ASRITE

Annual Symposium on Research and Industrial Training of Department of Electronics

Proceedings of 5th Annual Symposium on Research and Industrial Training of Department of Electronics

09th March, 2018

Department of Electronics

Faculty of Applied Sciences

Wayamba University of Sri Lanka

Kuliyapitiya, 60200

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Foreword

It is with deep satisfaction that I write this foreword to the proceedings of the 5th Annual Symposium on Research and Industrial Training of Department of Electronics (ASRITE) 2018 at the Faculty of Applied Sciences, Wayamba University of Sri Lanka. This symposium is the platform for undergraduates of the Department of Electronics to share their research findings acquired through the final year research and six-month Industrial Training, where they produce optimal solutions for practical research problems in their training industries.

The symposium represents the effort of many people, and I would like to express my gratitude to Prof. E.M.P Ekanayake, the Vice Chancellor of Wayamba University of Sri Lanka and Dr. L.D.R.D Perera, Dean of the Faculty of Applied Sciences for their guidance and support. Moreover, I should thank Prof. (Mrs). G.A.K.S Perera, Coordinator of ASRITE-2018, Prof. K.P Vidanapathirana, Research Coordinator, and Dr. U.S Liyanarachchi, Industrial Training Coordinator of the Department for their hard work. I also thank all the academic staff members of the Department for supervision and revising papers for this proceedings. My thanks goes to Dr. H. Suraweera for accepting our invitation for the keynote speech of the event, and all evaluators for their valuable service for chairing and evaluating presentations. Finally, the symposium would not be possible without excellent papers contributed by authors and their presentations. I thank all the presenters and their participation in ASRITE – 2018.

I hope that this symposium will further stimulate graduates to undertake research in various fields of Electronics for the development of their career and contribute to the development of the country.

Dr. W.A.S Wijesinghe
Head / Department of Electronics

CONTENTS

SESSION 01

Track 03

Track 04

SESSION 02

Proc. Annual Symposium on Research & Industrial Training, 05(2018) 1-6
Department of Electronics – Wayamba University of Sri Lanka

FABRICATION AND EVALUATION OF AN ELECTROCHEMICAL DOUBLE LAYER CAPACITOR

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ABSTRACT

At present, demand for power sources is increasing rapidly due to high usage of electronic equipment. Therefore, there is a considerable attention focussed on energy storage devices to fulfil the thirst for power. When energy storage is considered, batteries and capacitors are in the forefront. Various types of modification have been done for batteries and capacitors to improve their performance. Emerging of supercapacitor is one of the results of such attempts.

Supercapacitors are capable of handling more than standard capacitors. In general, two types of supercapacitors namely electro-chemical double layer capacitor (EDLC) and redox capacitors. In the present study, performance of an electro chemical double layer capacitor based on natural graphite and a gel polymer electrolyte (GPE) is reported. GPE was consisted with polyvinylidene fluoride, ethylene carbonate, propylene carbonate and zinc chloride. Composition of GPE was fine tuned to obtain the highest room temperature conductivity. Configuration of the EDLC was graphite: GPE: graphite. The capacitor was characterized using Cyclic Voltammetry tests, Galvanostatic Charge-Discharge test and Impedance Spectroscopy. The composition 275 PVdF: 40 $ZnCl_2$: 500 EC: 500 PC (by weight %) showed the highest room temperature conductivity of $8.68 \times 10^{-4} SCm^{-1}$. Results showed that the fabricated supercapacitor was rather stable even though the obtainable capacity value was not very high.

Keywords**:** Electro-chemical double layer capacitor, Graphite, Gel polymer electrolyte

1. INTRODUCTION

At present, demand for power is increasing day by day due to high usage of electronic equipment in the modern technological society. Accordingly, much research focus was on energy storage devices during past several years. Batteries and capacitors which have been serving as popular energy storage devices have undergone various modifications [1,2,3].

Emerging of supercapacitor is one of the result of such attempts. Supercapacitors which lie in an intermediate state between batteries and conventional capacitors offer power densities higher than batteries and energy densities higher than normal capacitors. Due to the fast energy delivery, short charging time, high power capability and environmental friendliness, they have received a considerable global attraction. Supercapacitors are already used in numerous applications, such as portable consumer electronics, computer power backups, hybrid electric vehicles, medical equipment and space crafts [4, 5].

There exist two types of super capacitors namely, electrochemical double layer capacitors (EDLCs) and redox capacitors , based on the type of electrode material employed. They have their own working principles and charge storage mechanisms. For redox capacitors, conducting polymers or transition metal oxides are used as the electrodes. EDLCs are consisted of two electrodes of graphite and carbon based materials. Conducting polymers provide higher capacitance and higher power capability than graphite based electrodes [6]. EDLCs are very much considered as low cost environmental friendly category of energy storage devices. It is mainly, because of using carbon based electrodes. Unfortunately, many of EDLCs are consisting with liquid electrolytes which carry a large number of drawbacks. As viable alternatives, gel polymer electrolytes (GPEs) are receving a major attention due to their unique features compared to liquid electrolytes.

In this reserch paper , it is reported about the fabrication of a EDLC based on a GPE and natural graphite electrodes.

