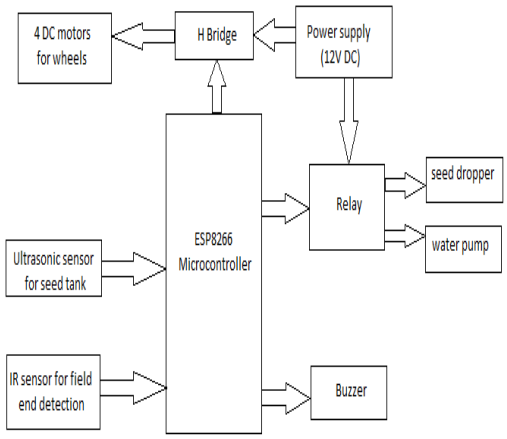

Fig. 1 Block diagram of agricultural robot

The block diagram of the agricultural robot for seeding and farming is as shown in the Fig. 1 above. ESP8266 module is capable enough of on-board processing and has storage facility which allows it to be integrated with many sensors [1]. The ESP8266 microcontroller supervises the entire process. The robot moves with the help of four DC motors connected to four wheels, the DC motor runs with the help of batteries connected to it as a source of power supply [4]. Four DC motors are driven with one L293D dual H bridge motor driver by using two pairs of drivers. The first pair of driver is used to drive left side of the two DC motors thus the two wheels are activated at once. Similarly the second pair of driver is used to drive right side of the two DC motors. This helps the

robot to move left or right based on the programming done using Arduino ide.

A. Sensor based navigation system

The sensor based guidance helps the robot to navigate correctly. Here, the IR sensor is used to inform the robot about the boundary present and guides the robot to move in a correct direction [3]. The infrared waves are emitted and received continuously by the sensor which on encountering the boundary sends signals to the microcontroller [5]. If the waves detect a boundary wall then it immediately takes a 90 degree turn to proceed to the next column of the field. This process continues till the last boundary wall is reached. Ultrasonic sensor is placed inside the seed tank. It is used to check whether the seeds are present inside the seed tank. It notifies the microcontroller as the seed tank becomes empty. The robot stops as the seed tank becomes empty. So that the farmer can refill the seed tank and continue the process.

B. Seed sowing mechanism

Seed tank is designed according to weight sustained by the robot as well as the required capacity for planting. A rotary wheel is placed adjacent to the seed tank. Rotary motion of the wheel for dropping the seeds is controlled by the DC motor connected to the wheel set up. As the wheel rotates the seed from seed tank is dropped to the funnel. From the funnel seed is dropped to the ploughed land.

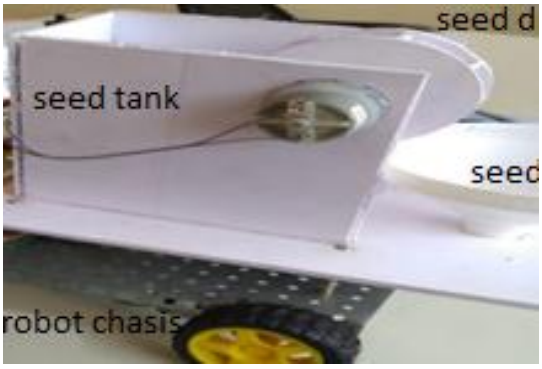

Fig. 2 Seed sowing mechanism

The seed sowing mechanism is as shown in the Fig. 2 above. The seed sowing setup depicts the seed tank along with rotary wheel and the seed dropper funnel.

C. Water supply

In the proposed system, the water is pumped from water tank and it is supplied to the soil for growth of crops. To connect the water pump motor along with seed dropper a relay module is required. Because a relay module uses 5V power supply and ESP8266 uses 3.3V power supply so a transistor is added to drive 5V relay with 3.3V ESP8266. A relay is a device which allows a low current device like ESP8266 to control a device with a high current requirement like a water pump and DC motor for seed dropper. The relay behaves like a switch. If the pump circuit and DC motor is connected between normally open and common terminals of the relay, then the pump is initially off. Giving a low signal to the input pin will cause the relay to close the circuit, and the pump will run. If the pump circuit and DC motor is connected between normally close and common terminals of the relay, then the pump is initially running. Giving a low signal to the input pin will cause the relay to open the circuit, and the pump will switch off.

III. RESULTS

The agricultural robot is mainly designed for sowing seeds. The modules are powered on and the robot is monitored using the microcontroller which is programmed using Arduino ide. IR sensor guides the robot to detect the boundary thus helps in navigation across the field. Ultrasonic sensor stops the robot when the seed tank turns empty. The four DC motor with H bridge motor driver circuit helps the robot to move effectively.

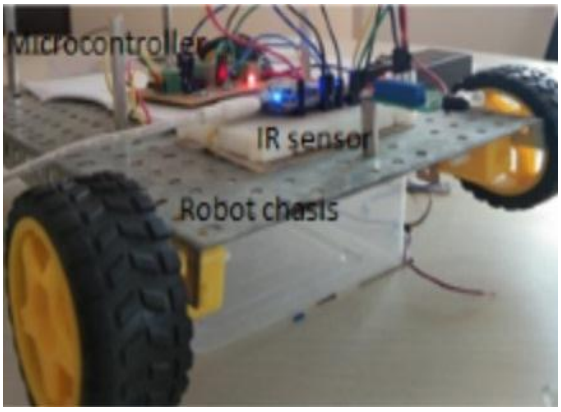

Fig. 3 Agricultural robot chassis setup

The agricultural robot chassis setup is as shown in the Fig. 3 above. The agricultural robot chassis setup includes ESP8266 microcontroller, H bridge motor driver, IR sensor, DC motor and chassis.

IV. CONCLUSION

Agricultural robot can be modelled using ESP8266 microcontroller and can be interfaced by using H bridge motor driver, IR sensor, ultrasonic sensor and relay. Various advancements shows agricultural robot serves better result than manual system used. Application of agricultural robot has significant role in terms of saving time, efficiency and minimizes the utilization of manpower. The system can be implemented in metro cities and other places where people are unaware of farming.

Agriculture has more scope compared to other fields for occupation if proper technology and approach is used. In future, the system can be adapted for other farming tasks such as weeding and spraying processes with some necessary mechanical designing modifications and by using advanced sensors and controllers. Using right mechanical parts such as robotic arm in designing of robot will help the system to advance. Further, a camera can be added to monitor the seeds [5].

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Brain Controlled Prosthetic Hand

Varun Bharadwaj[1#], Shreyas R. P.[2#], Shreyas Manoj Kotian[3#], K. N. Varad Narayan[4#], Rekha Bhandarkar[5#]

[#] Department of Electronics and Communication, NMAM Institute of Technology, Nitte, India

[1]rvarunbharadwaj@gmail.com
[2]shreyasrp888@gmail.com
[3]shreyaskotian09@gmail.com
[4]knvaradnarayan@gmail.com
[5]rekhabhandarkar@nitte.edu.in

***Abstract* — The aim of this project is to build a prosthetic hand which can be an affordable alternative to surgical implantations. Electro-encephalography (EEG) is used with the help of a non-invasive brain activity sensor which outputs raw brain signals, along with Attention and Meditation values. This approach eliminates the need for surgery and other charges imposed by hospitals. The data is transmitted via Bluetooth and a Raspberry Pi 3 is used to process the signals. The Attention and Meditation values from the user are used to train a machine learning model. The output is used to control the movements of the mechanical hand with the help of servo motors.**

***Keywords* – *EE*G, Machine Learning Model, Artificial Neural Network**

I. Introduction

About 15% of the world's population lives with some form of disability, of whom 2-4% experience significant difficulties in functioning. According to Census 2011, 2.21% of Indian population has one or the other kind of disability. About 69% of the overall disabled Indian population lives in rural areas. When an arm or other extremity is amputated or lost, a prosthetic device or prosthesis can play an important role in rehabilitation. For many people, an artificial limb can improve mobility and the ability to manage daily activities, as well as provide the means to stay independent. A prosthetic arm typically costs less than $5,000 for a purely cosmetic arm, up to $10,000 for a functional prosthetic arm that ends in a split hook, and up to $20,000-$100,000 or more for an advanced myoelectric arm, controlled by muscle movements, with a functioning artificial hand. Hence the price varies from Rs. 3 lakhs to Rs. 70 lakhs which is not affordable by everyone. This project incorporates an alternative approach to give an affordable solution in such situations. A non-invasive brain activity sensor is used which safely measures and outputs the EEG power spectrums, along with Attention and Meditation values. The output from the sensor is used to control servo motors, which are mounted on the mechanical hand.

II. Literature Survey

The authors of [1] have proposed the initial design of a brain-controlled, 3D printed mechanical prosthetic arm. The mechanical prosthetic arm is controlled via brain commands, obtained from an electroencephalography (EEG) headset. It is equipped with sensors and actuators that give feedback about the surroundings. This array of sensors and actuators provides the mechanical prosthetic hand with better hand functionality and smooth movements. The method of surgical implantation is discussed and it is found that the EEG method is an affordable alternative and provides accurate and natural control over the mechanical prosthetic hand. It also makes it easy for the user, as it is detachable. The system which is proposed in [1] is divided into 4 units namely, Input Unit, Processing Unit, Electromechanical Unit and Interface Unit. EEG signals are acquired using the Emotiv EPOC wireless recording headset bearing 14 channels.

The processing activity consists of two main parts: a pattern recognition part that identifies different patterns and behaviours of the brain captured by the input unit, and a command part that generates a sequence of instructions and commands which is sent to the mechatronics system of the mechanical prosthetic hand. A Raspberry Pi 3 microcomputer is used for this purpose. The Electromechanical Unit is designed and built from various lightweight high-strength materials that can handle high impacts and fragile elements as well. This unit integrates servos capable of handling 800 oz.-in. of stall torque. The placement of the servos are optimised in such a way that the usage of hardware can be reduced and it can achieve complex movements of the human hand. The Arduino Mega micro-controller is used in this setup to integrate the Mechanical Unit and the Processing Unit. It can also be programmed to perform some predefined movements, allowing the mechanical arm to perform complex and realistic hand movements. The Interface Unit is composed of an array of sensors, including temperature, skin pressure and ultrasonic proximity sensors, accelerometers, potentiometers, strain gauges and gyroscopes. These sensors provide the arm with continuous stream of information, thus allowing it to constantly adapt to its surroundings. The total cost of the entire setup is around Rs. 80,000/-.

The authors in [2] have proposed a simpler approach without the use of sensors for the control of the arm. A 16-electrode EPOC headset from Emotiv was used instead of a 14- electrode one as discussed in [1]. The signals from the headset are directly acquired by the PC via Bluetooth. The acquired raw EEG signals are processed in the PC by means of an application developed in LabVIEW, which includes a Software driver for the EPOC headset.

A continuous comparison between the "focus" or "meditation" levels and two different preset values which are properly adjusted to each user is done. These values represent three different threshold levels :(a) above the highest limit, the prosthetic arm moves up; (b) below the lowest limit, the prosthetic arm moves down; (c) between highest and lowest

limits, the prosthetic arm stops and maintains its angular position.

The current project aims to reduce the cost of the system further by making use of a single-electrode EEG headset. The accuracy of this headset is poor compared to the headsets discussed in [1] and [2] but with research and development, it is expected to deliver the same movements in a prosthetic hand as in the literatures.

III. METHODOLOGY

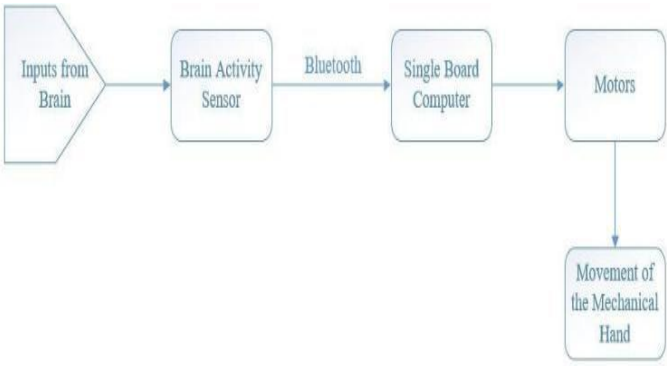

Fig. 1. Block Diagram

Fig. 1 shows the flow of the entire system. Electrical impulses are safely measured from the brain, using an EEG sensor. The data is transmitted via Bluetooth to Arduino, which in turn receives the data through a Bluetooth module which is connected with it. This data is then decoded by the code uploaded to Arduino which is shown in Fig. 2. The decoded data is split into Attention and Meditation values. The values of these vary from 0 to 100. Since a sigmoid function is used as an approximator in the Machine learning model, range of the data should be restricted between 0 and 1. The decoded values of Attention and Meditation are divided by 100 and then they are serially transmitted to Raspberry Pi via a USB cable. Here Arduino also acts as a buffer and it reduces the processing time.

Raspberry Pi contains the machine learning model which is trained with test data collected from the sensor. The model uses the correlation between attention and meditation to build an Artificial Neural Network (ANN) [3]. The Attention and Meditation values received from the Arduino are fed into the approximator function. Based on the input provided, the model outputs a value between 0 and 1. If the value is above 0.5, it means that the user wants to move his hand. If the value is less than 0.5 the prosthetic hand will not move. The entire process which happens in Raspberry Pi is shown in Fig. 3.

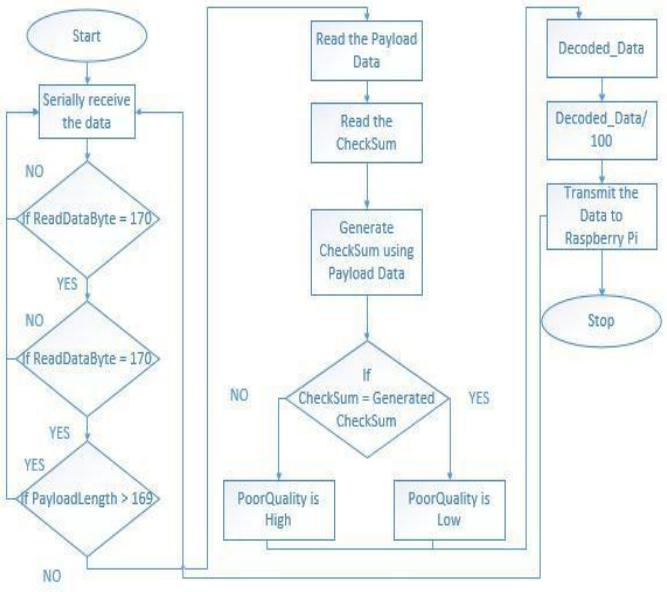

Fig. 2. Process flow in Arduino

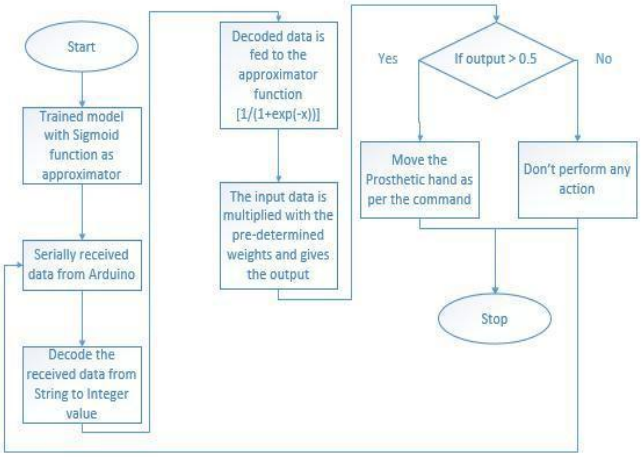

Fig. 3. Process flow in Raspberry Pi

IV. EXPERIMENTAL DATA AND RESULTS

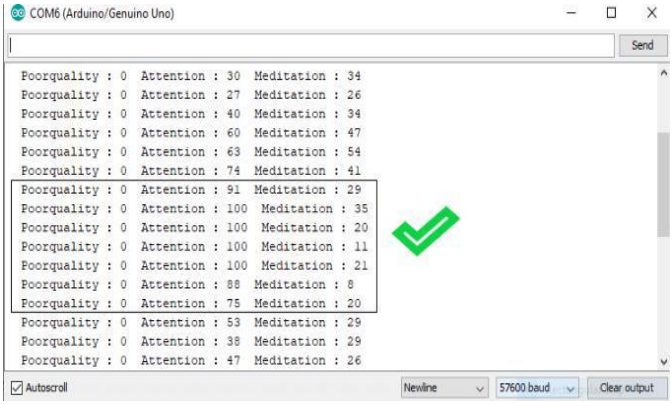

Fig. 4. Testing the Brain Sensor

The EEG Sensor was tested using Arduino. Arduino re-ceives the data serially via Bluetooth and the values of Attention and Meditation are displayed on the serial monitor. The highlighted part in the Fig. 4 shows the data when a person is concentrating. As per the image the attention value is near to 100 and the meditation value is around 30.

In the Fig. 5, a correlation between attention and meditation can be found. The segments with a green tick mark are the regions when the test subject was paying attention on a particular object. In this case the attention is high and the meditation is low. This data is fed into the machine learning model.

The segment with a red cross mark is the region where the test subject was singing a song. Attention might spike to a high value, even when one is speaking or performing certain action which require cognitive thinking. But the value of meditation is not low, hence it can be differentiated. In such cases the prosthetic arm will not move

Rest of the segments are the regions where the test subject was not performing any particular action.

The Raspberry Pi receives the data that is Attention and Meditation values and compares it with the model. Based on the comparison, it gives an output. Referring to the Fig. 6, if the output is greater than 0.5 then it means that the user is paying attention and wants to move the prosthetic hand. Fig. 7 shows the Robotic Prosthetic Hand.

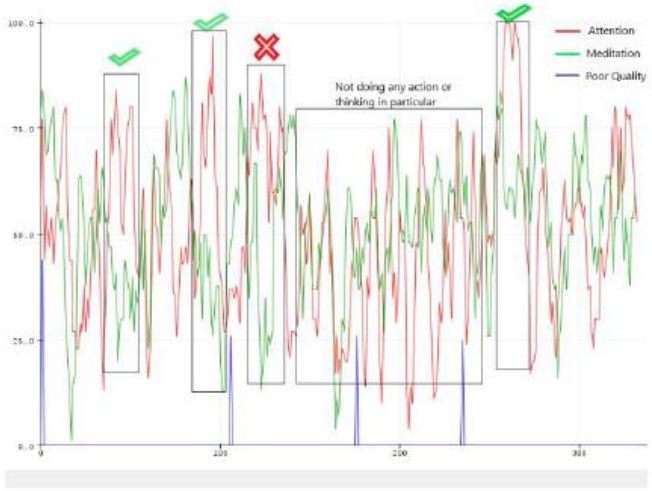

Fig. 5. Data extracted from Test Subject

Fig. 6. Output of the Model for the live inputs

Fig. 7. Robotic Prosthetic Hand

V. Conclusion and Future Scope

The technology of prosthesis is already available in the market, but it is not affordable by everyone and it involves a delicate surgical procedure. The mentioned papers demonstrate few methods and technologies which are similar to this project. In the discussed papers 32 channel EEG sensors are used, which introduces less delay in the system. Whereas, this project uses a single channel sensor, which introduces more delay in the system. However, none of the discussed papers have mentioned about the use of Artificial Neural Network (ANN) to train a model. Hence this method produces better result at an affordable price. By using an ANN, the system is able to distinguish better between the users action, that is when the user wants to move the prosthetic hand and when they don't. Usage of a non-invasive brain sensor and other electronic components has removed the need for surgery, thus making the technology a lot cheaper and easier to use.

By using a 32/64 channel sensor with an external processing board, the performance can be improved significantly.

Acknowledgment

We would like to express our sincere thanks to all the teaching and non-teaching staff of the department of Electronics and Communication Engineering, N. M. A. M. Institute of Technology, Nitte, for their patience and help during our project work.

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Development of Remote Triggered Lab for Analog Electronics Experiments

Ansal V[1#], Anum[2#], Anirudh Kamath[3#], Apoorva Shenoy[4#]
[#] Dept. of Electronics and Communication, NMAM Institute of Technology, Nitte, India
[1]ansal.v@nitte.edu.in
[2]anum981@gmail.com
[3]anirudhkamath98@gmail.com
[4]apoorvashenoy1997@gmail.com

***Abstract*—Physical separations and the absence of assets make us unfit to perform tests, particularly when they include modern instruments. Online and video-based courses somewhat address the issue of educating. Considering the present-day inter-networking and emerging technologies, these problems can be settled. This undertaking portrays the setting up of a remotely available research facility for electronics experiments. The work targets in helping the learners to get to the research facility during their relaxation time without being truly present, given the entire framework is consistently alive. The client (student in this case) can supply input data to the experimental arrangement placed in the laboratory from his PC through a webpage. These parameters are moved over the cloud to the PC in the lab which is at a remote area from where changes are made in the equipment. The result obtained is sent back to the client on his webpage for further processing and storage.**

***Keywords*—Virtual lab, Electronics experiments, Remote triggered, LabVIEW, MyRIO**

I. INTRODUCTION

Time and separation are the two boundaries vitally influencing the training framework everywhere throughout the world, particularly in nation like India. The web-based learning stages have acquired many changes in this present-day situation by giving virtual study hall or study rooms for instructing. Nonetheless, the field of essential sciences and designing require conduction of research and laboratory center for analyses and giving hands-on understanding. There is a shortage in the internet learning stage with regards to practical learning through research facility and laboratory.

Traditional laboratories in educational institutions have been providing practical experience for the students in most fields of science. Engineering colleges have been including labs as a crucial part of the curriculum. But sometimes, due to unavoidable circumstance, students fail to attend the regular laboratory sessions and it becomes difficult to catchup. To solve this problem, development of a remote triggering lab is necessary. The tests can be created utilizing myRIO (Re-configurable Input/Output) and National Instruments LabVIEW programming bundle.

A remote triggered lab is an interactive experience during which students observe and manipulate system-generated objects, data or phenomena in order to fulfil the learning objectives of a lab experience. The remote triggered laboratory experiments for electronics course in undergraduate electrical engineering curriculum have been developed using myRIO and National Instruments LabVIEW software package. These applications are suitable for internet delivery where students can conduct the experiments online. Remote triggered lab provides both hardware and software program execution with reliability. It also intends to develop a complete learning management where students can avail various tools for learning. Using remote triggered labs helps in sharing expensive laboratory resources which are otherwise available to only limited number of colleges. LabVIEW provides a low-cost solution for laboratory instrumentation compared to its traditional counterpart since appropriate software, operating through a plug-in myRIO, are readily available. Since LabVIEW is software based, it can model standard laboratory instruments while providing more flexibility.

Experiments conducting in the lab have a significant job in the learning procedure, particularly in building and exploration field. It isn't just a piece of the educational plan yet additionally assumes an imperative job in camaraderie and aggregate working [1]. Students experience a superior comprehension of the theoretical ideas through labs. Some intriguing perceptions are made when a student makes mistakes while directing the experiment. Remote triggered labs can additionally upgrade this traditional method of learning. It is seen that the viability of virtual labs in learning procedure eases the results. It demonstrates that virtual labs have a critical beneficial outcome on student's scholarly exhibition [2].

It is desirable to create tools for the expanded comprehension of virtual applications which is reasonable for the investigation [1]. In any case,

progression in the innovation makes it hard for giving the necessary arrangement of equipment required for experimentation. Subsequently IIT Bombay has attempted to overcome this issue among need and accessibility of laboratory resource by building up a remote activated lab on Digital Signal Processing with the LabVIEW programming and National Instruments (NI) unit [3] and further a lab on Field Programmable Gate Array (FPGA) based computerized framework in remote activating [4]. Working with simulation tools, for example, Multisim™ or MATLAB/Simulink™ is jumped to make the work less difficult by consolidating the activities with on-line and disconnected lab center and networking tools [1].

LabVIEW programming holds a multi-disciplinary utilization for mimicking just as ongoing improvements of frameworks. Understanding the challenges of traditional mechanics research facility, researchers have utilized the key standard of Mechanics of Solids, to actualize the instructing of Hook's law experimental analysis by remote triggering [5]. Utilization of the product is additionally applied in vitality protection zones like automation of road lights [6]. Thus, the LabVIEW programming can be utilized to build up a remote activating circuit for Electronics area related research experiments as well. LabVIEW streamlines the equipment interfacing for remote triggered labs [7].

With the assistance of LabVIEW, the presentation of the Electronic Control Unit (ECU) course of action demonstrates its prevalence with deference over the precision in testing just as with the easy documentation [8]. Some noteworthy work is additionally led in the remote triggering lab area for Robotics Architecture, plan and execution issues [9], Industrial Automation Laboratory [2], in multi-disciplinary lab for Hooke's law[5], FPGA based mechanized framework [10], computerized signal handling [3], structure and usage of radio-based sign generator[11] and advanced hardware framework where each trial makes some particular memories opening during which just a single client will be given access and subsequently no concurrent access will be permitted to various lab that tries simultaneously [12]. On the opposite side, the utilization of LabVIEW programming is done in the reference [13] work. An Infinite Impulse Response (IIR) notch filter is structured and reenacted with better effectiveness, having more noteworthy invulnerability to noise. The idea of building up a digital filter utilizing software and developing suitable hardware, at long last structure a remote triggering arrangement which can be gotten to from anyplace is a significant thought.

Simply creating or planning a LabVIEW front board would not fill the need of remote activating until it is made into a webpage promptly accessible for anytime availability. The reference [14], makes it simpler to build up a site page without experiencing any progressions in LabVIEW programming structure. Restriction of LabVIEW Remote Panel [15] procedure regarding hub usefulness and the traffic prompted National Instruments recommended an increasingly cross-program well-disposed arrangement – NI LabVIEW Web UI Builder dependent on Microsoft Silverlight innovation [16], for making less difficult program application on LabVIEW.

In [17], a remote activated lab is made accessible online for photovoltaic cell tests. Here, a site page has been made which incorporates the hypothesis behind the test, a step by step technique to direct the investigation, a recreation module lastly a user intelligent area for the remote triggered lab. The yield is indicated utilizing a webcam live broadcasting.

A. Proposed system

In the field of Electronics, a lot of online courses are offered by different colleges in collaboration with various online instructive websites. For obtaining practical information though, they request the subscribers to fabricate their own capstone equipment ventures, even though these colleges have refined and bleeding edge research facilities. As an answer for this current issue, a remote activating lab can be created. This paper talks about the Electronics Laboratory setup created utilizing myRIO and National Instruments (NI) LabVIEW programming bundle. LabVIEW widely supports interfacing gadgets and instruments. LabVIEW also possesses a built-in support system for NI equipment stage, for example, myRIO and myDAQ. This setup makes use of myRIO device which comprises of both processor and FPGA that can be controlled using LabVIEW software. Through the website designed, the client can change the boundaries relating to the circuit which is transmitted to Personal Computer (PC) present in the research facility. These information esteems are then given to the myRIO gadget which takes them to the equipment arrangement. The yield is detected by myRIO and afterward taken back to the LabVIEW software in the lab PC which is sent over the cloud to the client's PC.

RT Lab is a WIFI-enabled answer for convenience of student's hands-on understanding to laboratory experiments which is set up at a remote spot. Through the intelligent methodology of RT Lab, students can watch and control framework produced items, information or phenomena so as to satisfy the learning goals of a lab facility (electronic, PC lab) experiments.

II. NECESSITY FOR REMOTE ACCESS

Practical information in any field is of fundamental significance as it is vital for the better comprehension of any subject in the accompanying manners [18].

- It helps in increasing pragmatic experience which goes on for a more drawn out span than theoretical investigation.
- It helps in assimilating, manipulating, and comprehending information.
- It provides a motivation domain for the class.

- Uses communitarian learning in groups where students figure out how to impart and resolve issues.

Be that as it may, ordinary practice sessions experience the ill effects of some significant disadvantage [19]

- It so happens that all students in the gathering don't get equivalent open doors because of lack of equipment gear gradually prompting parasitism.
- Repetitive organizing and count of information make the procedure unremarkable or mundane.
- Traditional practice game plan advances neither seriousness among students nor the capacity to dole out the assignments [18]
- Virtual labs permit students to rehash experiments that they don't comprehend or utilize it as a survey for tests.
- Globally accessible uncommon segments with compactness issue can be additionally be made accessible for experimentation.
- Interactive liveliness makes getting the hang of learning intriguing and advantageous.
- Students can understand detailed experiments by changing variables or parameters.

III. Controlled Half Wave Rectifiers

Rectifiers convert AC supply voltage into DC voltage that can be used to operate devices like DC motors. The use of Silicon Controller Rectifiers (SCRs) in the half wave rectifiers allows us to control the output current by controlling the gate current. During the positive half cycle, the thyristor is forward biased. When the thyristor is fired, the device turns ON and the input voltage appears across the load. When the input voltage becomes negative, the device turns OFF. Hence no current flows through the output. The time after the input voltage starts to go positive until the thyristor is fired is known as the delay or the firing angle denoted by α. [20]

Fig. 1 shows the triggering circuit for a controlled half wave rectifier circuit. Fig. 2 shows the expected output waveforms.

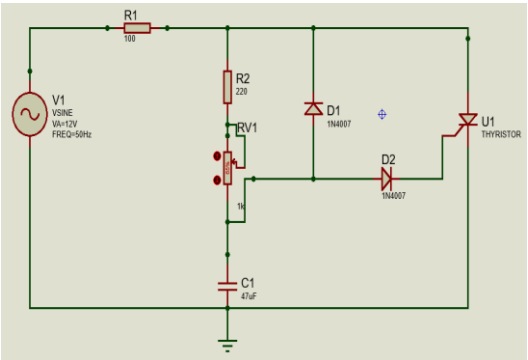

Fig. 1 Circuit diagram

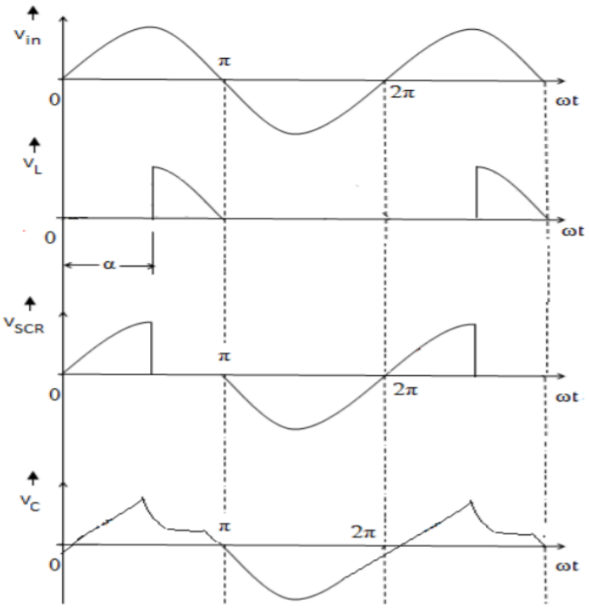

Fig. 2. Waveforms for input voltage Vin, load voltage V_L, SCR voltage V_{SCR} and Capacitor voltage V_C

IV. Experimental Setup

The system can be designed using NI LabVIEW software and NI MyRIO processor.

A. *LabVIEW*

Laboratory Virtual Instrument Engineering Workbench (LabVIEW) is a system design platform and development environment for a visual programming language from National Instruments. LabVIEW is commonly used for data acquisition, instrument control and industrial automation on a variety of operating systems (OSs), including Microsoft Windows, various versions of Unix, Linux and macOS. LabVIEW integrates the creation of user interfaces (termed front panels) into the development cycle. LabVIEW programs-subroutines are termed virtual instruments (VIs). Each VI has three components: a block diagram, a front panel, and a connector panel. The last is used to represent the VI in the block diagrams of other, calling VIs. The front panel is built using controls and indicators. Controls are inputs: they allow a user to supply information to the VI. Indicators are outputs: they indicate, or display, the results based on the inputs given to the VI. The back panel, which is a block diagram, contains the graphical source code. [21]

B. *NI MyRIO*

The National Instruments myRIO-1900 shown in Figure 3 is a portable reconfigurable I/O (RIO) device that students can use to design control, robotics, and mechatronics system. NI myRIO is a portable device and it operates on the frequency 667 MHz. NI myRIO is equipped with a Xilinx Zynq integrated FPGA and ARM Cortex-A9 processor so that students can program customized I/O and implement real-time

processing on one device. FPGA support in myRIO helps the students to design real life developing systems and to solve real problems quite faster as compared to the other micro controllers. Using FPGA support user can avoid the complicated syntax used in C language. It is student friendly device and is very easy to use. [22]

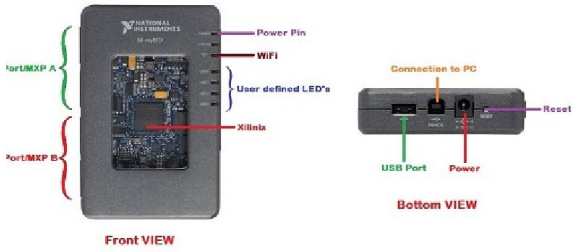

Fig. 3 NI MyRIO-1900

V. METHODOLOGY

Figure 4 shows the block diagram of the complete setup.

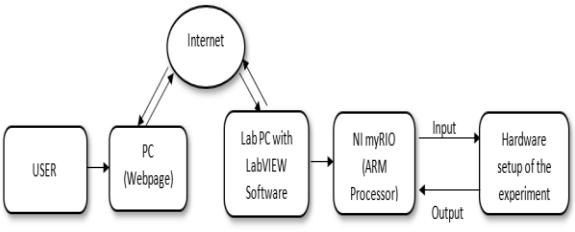

Fig. 4 Block diagram

The system setup is divided into 3 sections. The first section deals with the front end of the system where the users can view and perform the experiments through a web page shown in figure 5. This setup features a series of experiments that are available.

Fig. 5 Webpage developed for the experiment

The GUI displays knobs and switches through which the user can change the device parameters. Figure 6 shows the front panel of the stepper motor control LabVIEW code. This front panel can be controlled from the webpage using the web publishing tool available in the LabVIEW software.

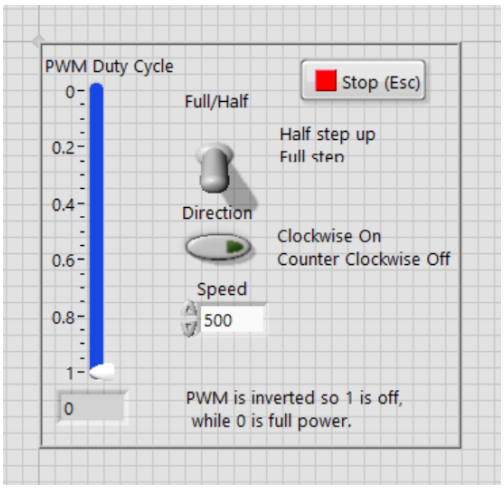

Fig. 6 Front panel

The next section is the data transfer between the user and the lab server. The final section is the lab system where the parameters received by the LabView server are transferred to the myRIO Student Embedded Device, which features a dual-core ARM Cortex-A9 processor. The ARM processor takes these values and manipulates the hardware components. The result is recorded by the ARM processor from the hardware setup and is transferred to the lab system from where it is sent to the user's system to be displayed on the result screen. Figure 7 shows the MyRIO connection to PC for data transfer between hardware and software.

Fig. 7 Hardware interface

VI. CONCLUSION AND FUTURE SCOPE

Remote triggered lab helps students' access laboratories from their place of choice. Managing the laboratory session timings is difficult, because not all sessions takes the same amount of time. Using this virtual platform allowed by WIFI, students can work on the experiments at their own convenience with time constraints. Another benefit of an RT lab is that the students can repeatedly conduct the experiments until they are pleased with their results. A lot of surveys were conducted to demonstrate the

effectiveness of Virtual Labs in improving the students learning process. Keeping the safety of the hardware setup in mind, a limit can be set for the input parameters above which, the experiment gets terminated and throws an error. If several users concurrently attempt to access the experiments, the LabVIEW server will queue the requests and gives control to the next user after a predefined time period.

Currently, the GUI is made available for internet connected desktop computers and laptops. A mobile web application can be built to enhance usability as well as the ease of access. More experiments from the same or different domain can be added to the lab for better understanding. Students may want to save their data for future reference or to compare with other iterations. For such situations, a database can be developed over the cloud where users can create account and save their respective experiment observations

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Detection of Plastic Bags in an Underwater Environment Using Raspberry Pi

Rahul Hegde[1#], Sanobar Patel[2#], Rosha G Naik[3#], Sagar K N[4#],
Rekha Bhandarkar[#5], K. S. Shivaprakasha[#6]

[#] *Department of Electronics and Communication Engineering, N. M. A. M. Institute of Technology, Nitte, India.*

[1]rahulhegde98@gmail.com
[2]sanobarpatel98@gmail.com
[3]naikrosha6@gmail.com
[4]sagarkodur@gmail.com
[5]rekhabhandarkar@nitte.edu.in
[6]shivaprakasha.ks@nitte.edu.in

Abstract **- Trash deposits in aquatic environments have a destructive effect on marine ecosystem and pose a long-term economic and environmental threat. A Remotely Operated Vehicles (ROVs) could very well contribute to the solution of this problem by finding and eventually removing trash. Detection of objects in underwater environment due to reduced visibility and the accuracy of the detected object are some of the major challenges in underwater scenario. In this paper, Single-Short-Multi-Box Detector (SSD) with MobileNet algorithm is used for performing the task of visually detecting plastics bags in underwater environments. A large and publicly-available datasets of plastics bags are annotated for training a number of SSD architectures for object detection. The object detection algorithm is deployed on a Raspberry Pi.**

Keywords- **Object detection, Deep Learning, Single Shot Detector (SSD), MobileNet, Raspberry Pi.**

I. INTRODUCTION

Accumulation of plastic waste in rivers, ponds, lakes, seas, oceans and other water bodies has become an increasing concern in recent days. Plastic waste not only pose a threat to animals but also plant life. Several initiatives to clean out plastic waste in rivers, ponds and lakes are undertaken. Cleaning of plastic waste in seas and oceans has proven to be great challenge. In any scenario, a survey is conducted on water bodies before clearing out plastic waste. Although survey is harder in seas and oceans than in smaller water bodies. Survey of plastic waste using deep learning algorithms is an emerging trend.

Survey of underwater waste raises a lot of problems. Detection of plastic waste underwater is hard due to the harsh environment and challenges such as reduced visibility, the water current, the nature of the plastic waste etc. The target device comprising of the object detector is deployed in an Autonomous Vehicle (AUV) or Remotely Operated Vehicle (ROV). Several algorithms have been used to train object detector for detecting objects underwater. Each algorithm has its own set of advantages and disadvantages, this includes size and shape of the objects and also the detection speed.

The rest of the paper is organized as follows: In section II a brief description of the literature survey is presented. Section III presents a brief note on SSD is provided. A description to the system architecture of the project is given in Section IV. The Results and tabulation of the performance of the object detector are presented in Section V. Section VI gives the concluding remarks of the paper.

II. LITERATURE SURVEY

Deep learning algorithms such as YOLOv3 and Single Shot Detector were surveyed for their efficiency and robustness for this project. YOLOv3 algorithm was used to train the object detector for underwater imaging in [1]. The implementation of YOLOv3 algorithm in real time object detection was outlined in [2, 3, 4]. YOLOv3 had a shortcoming of detecting smaller objects. SSD algorithm [5, 6] is also used in real time object detection as it had a high accuracy but lacked in the ability of detecting similar objects. The use of SSD was decided as Raspberry Pi was the target device as its resources such as processing power is constrained.

Tutorials on deep learning by Dr. Adrian Rosebrock [7, 8] and Edje Electronics [9, 10] provided a basis to understand machine learning and the approach towards the object detection. Code basics [11] Youtube channel provided the basics for machine learning and deep learning.

SSD models use VGG net or MobileNet as the image classification network. In this project SSD with MobileNet [12] was taken as the model to train the datasets. The reason being MobileNet performs better in resource constrained devices such as android and Raspberry Pi. SSD MobileNet Quantized V2 model [13, 14] was used for the training process for the object detector.

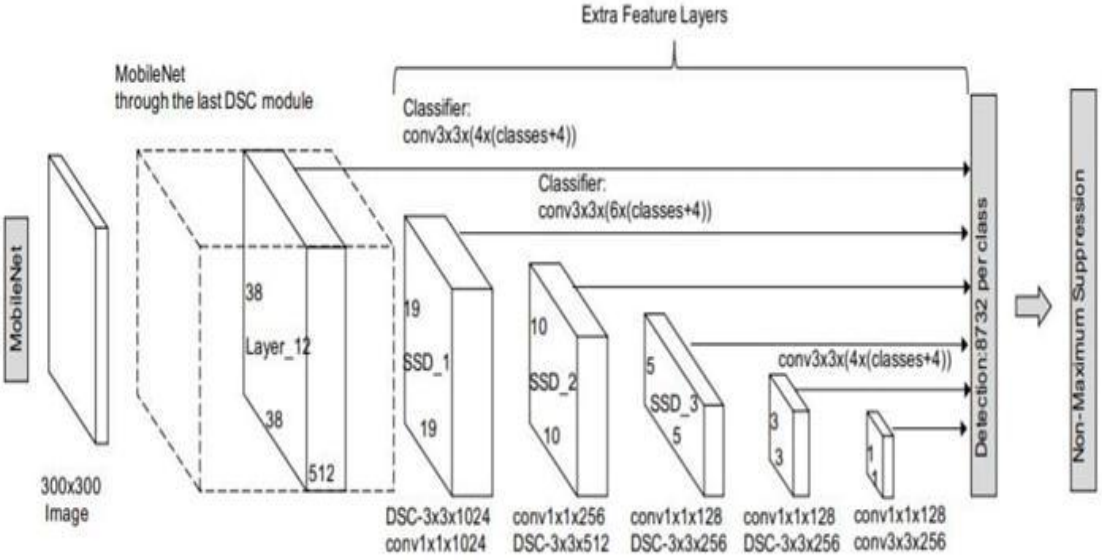


Fig.1 Layers of SSD Architecture with Mobilenet for Image Classification [15]

III. Single Shot Detector

Single Shot Detector (SSD) uses a VGG16 as its image classification network. Convolutional feature layers that progressively reduce in size are added to its end so that it is able to predict object at different scales [1]. In SSD, convolution filters are applied to feature maps to predict the score of a particular class of object and to obtain the offset coordinates of the bounding boxes of the object. Multi box technique is used for bounding box regression.

VGG-16 has a robust performance in high quality image classification. In an SSD as a substitute to the original VGG fully connected layers, a set of auxiliary convolutional layers are added. This enabled feature extraction at multiple scales and progressively decreased the size of the input to each successive layer. [2]

Fig. 1 shows SSD Mobilenet [13] layers. It replaces the VGG16 neural network used for image classification. Mobilenet is faster in detection speed and smaller in size when compared to VGG net [16].

IV. General System Description

The function of the system is to detect plastic bags in an underwater environment. Images are acquired by a Raspberry Pi camera. The captured image is then processed by a raspberry pi. The object detection script is used to detect plastic bags in the image and draw bounding boxes around it. The image is captured at regular intervals of 2seconds. Figure 3 gives the basic block diagram of the project. Fig. 4 shows the general flow of the project.

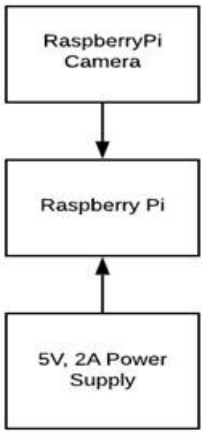


Fig. 2 General Block Diagram Description

Datasets to train the model was obtained from Google Images. The images were resized to a dimension of 300 x 300 and augmented [17] in order to produce the images for the train and test dataset. SDD MobileNet Quantized V2 model was used for training the object detector. 2500 images of plastic bags formed the dataset. Out of these

80% were taken as training dataset and 20% were taken for test dataset.

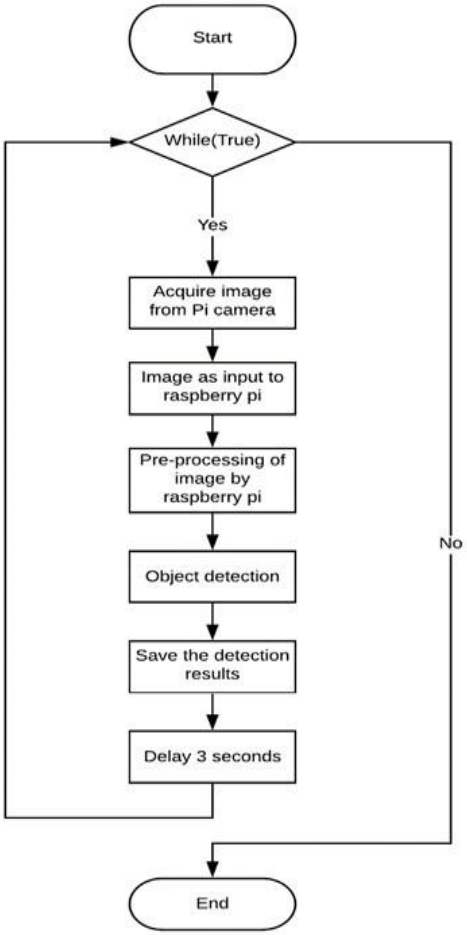


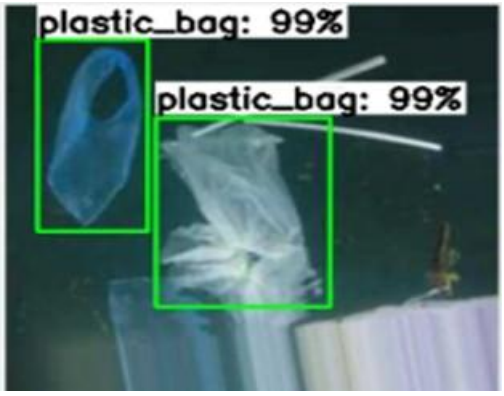
Fig. 3 Process flow diagram of the project

V. Results and Anlysis

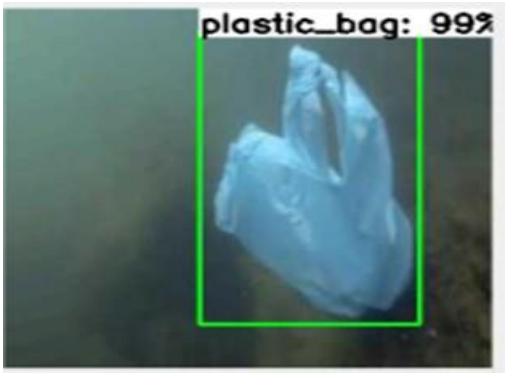
Testing of Object detection

- A set of 100 images was given as an input to the object detector. This had of 85 images of plastic bags, 5 images each of Plastic bottle, plants and cities. All the images were taken from Google.
- Table 1 details the results of the object detector regarding parameters such as True positive, true negatives, false positives, and false negatives. The threshold for object detection was kept at 0.5. Any object having a score less than 0.5 will not get detected. The detection results can vary based on the threshold score.
- Table 2 contains results such as True positive, true negatives, false positives, false negatives rates, the precision and accuracy.
- Images of detected objects from Google images are shown below.

(a)

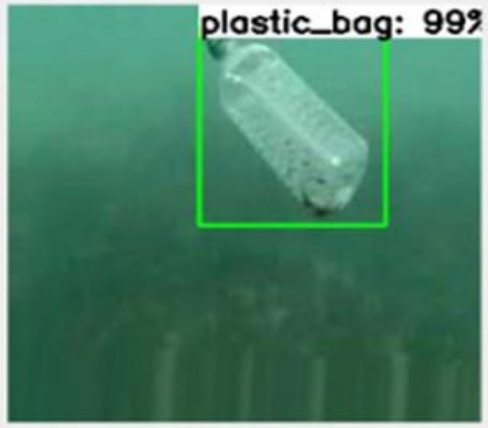


(b)



(c)

(d)



(e)

(f)

Fig. 5. (a), 5. (b), 5. (c) and 5.(d) shows the detection of plastic bags. Figure 5.(e) shows a plastic bottle being falsely detected as a plastic bag and Figure 5.(f) shows an image of a city thus plastic bag is not detected in the image

TABLE 1
DETECTION RESULTS OF THE OBJECT DETECTOR

Class	**True Positive**	**True Negative**	**False Positive**	**False Negative**
Plastic Bags	96	7	12	6

TABLE 2
PARAMETERS OF OBJECT DETECTION

Parameter (in %)	**Plastic Bags (in %)**
Accuracy	85.12
Precision	88.88
True Positive Rate	94.11
False Positive Rate	63.15
True Negative Rate	36.84
False Negative Rate	5.88
Misclassification Rate	14.87

VI. CONCLUSION

A simulation based testing was conducted by providing 100 images. The object detector detected objects with an average confidence score ranging from 70-90%. The object detector detects single as well as multiple objects with a high score. Although as seen in the images plastic bottle was falsely detected as plastic bag. From Table 2 it can be observed that the Accuracy is good. The object detector did perform not up to the mark in True Negative cases as the score is a little low. The probability that the object detector would misclassify plastic bags is low.