2. EXPERIMENTAL

2.1 Preparation of the electrode

The cathode material was composed of graphite, polyvinylidene fluoride (PVdF) by weight ratio in 18:3. The sample was prepared by mixing graphite, PVdF with some acetone. The sample mixture was stirred in a magnetic stirrer for 3 and 1/2 hours continuously. Slurry was deposited on FTO glass plates of area 1 cm^2.

2.2 Preparation of the GPE

GPE was consisted with polyvinyldine fluoride (PVdF) (Aldrich), zinc chloride ($ZnCl_2$) (Aldrich), ethylene carbonate (EC) (Aldrich), propylene carbonate (PC) (Aldrich). Starting materials were magnetically stirred well and heated inside a glass tube furnace. The hot mixture was pressed in between two glass plates to obtain a bubble free thin film [7].

2.3 Evaluation of the performance of GPE

Varying polymer, salt concentration, samples were prepared and room temperature conductivities were calculated using impedance data. A thin circular shape electrolyte film was loaded in between two stainless steel electrodes of a brass sample holder. Impedance data were gathered using Metrohm Impedance Analysis at room temperature in the frequency range 400 kHz to 0.01Hz.

2.4 Fabrication of the EDLC

EDLC was fabricated by using two electrodes and a GPE having same area. Configuration was in the form of graphite/ GPE/ graphite.

2.5 Analysis of the EDLC

Cyclic voltammetry tests were carried out for the EDLC in the potential range 0.7 - (-0.7) V using a computer controlled potentiostat/galvanostat. One electrode served as the working electrode and the other as both the counter and reference electrodes. Using cyclic voltammogram, specific capacitance was calculated by the equation, $C_s = 2\int idv/m(\Delta V)S$. where, C_s is the specific capacitance (F/g), $\int idv$ is the integrated area of the CV, m is the mass of one electrode, ΔV is the voltage window and S is the scan rate[7].

Continuous Galvanostatic Charge and discharge (GCD) tests were carried out to check the ability to withstand long term cycling. The maximum charge and discharge current were set to 25μA. The potential window was from 0 V to 0.5 V. Using the charge discharge curve, the discharge capacitance of the EDLC (C_d) was calculated using the equation, $C_d = i(\Delta t/\Delta V)$ [5]. Here i is the constant current while $(\Delta V/\Delta t)$ is the ratio of the potential drop excluding IR drop. For each test, specific capacitance was determined using the weight of a single electrode [8].

3. RESULTS AND DISCUSSION

Figure 1 shows the variation of room temperature conductivity with PVdF concentration. Room temperature conductivity first increases and then decreases with PVdF concentration. The maximum conductivity (σ) occurs at 275 mg of PVdF. When increasing the PVdF concentration, assistance for ion motion from polymer network may increase. This might be the reason for initial conductivity increases. As PVdF concentration increases further, viscosity of the system may increase, so that there can be a resistance for ion motion. Due to this, the conductivity may be reduced.

Figure 2 depicts the variation of room temperature conductivity with $ZnCl_2$ concentration. When $ZnCl_2$ concentration increases, conductivity increases followed by a decrease after the $ZnCl_2$ concentration of 40. Initial increment may be due to the increase of ion concentration which assists conductivity greatly. Further increment of $ZnCl_2$ may lead to formation of ion clusters which are in neutral state and not supporting ion conduction.