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Smart Component Organizer using Google Assistant

Swathi P[1#], Sanjana G S[2#], Swathi R[3#], Rajendra R Patil [4#], Priyanka P[5#],
[#]*Dept. of Electronics and Communication, GSSS Institute of Engineering and Technology for Women, Mysore, Karnataka, India*
[1]swathi.iemysore@gmail.com
[2]sanjanasubramanya1999@gmail.com
[3]swathichennappa.mysore@gmail.com
[4]rajendrarpatil@gsss.edu.in
[5]priyankap@gsss.edu.in

***Abstract*—With the rapid development of electronics technology, there are many types of electronic components than ever before. This leads to many problems in the management of components. Some of the most commonly faced problems are unnecessary repeat purchases, time-consuming storage, and poor management of existing parts and mistakes that could have been avoided. Management of such a variety of components has been a typical issue among various organizations. Huge time and money are invested in the management of these items. However, there are many instances where these resources are wasted due to the lack of proper management system. Consider the following scenarios: 1.When the item is available, but its location is unknown. 2. When an item is available, but it cannot be searched due to time constraint. 3. When an item is available, but still the operator places an order. In the above listed scenarios, there is no full utilization of the available items. The proposed framework aims to design a smart component organizer which helps the operator to organize and manage a cluster of items using voice commands, enable hands free-searching and maintain a database of all the components, which keeps track of name, location, available quantity and search tags of each component.**

***Keywords*—Google Assistant, Particle Photon, Microsoft Azure, IFTTT, SQL database, LED Strips, Components.**

I. INTRODUCTION

The era of electronics began with the invention of the transistor in 1947 and silicon-based semiconductor technology. Seven decades later, we are surrounded by electronic devices and, much as we try to deny it, we rely on them in our everyday lives. Most of the electronic instruments and equipment would not have been possible without advances in electronics. In particular, the new, high volume applications has increased the pace of innovation in the development of a wide variety of components and devices.

There are a variety of container options to store electronic components as per the user requirement. Moulded plastic boxes that can be side locked and stacked either vertically or horizontally are available. Each compartment with a label for easy identification. The electronic components need to be sorted and stored in these compartments manually. A big problem is that the user cannot locate the required components immediately. Other problems include repeat purchases of existing components, time-consuming storage and poor management of the components.

In this paper, we propose a system to organize and digitally catalog each component to maintain a record of the available components and to mitigate the delay of searching the desired component. The objectives of the intended system are: to manage a cluster of components using voice commands, to enable hands-free searching, to eliminate duplication in ordering stocks and to maintain a record of each component.

II. REQUIREMENTS

The proposed project is an IoT - based component organizer which embraces the following elements: Google assistant, IFTTT (If This Then That), Particle Photon, Microsoft Azure, Azure SQL Database, 3.3 to 5V logic level converter and individually addressable LED strips. The block diagram of the intended project is as shown in figure 1.

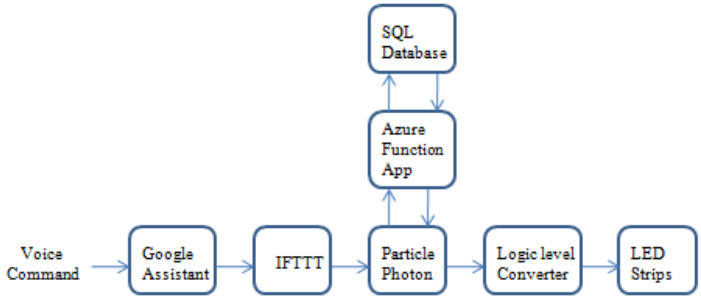

Fig. 1 Block Diagram.

A. Google Assistant

Google Assistant is an artificial intelligence-powered virtual assistant which is primarily available on mobile and smart home devices. Google Assistant can engage in two-way conversations. Google smart home lets users control the connected devices through the Google Home app [1]. In the proposed project, the operator gives voice commands to Google Assistant and those voice commands are converted to text. This text is used to trigger IFTTT.

B. IFTTT

If This Then That, also known as IFTTT, is a freeware web-based service that creates chains of simple conditional statements, called applets. In the proposed project, we have used IFTTT to integrate Google Home and Particle Photon [8]. We have created various applets which will enable the operator to search for the required components using suitable voice commands.

C. Particle Photon

Particle Photon is a Wi-Fi capable microcontroller, which is programmable Arduino style. Particle combines a powerful ARM Cortex M3 micro-controller with a Broadcom Wi-Fi chip in a minute module called the PØ (P-zero). Particle adds a 3.3VDC SMPS power supply, RF and user interface components to the PØ on a small single-sided PCB called the

Photon [7]. The design is open source. In the proposed project Photon is used to publish an event to Azure Function App and to turn on the LED strip indicating the location of the desired component.

D. Microsoft Azure Function

Azure Function is a serverless compute service that lets the user run event-triggered code without having to explicitly provision or manage infrastructure [3]. Azure Functions allows the user to run small pieces of code (called "functions") without worrying about application infrastructure. With Azure Functions, the cloud infrastructure provides all the up-to-date servers the user needs to keep the application running at scale. A function is "triggered" by a specific type of event. Supported triggers include responding to changes in data, responding to messages, or as the result of an HTTP request.

E. Azure SQL Database

SQL Database is a cloud-computing database service (Database as a Service), that is offered by Microsoft Azure Platform which helps to host and use a relational SQL database in the cloud without requiring any hardware or software installation. Also, it provides various advanced features to its users and some of them are: long-term backup retention, geo-replication, automatic tuning, high-availability, scaling database resources and automated backups [3][4].

F. Logic Level Converter

A level shifter in digital electronics, also called logic-level shifter or voltage level translation, is a circuit used to translate signals from one logic level or voltage domain to another, allowing compatibility between ICs with different voltage requirements, such as CMOS(Complementary Metal Oxide Semiconductor) and TTL(Transistor-Transistor Logic). In the proposed project, we use the level shifter to convert 3.3V signal received from the microcontroller to 5V for driving the LED strip.

III. IMPLEMENTATION

A. Circuit Diagram

The circuit consists of Particle Photon, 3.3V to 5V logic level converter, 5V 4A power supply, terminal blocks, LEDs, relay, capacitors, resistors and diodes. A 5V 4A power supply is fed to the circuit with the help of a terminal block. The LED strips are connected to the four terminal blocks on the right side of the schematic. The pin 2 of the terminal blocks is connected to the data wire of the LED strip. The VIN pin of Particle Photon is connected to 5V, 4A supply and the GND pin is connected to ground. The D3 pin of Particle Photon is connected to LV (3.3V) of the logic level converter. The logic level converter considered is of a single channel. It is composed of 2N7000 N-channel E-MOSFET and 10k resistors. The 5V signal from the logic level converter drives the LED strip. The digital input/output pin D3 is used to publish the location of the component by turning on the LEDs of the corresponding tray. The relay is used to turn on/off the LED strip display. Figure 2 shows the schematic diagram of the project. Figure 3 shows the designed printed circuit board.

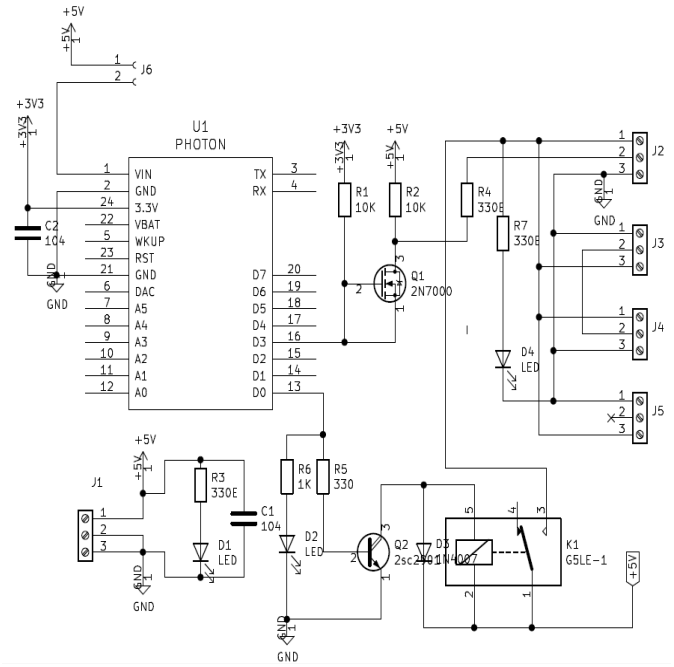

Fig. 2 Schematic Diagram.

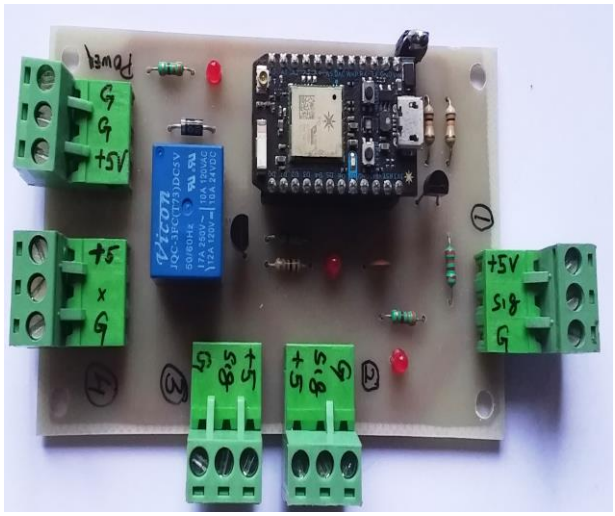

Fig. 3 Designed PCB.

B. Flow Diagram

In this project, Google Assistant is used to receive the voice command regarding the required component from the operator. Google Assistant converts this voice command into text. This text then triggers IFTTT. IFTTT is an online platform which enables different applications to communicate with each other. IFTTT publishes an event via webhook to Particle Photon. Webhook is used to send or receive data from Particle devices and applications. Particle Photon sends the JSON payload via webhook to Microsoft Azure Function App. The Function App deserializes the JSON payload, generates a query and then queries the database. The database then sends the results of querying back to the Function App. The Function App sends results to Particle Photon via webhook. Finally, Photon publishes the location of the required component by turning on the LEDs of the storage unit containing it. Figure 4 shows the sequence of operation of the proposed project.

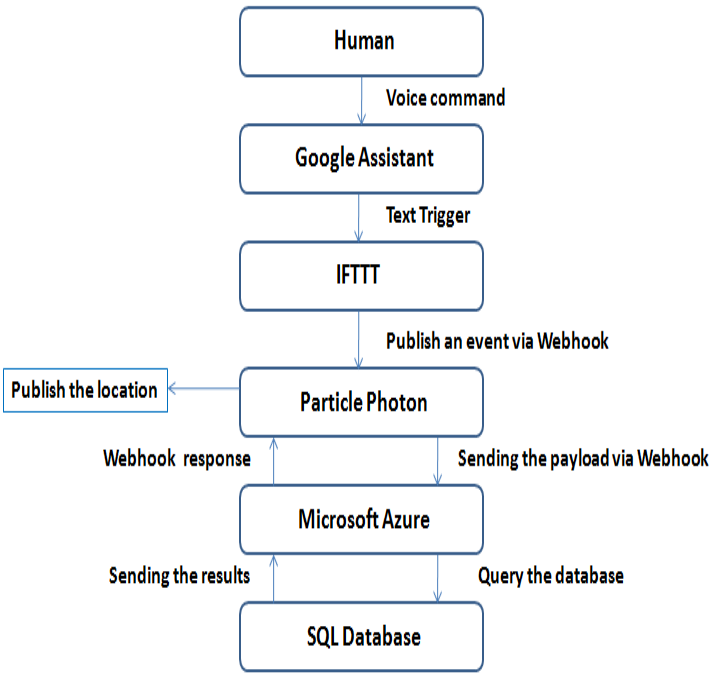

Fig. 4 Sequence of Operation.

The voice commands used to search for components are listed in the below table I.

TABLE I.

IFTTT Commands	**Description**
FindItem	Find the component
FindTags	Finds all the components matching the provided tags
InsertItem	Inserts a new component into the organizer
RemoveItem	Removes a component from the organizer
AddTags	Add tags to an existing component
SetQuantity	Set the quantity of the component to the said value
UpdateQuantity	Updated the quantity of an existing component

C. SQL Database

The SQL Database keeps track of each component in terms of names, quantities, locations, search tags. The database is queried to insert, remove or find a component, or update the component details. The SQL database consists of four tables. They are: dbo.Commands, dbo.HttpRequests, dbo.Items and dbo.Tags. The Items table stores the NameKey, Name, Quantity, Row, Column, Date of Creation information and last updated date and time information. NameKey is a unique identifier. The Tags table stores the Component Id, NameKey and the associated Tags for the component. The Commands table stores the Component Id, Date of Creation Information, associated Commands, DataIn and DataOut information. The HttpRequests table stores the component id, name of the published event and the date of creation information. The Commands and HttpRequests tables will show raw data logged from the Azure Function App, which may help debug malformed JSON input or bad speech-to-text translations from Google Assistant.

Figure 5 shows the Items table and figure 6 shows the Tags table. Visual Studio 2019 is used to view the contents of the SQL database.

dbo.Items [Data] | dbo.Tags [Data]

Max Rows: 1000

NameKey	Name	Quantity	Row	Col	IsSmallBox	DateCreated	LastUpdate
10k resistor	10k resistor	1	2	2	True	10-05-2020 14:39:02	10-05-2020
1k resistor	1k resistors	1	0	1	True	10-05-2020 14:20:52	10-05-2020
1mf capacitor	1mf capacitor	1	3	4	True	10-05-2020 14:46:29	10-05-2020
1n5819	1N5819	1	0	5	True	10-05-2020 14:34:32	10-05-2020
680e resistor	680E resistor	1	2	3	True	10-05-2020 14:39:57	10-05-2020
arduino uno	arduino uno	1	2	5	True	07-05-2020 16:33:10	07-05-2020
bolt	bolt	1	3	0	True	10-05-2020 14:41:03	10-05-2020
breadboard	breadboard	1	2	4	True	26-06-2020 11:24:05	26-06-2020
fuse	fuse	1	3	5	True	26-06-2020 07:43:08	26-06-2020
ic base	IC base	1	0	4	True	07-05-2020 16:32:18	07-05-2020
insulation tape	insulation tape	1	3	3	True	10-05-2020 14:45:31	10-05-2020
irf 540 n	IRF 540 N	1	1	3	True	07-05-2020 16:47:15	07-05-2020
irf z44n	IRF Z44N	1	1	0	True	10-05-2020 14:35:37	10-05-2020
jumper	jumper	10	2	1	True	07-05-2020 16:31:08	07-05-2020
ldr	LDR	1	1	1	True	10-05-2020 12:02:41	10-05-2020
lm 35	lm 35	1	1	4	True	10-05-2020 12:39:59	10-05-2020
male header	male header	1	1	5	True	07-05-2020 16:31:30	07-05-2020
nodemcu	NodeMCU	1	3	2	True	10-05-2020 14:44:03	10-05-2020
pir sensor	PIR sensor	1	3	1	True	10-05-2020 14:43:37	10-05-2020
pushbutton	pushbutton	1	0	3	True	07-05-2020 16:30:38	07-05-2020
red led	red led	7	0	0	True	07-05-2020 16:28:50	07-05-2020
rgb led	RGB LED	1	1	2	True	10-05-2020 14:36:28	10-05-2020
seven segment	seven segment	1	0	2	True	07-05-2020 16:29:47	07-05-2020
yellow led	yellow LED	1	2	0	True	08-05-2020 16:01:35	08-05-2020
NULL	*NULL*	*NULL*	*NULL*	*NULL*	*NULL*	*NULL*	*NULL*

Fig. 5 SQL Database: Items table.

dbo.Tags [Data] | SQL Server Object Explorer

Max Rows: 1000

Id	NameKey	Tag
79	red led	red
80	red led	led
82	seven segment	seven
83	seven segment	segment
84	breadboard	breadboard
85	pushbutton	pushbutton
86	jumper	jumper
87	male header	male
88	male header	header
89	ic base	ic
90	ic base	base
92	arduino uno	arduino
93	arduino uno	uno
102	irf 540 n	irf
103	irf 540 n	540n
134	red led	diode
135	yellow led	yellow
136	yellow led	led
139	1k resistor	1k
140	1k resistor	resistor
141	1n5819	5819
142	irf z44n	irf
143	irf z44n	z44n
145	rgb led	rgb
146	rgb led	led
148	10k resistor	10k
149	10k resistor	resistor
150	680e resistor	680
152	680e resistor	resistor
153	bolt	bolt
154	pir sensor	pir
155	pir sensor	sensor
156	nodemcu	node
158	nodemcu	mcu
159	insulation tape	insulation
160	insulation tape	tape
161	1mf capacitor	1mf
162	1mf capacitor	capacitor
163	fuse	fuse
164	ldr	ldr
167	lm 35	lm
168	lm 35	35

Fig. 6 SQL database: Tags table.

IV. OPERATION

The sequence of operation is discussed in this section.

- First, the user gives the voice command. In this case, the voice command is Find NodeMCU.
- This command triggers IFTTT. IFTTT then publishes 2 events: Google_FindItem and callAzureFunctionEvent. Since we are finding an item, Google_FindItem event is generated. The callAzureFunctionEvent is published to Particle Photon.
- Particle Photon then sends the JSON payload to the Azure function app via webhook.
- The function app deserialises the payload, and queries the database.
- The database then sends the results of querying back to function app.
- The function app sends the webhook response to Particle Photon.

- Finally, Particle Photon gives a visual indication of the location of NodeMCU. Figure 7 shows the sequence of operation.

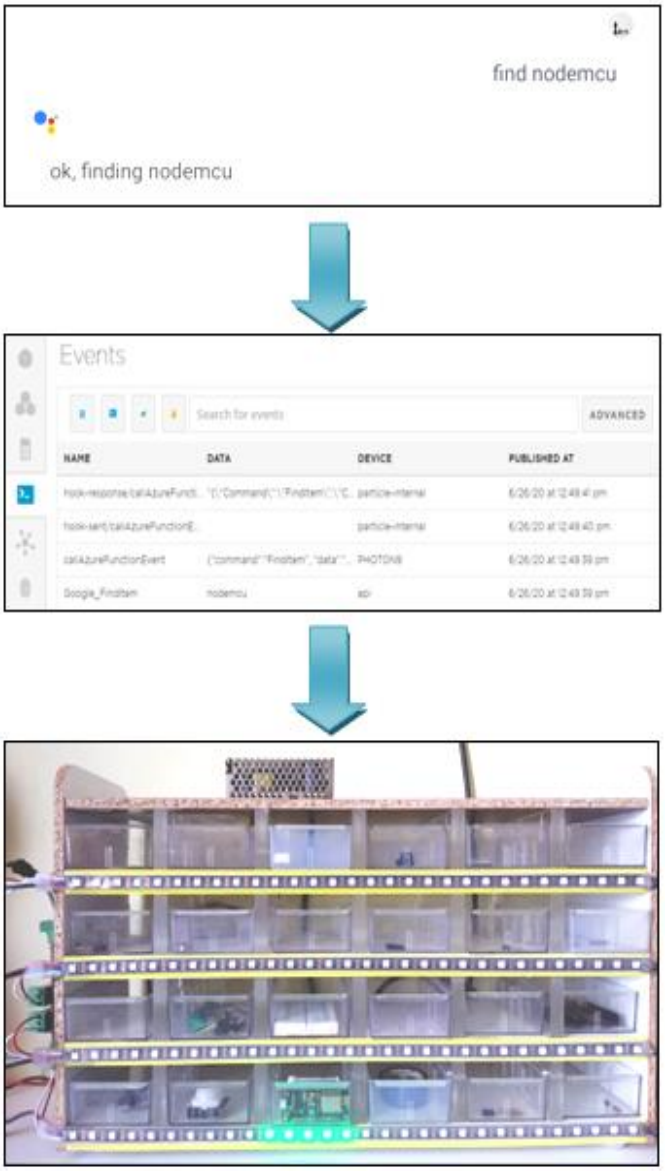

Fig. 7 Sequence of operation

V. APPLICATIONS

The proposed system find applications in the following fields:

1. *In Industries*
2. *In Pharmacies*
3. *In laboratories*

VI. ADVANTAGES

- *Efficient management and Storage:* The organizer provides an effective method to store and manage the components, and ensure that the user acquires the desired components by ejecting the right storage units.
- *Easy to incorporate:* The organizer caters to many fields such as industries, laboratories, pharmacies etc.
- *Precision mechanisms and user-friendly:* All that the user requires is a voice assistant to organize the components.
- *Zero-delay:* There is zero delay in seeking the desired components.
- *Easy to handle and operate:* As the system is voice-controlled, the user does not have to put too much work in organizing and managing the components.
- *Collective Documentation:* The component name, quantity and location is maintained in a database and it updates itself when the new components are inserted or when existing components are removed.

VII. DISADVANTAGES

- The proposed system requires it to be connected to the internet when in use.
- The user should have knowledge of the correct tags before using the organizer.

VIII. CONCLUSION AND FUTURE WORK

In this paper, it is shown how Smart Component Organizer organizes and manages the components significantly with the use of voice assistant. We believe that the derived smart organizer model is important not only because it helps to improve the efficiency of the operations in the specific domain but it also has good implications to a more general domain. Figure 8 shows the Smart Component Organizer. In future research, we plan to extend our analysis to a more challenging case when the storage space is a decision variable. We also plan to use actuators to push the storage unit of the most promising location identified for the searched component.

Fig. 8 Setup of Smart Component Organizer

ACKNOWLEDGMENT

We consider it is a privilege and honour to express our sincere thanks to Dr. Rajendra R Patil, Professor and Head, Department of Electronics Communication Engineering for his support and invaluable guidance throughout the tenure of this project.

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Generating Normal Sinus Rhythm Using Geometrical and Fourier Series Approximaion

Venkatesh Nayak[#]
[#]*Deprtment of Electrical and Electronics Engineering, NMAM Institute of Technology, Affiliated to VTU, Belagavi, Nitte-574110 Karkala, India*
venkatesh17nayak@gmail.com

***Abstract*—The objective of the proposed model is to generate synthetic Normal Sinus Rhythm ECG signal using the geometrical features and the Fourier series analysis using MATLAB. The resulting signal is a close to accurate signal with no noise and artifacts. The aim of the proposed model is to be beneficial for academic studies. Without putting any effort in processing the signal and just by knowing the parameters of the signal.**

***Keywords*-Synthetic ECG, Normal sinus rhythm, Fourier series approximation.**

I. INTRODUCTION

An Electrocardiogram (ECG) or EKG is a device used in cardiology to record electrical signals which is tapped from a heart to check different heart conditions. In addition to monitoring heart conditions, ECG is also used to measure the heart rates, size and positions of the heart chambers. Electrodes are placed on the surface of the skin on the chest, mostly non-invasive, which detect the small potential difference that is a consequence of cardiac muscle depolarization (contraction) followed by repolarization (relaxation) during each cardiac cycle (heartbeat).

Extracting real-time signals which are contaminated with noise and artifact requires reliable signal processing [2] and consumes time and ample amount of effort to get the accurate result.

As a matter of fact, accuracy is not of a prime concern, if it comes down to just analyzing the data for academic studies. With this regard, various automotive/synthetic models have been developed in the past. The most widely used models such as dynamical model based on three coupled ordinary differential equations [2], other models such as generating artificial ECG based on geometrical features of a real ECG signal [3, 5]. Importantly, creation of a synthetic ECG signal model based on the Fourier analysis [4].

This paper strongly concentrates on generation of artificial ECG signals for various (normal) heart rates using geometrical features and Fourier series approximations. This paper is one half of the research study which throws a light on generating various abnormal signals based on the various study cases regarding Cardio abnormalities.

This paper is organized as follows: Section II gives an insight into the typical ECG heartbeat, Section III briefs the proposed model with flowchart and detailed explanation on the mathematical model. Section IV presents the results obtained and finally Section V concludes the paper.

II. FEATURES OF ECG

An ECG signal consists of consecutive heartbeats. Each beat can be observed as series of deflection away from the baseline. It can be represented by five waves. Atrial and ventricular depolarization and re-polarization are represented on ECG as a series of waves: P wave, QRS complex and T wave. [1]

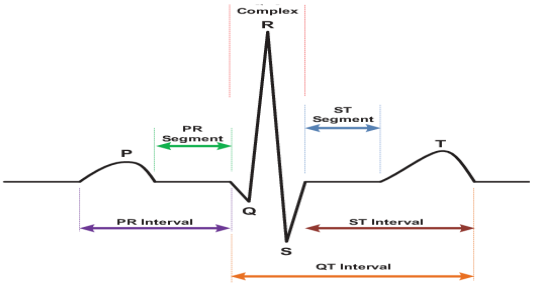

Fig. 1 P Q R S T waveforms and the intervals of an ECG signal

The P wave, PR interval and PR segment:
ECG interpretation starts with an assessment of the P wave. The P wave represents the depolarization of the left and right atrium and also corresponds to atrial contraction. The PR interval is the distance between the onsets of the P wave to the onset of the QRS complex. The flat line between the end of the P wave and the onset of the QRS complex is called the PR segment.

In most cases, these waves will be smooth and rounded with amplitude less than 2.5 mV and around 0.6 to 0.11 seconds in duration. [1] [7]

A. The QRS complex

The second wave is the QRS complex. These complex wave represents the depolarization of the ventricles. It includes the Q wave, R wave and S wave. These three waves occur in rapid succession. The first deflection in the complex is negative, it is called a Q wave. The first positive deflection in the complex is called an R wave. A negative deflection after an R wave is called an S wave. Some QRS complexes do not have all three deflections. QRS duration is the time interval from the onset to end of the QRS complex. The duration of the QRS complex will be between 0.06 and 0.10 seconds [1].

Following the QRS complex is the ST segment, extending from where the QRS ends to where the T wave begins. J point is the junction between the end of QRS and the beginning of the ST segment. ST segment reflects the current flow associated with phase 2 of ventricular re-polarization. ST segment corresponds to the plateau phase of the action potential [1, 7].

B. The T wave

The T wave reflects the current of rapid phase 3 ventricular re-polarization. Unlike a P wave, a normal T wave is slightly asymmetric, with steeper downward slope. The peak of the wave is a little closer to its end than to its beginning. The QRS complex deflection defines the polarity of the particular wave. The transition from the ST segment to the T wave should be smooth. [1]

A normal sinus rhythm or a normal ECG signal must consist of all the above mentioned waveforms, with a resting heart rate between 60 to 100 bpm (beats per minute). If the heart rate is above or below than the mentioned bpm, implies that heart condition is abnormal, abnormal conditions such as Bradycardia or Tachycardia respectively [1].

III. METHODOLOGY

The proposed model uses geometric approximation of each major waves present in a Normal Sinus Rhythm (Normal Heartbeat) and is analyzed using Fourier series. Moreover, Fourier series is used for the decomposition of the periodic functions into its sum of cosines and sines [6, 4]. Albeit an ECG signal is not exactly periodic, however can be considered as close to being periodic.

A. Flow Chart

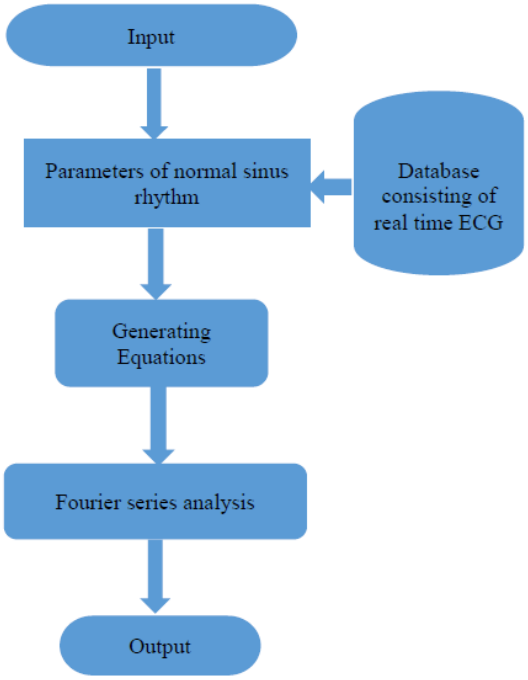

Fig. 2 Flowchart of the Process

Also various irregularities such as noises and artifacts introduced by the ECG is being forsaken. Hence, resulting signal will not be a realistic but, however, will be an ideal waveform with a good approximation and relatively very less computation time is achieved.

Therefore, the necessary parameters required to generate a Normal Sinus Rhythm are the intervals of the P Q R S T waves and PR interval and QT interval including the RR interval to determine the heartrate in bpm.

B. Modals of P Q R S and T waves

The heartbeat initiates with a short isoelectric line or baseline. Realistically a Normal ECG signal is close to zero but not constant because of baseline wandering [13] but practically is considered to be zero.

The P and T waves, when analyzed from a typical ECG turns out to be governed by the same mathematical functions. Although T wave is slightly asymmetric, in this case it is forsaken. These waves in fact can be approximated to parabolic functions by tweaking their parameters. A typical parabolic function which can be approximated to P or T wave is given by $f(x) = -x^2$. [4]

We can define the width of this conic section and exact location. More precisely, the equation becomes

$$f(x) = -a(x-t)^2 + A \quad (1)$$

Where 'a' defines the width of the section. 't' represents the position and 'A' is the amplitude. For a given amplitude and interval(s) the P wave and T wave can be represented.

$$f(x) = ai(x-ti)^2 + Ai \quad (i = p \text{ or } t) \quad (2)$$

$$ai = \frac{Ai}{\left(\frac{ti}{2}\right)^2} \quad (3)$$

Where ai defines the width or the interval of the P or T wave, and t_i is the total time interval of the P or T wave including the baseline which describes the position of the entire wave. Now each of the equation of P wave and T wave are generated using the necessary parameters, are analyzed using the Fourier series analysis which is explained in the next segment.

Under QRS complex lies the three sub major waves they are Q, R and S. The Q and S wave can be particularly represented using falling or rising slopes [6, 4]. A typical rising or falling slope can be defined as

$$f(x) = mx + b$$

Where 'm' is the slope of the line and 'b' represents the amplitude of the wave.

Q wave is depicted to be a falling edge slope and in the negative component of the graph. Also, since it is a falling

edge the slope will be negative therefore, the equation becomes

$$f(x) = -Mx + B \quad (4)$$

$$M = 2 \times \frac{Aq}{tq} \quad (5)$$

$$B = tq \times Aq \quad (6)$$

Where A_q is the amplitude of the Q wave in the negative y axis and t_q is the q wave interval.

S wave is depicted to be a rising edge slope and in the negative component of the graph. The equation is given by,

$$f(x) = Mx - B \quad (7)$$

$$M = 2 \times \frac{As}{ts} \quad (8)$$

$$B = As \times ts \quad (9)$$

Where A_s is amplitude of the S wave in the negative component of the graph and t_s is the S wave interval.

R wave, can be analyzed to be a typical triangular function also called as hat function, which can be deduced from the intersection of two raising and falling edge slope functions.

$$f(x) = \begin{cases} Mx + B, & x < 0 \\ -Mx + B, & x \geq 0 \end{cases} \quad (10)$$

$$M = 2 \times \frac{Ar}{tr} \quad (11)$$

$$B = Ar \times tr \quad (12)$$

Where A_{qRs} is amplitude of the QRS complex and t_{qRs} is the QRS interval.

These QRS complex is so generated and further analyzed using the Fourier series analysis, the equations describing it are detailed in the next segment.

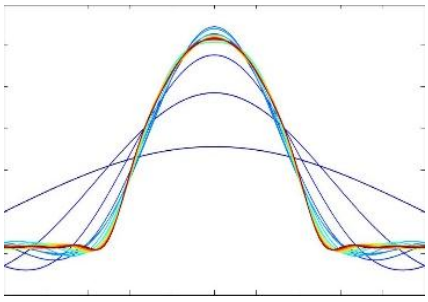

Fig. 3 Fourier approximation of P or T wave.

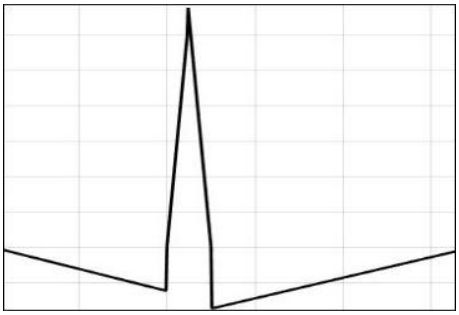

Fig. 4 Fourier approximation of QRS complex

C. Fourier Series

Since, this paper approximates an ECG signal to be periodic, the Fourier series is used to represent the function in terms of its fundamental frequencies of sines and cosines. As stated in the above segment.

The co-efficient of Fourier series are given by,

$$Ao = \frac{1}{L}\int_{-L}^{L} f(x)\, dx \quad (13)$$

$$An = \frac{1}{L}\int_{-L}^{L} f(x) \cos\left(\frac{n\pi x}{L}\right) dx \quad (14)$$

$$Bn = \frac{1}{L}\int_{-L}^{L} f(x) \sin\left(\frac{n\pi x}{L}\right) dx \quad (15)$$

$$f(x = i) = \frac{Ao}{2} + \sum_{n=0}^{n} An \times \cos\left(\frac{n\pi x}{L}\right) + \sum_{n=0}^{n} Bn \times \sin\left(\frac{n\pi x}{L}\right) \quad (16)$$

$i = p, q, r, s, t\ waves$
L is Period of a function.

Thus Fourier series of all the waves P Q R S and T waves are computed individually and are finally put together to get the output based on the parameters given while generating the equations. The number of coefficients while computing the equation also matters. As the number of coefficients increases, the approximation gets closer to the expected output.

A considerate balance between the accuracy and computation time is to be taken.

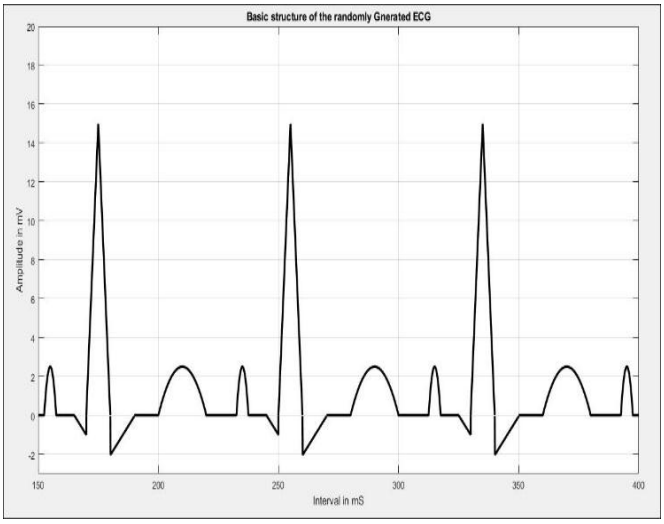

Fig. 5 The PQRST ECG signal output after the Fourier analysis using random parameters

IV. RESULTS

This section describes the generation of a Normal Sinus Rhythm [13, 14]. Two different ECG signal parameters as shown in Table I are taken to validate the generated ECG with that of the parameters of the real-time Normal Sinus Rhythm ECG signal. The simulation of the particular model described in the previous segment was carried out using the MATLAB software. The resulting output is not very realistic. However, a very close to accurate result is obtained. As claimed in the earlier segment, the output was obtained relatively with less computational time to that described in the model [4].

Using the proposed model, precise heart rate can be measured by analyzing the output, with relatively very less error. The crux of the model completely depends on the authenticity of the parameters governing the model. The resulting generated signals were closely accurate to the real signal.

The two graphs Fig. 5 and Fig. 6 depict the two separately generated Normal Sinus Rhythm ECG signal using the data tabulated above of different hearts and different parameters. Furthermore, various real time ECG signals can be extracted from the database such as MIT-BIH (NSRdb) available in websites such as PhysioNet that provides with tools for data processing in MATLAB [10, 11], and the parameters can be extracted using some reliable signal processing models such as P and T peak parameter detection algorithm [9] and QRS complex detection method [8].

A. Figueres And Tables

TABLE I.
NORMAL SINUS RHYTHM ECG PARAMETERS OF HEART RATE AROUND 84BPM

ECG Parameter	Normal values	
	Amplitude (mV)	Duration(s)
P wave	0.05	0.1769
Q wave	-0.2	0.0291
R wave	1.2	0.0448
S wave	-0.4	0.0448
T wave	0.5	0.2041
ST interval		0.5089
PQ interval		0.3505

TABLE II.
NORMAL SINUS RHYTHM ECG PARAMETERS OF HEART RATE AROUND 60BPM

ECG Parameter	Normal values	
	Amplitude(mV)	Duration(s)
P wave	0.15	0.09
PQ interval		0.15
Q wave	0.25	0.02
R wave	1.30	0.04
s wave	0.35	0.03
QRS interval	---	0.09
T wave	0.30	0.21
QT wave		.040

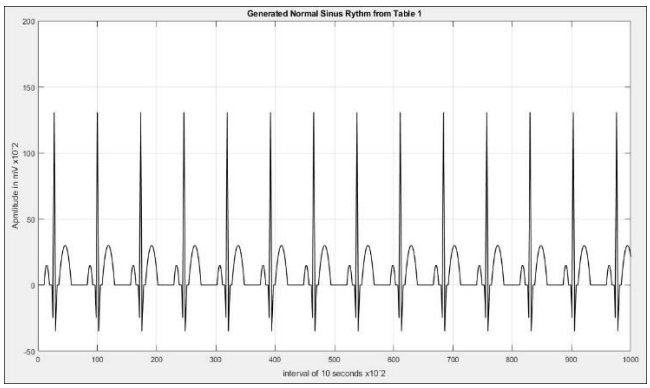

Fig. 6 Normal sinus rhythm using the parameters in the above table 1 for 10 seconds. Scale in both the axis is $\times 10^{-2}$.

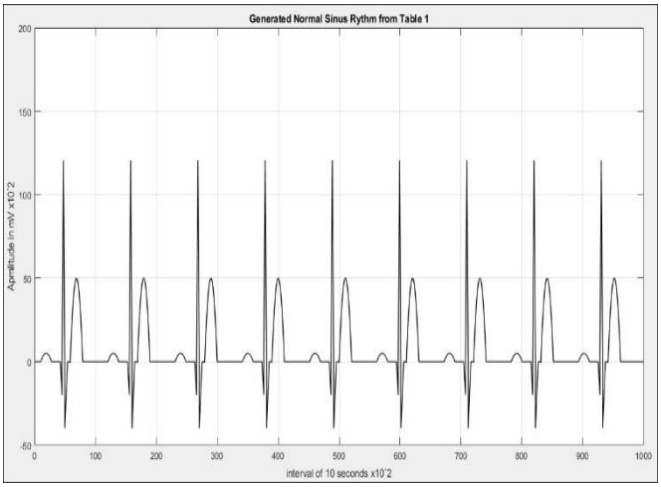

Fig. 7 Normal sinus rhythm using the parameters in the above table 2 for 10 seconds. Scale in both the axis is $\times 10^{-2}$.

V. CONCLUSION

Normal Sinus Rhythm ECG signal was generated using the geometrical features and Fourier series analysis based on the parameters given to the model. An approximated Normal ECG signal was obtained by using MATLAB as a tool for simulation of the proposed model. The proposed model only generates regular rhythm and cannot generate any irregularities and hence is not realistic. However, further studies can be taken forward to develop even better models to describe such intricacies.

The heart rate obtained from the simulated model is nearly accurate to that of the actual heart rate with less error. Using this model, regular rhythmic abnormalities such as Sinus Bradycardia and Sinus Tachycardia can easily be developed. This research paper was a part of the project undertaken, which is to generate 16 different abnormalities. After studying the various heart rates, synthetic ECG can easily be developed by tweaking the parameters of a normal ECG signal.
Therefore, further studies can be done using the current study as the basis, to simulate the different abnormalities.

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Robotic Border Surveillance System using LBP Algorithm (RBSS-LBP)

Shreyas. Arunesh[1#], Prajwal Hegde N[2#], Mahesha B[3#], Shridhara Bhat P[4#]
[#] *Department of Electronics and Communication, NMAM Institute of Technology, Affiliated to VTU, Belagavi, Nitte-574110 Karkala, India*
[1]shreyasarunesh@gmail.com
[2]prajwal.hegde@nitte.edu.in
[3]maheshkulalb909@gmail.com
[4]shridharbhat427@gmail.com

***Abstract*—The surveillance of International border areas has been one of the major concerns all across the globe. It is very essential that unauthorized people should not enter inside the restrained areas. The supervision of these restricted areas by border guarding forces is impossible at each and every moment. The proposed work presents a design and development of a new security solution which integrates vision, machine intelligent algorithm and multipurpose smart robot technology. Wireless camera for continuous monitoring of the restricted area form the base station and through machine intelligent algorithm harmful gases, fire, metal sensors, GPS (Global Positioning System) to locate the robotic vehicle is mounted on the robot, these information are continuously transmitted and displayed in the base station to alert the anomalies appearing in the border vicinity. The framework of this robot is that, it can be operated by both Automatic and Manual mode. Ultrasonic sensors are functional for automatic action whereas Joy stick is interfaced with Raspberry pi 4 controller to operate in Manual mode. Robotic Arm is used for pick and place of any object and to capture the enemies. Base station is equipped with advanced biometric security system i.e Face Recognition (FR) using Local Binary Pattern (LBP) algorithm. In Addition, a GSM (Global System for Mobile) module is interfaced to alert the Authority if there is any intruder who is trying to access the control. The proposed work would create a revolution in military applications as a surveillance and inspection robot.**

***Keywords*-Global Positioning System (GPS) , Autonomous Driving System (ADS), Convolution Neural Network (CNN) , Global System for Mobile (GSM), Short Message Service (SMS), Analog to Digital Converter (ADC), Face Recognition (FR).**

I. INTRODUCTION AND BACKGROUND

Nowadays robotics field is growing drastically; some of the common applications are in the industries, defense, academic and research communities. It is defined as a machine programmed by the computer capable of performing a complex series of actions automatically. This system might not fully replace the responsibility of the soldiers, but manages to take the supreme reliability and thus reduces human mistakes on the border [1].

In our social associations, classifying based on individual's character, features of human face assumes an essential part. Utilizing the human face as a key to border security system as a "Biometric Confront Acknowledgment Innovation" has got an incredible consideration and applications in the field of Image processing because of its potential for a wide range of implementation [2]. A facial acknowledgment framework application is one which captures facial pictures and distinguish person character using computerized vision after capturing the image from a propelled camera [3].

The proposed system is divided into two parts 1. Robotic vehicle and 2. Base station. The robotic vehicle uses Embedded C Language to program the ARM Controller and the Sensory network involves Metal detector for detecting metals at the border areas because parameters like "mines, bombs, pistols, electronic circuits are made up of metals", Temperature sensor measures the temperature and humidity of the vehicle's outside environment. For every sensors one GPIO pin in the controller is SET [4]. When any deviation from the original state, according to fed algorithm robot transmits the signals to the base station through Xbee transceiver where authority can take necessary actions. Wireless camera is used for continuous monitoring and wireless control by providing additional benefits including increased flexibility and reduced installation cost [5].

Base station uses Python language to program the Raspberry Pi 4 controller board. Developing a set of image acquisition to store in the database and recognition of the individual face is done using LBP algorithm. The aim is to develop a base station with face recognition as a biometric security [6].

II. METHODOLOGY AND WORKING OF PROPOSED BOARDER SECURITY SYSTEM

A. Robot Module Mechanism

The proposed module shown below in Fig 1:Vehicle Side Block Diagram, Arm Cortex M3 LPC1768 Microcontroller acts as the heart of the Robot Module. The Xbee transceiver module i.e CC2500 is used for the wireless communication between the robot and the base station. It is communicated via

UART 0 port of the ARM board with the help of Serial Interfacing (I/O) commands and Networking commands.

The sensor network consists of Metal sensor, Temperature sensor, GPS, Gas sensor and Ultrasonic sensor [7]. All these sensors are interfaced with the microcontroller and when the system is initialized, the data fetched from these onboard sensors are transmitted to the base station through Xbee transceiver. Robotic ARM is also interfaced with the microcontroller through Relay board with driver IC L2963D to perform necessary actions like pick and place of heavy objects or to capture enemies in the restricted area based on the data fetched from the onboard sensors [8].

The Wireless camera which mounted on the Robotic vehicle is used for the continuous surveillance of the restricted area; the audio microphone installed in the same package is used for the speech communication from the base station. The real time video and audio signals are transmitted through transmitter and the receiver outputs the collected signal to computer or laptop.

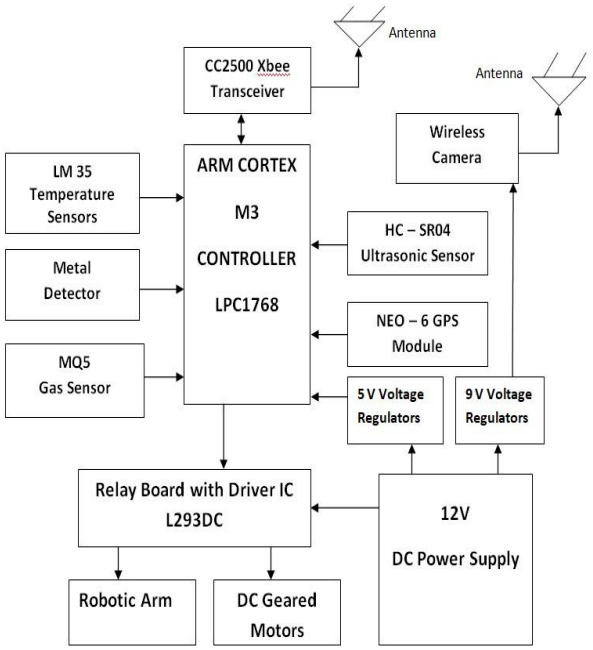

Fig. 1 Vehicle Side Block Diagram

B. Base Station Mechanism

The proposed module shown below in Fig 2: Base Station Block Diagram, Raspberry PI 4 Model B acts as a heart of the base station [9]. Firstly the access to the base station can be achieved by the latest biometric i.e Face Recognition (FR). First step is to capture the image of the authorized person and creating a database. By using "Eigen faces methodology" features are extracted from the images captured in different location with various light intensity i.e totally 100 images are stored in the database. Second step is to compare these images stored in the database with live captured image [10]. If the output is positive, the remote is unlocked and authority is accessed to the base station. If negative, the "AT and ATD commands" are sent to the Global System for Mobile (GSM) to alert the authority by sending SMS (Short Message Service) and CALL if the intruder is trying to access multiple times [11].

Two Joy Sticks are interfaced to controller through ADC (Analog to Digital Converter), Joy Stick no.1 to control the DC geared motors connected to the wheels for the directions of the vehicle and Joy Stick no.2 to control the movement of the Robotic ARM [12]. CC2500 Xbee transceiver for wireless communication with the vehicle and Push Buttons, Automatic/ Manual mode dd88545switch is interfaced with the controller. When the push button is activated, an interrupt is raised on the Vehicle side and the values from the Onboard Sensors are displayed on the 20X4 LCD display. Except for the Metal detector, there is no interrupt raised and the information is continuously transmitted and displayed [13].

Automatic / Manual mode switch is used to shift between the two states. In manual state Joy stick is used to control the directions of the robotic vehicle manually. Whereas in Automatic state, according to the algorithm fed to ARM Cortex the ultrasonic sensors are used to control the directions of the robotic vehicle. The shift between these two states is very fast without any delay [14].

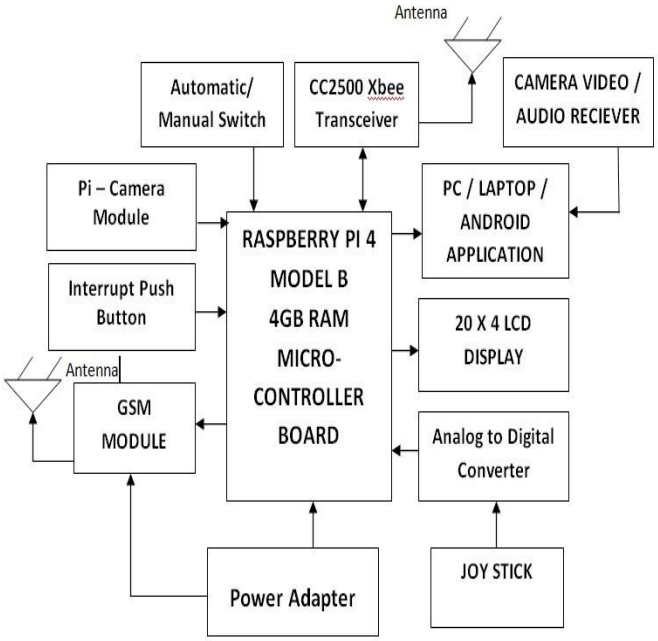

Fig. 2 Base Station Block Diagram

III. INTELLIGENT APPROACH ON VEHICLE SIDE

The below Fig 3: Flow Chart of Vehicle Section shows the intelligent approach on vehicle section and the data flow in the robot section is as shown below

Step 1: Start the process.