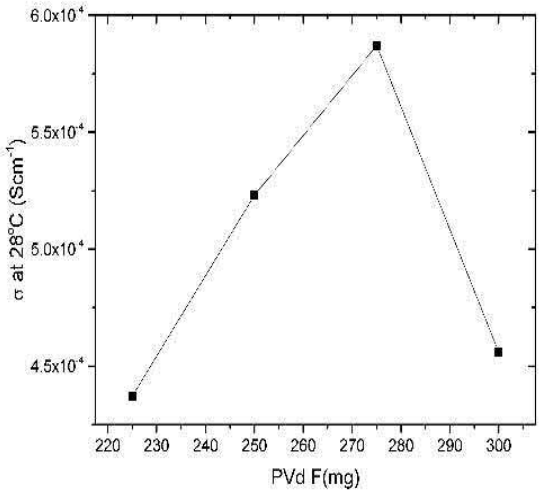

Fig. 1 Room temperature conductivity variation with PVdF concentration

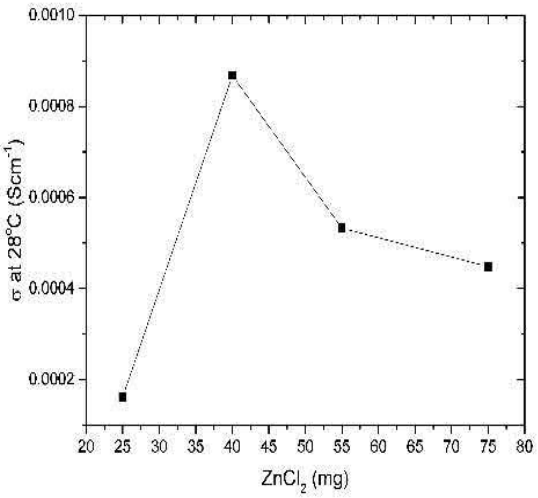

Fig. 2 Room temperature Conductivity variation with ZnCl2 concentration

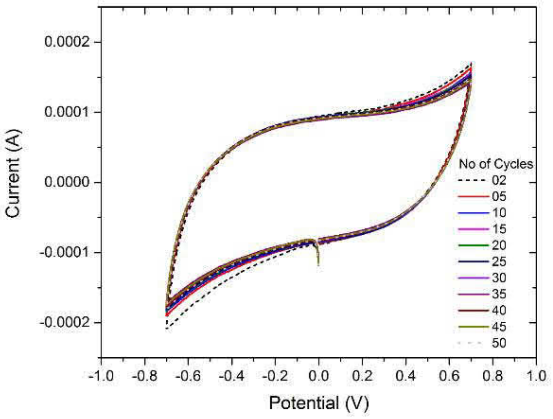

Fig. 3 Cyclic voltammogramms for the EDLC Scan rate 50 mV/s

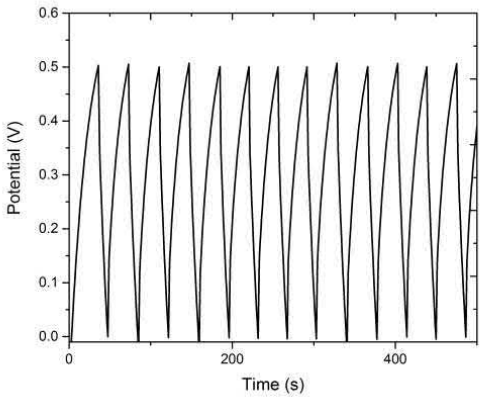

Fig. 4 Galvanostatic charge discharge curve of EDLC

The maximum room temperature conductivity of 8.68 $x10^{-4}$ Scm^{-1} was obtained with the GPE composition of 275 mg of PVdF and 40 mg of $ZnCl_2$ with 500 mg of EC and PC each.

Cyclic Voltammetry test was carried out for 6 cycle windows. The best cycle window was selected as the 0.7 – (-0.7) V. In that window, continuous cycling was done to check the stability of the EDLC. Figure 3 shows the resulting cyclic voltammograms and it is seen that they have a rectangular shape evidencing the characteristic shape of an EDLC. Upon continuous cycling, the shape is not disturbed. This well proves the stability of the EDLC. The specific capacitance values of the each scan were also nearly same. It was 2.0 F/g. It can be concluded that is the fabricated EDLC is rather stable.

Continuous Galvanostatic Charge and discharge (GCD) tests were also carried out to check the ability to with stand long term cycling. Results are illustrated in figure 4.

First, EDLC was discharged to 0 V and then charged to 0.5 V. The average C_d of the EDLC was 0.84 F/g. This is quite a low value. But, the shapes of the GCD curves remain same showing a rather stable behavior. Also, the obtained C_d is quite comparable with the Cs obtained with CV study.

4. CONCLUSION

According to the study, optimized composition of the gel was PVdF 275 mg, $ZnCl_2$ 40 mg, EC: PC 500 mg each. Maximum room temperature conductivity of the optimized sample was 8.626 x 10^{-4} Scm^{-1}. Continuous cyclic Voltammograms were obtained within the potential range of -0.7- (0.7) Vat a scan rate of 50 mv/s. According to the Cyclic Voltammetry test the highest value of C_s was 2.0 F/g. C_d was 0.84 F/g.

ACKNOWLEDGEMENTS

Authors would like to extend their sincere thanks to all the staff members of the Department of Electronics, Wayamba University of Sri Lanka. Also the assistance given by National Research Council, Sri Lanka, National Science Foundation, Sri Lanka, University Grants Commission, Sri Lanka and Wayamba University of Sri Lanka are highly acknowledged.

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Proc. Annual Symposium on Research & Industrial Training, 05(2018) 7-11
Department of Electronics – Wayamba University of Sri Lanka

MULTI FUNCTIONAL REMOTE CONTROL MODULE

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ABSTRACT

Remote controlling can be often seen in day to day life today. For many appliances, the remote controller comes with the installation from the service provider. These remote controllers are specifically designed to perform certain specific tasks. An IR based multi-purpose remote controller module which can be used to control several day-to-day household tasks was designed. With this remote controller it was targeted to switch on or off lights, open or close a gate and change channels, increase/decrease volume and switch on or off a Television. Also, it can power on/off an Air Conditioner and increase/decrease temperature. This is an application where a compact device can perform multiple operations. This remote controller was designed using Arduino Uno board, LCD Display shield with five push buttons, IR receiver and IR transmitter. This remote controller can decode signals from the remotes of Televisions and Air conditioners and then transmit the decoded signals to operate them. The decoded signals are saved in Arduino Atmega 328 IC. The designed remote controller is low cost and saves both time and effort.

Keywords: Infrared (IR)**,** Remote controller

1. INTRODUCTION

Traditionally electrical appliances in a home are controlled via switches that regulate the Electricity to these devices. As the world gets more and more technologically advanced, we find new technology coming in deeper into our personal lives even at home. Home automation is becoming more and more popular around the world and is becoming a common practice. The process of home automation works by making everything in the house automatically controlled using technology to control and do the jobs that we would normally do manually. Home automation takes care of a lot of different activities in the house.