Step 2: Initializing all the sensor modules and fetch the data from the following modules.

Step 2.1: Temperature value from LM 35 (Temperature sensor) in Degree Celsius.

Step 2.2: MQ 5 Gas Sensor to detect Methane, LPG and other harmful gasses ranging from 100 – 3000 ppm.

Step 2.3: Metal Detector to detect Bombs, iron, brass.

Step 2.4: NEON - 6 GPS which gives signals of pseudorandom code, Ephemeris data and Almanac data.

Step 3: Transmit the onboard Sensor values through Xbee transceiver to the base station.

Step 4: Receive command from the base station about the following mode**.**

Step 4.1: Automatic Mode - Operates as per the logic used as shown in Fig 5: Algorithm used for Autonomous Driving System (ADS)

Step 4.2: Manual Mode – Operates based on the user input from the base station.

Step 5: Return to Step 2.

Step 6: Stop the process.

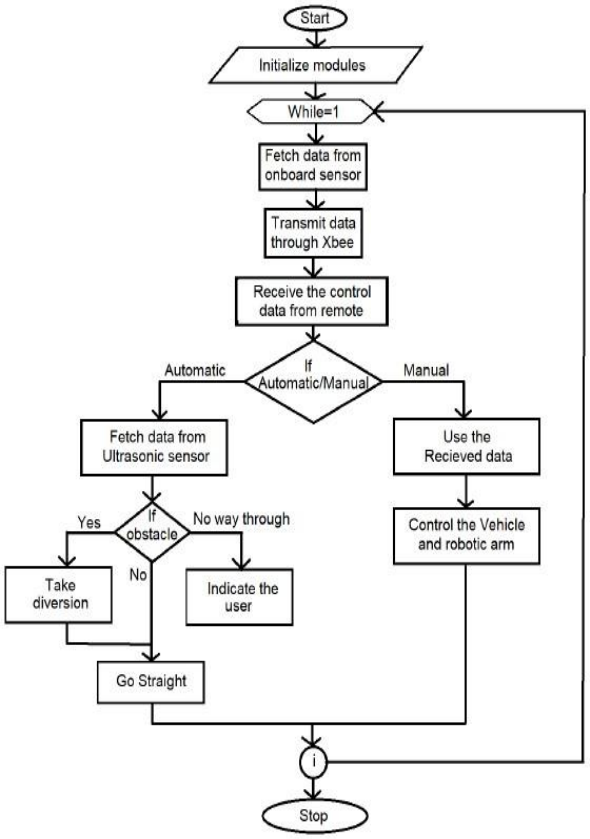

Fig. 3 Flow Chart of Vehicle Section

A. Implementation of Autonomous Driving System(ADS)

The implementation of this mode is also referred as Autonomous Driving System (ADS) [15]. When the Automatic mode is enabled, depending on the algorithm defined in the microcontroller the vehicle moves. For any obstacle in path two Ultrasonic sensors are installed in the front side of the vehicle and the sensors are triggered and echo signals are received continuously and the distance is calculated [16]. Both sensors are programmed to detect obstacle within 30cm range. then the vehicle operates as per the logic shown bellow in the Fig 4: Algorithm used for Autonomous Driving System (ADS), thus avoiding collision.

```
15
16 if(distance1<=29&&distance2>=30)     // Change the direction
17    {
18      LPC_GPIO1->FIOCLR = 0x0F000000;
19      LPC_GPIO1->FIOSET = 0x09000000;     // Go Right
20        delay(400000);
21        LPC_GPIO1->FIOCLR = 0x0F000000;
22        LPC_GPIO1->FIOSET = 0x0A000000;   //Go staight
23        delay(400000);
24        LPC_GPIO1->FIOCLR = 0x0F000000;
25        LPC_GPIO1->FIOSET = 0x02000000;   // Go Left
26       delay(400000);
27    }
```

Fig. 4 Algorithm used for Autonomous Driving System (ADS)

B. Implementation of Manual mode

In this mode of operation, the user can control the vehicles directions and robotic arm manually through joy stick from the base station by sending the RF (Radio Frequency) signal of 2.5 GHz to the vehicle side. Even in this mode all the onboard sensors work normally when an interrupt is raised. And Wireless camera is used for real time monitoring to control the robot. This mode is useful if vehicle in Automatic mode malfunctions [17].

The 2 axis in the Joy stick indicates directions of vehicle i.e Forward, Backward, left, Right respectively. If the joy stick position is in the centre, it indicates Neutral. The logic used in controller in this mode is if the voltage value is 2.5v then vehicle in in stop position, is the voltage is greater than 2.5V (>2.5V) the vehicle moves forward/ Right based on the axis and if the voltage value is less than 2.5V (<2.5V) then vehicle moves Backward / left [18]. The voltage values w.r.t Joy Sticks position are shown bellow in TABLE I. Voltage to Direction based on Joy Stick position

TABLE I.
VOLTAGE TO DIRECTION BASED ON JOY STICK POSITION

Joy stick Position	**Voltage reference**	**Direction indication of joy Stick 1**	**Direction indication of joy Stick 2**
+ ve X-Axis	5 v	Front (F)	Fire (f)
-ve X- Axis	0 v	Back (B)	Release (r)
Centre (Origin)	2.5 v	Neutral (N)	Neutral (n)
+ ve Y-Axis	5 v	Right (R)	Hold (h)
-ve Y- Axis	0 v	Left (L)	Release (r)

IV. FLOWCHART AND ALGORITHM USED IN BASE STATION

The bellow Fig 5: Flow Chart of Base station shows the step by step intelligent approach in Base station and the data flow of this section is as shown below:

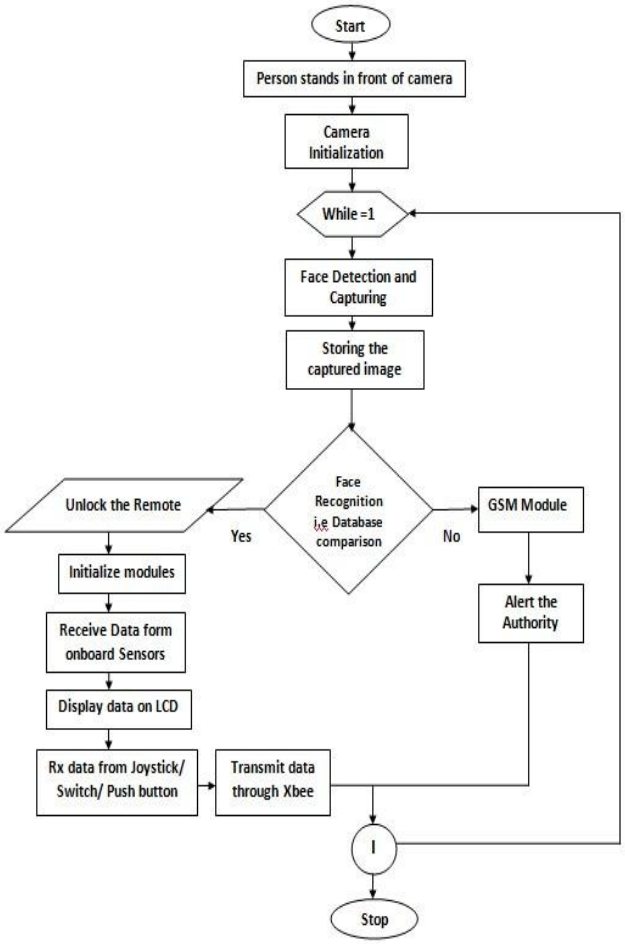

Fig. 5 Flow Chart of Base station

Step 1: Start the process
Step 2: Initialize camera when the person stands in front of it.
Step 3: Detecting face using "Haar cascade classifier" and storing it in the database.
Step 4: Comparing the live captured image with the existing database using LBP algorithm.
Step 5: If the o/p is negative, AT AND ATD commands are sent to GSM module to alert the authority.
Step 6: If the o/p is positive Communicate through Xbee perform following actions:

Step 6.1: Raise an interrupt and receive the data from the sensors

Step 6.2: Receive commands from joystick.

Step 6.3: Display on Joy Stick**.**

STEP 8: STOP

A. The Face Recognition Algorithm

To implement face recognition, the proposed system uses Local Binary pattern (LBP) algorithm. It is a bit wise transition from 0 or 1, it is used to describe the local neighboring textures of the pixels in the grayscale image [19]. The threshold value of the center pixel and the neighboring 8 pixels are compared, if the neighboring pixel value is greater than the center pixel value, the position of that pixel in the grayscale image is marked as 1, otherwise it's marked as 0.LBP is formally defined as:

$$LBP(x_c, y_c) = \sum_{p=0}^{p-1} 2^p s(i_p - i_c) \quad (1)$$

Where Xc and Yc is the center pixel of the 3x3 grayscale image and ic represents the brightness of center pixel, ip represents the brightness of adjacent pixels. S (.) is a sign function defined as:

$$s(x) = \begin{cases} 1 & if \quad x \geq 0 \\ 0 & else \end{cases} \quad (2)$$

The applications of original LBP is shown in Fig 6: The fundamental representation of the original LBP.

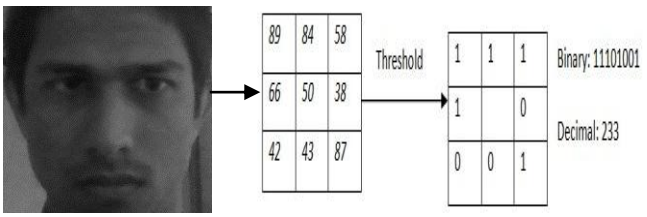

Fig. 6 The fundamental representation of the original LBP.

Input to the model is filtered Training Image. The features are extracted from the training face image and is compared with the pixel of with the unknown face image which is the live captured image from the Pi camera. [20]. The logic is as depicted bellow:

1. Initialize temp =0
2. For each training image I
   Initialize H =0 (Histogram)
3. For each center pixel tc ϵ I
4. Compute the label pattern LBP(1)
5. END For
6. Find the highest LBP feature and combine to single vector
7. Compare 6. With trained image.
8. If it matches with the database then the remote is unlocked
9. Else go back to 1.

V. RESULT AND SNAPSHOTS

In this, we depict the results and snapshots of the proposed border security system. The Robotic Arm, Wireless camera, onboard sensors, Xbee transceiver and the power supply can be depicted in Fig 7: The rare view of the Robot for Surveillance system.

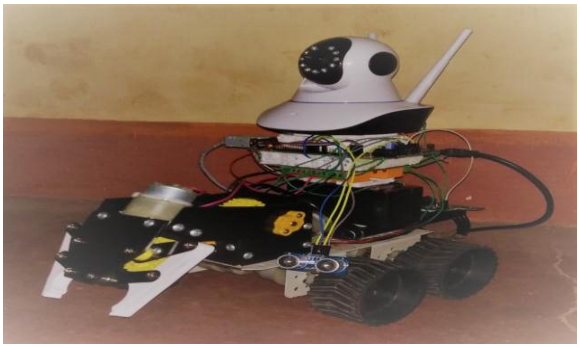

Fig. 7 The rare view of the Robot for Surveillance system.

In the Fig 8: Base Station prototype, it depicts the implementation of Joy sticks, Xbee transceiver and the output of the onboard sensors displayed on the 20X4 LCD.

Fig. 8 Base Station prototype

The output of the Face recognition System is depicted in Fig 9: Output obtained when Face not found. This is the first convolution neural network where the features of the image is extracted and compared with the database before executing the dense neural network of the convolution model which recognizes the face and further unlocks the remote.

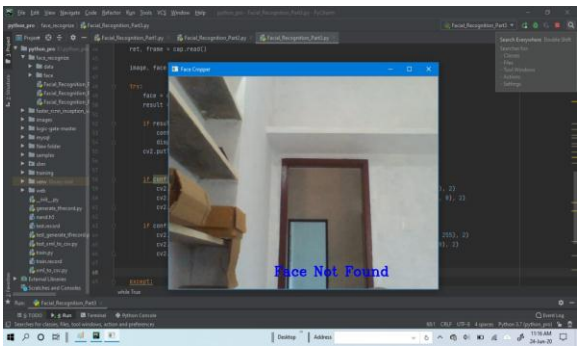

Fig. 9 Output obtained when Face not found

The Fig 10: Output obtained for Unauthorized person depicts the output when an unauthorized person tries to access the remote, which remains unlocked and captures the image for further verification and in the Fig 11: Output obtained for Authorized person, depicts the result when an Authorized person stands in front of the camera, thus the dense neural network recognizes the face and unlocks the remote to access the base station.

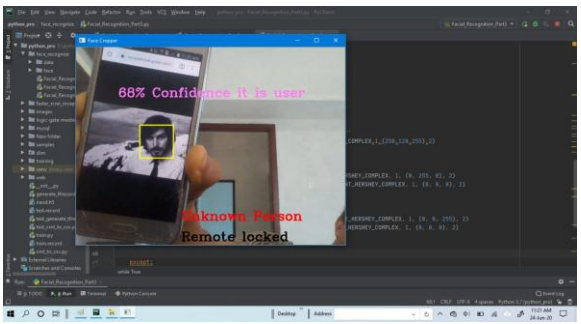

Fig. 10 Output obtained for Unauthorised person

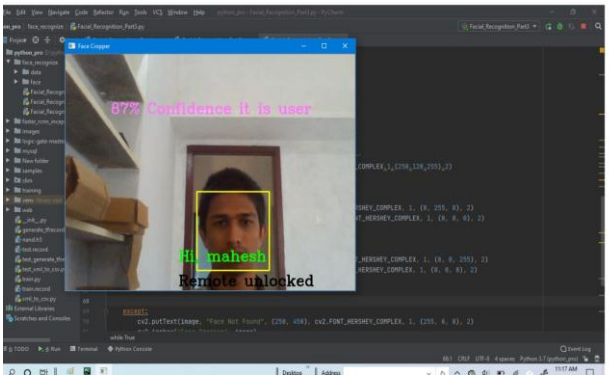

Fig. 11 Output obtained for Authorised person

VI. CONCLUSSION

This paper presents the intelligent approach for border Surveillance System using the concepts of Robotics and Image processing. A big idea of multipurpose, remote controlled smart robot is designed and developed, which is the wireless

control through the base station and the implementation of Autonomous Driving System (ADS) and manual mode of operation of vehicle is discussed. This system will reduce the work effort of soldiers in the border.

A face recognition system using LBP algorithm for Intelligent remote unlocks in the base station is designed and implemented in this paper. This system realizes the fast recognition, high accuracy and efficiency for human face.

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Head Movement Based Voice Enabled Wireless Device Switching for Physically Challenged

Shrividya G[1#], Shrusti Diggavi[2#], Sweekriti Chandrakant[3#], Trishal Shetty[4#]

[#] *Department of Electronics and Communication, NMAM Institute of Technology, Affiliated to VTU, Belagavi, Nitte-574110 Karkala, India*

[1]shrividyagp@nitte.edu.in,
[2]diggavishrusti@gmail.com,
[3]shettytrishal@yahoo.com,
[4]sweekruthic@gmail.com

Abstract **— The main aim of this project is to design and construct a head movement-controlled device switching system for physically challenged and paralysed patients. The body of the paralysed patient does not respond properly but can move the head. In the project Micro Electro Mechanical Sensor (MEMS) is used which senses the movement of the head and according to that movement, proposed model generates the voice signal that define the requirement of the paralysed patient. The user can wear this device on the head and with the simple head movement the patient can request the basic needs like water, food or medicine. The patient can also control electrical equipment like light, fan etc with head movement.**

Keywords—**MEMS Sensor, ARM7, RF Transmitter, RF Receiver, APR33A3 Voice Chip**

I. INTRODUCTION

Head movement-controlled device switching system for physically challenged people is a portable device and the system operation is entirely driven by wireless technology. User can wear it to his head like a band and can operate it by tilting the MEMS sensor [1]. The helper need not monitor the patient and can easily take care of patients at home with the help of the device. For interfacing the MEMS, ARM7 microcontroller is used. To recognize the sound which is coming from the MEMS sensor voice sensing circuit is used and it will generate different types of sounds. The project makes use of a switching device and APR33A3 voice chip for audio announcement. The microcontroller is programmed and is capable of communicating with transmitter and receiver modules. The sensor finds the tilt and operates the electrical devices and announces the basic needs depending on tilt.

A. Literature Survey

1. V Sundara Siva Kumar, G. Ramesh and P. Nagesh, in their work developed "MEMS based Hand Gesture Wheel Chair Movement Control for Disable Persons". Considerable research has already been done in the field of control using human gesture. MEMS accelerometer sensor detects the tilt which is used to change the direction of the wheel chair. The paper has explained the controlling of a wheel chair and electrical devices by using MEMS. Micro Electro-Mechanical Sensor (MEMS) which is a highly sensitive sensor capable of detecting the tilt.

2. Alexander Goldin, Haifa (IL), in their work developed "Head mounted voice communication". The paper discusses about the hands-free method of controlling a voice communication or music session via a sound terminal by an user employed connection headset.

3. M. Venkatasureshkumar, B. Neelima, in their work developed "A Portable Wireless Head Movement Controlled Human-Computer Interface for People with Disabilities". It focuses on the invention of a head operated computer mouse that employs one tilt sensor placed in the headset to determine the head position and to function as a simple head-operated computer mouse.

4. Fahmida Ahmed, Shakh Md Alimuzjaman Alim, Shafiqul Islam, KantiBhusan Roy Kawshik, Shafiul Islam, in their work developed a 433 MHz (Wireless RF) Communication between Two Arduino UNO". Current paper gives brief idea of the RF transmitter and receiver module.

II. METHODOLOGY

Head movement based voice enabled wireless communication system is a translator system of human head gestures pointed to physically challenged people [2]. With simple head movements they can request for the basic needs like water, food or medicine by using MEMS technology. The device is portable and helps them to do their work without depending on others [3]. The system has transmitter and receiver section. In transmitter section head movement is detected using MEMS sensor. LCD is used to display the status of movement and electrical device. In receiver section a RF receiver receives the command and gives to the microcontroller interfaced with it [4]. According to the commands from the transmitter section corresponding voice is played in the receiver section automatically and electrical devices are controlled.

Table 1 represents the specified work done for particular head movement i.e, when the head is moved two times to the left the light is turned on and it turns off if the action is repeated. Similarly if the head is moved two times to the right the fan turns on and it turns off if the action is repeated. The movement of the head three times to the left indicates that the

patient is in need of water. Similarly if the head is moved three times to the right it indicates that the patient is in need of medicine.

TABLE 1.
MOVEMENT OF HEAD AND WORKDONE

Movement	**Workdone**
2 times left	Light on
2 times left	Light off
2 times right	Fan on
2 times right	Fan off
3 times left	Water
3 times right	Medicine

III. DESIGN

The two major objectives of the design are
1. To develop a head movement-controlled device switching for physically challenged, paralysed patients and display the status of the movement on LCD.
2. To develop a voice circuit that identifies the matching voice for the movement and to switch on the devices based on the tilt.

A. Working of the proposed system

ADXL335 is an accelerometer sensor. When the head moves along the X-axis and Y-axis the analog voltage value of the sensor changes [5]. These values are given to analog to digital converter of ARM microcontroller which produces digital output which is given to HT12E encoder module [6]. The LCD displays the status of the head movement and electrical device. The LED in the transmitter section displays the bits sent by encoder as shown in Figure 1. The address lines of the encoder module are set as per the desired values (11111110). The 8 bit address of HT12E must match with the 8 bit address of HT12D for the communication to take place between transmitter and receiver. The output of HT12D is given to digital to analog converter of the ARM 7 microcontroller which converts it to analog voltage and is given to two relays to control the light and the fan. The output of HD12D is also given to APR33A3 which is 8 channel record and playback device that generates voice as shown in Figure 2.

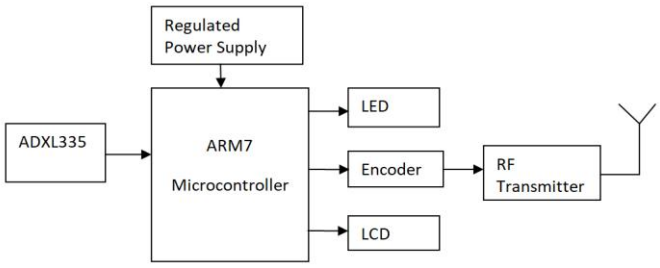

Fig. 1 Transmitter circuit

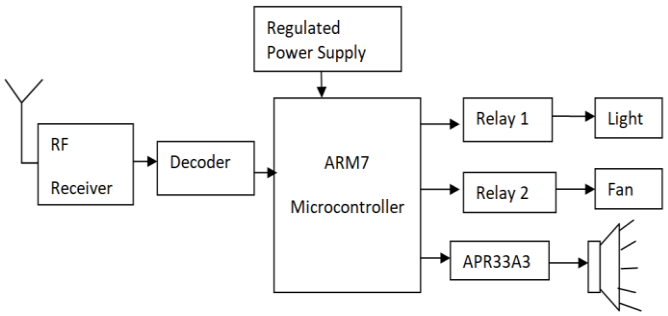

Fig. 2 Receiver circuit

IV. TESTING AND RESULTS

The following are considered for testing
1. Head movement detection.
2. LCD provides visual output.
3. Generation of voice and control of electric device.

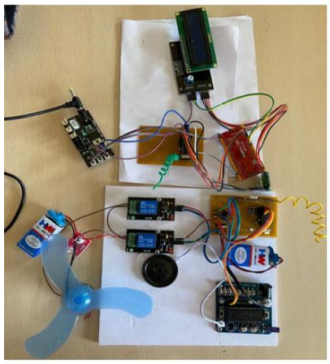

Fig. 3 Hardware setup

The Figure 3 consists of LPC2148 microcontroller, ADXL335 sensor, Encoder and decoder module, LED, LCD, RF transmitter and receiver, relay, APR33A3 voice chip, speaker, light and fan. The power supply is given through a 12 V adapter. When the head is moved 2 times in the left direction the light turns on and to off the light head is again moved 2 times to the left. When the head is moved 2 times in right direction the fan turns on and to off the fan head is again moved 2 times to the right. When the head moves 3 times in left direction voice is generated saying “I need water”. When the head moves 3 times in right direction voice is generated saying “I need medicine”. The LCD displays the status of head movement and electric devices. The module is tested and results are verified. The proposed system is found to be working satisfactorily.

V. CONCLUSION

This project can be used to monitor people with disability. The aim of this project is to ease the basic day to day needs for physically challenged people. An extremely sensitive head movement sensor, MEMS is used in this project to detect the

head movement of the patient by detecting the direction of tilt. The microcontroller is capable of communicating with transmitter and receiver modules. RF communication is used for controlling home appliances with an audio feedback about the successful execution of the command/head gesture. There is also a safety measure installed in the system in the form of a switch. The switch is used to prevent accidental actions to act as gestures. Presence of every module has been reasoned out and placed carefully thus contributing to the best working of the unit. Using highly advanced IC's and with the help of growing technology the project has been successfully implemented.

VI. Future Scope

A prototype is developed for the purpose of project demo. In future, this project can be taken to the product level. To make this project as user friendly and durable, we need to make it compact and cost effective. Going further, most of the units can be embedded along with the controller on a single board with change in technology, thereby reducing the size of the system.