Day today activities such as opening a Gate, switch ON/OFF a bulb, switching on the water motor are done using manual switches. A multifunction remote control module can easily replace above requirements at the home.This remote was designed using Arduino Uno board, LCD Display shield with five push buttons, IR receiver and IR transmitter. This remote can decode signals from the remotes of Televisions and Air conditioners and then transmit the decoded signals to operate them. The decoded signals can be saved temporarily in Arduino Atmega 328 IC RAM memory. This multifunction remote controller can decode signals from popular brands such as Sony, Panasonic, LG, Sharp etc. Also, it can decode signals from unknown brands which use 38 kHz band. We can just program the remote and use it [1, 4].

2. EXPERIMENTAL

The block diagram of the proposed system is shown in the figure 1.

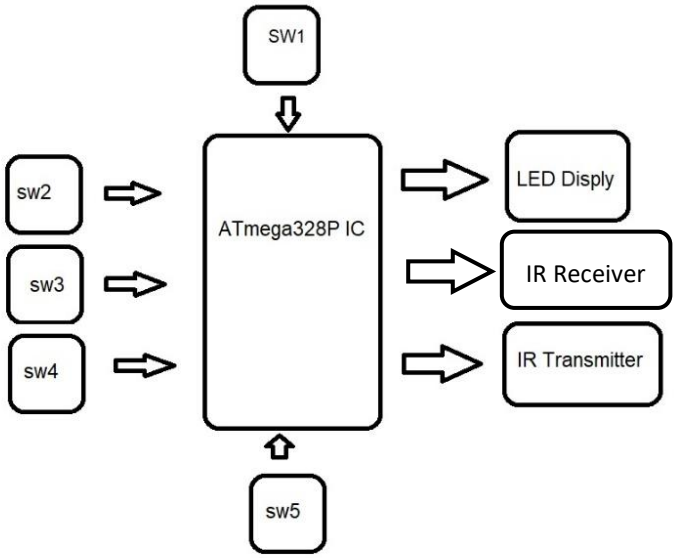

Fig. 1 Block diagram of the system

First the waves belonging to different remote controllers were decoded using Arduino board. The easiest way to obtain codes to work with a device is to use a library to decode and print the codes from existing remotes. Various libraries of codes are available online, often in proprietary formats. There are cases where a particular manufacturer may use the same codes for multiple products.

S1, S2, S3, S4, S5 indicate the switches in the remote. Arduino ATmega 328 IC is connected to the switches and a 16*2 LCD display. Also there is an IR Transmitter and Receiver. LCDdisplay indicates the status of the remote: Television mode, Air conditioner mode or

switching mode to open/close gate and power on/off bulb. The users can access relevant functions using five buttons.

The code was written by decoding the hexadecimal value of frequencies of each of the remotes. These values are entered in a temporary data base. When we call the desired function, the hexadecimal value of the function is selected from the database and the specific signal is transmitted [2].

The IRrecv library consists of two parts. An interrupt routine is called every 50 microseconds, measures the length of the marks and spaces, and saves the durations in a buffer. The user calls a decoding routine to decode the buffered measurements into the code value that was sent (typically 11 to 32 bits). The decode library tries decoding different protocols in succession, stopping if one succeeds. It returns a structure that contains the raw data, the decoded data, the number of bits in the decoded data, and the protocol used to decode the data [3].