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Wheelchair Controlled by Head Movement

Varshini S[1#], Veena V G Math[2#], Vijayalakshmi M C[3#], Vindhya S R[4#], Spoorthi Y[5#]
[#]*Department of Electronics and Communication, GSSS Institute of Engineering and Technology for Women, Mysuru, India*
[1]varshinigowda786@gmail.com,
[2]vvgmath@gmail.com,
[3]gudduvijayalakshmi@gmail.com,
[4]vindhyasr2016@gmail.com
[5]spoorthi@gsss.edu.in

***Abstract*—In this quick moving, ravenous world, individuals need to refresh and create themselves. Individuals with Quadriplegia cannot move any of their appendages and are hence constrained in their capacities of interfacing with their condition. In any case, a significant number of them can even now move their heads which can be used for the improvement of assistive gadgets. This sort of clients experiencing quadriplegia requires exceptional wheelchairs as opposed to utilizing customary ones that are constrained by joystick, since they are incapacitated underneath their neck. This undertaking plans to head direction controlled savvy wheelchair so as to improve their everyday exercises of living, with no help. The proposed framework utilizes accelerometer module which is given to Arduino Nano. As per the orders, wheelchair moves. Alongside obstruction recognition is likewise done utilizing ultrasonic sensor. Patient monitoring framework incorporates temperature and pulse estimation with informing administration by means of worldwide framework versatile communication (GSM).**

***Keywords*-Arduino Nano, GSM, Quadriplegia, Ultrasonic sensor, Accelerometer (ADXL335), RF 433MHz, Head Move- ment.**

I. INTRODUCTION

Quadriplegics are people who can't utilize any of the furthest points. The purposes behind such diminished movement prospects can be unique: stroke, joint pain, and hypertension, degenerative sicknesses of bones and joints and instances of loss of motion and birth abandons [1-3]. Likewise, quadriplegia shows up as a result of mishaps or age. The patients with such serious incapacities can't play out their ordinary activities, for example, taking care of, and development through space. Contingent upon the seriousness of the incapacity, a patient can hold opportunity of development to a specific level by utilizing diverse clinical gadgets. Versatility has gotten significant for a decent personal satisfaction.

Arranging a system with free versatility for such debilitated people is our point in this endeavor. We target planning a straightforward savvy wheelchair constrained by head development which additionally incorporates patient monitoring framework and obstacle detection framework [4-5]. This wheelchair incorporates ADXL335 sensor, ultrasonic sensor, pulse sen- sor, temperature sensor, battery, dc motor, GSM module and Arduino Nano microcontroller. ADXL335 which is used for perceiving the tilt. This sensor finds the tilt and alters the Course of the wheelchair relying upon tilt. The ultrasonic sensor assists with staying away from deterrents, utilizing nature data assembled during route [5-8]. Observing is accomplished by temperature sensor and heartbeat sensor and the detected values is given to microcontroller. At whatever point the boundary surpasses the edge esteem, an alarm message is sent to the specialist's telephone utilizing GSM module. The normal result of the undertaking is the framework utilizes head development to control the wheelchair and patient monitoring is achieved.

II. METHODOLOGY

The Transmitter and Receiver block diagram portrays the execution of a wheelchair with head controlled development, quiet checking framework and impediment recognition. This plan is predominantly created for quadriplegia patients. In this venture, the head controlled development assists with moving the wheelchair a particular way. The patient monitoring framework assists with estimating the pulse and temperature of the patient. The obstacle detection framework assists with distinguishing the deterrent in a navigational way and stops the wheelchair when hindrance is identified.

A. Transmitter Section

The Transmitter side mainly consists of three parts, Arduino Nano Microcontroller, Accelerometer, RF 433MHz Transmitter.

Fig. 1 Transmitter Section.

- Accelerometer
  The head development module has been founded by utilizing a triple pivot accelerometer sensor (ADXL 335). the widely minimal effort sensor gives the knowledge to the direction of the pinnacle . The accelerometer sensor senses the accelerating force (acceleration because of gravity) and during this manner gives a selected voltage for the x and y co-ordinate direction. Yield of ADXL335

is gotten at Xout, and Yout. These pins are related to the ADC pins of the microcontroller. Accelerometer placed on the patient's head detects the event made by the patient. This development compares to the straightforward voltage.

- Arduino Nano
  The proposed structure utilizes Arduino Nano Micro-controller. Arduino Nano is a small and breadboard-accommodating board dependent on the ATmega328 (Arduino Nano 3.0). The Arduino Nano can be fueled by means of the Small scale B USB association, 6-20V unregulated outside force gracefully (pin 30), or 5V directed outer force flexibly (pin 27). The force source is naturally chosen to the most elevated voltage source. It has 14 Digital Input/Output Pins (of which 6 provide PWM output) and 8 Analog Input Pins. The microcontroller creates control sign to drive engines of wheelchair.

- RF 433MHz Module
  RF Transceiver Module gives a total RF transmitter and recipient module arrangement which can be utilized to transmit information at up to 3KHz from any standard CMOS/TTL source.
  A transmitter module is extremely easy to work and offers low current utilization (average. 11mA). Information can be provided legitimately from a chip or encoding gadget, consequently keeping the segment tally down and guaranteeing a low equipment cost.

B. Receiver Section

A fundamental piece of this Head Movement Controlled Wheelchair is in the Recipient side. It contains all the motors and driver for working Wheelchair.

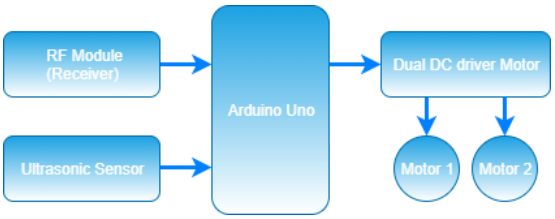

Fig. 2 Receiver Section.

- Ultrasonic Sensor
  HC-SR04 ultrasonic going sensor is utilized for deterrent recognition. This judicious sensor offers 2cm to 400cm of non-contact estimation handiness with a running precision that can reach up to 3mm. Each HC-SR04 module joins a ultrasonic transmitter, a recipient and a control circuit.
  There are four pins on HC-SR04:
  VCC, Trigger, Echo, Ground

  (1) Utilizing IO trigger for at any rate 10us elevated level sign.

  (2) The Module normally sends eight 40 kHz and recognize whether there is a heartbeat signal back.
  (3)In the event that the sign is restored, through enormous level, time of exceptional yield IO long. This obstacle detection has two conditions. The main, the nearness of the deterrent in the navigational way then the wheelchair stops. The second is without snag in a navigational way then the wheelchair keeps on moving.

- DC Motor
  A DC engine produces force by making a connection between a fixed and pivoting magnet field. The fixed field is provided by high vitality changeless magnets. The turning field is made by passing a DC current through a few unique windings on the armature (pivoting part) and timing which winding is controlled through a gadget called a commutator. Force is applied to the armature by brushes which ride on the commutator. An electro mechanical vitality transformation gadget is basically a mode of move between an info side and a yield side.
  The vitality change in a DC engine resembles; if electrical vitality is provided to a conduit lying opposite to an attractive field, the association of flow streaming in the transmitter and the attractive field will deliver mechanical vitality as power.

- Dual H-Bridge Motor Driver Circuit
  This dual bidirectional motor driver, is based on the very popular L298 Dual H-Bridge Motor Driver Integrated Circuit. The circuit will allow you to easily and independently control two motors of up to 2A each in both directions. It is ideal for robotic applications and well suited for connection to a microcontroller requiring just a couple of control lines per motor. It can also be interfaced with simple manual switches, TTL logic gates, relays, etc. This board equipped with power LED indicators, on- board +5V regulator and protection diodes.

C. Patient Monitoring

Real time monitoring of the patient's health condition can be done with the assistance of patient monitoring framework.

Fig. 3 Patient Monitoring Section.

- GSM Module
  The message sending process is finished by the GSM framework. This framework is known as the Worldwide Framework Versatile correspondence framework. The in-formation move rate is high and simple exchange. GSM is a cell arrange, which implies that cell phones associate with it via scanning for cells in the quick region. There

are five diverse cell sizes in a GSM network Macro, Micro, pico, and femto cells.

The proposed framework utilizes GSM Sim 800C Module.

- Heart Rate Measurement
  In this proposed structure heart beat is evaluated using Heartbeat sensor. The sensor has various sides, on one side the drove is set close by an encompassing light sensor and on the contrary side we have some equipment. This equipment is liable for the improvement and disturbance clearing out work. The drove on the front side of the sensor is put over a vein in our human body. It should be put direct on a vein. Directly the drove exudes light which will fall on the vein clearly. The veins will have circulatory system inside them exactly when the heart is siphoning, so in case we screen the movement of blood we can screen the heart throbs as well. If the movement of blood is recognized, by then the encompassing light sensor will pickup lighter since they will be reflected by the blood, this minor change in got light is analyzed after some an ideal opportunity to choose our heart pounds.
- Temperature Estimation
  The proposed framework utilizes LM35 sensor for temperature estimation. The LM35 sensor is a precision composed circuit temperature contraption with a yield voltage legitimately comparative with the Centigrade temperature. LM35 is a simple straight temperature sensor. Its yield is corresponding to the temperature (in degree Celsius). The working temperature stretch out is from - 55°C to 150°C. The yield voltage shifts by 10mV considering each °C rise or fall in temperature. It tends to be worked from a 5V just as 3.3 V flexibly and the backup current is under 60uA.

III. WORKING PROCEDURE

The undertaking comprise proposition of head development controlled wheelchair. The above proposed work takes focal points of both 3 axis accelerometer innovation and patient monitoring framework empowering patients to move their wheelchair by simply inclining accelerometer and patient's body parameters are measured.

The Transmitter side has an accelerometer for the head movement acknowledgment and Arduino Nano is utilized as a microcontroller. The accelerometer sends the x and y directions to Arduino Nano microcontroller. At that point this microcontroller uses the signal, and according to the given code, it transmits signal utilizing radio frequency transmitter module, utilizing 433MHz of frequency. With the assistance of reception apparatus, transmitter sends the code to the recipient end.

At the recipient end radio frequency receiver module is associated with Arduino Uno microcontroller. This gets and forms the 433MHz signals transmitted from transmitter. The yield of the microcontroller is associated with the mechanical motors, which is utilized to drive the wheelchair as per the user's command. Along these lines, user's head movement is converted into mechanical movement of the motor.

In this proposed venture obstruction recognition is likewise included. The ultrasonic sensor is utilized for hindrance recognition. Ultrasonic sensors information is prepared by the code executed inside the microcontroller, at whatever point there is hindrance in the scope of 50 cm, the wheelchair stops.

Patient monitoring is likewise consolidated in this task which incorporates temperature sensor, pulse sensor and GSM module. The patient's temperature and heartbeat rate is shown on LCD. At the point when the estimation of temperature is more noteworthy than 37 degree celsius message is sent to the doctor notice "Alert! Temperature has crossed the edge". At the point when the beat rate is under 60 bpm message is sent to the specialist notice "Alert! Heartbeat is not as much as limit", and correspondingly when heartbeat rate goes over 120 bpm "Alert! Heartbeat has crossed the limit" message is sent to doctor by means of GSM module.

APPLICATIONS

- In Hospitals
  Some patients who can't control the wheelchair with their arms because of an absence of force. The wheelchair is worked with the help of accelerometer, which in this manner controls the wheelchair with the help of head movement. The weakened and mostly stifled patients can uninhibitedly move and even the patient whose arms are hurt, can work this wheelchair with their head movements.
- Virtual game simulation
  Virtual games can be constrained by the head movement of the player to improve the experience of a player playing the games. The movement of the objects on the screen can be controlled.
- Giving PC Access to Debilitated
  The different blends of head movements, are utilized to outline different sorts of mouse occasions, for example, move, snap and drag to up, down, left, right, etc. The HMD framework can be utilized for the upper appendage impaired individuals who failed to utilize the customary mouse and console of PC.
- Old Age Homes
  Individuals at mature age homes can utilize this seat according to their prerequisite.

ADVANTAGES

- Expanded portability, for handicapped individuals who can't utilize their arms to control a manual wheelchair.
- Easy to use.
- It is less weighted.
- Motorized wheelchair with front line control.
- Solid and practical structure.
- Decreases Human action and physical strain.

DISADVANTAGES

- It requires external power supply.
- It is constrained to indoor condition.

IV. RESULT AND CONCLUSION

The proposed framework is expected to make a financially savvy wheelchair to assist quadriplegic with peopling who think that it's hard to move freely. The structure uses head advancement to control the wheelchair. The tilt focuses made are distinguished and voltages are created by accelerometer. These voltages are taken by microcontroller which in this way controls the course of wheelchair.

Fig. 4 Prototype of the Wheelchair

This venture work was carried on to satisfy the prerequisite of older and impair individuals, giving the autonomous route utilizing head movement controlled wheelchair. It causes them to move effectively as like ordinary people do. The circuit works appropriately to the order given by the user and the wheelchair is moved in understanding to the head signal given by the individual. Head movement controlled wheelchair incorporates obstacle detection, which assists with distinguishing the hindrance and stops the wheelchair. Monitoring of the patient's wellbeing condition is possible with the assistance of patient monitoring framework.

V. FUTURE SCOPE

Mind control:

Controlling wheelchair by the electric sign created from mind. As our cerebrum contains a great many neuron, there is sure likely distinction between every neuron. At the point when we think something neuron radiates 0 to 50 Hz electric sign. By deciphering the sign by demodulation, we can control the chair.

ACKNOWLEDGEMENT

We consider it is a privilege and honor to express our sincere thanks to Dr. Rajendra R Patil, Professor and Head of the Department for his support and invaluable guidance throughout the tenure of this project.

We would like to thank our internal guide Smt. Spoorthi Y, Assistant Professor, for her support, guidance, encouragement for the effective finishing of this venture.

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Accident Avoidance System and Evidence Collection in Road Vehicles for Legal Claims

S Omkar Nayak[1#], Sabya S Rai[2#], Samhita Sangam[3#], Samrudh R Shetty[4#], Krishnananda Shet[5#]
[#]*Department of Electronics and Communication, NMAM.Institute of Technology, Affiliated to VTU, Belagavi, Nitte-574110 Karkala, India*
[1]shiriyaromkarnayak@gmail.com,
[2]sabyasrai98@gmail.com,
[3]samhivs@gmail.com,
[4]samrudhshetty7@gmail.com,
[5]konikrishna@nitte.edu.in

***Abstract*— With the number of vehicles on the road increasing by the year, the number of fatal accidents has also seen a rise. With the introduction of Black Boxes in cars, the avoidance of these accidents is easily possible and insurance companies can keep proper logs of driving activity to safeguard themselves from false claims. Black Boxes are systems designed to monitor various parameters of the driver and the vehicle. The comprehensive data gathered by the black box provides information on how safe the driver is. The Black Box alerts the concerned authorities and provides the data collected which will help them to take action and analyse the data.**

***Keywords*-Black Box, Smart phones, Networks**

I. INTRODUCTION

The number of Vehicles on the road is increasing every day. Most of the households now own at least one vehicle. This number will only increase with time. Owning an automobile these days has become a lot easier than how it was a decade ago due to various factors which have contributed to an increase in the number of vehicles. In India, the increasing count of vehicles is making commuting convenient and more comfortable. However, the fatalities in road accidents have also seen a huge rise as a result of the increase in count of the vehicles. The need for tools and methods to either decrease the chances of an accident or prevent them from ever happening is huge. The proposed system is designed with this as its core purpose. The evidence collected is used to analyse the things that went wrong and can be used to avoid the same mistakes from happening in the future. It is used to decrease the number of fatalities on road accidents as well as the damage to property. Insurance companies can also take help of the evidence collected to support their claim statements. The Black Box consists of economical boards and sensors, thus making an essential system, affordable.

Kangsuk Chae et.al [1] have proposed a system where the black box is a vehicle-based CCTV (Closed Circuit Television) which will record video images, sound, GPS position, speed, and time. The data collected from the black box will help not only to be used for accurate investigation of accident but also in reducing public crimes since the black box will be capturing the video of the surrounding. The system is proposed to reduce the privacy concerns. The server's monitor has a user interface to input accident files and play the video. The server is set up with accident files that indicate time and place of the accident. If vehicles send a query, the server responds with accident lists, and the vehicles match the date and time on the accident lists. If the vehicles have matching films, they send the films to the server for evidence. The user can choose which part of the recorded video he/she wishes to share with police.

Chulhwa Hong et.al [2] have proposed a system where video recordings from car are collected from black boxes using smart phones. The recordings in the black box are hashed to provide data integrity before being transmitted to the police server. Smart phones are valuable when there is absence of VANET (Vehicular Ad Hoc Networks). The user can choose to cancel the upload process or select the part to be uploaded using the smart phone. Authentication is needed for smart phone to access the recordings. The communication between car black box and police server though possible using VANET infrastructure is very hard to implement in real life and easier when smart phones are used.

Abdallah Kassem et.al [3] proposed a prototype of Vehicle Black Box System (VBBS). It was designed such that it could be installed into any vehicle and make these vehicles safer by enhancing the road status and thus reducing the death rate caused due to road accidents. The two main objectives of this prototype were to record the data from the vehicle when an accident occurs and the second was to present this data in a simplified way. This will help the insurance companies with evidences for their claim and also the crash investigation by other authorities. The VBBS uses an EEPROM where the data of the last 21 seconds are always saved and in case of an accident, extra 10 seconds after the crash are also saved.

Sayem Chaklader et.al [4] proposed an integrated system that eases the work of the emergency rescue services when an accident occurs. The project focused on building an integrated system which would alert the authorities when a crash occurs using GSM text service and hence reduce the time taken by the emergency rescue to reach the accident spot. GPS is used in order to track the location where the accident has occurred. The

system also provides details on how the crash occurred and records the event in the form of images. It uses motion sensors to analyse the crash. The main aim of this project was to build an efficient and affordable device that everyone could use in their vehicles

Qiang Wu et.al [5] have designed and studied a vehicle black box which records video with acceleration sensitive function. When acceleration exceeds the limitation value, the system records and stores the analog video of the surroundings. This solves the problem of storing large amount of data. A video decoder is used to convert analog video signal to digital signal. The main drawback of the system is that when the car is driven normally the system could not make aware of any accidents.

Chanjin Kang et.al [6] have proposed an intelligent safety information gathering system which is like a conventional black box that captures images and has a video signal compression engine. Few other additional functionalities, such as Advanced Driver Assistance Systems (ADAS) and recognizing pedestrians and obstacles are also added. It analyzes and extracts key information of the surrounding vehicles while driving using different algorithms. The recognition engine is one of the algorithms where it detects the lane of road and neighbouring vehicle information such as its license plate number and color. In the next step a communication engine is used to upload the information gathered from the server to the cloud. In addition to these a GPS engine is used to record the time and driving route information.

II. METHODOLOGY

The box is physically installed in the car. It links to sensors that measures and records location, date and time of day the car is in motion. In an event of a collision, the readings from the sensors are recorded in real time and is saved in the memory. A notification about the occurrence of an accident and location of the vehicle is sent using GSM and a picture is captured using camera module and is sent to the concerned authority/family through email using Raspberry Pi.

The vehicle does not start if the door is not closed. Once the door is closed the vehicle is started. The door sensor works on the principle of comparator. LCD is used to display whether the door is closed or not along with other messages to the driver. The vehicle can travel at one of the two preset constant speed using the cruise control feature. Relay is used to switch between the two speeds. The proximity sensor based on the principle of IR detects if there is any object too close to the vehicle, in which case, the coordinates of the vehicle are sent through text message to the concerned authorities through the GSM module. The camera captures a picture of the surrounding of the vehicle and the image is sent through email to concerned authorities. The ARM Microcontroller is used to monitor the sensors and take reading in case of an event and the Raspberry Pi is used to enable the integration of the camera into the system.

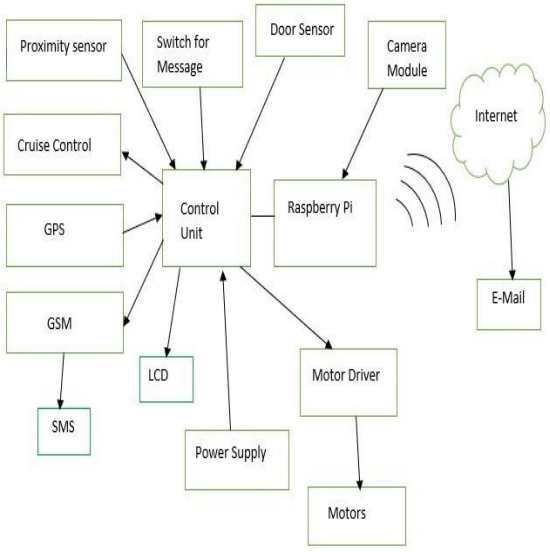

Fig. 1 Block Diagram

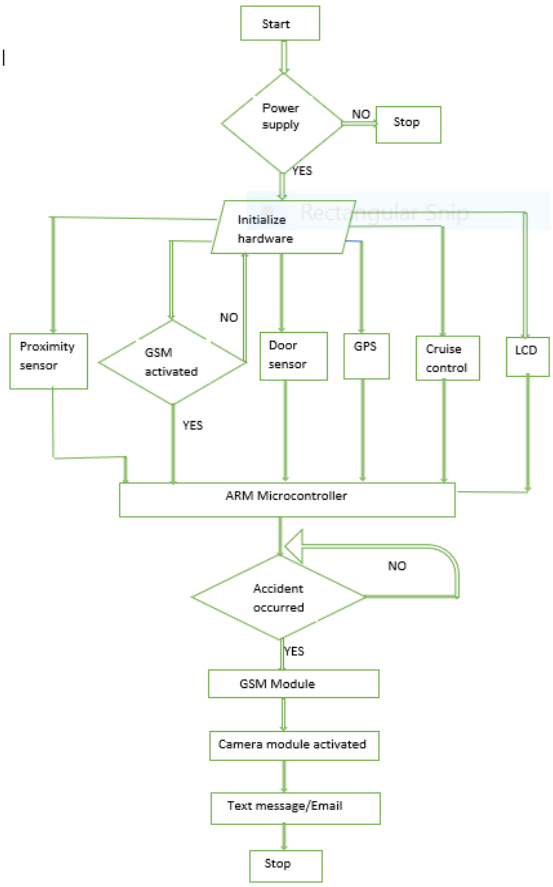

Fig. 2 Flow Chart

Fig. 3 When surrounding is clear When Object is detected

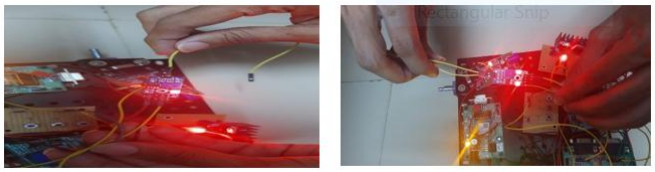

Fig. 4 When door is closed When door is open

Fig. 5 Image captured using camera module

When a vehicle meets with an accident, proximity sensor detects the object as shown in Fig 3, and in turn turns on the raspberry pi camera module and captures the image as seen in Fig 5. Fig 4 shows the door sensor detecting whether the door is closed or open. If open, the vehicle will not be able to move forward.

III. Results and Discussion

The ARM Microcontroller was used to collect data from proximity sensor and door sensor. GSM and GPS module was interfaced with the ARM microcontroller. The Raspberry 3b+ was used with the camera module to capture crash images. The email to the authorities/family was sent using the Raspberry Pi over an internet connection. The motors to drive the car were run using the ARM controller with the help of a relay for the cruise control setup.

IV. Conclusion and Future Scope

Due to increased number of vehicles in our present society, there has been an increase in accidents that occur every day. The process of finding the evidences by the police and also the insurance claim process takes a lot of time. The Black Box sends evidences as messages to the authorities through e-mail as soon as the accident occurs, hence reducing the time taken to collect evidences. It also helps to reduce the human resources needed.

The project is designed using functional modelling and is able to provide the desired results. It can be successfully implemented as a real time system with certain modifications. To increase the solidity of the evidence collected, further work can be done in recording videos of the surroundings where the accident has occurred instead of the photos clicked in this project. Science being the ever-evolving field, technology keeps changing from time to time. It is entirely possible that most of the units can be fabricated on a single board along with microcontroller thus making the system compact thereby making the existing system more effective and efficient.

Since this is a proof of concept, components with greater range need to be employed for the project to be implemented.