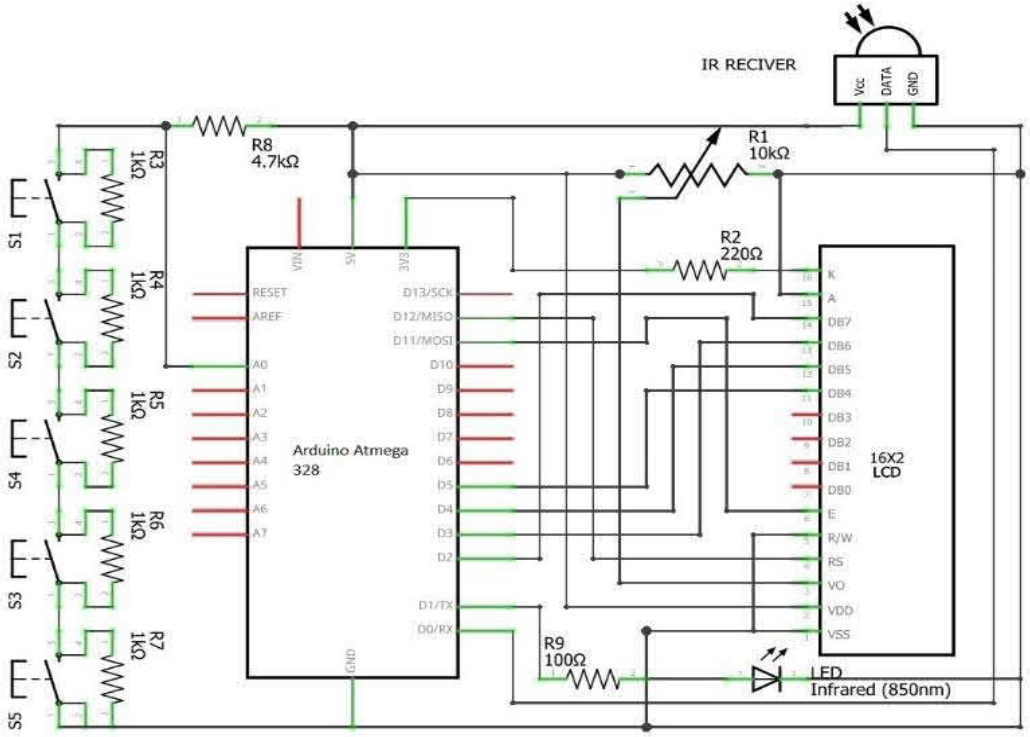

Fig. 2 The circuit diagram of the system

3. RESULTS AND DISCUSSION

The designed remote controller can control up to three devices at home and it has the ability to control the volume of the TV, and change the TV channel, switch on or switch off a bulb and open or close a gate. By adding other decoded functions, the functions can be increased. The total cost spent on the project was less than Rs.2000 and therefore the implementation would be economical. The maximum transmission distance is 5m. When using for a television, the maximum time delay of 5ms was observed in changing a channel.

If transmitter isn't working, first we have to make sure the IR LED is actually transmitting. IR will usually show up on a video camera or cell phone camera, so this is a simple way to check. We can try putting the LED right up to the receiver. The next potential problem is if the receiver does not understand the transmitter, for instance if we are sending the wrong data or using the wrong protocol. If we have a remote, we can use a library to check what data it is sending and what protocol it is using.

The Sony and RC5/6 protocols specify that messages must be sent three times. It was found that receivers will ignore the message if only sent once, but will work if it is sent twice. For RC5/6, the toggle bit must be flipped by the calling code in successive transmissions, or else the receiver may only respond to a code once.

If receiver is not working, first make sure the Arduino is at least receiving raw codes. The LED on pin 11 of the Arduino will blink when IR is being received. If not, then there is probably a hardware issue. If the codes are getting received but cannot be decoded, make sure the codes are in one of the supported protocols. If codes should be getting decoded, but are not, some of the measured times are probably not within the 20% tolerance of the expected times.

The designed remote controller can be develop for various devices with IR remotes such as Fans, Stereo setups, DVD players etc. Memory of this Multifunctional remote can be expand using external storage to save decoded frequency signals of several devices such as Televisions and Air conditioners.

The major limitation of the designed remote controller is that it can decode the signals which are working at 38kHz range and the decoded signals were deleted when remove the batteries of the remote because Arduino board has only 1KB RAM memory.

4. CONCLUSIONS

The proposed Multi-Function Remote controller is user friendly and cheaper. With this design, user can easily operate different electronic appliances by using a single remote controller. The

electronic appliances controlled are TV, AC, Gate & Bulb, and user can also open the gate from outside and inside the home.

An IR receiving diode decodes waves related to each type of conventional remote. This technique was used for above mentioned electronic devices. A database was created by adding hexadecimal values of different functions of different remote controllers. A user can select necessary function from the menu by using the buttons, and waves corresponding to selected function are then transmitted by IR transmitter to the electronic equipment.

ACKNOWLEDGEMENTS

Authors would like to extend their sincere thanks to all the staff members of the Department of Electronics, Wayamba University of Sri Lanka and to all those who supported in this project.

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Proc. Annual Symposium on Research & Industrial Training, 05(2018) 13-18
Department of Electronics – Wayamba University of Sri Lanka

AUTOMATED WATER PUMP CONTROL SYSTEM FOR TUBE WELLS

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ABSTRACT

Technology plays an essential role all around the world today. Each and every aspect of the human life is impacted by the technology in numerous ways. With the enhancement of the technology, household applications are changed rapidly by using automated methods. Water is used for a variety of purposes which are sourced from both above ground sources and underground sources. Water pump is one of the easiest ways to move water from ground level to the roof-top level. There are many automatic pump controller systems used in normal house-hold pumps. These controller systems cannot be used for tube wells because of their irregular water supply. This paper describes pump control system suitable for tube wells that works without any manual interference.

Keywords: Tube well, Automated water pump

1. INTRODUCTION

Water covers a larger area of the earth, but it is not easily available for human to use, due to its composition and distance from place of necessity. And also the sustainability of available water resources of the world is now a major issue. These matters have led to the attempt of storage of water. Various water storage methods from water resources engage the use of a water pump to help its transportation during storage.

With the need of water pump, efficient use and water management are potential necessities for water pump controlling system. Last few decades lot of pump controlling systems integrated with water level detection have become accepted. Most people are using manual systems to achieve their needs of water and face many physical challenges in order to successfully maintain the functionality of their water pump system. Therefore people are interested in an automated pump control systems [1].

This paper is aimed at developing an automated water pump control for a tube well. One of the motivations for this research was the need to bring a solution to the problem of water pump controller for a tube well, because of the un-continuous water supply due to limited water storage in them. This system can control a water pump which inside a tube well. After processing input variables that are sent by water sensors, which are positioned at both tube well and overhead tank, resultant output decides the water pump's action (on/off) with respect to current water status of the tank.