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A Review on Stabilization Methods for Lateritic Soil

Ashmitha N M[#1], Shriram Marathe[#2], Arun Kumar Bhat[#3] Siddhivinayaka Dattatraya Hegde[#4]

[#]*Department of Civil Engineering, NMAM Institute of Technology, (Visvesvaraya Technological University, Belagavi), Nitte 574110, Udupi District, Karnataka, India.*

[1]ashmithanm21@gmail.com

[2]ram.nmamit@gmail.com *Corresponding Author

[3]arun.bhat@nitte.edu.in

[4]siddhivinayakah@gmail.com

***Abstract*—The method or technique of changing the physical, chemical, and mechanical property of a natural soil, in order to improve their tensile strength, bearing capacity and overall performance, by using controlled compaction, proportioning, in addition of suitable stabilizer and admixture is known as stabilization of soil. The major application of soil stabilization is in the field of pavement subgrade, which is very much essential to improve its strength, bearing capacity and performance to a level better than the existing condition. By modifying the sub grade properties, the economy can be achieved in pavement construction by having reduced upper crust thickness. The objective of this paper is to review the various papers on the techniques already adopted for improving the engineering properties of soil to be used as a effective subgrade material.**

***Keywords*—Locally Available soil, Subgrade, CBR, UCS, Stabilization.**

I. INTRODUCTION

It's a one of the low cost road construction methods by effectively utilizing the locally available material to increase in the strength characteristics, modified in some of the undesirable properties of soil and retaining the desired minimum strength even after subjecting the stabilized soil to moisture condition.

The various methods are used to soil stabilization such as proportioning and mixing different material, using cementing agents, using modifying agents, using water proofing agents, using water repelling agents, using water retaining agents, by heat treatment and by chemical stabilization.

1) Proportioning and mixing method: some of cohesion less soil like sand may be improved by addition of some of cohesion soil in suitable proportion.
2) Using cementing agents method: addition of binding material to improve the strength properties of soil.
3) Modifying agents method: the addition of some stabilizer to modifying index properties as well as of engineering properties of highly clay soil.
4) In heat treatment method: the temperature and duration of heat to change the properties of soil.
5) The chemical stabilization method: the small percentage of chemical addition to soil may impart the useful changes in soil.
6) Waterproofing and water repelling methods: the waterproofing agent method is similar to water repelling method the entry of water in compacted soil mass may be weakened stability, to avoid the ingress of water waterproofing agent can be used.
7) In water retaining method: the fully dried soil losses its stability by imparting apparent cohesion to soil surface .in such cases some of retain material will be useful to absorb the moisture from the atmosphere and thus impart the apparent cohesion and retain the stability.

II. LITERATURE RIVEW

B M Lekha et al(2014): In this paper they have studied the addition of 0.2 to 1% randomly spaced arecanut coir with an increments of 0.2% and fixed the cement content of 3% to laterite soil which increase the unconfined strength 540 to 896 N/mm^2, CBR value 51 to 64% of 0.6% of coir and 3% of cement. They adopted cement stabilization method and they concluded the medium improvement of laterite soil. Analysis was carried out using kenpave software. the addition of coir fibre increase the strength up to the 0.6% (5595N/mm^2) of fibre then further addition to decrease (501 N/mm^2) the strength.

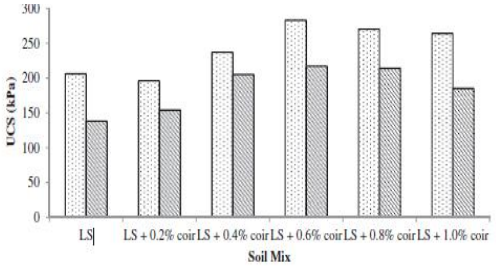

Fig. 1 variation of the unconfined compressive strength with addition of coir fiber for laterite soil (B M Lekha et al, 2014)

Saikrishnamacharyulic et al (2017): Studied on improve the engineering properties of soil using the waste fiber materials and tire waste. In addition of 0.25 to 1% of fiber with an increment of 0.25% and 1 to 8% of tire waste with an increment of 1% to laterite soil. The addition of 2% of tyre and 1% of coir the UCC increases 0.36 to 0.52 kg/cm^2, CBR value 1.95% to 3.19%. Behrouz et al (2015): In this paper they have studied flexibility of laterite soil using the tire powder and micro silica. The best performance was found using 6% of additives, 3% of micro silica and 3% of tyre driven aggregates. The mix with micro silica to soil controlling the seepage and increase strength. They are made to 6 sample. The increasing flexibility then decreasing the modulus of elasticity when

using the tire powder. The elasticity modulus was 15283.72kPa.

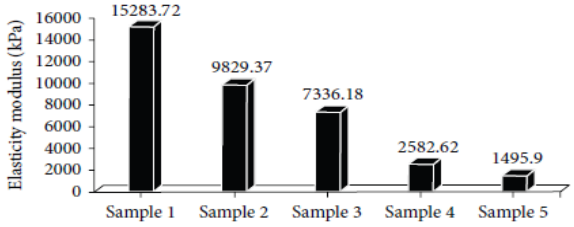

Fig. 2 variation of the elastic modulus with addition of micro silica and tire powder to lateritic soil (Saikrishnamacharyulic et al 2017)

Jeeja et al (2012): The study undertaken to evaluation strength properties of problematic soil to modified by addition of polymer fiber like polyethylene terephthalate bottle fiber and polypropylene sack fiber of dosage was 0 to 0.2% by weight of soil with increment of 0.05%.The addition of 0.1% and 0.15% of PET fibers and SACK fibers to obtained the better performance.

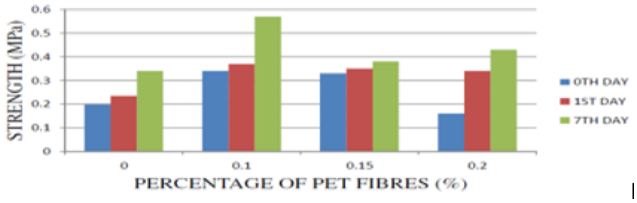

Fig. 3 variation of unconfined compressive strength with addition of PET fibres for the laterite soil (Jeeja et al 2012)

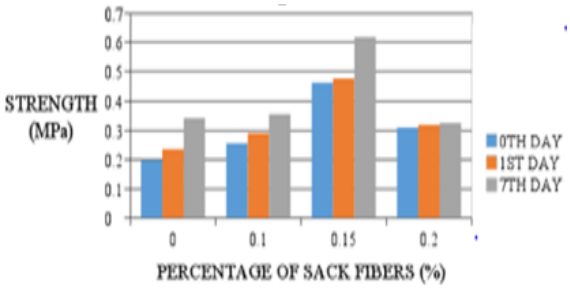

Fig. 4 variation of unconfined compressive strength with addition of SACK for the laterite soil (Jeeja et al 2012)

Adrian (2011): In this they have studied consolidation properties of treated laterite soil. They treated laterite soil with rice husk ash of dosage 0 to 16% with an increments of 4%. It shows that increased liquid limit and plastic limit, decreased plasticity index .one dimensional consolidation test was conducted on zero air voids soil. The increase the rice husk ash content to increase the maximum dry density and decrease the optimum moisture content.

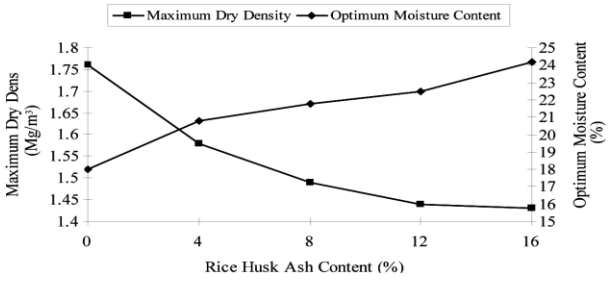

Fig. 5 variation of the maximum dry density and moisture content with addition of rice husk ash (Adrian 2011)

Pallavi et al (2017): In this paper they have studied on geotechnical properties of laterite soil in addition of thermal power plant industrial waste and coir fibre. Soil mixed with various proportion of thermal industrial waste 5, 10, 15% by the weight of soil and coir fibres of 0.25, 0.50, 0.75, and 1% by the weight of soil. Several test are conducted in unmodified as well as modified soil. The tests are consistency limit, modified proctor test, unconfined compressive test. The 5% of fly ash and 0.1% of fibres the optimum results are obtained.

B M Lekha et al (2013): Studied on laterite soil using zycosoil chemical and analysis conducted in kenpave software. It showed that subase can be replaced with treated soil for low volume roads. The chemical used for laterite soil is diluted in water of 1:100 concentrations and they are evaluated the index properties, compaction characteristics, unconfined compressive strength, California bearing ratio and fatigue behaviour.

Karthik et al (2018): In this paper they have studied the addition of 2% to 12% of groundnut shell ash at 2% interval to the soil which reduces the plastic index and change the soil to non-plastic state. After 6% of groundnut shell ash, the liquid limit value was increased and thereby increasing the plasticity index of soil. The plastic limit value is decreased gradually when the groundnut shell ash is added from 2% to 6% and it gradually increased after 6% at an interval of 2% to the soil. Increase in the addition of groundnut shell ash to the soil sample caused a change in the liquid limits and plastic limits, which consequently affects the plasticity index of the soil. Increase in the plastic limit from 38.5% to 55% is due to increase in the amount of fines. The plasticity index of the soil is reduced from 25% to 19.3% with the addition of groundnut shell ash. The reduction of plasticity index is an indication improvement of soil property. An adding groundnut shell ash from 2 to 12% the pH value increases gradually from 8.612 to 9.155.

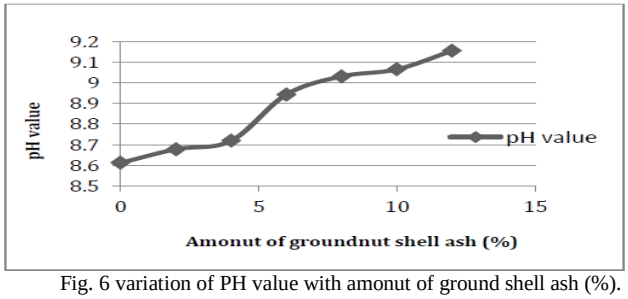

Fig. 6 variation of PH value with amonut of ground shell ash (%).

Sharmila et al (2018): Studied the behaviour of black cotton soil. It was found to the inherent deleterious property of swelling and shrinking .The study made to improve the properties of soil by various proportion of cashew nut shell and lime .For effective utilization of soil as subgrade it has to be stabilized and more importantly at a relatively cheap cost of locally available material. For in this study 5, 10, 15, 20 and 25% of Cashew nut shell ash was added to the Black cotton soil while keeping the Lime percentage at 5% for all mix. Experimental tests conducted in this research includes Atterberg's limits, Specific Gravity, Standard Proctor Compaction, Unconfined Compressive Strength and California Bearing Ratio.There is marginal improvement in the CBR and UCS value. Combination of 20% Cashew nut shell ash + 5% Lime is better for stabilizing the Black cotton soil. Thus

observation a increasing CBR value in unsoaked condition from 2.92% to6.8% and soaked condition from 2.59% to 6.16% and UCC value increases from 72.39 to 144.5kN/m^2.

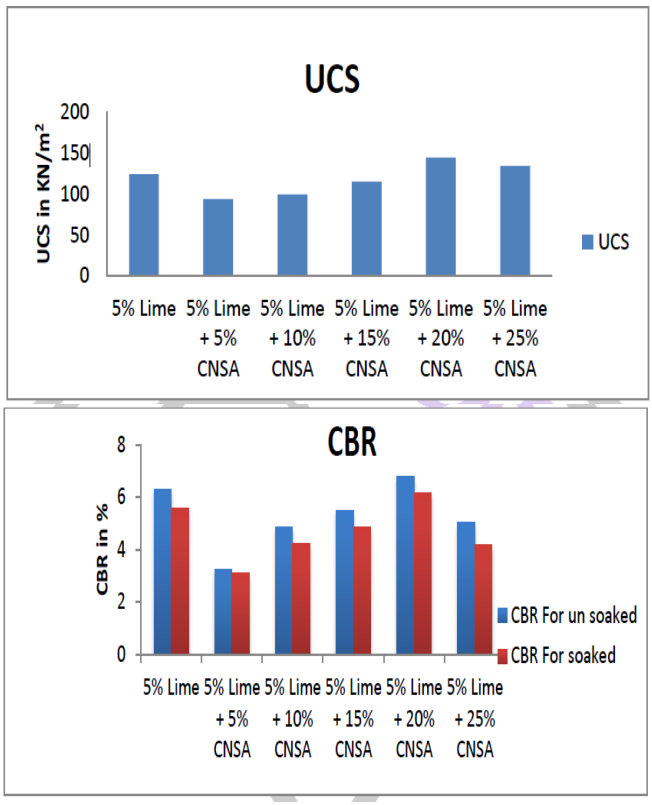

Fig. 7 Variation of CBR and UCS with addition of cashewnut shell ash and 5% lime for black cotton soil (Sharmila et al 2018)

K R Thanaki et al (2015): In this paper, the properties of black cotton soils are very good for agricultural purposes, they are not so good for laying durable roads. They studied the stabilization of black cotton soils in Gujarat state using groundnut shell ash. Index properties of the natural soil showed that, the soil is a poor for engineering use. Liquid limit and Plasticity index values of 83.36 % and 89.32 % respectively for the natural soil suggest that the soil is highly plastic. There was gradual decrease in the free swell to a minimum value of 2.91% at 10% GSA as compared to the natural value of 15.25%. The soaked CBR for the natural soil is 1.68% which increased to 2.19% at 10% GSA. The requirement of the CBR value to be used as sub-base or base material has less value than specified. This research is aimed at evaluating the possibility of utilizing groundnut shell ash in the stabilization of black cotton soils.

TABLE 1:
VARIATION OF CBR WITH ADDITION OF GSA TO BLACK COTTON SOIL IN SOAKED AND UNSOAKED CONDITION (K R THANAKI ET AT 2015)

GSA content	0	2	4	6	8	10
Soaked CBR %	1.68	1.56	1.59	1.61	1.63	2.19
Unsoaked CBR %	2.2	2.08	1.46	3.38	6.31	5.83

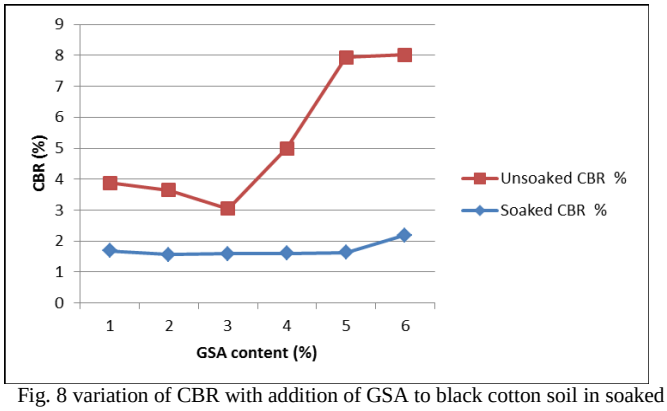

Fig. 8 variation of CBR with addition of GSA to black cotton soil in soaked and unsoaked condition (K R Thanaki et al 2015)

J S Ijimdiya et al (2012): In this paper, they carried out laboratory studies to investigate the possibility of utilizing Groundnut Shell Ash (GSA) as a stabilizing agent to improve the engineering properties of black cotton soil. Black cotton soil is classified as A-7-6 in accordance with AASHTO soil classification system. Groundnut shell is an agricultural waste product obtained from the milling of groundnut. The groundnut shell are found extensively in the northern part of Nigeria where they are cultivated. The results in this studies had the moisture- density relationship follows a trend of increasing optimum moisture content and decreasing maximum dry density at the standard Proctor compaction test. California bearing ratio values obtained are lower than the 10%. The peak CBR value obtained was at 8 % GSA. This value did not meet there recommended criterion for subgrade material.

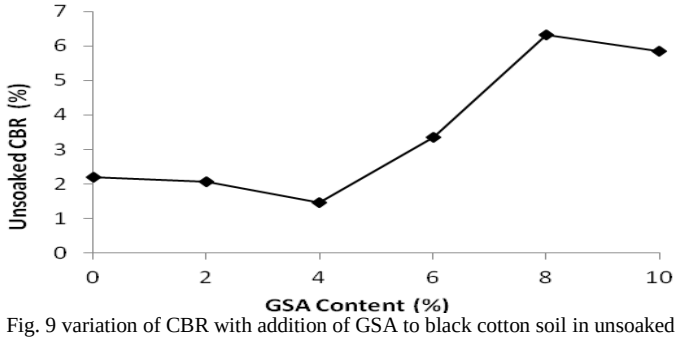

Fig. 9 variation of CBR with addition of GSA to black cotton soil in unsoaked condition (J S Ijimdiya et al 2012)

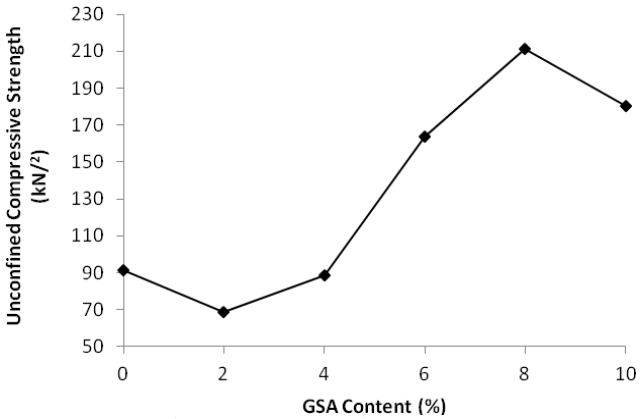

Fig. 10 variation of UCS with addition of GSA to black cotton soil in (J S Ijimdiya et al 2012)

Olugbenga et al (2011): In this paper they have examined the geotechnical properties of lateritic soils modified with coconut shell and husk ash which is cheaper and effective road stabilizer. After collecting samples A, B and C from the borrow pits meant for road construction works, we performed

preliminary tests on them for identification and classification purposes, followed by the consistency limit tests. They also performed testes on engineering properties likes compaction, California bearing ratio and triaxial both at the stabilized and un stabilized soil with the addition of 2, 4, 6, 8 and 10% coconut shell and husk ash contents. The result showed that the soil sample are well graded sand with good to excellent rating as subgrade material for pavement construction. However, the engineering properties of the different sample were further improved with the addition of 4% CSHA contents. This caused reductions in the PI of samples. We obtained optimum values of maximum dry densities and shear strengths at 4% CSHA stabilization. The addition of CSHA increased the values of shear strengths shown in table 3. They concluded that coconut shell and husk ash has a good potential for improving the geotechnical properties of Laterite soil.

TABLE 2:
VARIATION OF CBR WITH ADDITION OF COCONUT SHELL AND HUSK ASH TO LATERITE SOIL IN UNSOAKED CONDITION (OLUGBENGA ET AL 2011)

Sample	Percentage Stabilization	Unsoaked CBR (%)
B	0%	1.14
	2%CSHA	1.90
	4% CSHA	3.55
	6% CSHA	4.15
	8% CSHA	5.85
C	0%	4.15
	2%CSHA	7.60
	4% CSHA	8.95
	6% CSHA	16.75
	8% CSHA	23.05

TABLE 3:
VARIATION OF UCS WITH ADDITION OF COCONUT SHELL AND HUSK ASH TO LATERITE SOIL (OLUGBENGA ET AL 2011)

Sample	CSHA Content	Deviator Stress (kN/m^2)	Cohesion (kN/m^2)	Angle of Internal friction (ϕ)	Shear Stress τ
	0%	87.115	24.41	13	44.52
	4%	170.82	37.7	30	136.32
A	6%	83.497	19.5	17	45.02
	0%	154.372	67.25	10	94.47
B	4%	208.497	40.68	27	146.91
	6%	163.141	73.5	7	93.53
	0%	156.286	25.5	27	105.13
C	4%	167.857	42.43	27	127.96
	6%	122.91	42.43	20	87.17

Karthik et al (2014): The work was carried out in soil stabilization by using fly ash**.** They used waste material like Fly Ash to make the soil to be stable. Addition of these materials will increase the physical as well as chemical properties of the soil. They conducted some test such as CBR value, shear strength, liquidity index, plasticity index, unconfined compressive strength and bearing capacity, specific gravity test, grain size analysis, atterberg limits, proctor compaction test, and North Dakota test. fly ash dosage 0 to 9% of 3% increment and the optimum dosage of 6% to obtained the maximum result of CBR (3.75mm of 2.5 mm penetration and 4.82mm of 5mm penetration), UCC (8.88 N/cm^2), North Dakota value (35.06 kg/mm^2).The Increment of CBR value is used to reduce the thickness of the pavement. And increasing the bearing capacity of soil. The bearing capacity of soil was $10kg/mm^2$.

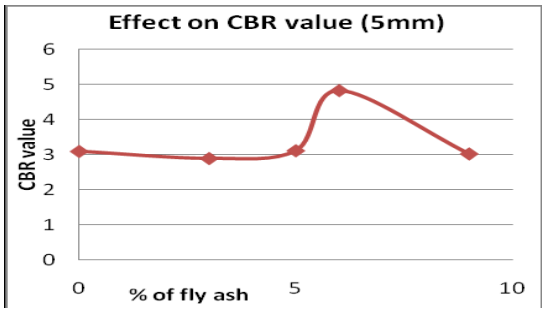

Fig. 11 variation of CBR with addition of fly ash to laterite soil (Karthik et al 2014)

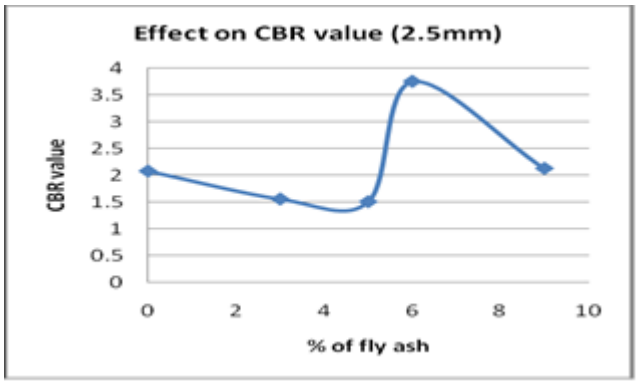

Fig. 12 variation of CBR with addition of fly ash to laterite soil (Karthik et al 2014)

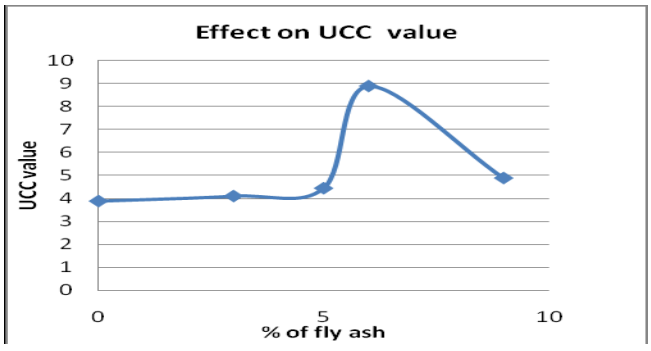

Fig. 13 variation of UCS with addition of fly ash to laterite soil (Karthik et al 2014)

Afaf Ahmed (2014**):** The work was carried in fly ash utilization in soil stabilization. In this study, clay soil was

stabilized for the construction of durable urban roads is investigated using fly ash. It was found that the optimum ratio of the fly ash with clay soil under study was 15% by the weight of soil. The liquid limit and plasticity index reduction is 54.12%, 29.57% respectively. while results found to be the soaked CBR of the soil increased from 3 to 56 % .

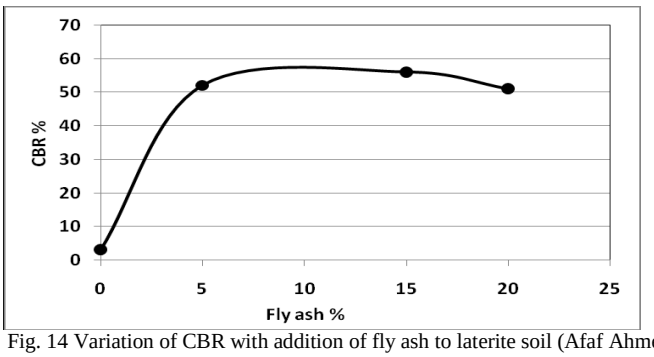

Fig. 14 Variation of CBR with addition of fly ash to laterite soil (Afaf Ahmed 2014)

F H M Portelina et al (2015**)**: Lateritic soils are widely spread in the Brazilian territory and they have been used as subgrade of pavement layers. Specifically, the Red-yellow laterite soils are usually clayey soils and are characterized as low bearing capacity material for flexible pavement layers. The solution of that type of soil was stabilized by hydrated lime or Portland cement has been used as pavement layered reinforcement. Whenever the addition of low contents of stabilizers the modification, of soil has not been applied on regular basis in highway designs. The workability, chemical properties, mechanical behavior and mineralogical composition were evaluated. Experimental results showed that addition of 2% and 3% of lime or cement was enough to change the soil workability and its mechanical strength. Additionally, mechanistic analyses supported the soil modification technique as valuable practice with low elastic strains in the asphalt layer when applied in pavement base layers.