2. EXPERIMENTAL

In this project, the automated water pump controller consists of the following major units: Sensor unit, microcontroller unit, Pump control unit and the power supply unit. The diagram below describes the flow of operations in the system as well as their inter-operability

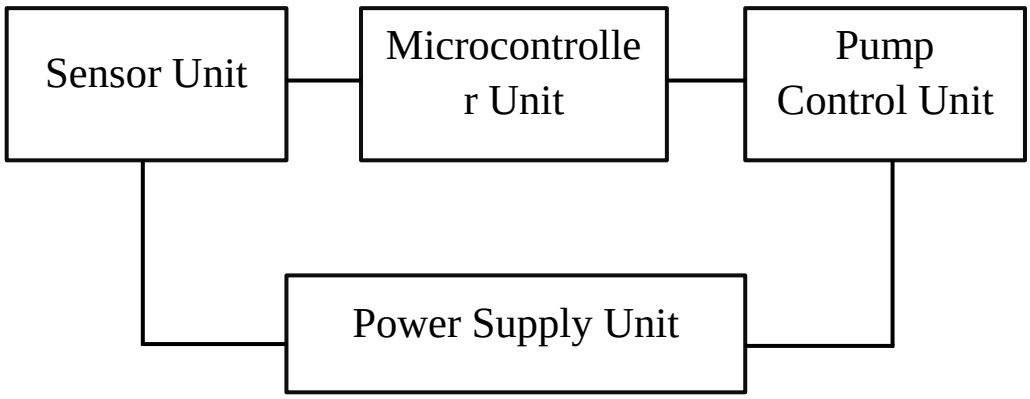

Fig. 1 Block Diagram of the System

Sensor Unit

Sensor unit consists of two water sensors. One sensor is positioned at the bottom of tube well and other sensor is placed at top of the overhead water tank. Moreover, these water sensors are composed with two conductivity probes, transistors, resistors etc. These sensors sense the availability of water using the advantage of the electrical conductivity property of water and give the signal to the microcontroller as input signal. These water sensors detect whether the water is available or not. Here, two homemade water sensors were used to reduce the cost and complexity.

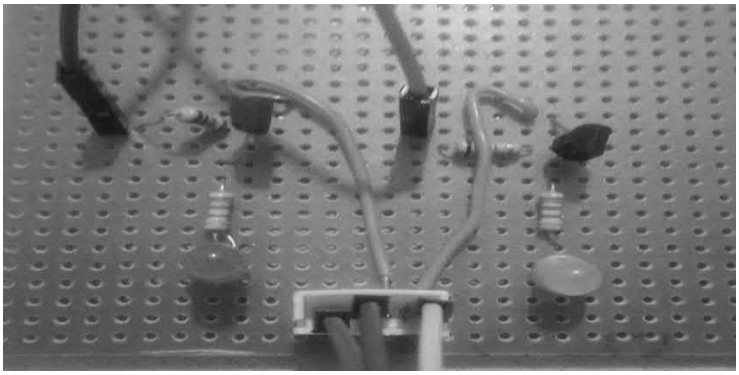

Fig. 2 Designed water sensor unit

Microcontroller Unit

Microcontroller unit does the controlling part of the system. This is the brain of the system. Therefore, proper selection of a microcontroller is very important. Here, TM4C123GH6PM is used as the microcontroller due to its special features. The TM4C123GH6PM is a 32-bit ARM Cortex-M4-based microcontroller with 256-kB Flash memory, and 80-MHz operation, USB host device and a wide range of other peripherals. Here the system architecture of this microcontroller consists of Micro Direct Memory Access (μDMA), General-Purpose Timer (GPTM) six 16/32-bit GPTM blocks and six 32/64-bit Wide GPTM blocks, Watchdog Timer (WDT) with two watchdog timers, Hibernation Module (HIB) low-power battery-backed Hibernation module and General-Purpose Input/ Output (GPIO) Six physical GPIO blocks. Some special features of GPTM and GPIO were used to implement this system [2].

Pump Control Unit

The necessity of a water pump is to pump water from tube well to rooftop tank. Here Ultra-Quit Mini DC 12 V brushless water pump is used. Power consumption of the pump is 4.2 W with a maximum rate current is 350 mA. This pump is submersible and entirely waterproof with low consumption and low noise. The basic operation of control unit is the switching of water pump according to the microcontroller program written. Water pump can be controlled by connecting it with an output pin of microcontroller via a relay circuit.

Power Supply Unit

Power supply unit supplies the power to water pump and two water sensors. Supply voltage of the water pump and sensors are 12 V DC. 12 V power module has been used to provide power to the water pump and the sensors. Launchpad requires 4.75 V DC- 5.25 V DC and it is sourced by USB Device Micro-B cable (connected to a PC).

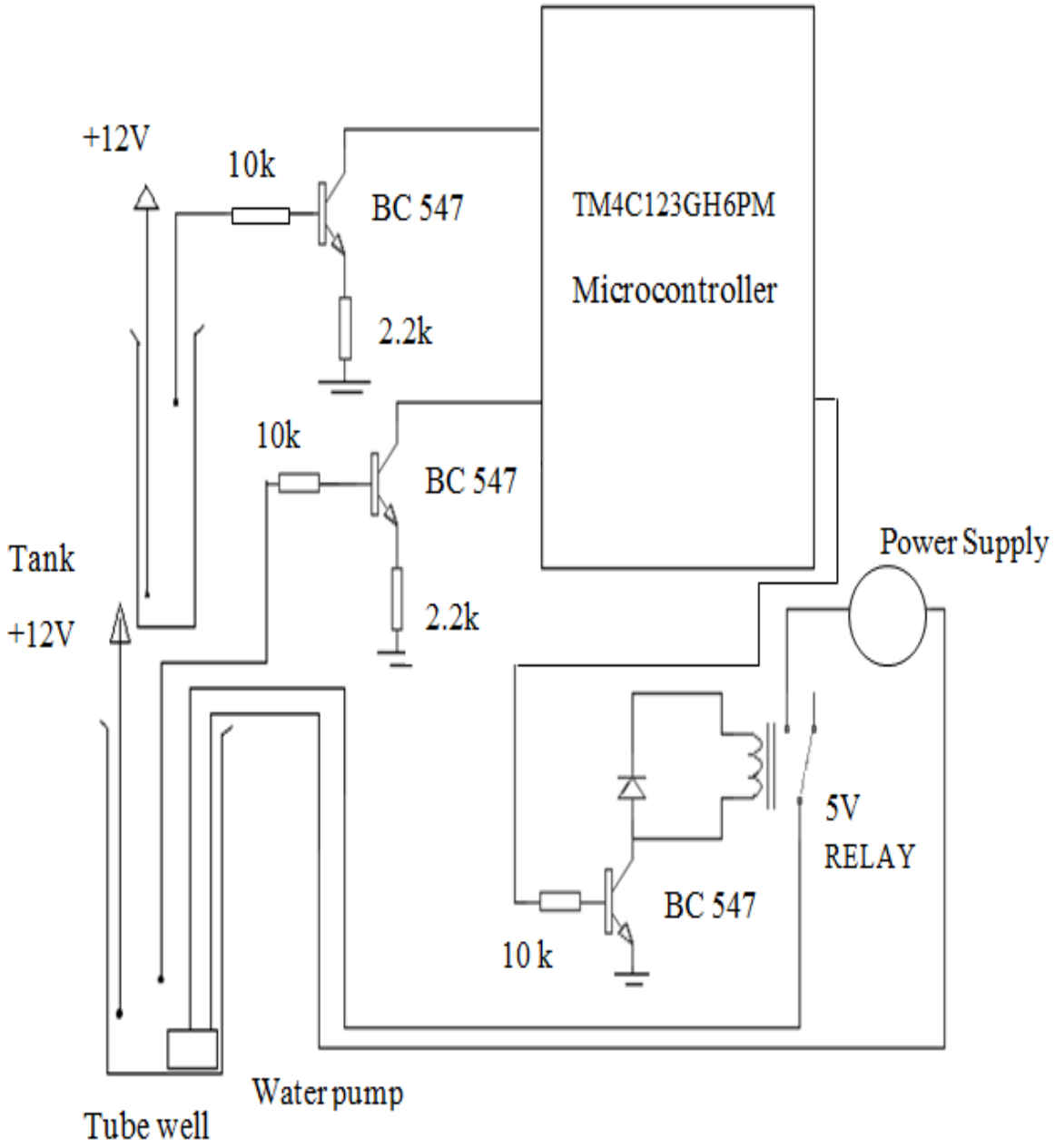

Fig. 3 Circuit diagram of the system

Control unit performs following actions:

- Off operation*:* When the microcontroller sends 0 V to the base of the transistor then it becomes off and its emitter and collector becomes open. Then no ground signal is collected in the relay circuit. Therefore, the motor pump will be switched OFF.
- On operation*:* Transistor is switched on, when the microcontroller sends positive signal (+3.3 V) and its emitter and collector become short. Relay circuit and motor pump will get ground signal and for this reason the motor pump will be switched ON.

When the system is powered on, if there is water available in the tube well and if the roof top tank has free space, the pump will turn ON. When the water level of the tube well becomes lower than the sensor level or rooftop tank water level is above its sensor level, pump will turn OFF automatically. Likewise by functioning of the pump, initial water is pumped to the tank [3].

Thereafter again it is checked whether the water levels in two resources are in required levels. Then the programmable timer turns on. Programmable timers can be used to count or time external events that drive the Timer input pins. Each 16/32-bit General-Purpose Timer Module-GPTM block of The TM4C123GH6PM microcontroller, GPTM provides two 16-bit timers/counters that can be configured to operate independently as timers or event counters, or concatenated to operate as one 32-bit timer or one 32-bit Real-Time Clock (RTC) and each 32/64-bit Wide GPTM block provides 32-bit timers for Timer A and Timer B that can be concatenated to operate as a 64-bit timer. [2]

There are various timer modes available in this microcontroller. Here one shot/periodic timer mode has been used to set timer to implement on/off function of the water pump while check both water levels in tube well and tank. These operations can be performed automatically and continuously with this system.

3. RESULTS AND DISCUSSION

Due to the sense of the water, water pump switch off with no water in the tube well. By doing so the damages of the pump is decrease by pump siphons air. By using this system switch on the water pump when the tank is empty and switch off the same pump when the tank is full while check the water availability of tube well without any need for human intervention. By doing so, the incidence of water wastage is eliminated.

The prototype of this system consists of two separate water sensors and the pump control system. Water sensors are simple homemade sensors. This water sensor can be used for experimental use and these are not very effective sensors for practical applications. To design this prototype a 12 V DC water pump was used. But in practical situations, more powerful water pumps are necessary with high voltage and that can work with normal domestic voltage (230 V).