Rathan et al (2016): in this paper studied stabilization of soil using rice husk ash. In today scenario, lack of stable ground for development of infrastructures is very common. They studied the behaviour of problematic soil to the addition of Rice Husk Ash. The rice husk ash is mixed with soil in various proportions like 5%, 10%, 20%, 30%, 40%, 50% and 80%. The various tests were conducted on these proportions and optimized proportion is arrived. When increased % of RHA decreased the liquid limit and swell index from 59% to 13.6%.An addition of 80%of RHA to clay soil the CBR value in unsoaked condition increased from 3.2 to 9.3% and soaked condition 2.4 to 4.4%.In case of alluvial soil the CBR value increased from soaked and unsoaked condition 2.4% to 6.4%, 3.2% to 12% respectively.

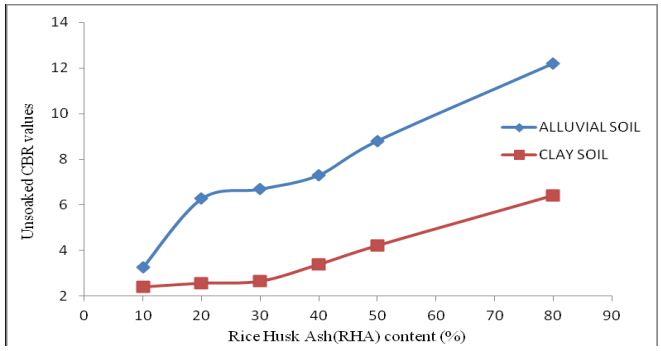

Fig. 15 variation of CBR with addition of rice husk ash to laterite soil (Rathan et.al.2016)

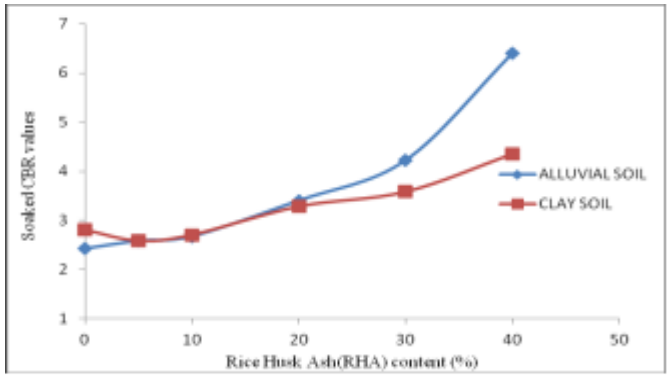

Fig. 16 Variation of CBR with addition of rice husk ash to laterite soil (Rathan et al 2016)

Oormila.et al (2014): the work was carried out in stabilization of the soil using granulated grounded blast furnace slag (GGBS) and fly-ash. They conducted unconfined compressive strength and California Bearing Ratio test on soil with different dosages of GGBS (15%, 20%, and 25%) and fly-ash (5, 10%, 15%, and 20%) respectively. They found that maximum CBR value was achieved by blending 20% GGBS.

Olugbenga et al (2011): The suitability and lime stabilization requirement of selected samples of lateritic soil as pavement construction materials are studied in this paper. Three samples A, B, and C collected from a dam site and stabilized with 0 to10% of lime with 2% of increment were subjected to basic test such as natural moisture content, specific gravity, particle size analysis and Atterberg limits and strength tests such as compaction, California bearing ratio, unconfined compression and un drained triaxial. Observed basic test results the samples are poor to pavement construction. The samples A, B and C was improved by optimum lime stabilization at 8, 6, and 6% respectively. The addition of lime to the samples caused a reduction in the plasticity indices of the samples. The CBR value of A and C has been increased. The compressive and shear strengths were also improved. The uncured compressive strength of B improved from 119.13 kN/m^2 at 0% to 462.81 kN/m^2 at 6% lime and then they concluded that samples A and B were suitable for base materials and sample C was suitable for sub-grade material in pavement construction. In this research they carried a study on the characteristics of bamboo leaf ash stabilization on lateritic soil in highway construction. The basic tests were performed on three samples, A, B, and C. Test are carried out on this soil for the

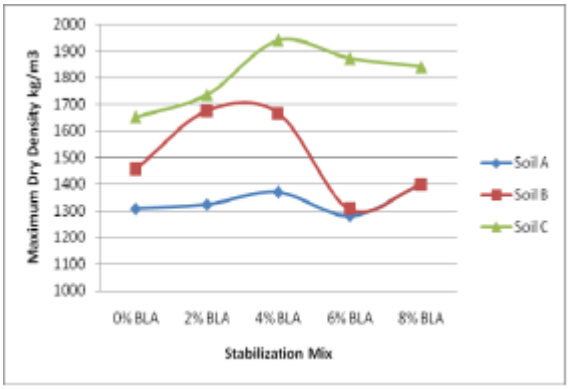

Fig. 17 Variation of MDD with addition of BLA to laterite soil (Olugbenga et al 2011)

compaction, California bearing ratio and triaxial for 3 samples both at the stabilized and unstabilized condition. By adding 2,

4, 6, 8 and 10% bamboo leaf ash (BLA) by weight of sample to the soils. The results showed that the addition of BLA improved the strength of the samples. The unsoaked CBR values of sample A increased from 5.44 to 38.21% and B from 11.42 to 34.99%. The shear strengths of sample A increased from 181.31 to 199.00 kN/m^2 and B from 144.81 to 155.90 kN/m^2.Then it was concluded that bamboo leaf ash has a good stabilizing agent for lateritic soils in highway construction.

Ramesh et al (2011**):** Studied on strength parameter of shedi soil treated with Neyveli fly ash. The dosage of NFA was 0 to 40% with an increment of 10%, carbide lime was 0 to 15% with an increment of 5% and sodium chloride fixed for 1%.the optimum results are obtained 20% of NFA+5% of carbide lime+1%NaCl.studied on density and compaction effort of shedi soil treated with Neyveli fly ash, carbide lime and sodium chloride. The graph indicates that variation of unconfined compressive strength of shedi soil treated with 20% NFA for soaked and unsoaked condition. The UCC strength of NFA alone for both soaked and unsoaked condition is very much higher compared to soil alone. With the addition of 20% of NFA the strength of shedi soil increases with the both soaked and unsoaked conditions.

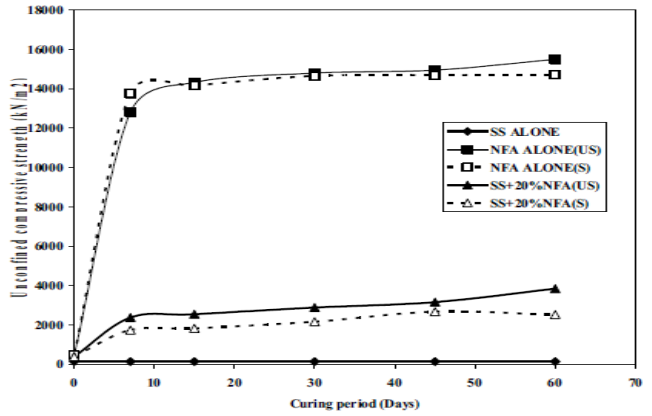

Fig. 18 Variation of UCS with addition of NFA for lithomargic soil (Ramesh et al 2011)

Shriram et al (2015): Studied on modified of shedi soil using cement and rubber tyre chips. They are used ordinary Portland cement 53 grade as binding material

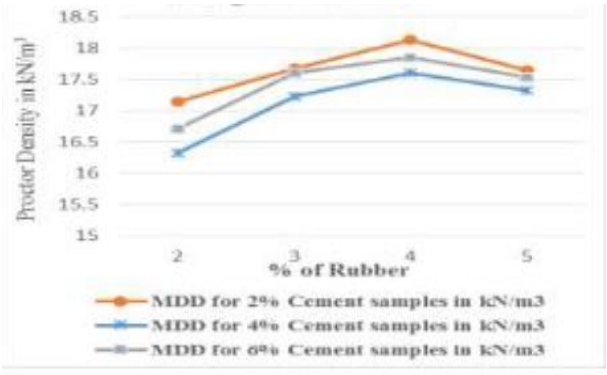

Fig. 19 Variation of MDD with addition of cement and rubber tire chips for lithomargic soil (Shriram et al 2015)

addition to chips to modify the shedi soil. They are to determine the geotechnical properties the following evaluation are carried out such as specific gravity, consistency limit, grain size distribution, un confined compressive strength ,California bearing ratio. The engineering and index properties obtained maximum of 4% of rubber tyre chips+2% of cement. The CBR value increases 19.04% to 37.57%.The graph indicated that maximum dry density initially increases with increase the percentage of rubber up to maximum value and then further decreases and UCC strength increased from 61.01kPa for 0 day curing period to 193.21kPa for 28 day curing period.

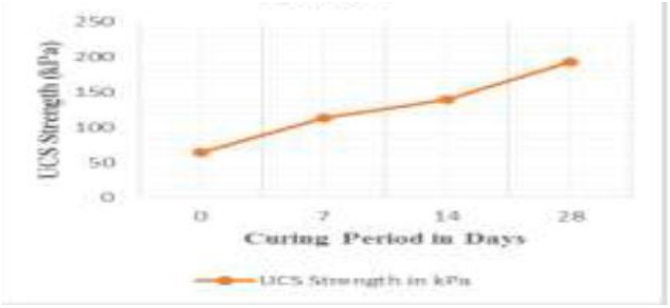

Fig. 20 Variation of UCS with addition of cement and rubber tire chips for lithomargic soil (Shriram et al 2015)

Ramesh et al (2018): studied on effect of laterite soil in addition of rice husk ash and carbide lime. For in this study 5, 10,15,20,25 and 30% of rice husk ash added to shedi soil and carbide lime is 2, 4, 6,8,10 and 12%.Experimental tests conducted on liquid and shrinkage limit in a combination of 20% of rice husk ash+6% of carbide lime obtained better performance and further they added 1% of sodium salt to soil marginally increasing the liquid limit and shrinkage limit. The shrinkage limit increases 33 to 57% and liquid limit 45 to 67%. Hence they concluded that better resistance to shrinkage and liquid limit in shedi soil to addition of carbide lime, rice husk ash and sodium chloride salt. They are conducted the UCC strength in treated soil with rice husk ash and carbide lime are separately. Treated the carbide lime give the better performance immediate as well as after 7 days curing.

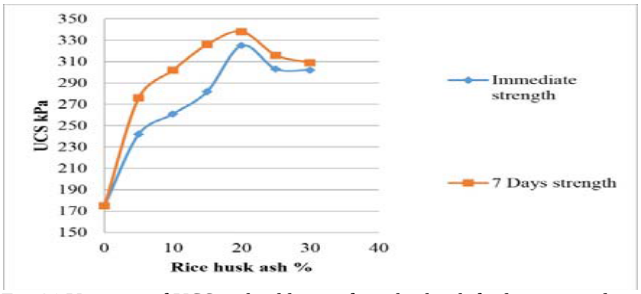

Fig. 21 Variation of UCS with addition of rice husk ash for lateritic soil in immediate and 7 days strength (Ramesh et al 2018)

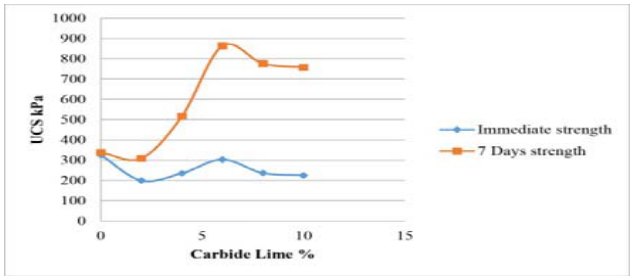

Fig. 22 Variation of UCS with addition of carbide lime for lateritic soil in immediate and 7 days strength (Ramesh et al 2018).

Sitaram et al (2012): Studied on effect cement and quarry dust in shear strength and hydraulic characteristics of the lithomargic clay after modification. Micro fabric and

mineralogical studies were carried out using the XRD and SEM analysis. They used ordinary Portland cement of 2.5 to 10% with an increments of 2.5% .the addition of 10% of cement liquid limit and plasticity index is reduced to 22.6%, 81.9% respectively and sharp improvement of shear parameter like angle of internal friction and cohesion% are 114%, 217% respectively. In addition of 50% quarry waste reduction of liquid limit and plasticity index are 50.5%, 75.4% respectively and improvement of shear parameters of angle of internal friction and cohesion are 43%, 67% respectively. The combination of 10% cement+50% of quarry dust liquid limit, plastic limit and shrinkage limit is 97.4%.SEM analysis concluded change in soil properties in addition to cement and quarry dust. The graph showed that the addition of 5% of cement content the angle of internal friction is 33 degree, cohesion 73.5kPa and normal stress is 73.5 kN/m^2 and reduction coefficient of permeability.

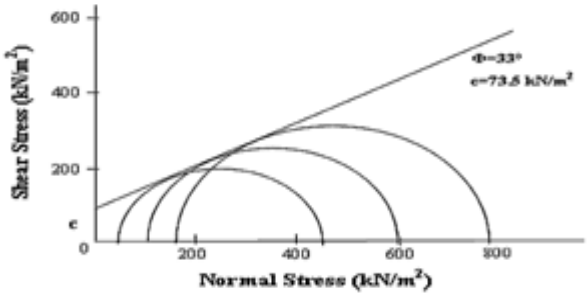

Fig. 23 Variation of the normal stress and shear stress with addition of cement and quarry dust for lithomargic soil (Sitaram et al 2012)

Srikanth et al (2018): Studied on strength characteristics of paper mill industrial waste of hypo sludge stabilized lithomargic soil. They studied experimental investigates the effect of hypo sludge on CBR and unconfined compressive strength of different percentages such as 2 to 8% with an increment of 2% had different curing period such as7,14 and 28th day. The 2% of paper mill waste increases the UCC and CBR value in both soaked and unsoaked condition compare to untreated soil. Hypo sludge increase the CBR value is 1.2 times in soaked and 2.7 times in unsoaked condition compare to untreated soil. The UCC increase 116.28kN//m^2 to 149.47 kN//m^2 and CBR value for unsoaked and soaked are increases 2.89 to 3.468%, 4.81 to 7.803% respectively. The graph showed that the addition of 2% sludge to obtained the maximum dry density and unconfined compressive strength.

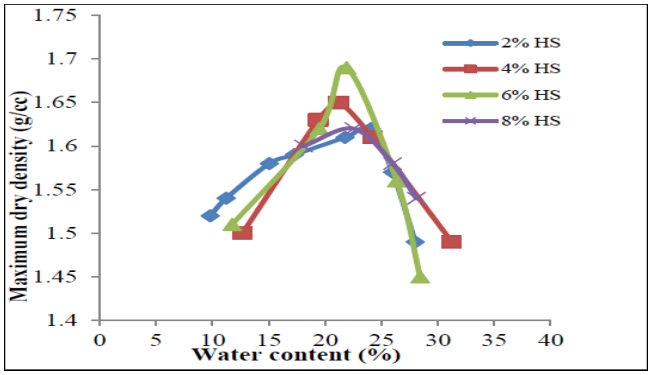

Fig. 24 Variation of the maximum dry density and optimum moisture content with addition of hypo sludge in different curing period for lithomargic soil (Srikanth et al 2018)

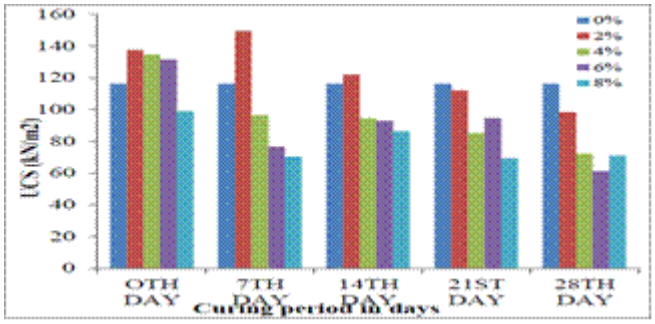

Fig. 25 Variation of the unconfined compressive strength with addition of hypo sludge in different curing period for lithomargic soil (Srikanth et al 2018)

Chidanand et al (2016): Studied on compaction and strength characteristics of shedi soil modified with thermal power plant waste and polypropylene.in this paper includes the experiments of shedi soil properties like optimum dry density, strength parameter for various proportioning of fly ash and polypropylene fibre by the weight of soil. The fibres are fixed for 2% and fly ash varies 10 to 40% with an increment of 10%.The increases strength parameter is 2% of fibre and 20% of fly ash.

Anilkumar et al (2015): studied on modification of lithomargic soil using industrial waste product such as fly ash and ground granulated blast furnace slag, sodium hydroxide flakes. The evaluation carried out UCC and CBR for various percentage of fly ash (0,10,15,20,25,30) GGBS(0,10,15,20,25,30) and sodium hydroxide flakes of 14M at the curing period of 0,1,3 and 4 weeks. They concluded that 14M of NaOH +20% of fly ash+20% of GGBS found the optimum strength for 28 days. The figure indicates the maximum dry density of lithomargic soil was found to be 14.81kN/m^3 and optimum moisture content was found to be 21% and UCC graph indicated that addition of stabilizer to increase the strength.

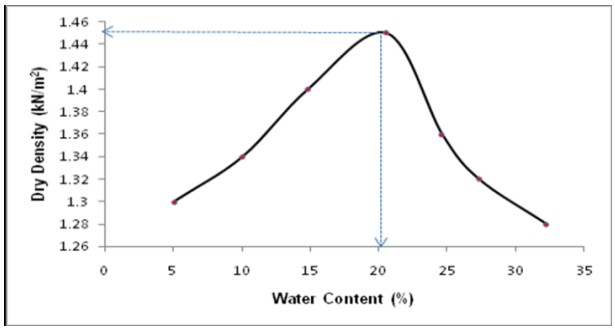

Fig. 26 Variation of the maximum dry density and water content with addition of fly ash, ground granulated blast furnace and sodium hydroxide flakes in different curing period for lithomargic soil (Anilkumar et al 2015)

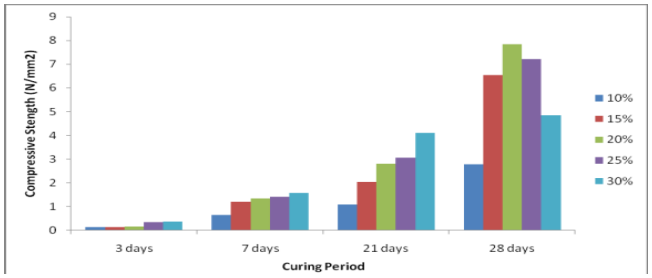

Fig.27 Variation of the unconfined compressive strength with addition of fly ash, ground granulated blast furnace and sodium hydroxide flakes in different curing period for lithomargic soil (Anilkumar et al 2015)

Shaik et al (2018): Studied on treated the shedi soil using sulphur sludge and silica fume.in this paper they have various percentage of sulphur sludge such as 10,15 and 20% and silica fume such as 1 and 2%. They conducted various test to determine the index and engineering properties of treated soil. The optimum result obtained by 20% of silica sludge and 2% of silica fume. The graph indicate the addition of 2% percentage of silica fume increase the strength compare to the addition of 1% silica fume it shows in figure 28.

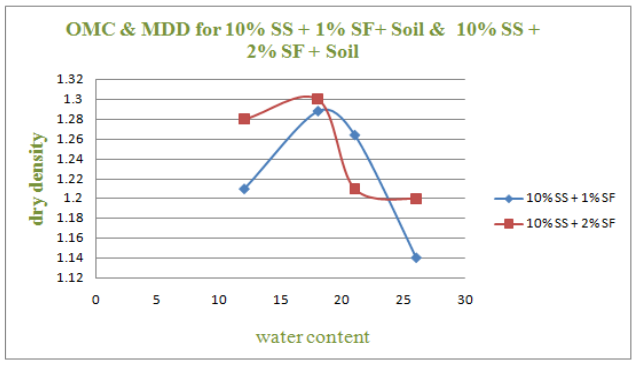

Fig. 28 Variation of the OMC and MDD with addition of 10%SS+1% SF+ soil and 10%SS+2%SF+soil (Shaik et al 2018)

Suresh et al (2009): Studied on laboratory investigation of strength parameter of shedi soil treated with solid industrial waste of pond ash and coir fibre. They conducted specific gravity, grain size distribution, consistency limit, strength parameters and California bearing ratio test. The solid waste treated with soil in a different dosages like 0 to 60 % with an increment of 10% and coir fibre carried manually. The optimum results are obtained 20% of solid waste and 0.8% of coir fibres the unconfined compressive strength found to be 350kN/m^3.

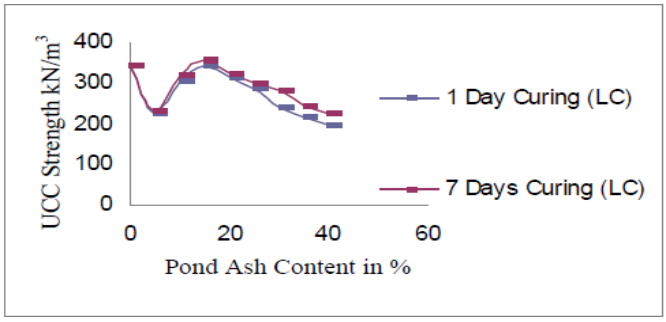

Fig. 29 Variation of UCS with addition of pond ash for lithomargic soil (Suresh et al 2009)

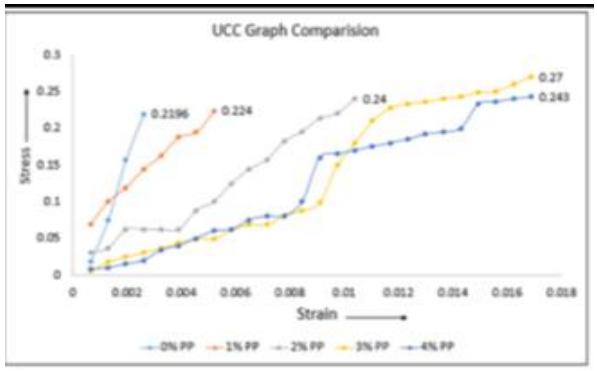

Fig. 30 Variation of CBR with addition of strips for lithomargic soil (Prasanna et al 2018)

Prasanna et al (2018): Studied on polypropylene strips used to modifying the lithomargic soil. Polypropylene is a combination of polymer and filler material, they are highly chemically inert with all types of soil. the dosages of polypropylene various from 0 to 4% with an increment of 1%.the results showed that addition of 4% the CBR value decreases compare to addition of 3% strips and addition of 3% UCC strength maximum compare 4% ,hence they concluded 3% of strips would gave the maximum strength of soil.

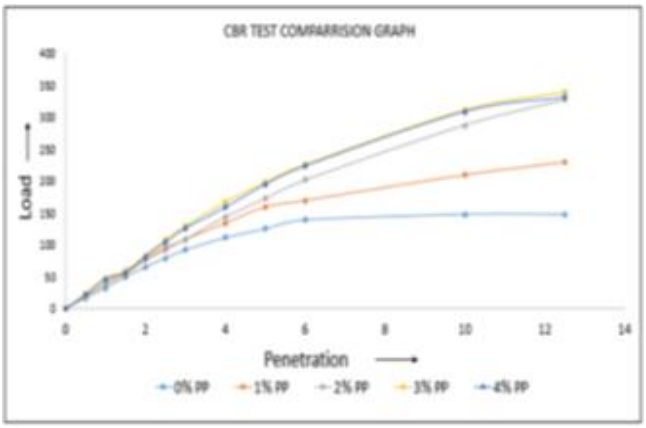

Fig. 31 Variation of UCS with addition of strips for lithomargic soil (Prasanna et al 2018)

III. Conclusions

The stabilization of soil is very much essential for achieving adequate stability of the foundation. To achieve this, it is very much essential to modify the existing weak mechanical properties of the soil by using the various available soil stabilization techniques. The effectiveness of the individual method depends on the existing properties of the soil. Thus by choosing the appropriate ground improvement method, the weak soft soil can be effectively stabilized to achieve the strong and durable foundation. In pavements, an economical pavement design can be achieved due to reduced thickness due to stabilized subgrade.

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