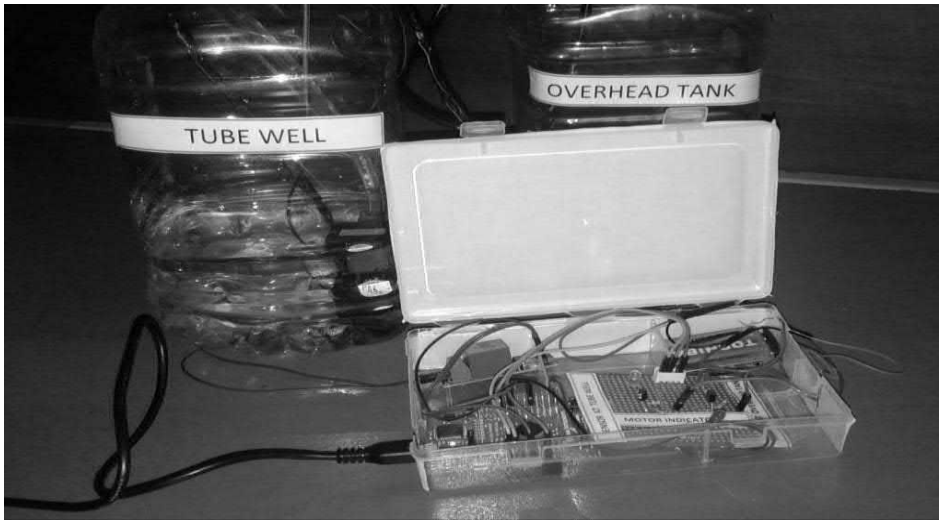

Fig. 4 A picture of the prototype pump control system

4. CONCLUSION

The designed water pump control system can be used in domestic or industrial works. It is a low cost, effective, efficient and flexible designed which can be used by any user. This concept of automated pump controlling system is specially targeted at tube wells. The proposed system has a substantial benefits automating complete pump controlling and protecting the pump situations like running it without water.

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Department of Electronics – Wayamba University of Sri Lanka

AUTOMATED RUBBER TREE (*Hevea brasiliensis*) GIRTH MEASURING INSTRUMENT USING ULTRASONIC PROXIMITY SENSORS

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ABSTRACT

Latex is the one of most economically important parts of the rubber tree for which the girth increment is a very important factor to ensure higher latex yield. Therefore, precise measurement of tree girth is essential to monitor the growth conditions of rubber tree. This study is focused to overcome the issues of precise tree girths measuring and recording by providing a low cost electronic solution for those who are involving in tree girth measuring process in Rubber Industry in Sri Lanka. By developing, an automated tree girth measuring instrument the authors wishes to help to increase the profit margins by reducing overhead costs and labor cost for measuring tree girths. The device was made with two ultrasonic proximity sensors, a microcontroller based controller which capable of calculating the tree girth, store the measurements, display them in a liquid crystal display and capable of identifying three with radio frequency identification tag. It is found that the Mean Absolute Percentage error is ±4.36% with the standard deviation of 5.5 against the standard tape measurement. It was assumed that the rubber trees are almost in cylindrical shape.

Keywords: Tree girth, Rubber, Ultrasonic

1. INTRODUCTION

Tree trunk diameters frequently are measured by the tree, forestry, and ornamental industries as well tree fruit researchers. Current methods for measuring diameters use mechanical and electronic calipers, diameter sticks and tapes, which are often time-consuming and tedious to operate over long periods. The only record of the measurements are those written manually on an inventory sheet or entered manually into a data-logger [1].

Sri Lanka has an agriculturally based economy of which the plantation sector consists of tea, rubber and coconut. Although industrial exports bring in a higher percentage of foreign exchange earnings agriculture is the biggest net earner to the country. Rubber, (Hevea brasiliensis) plays an important role in the Sri Lankan economy as a foreign exchange earner, commodity for domestic consumption and a source of employment.

The economically important part of rubber is latex. To have a higher number of latex vessels, girth increment is a very important factor. To attain economic yield, the general health, girthing of the tree must be maintained at a satisfactory level.

In a rubber plantation there are thousands of trees and it is not an easy task to measure their girths manually. Therefore the current study was conducted to develop an automated rubber tree girth measuring instrument to measure the rubber tree girth to predict the correct outcome of future experiments related to rubber.

Fig. 1 Rubber tree plantation

2. EXPERIMENTAL

The project design involves software and hardware design part. The project was completed once the hardware development part is successfully done. Once the hardware part is done, then it was integrated with the whole system of the project. In hardware process, there is a part where testing and calibrating are needed. Lastly, the software and hardware will be integrated together.

After finalizing the research on issues of measuring and recording rubber tree girth (<=0.5m) measurement, as the solution, a girth measuring instrument was implemented to get the

measurements accurately and record them automatically. Then all the equipment will be gathered to carry out the electronic implementation.

Arduino mega 2560 microcontroller board plays a major role in the proposed project. It is the unit that controls and processes the inputs and outputs. Coding was done with the Arduino software and a power bank was used to supply 5 V DC current to the board.

After a thorough studying of the problem, novel techniques and technical details, following architecture was selected to implement as the solution.

Fig. 2 Block diagram of the proposed system

3. RESULTS AND DISCUSSION

Fifty number of rubber trees were selected from a rubber plantation and girths of them were measured using the instrument and a tape.

By using the girth values measured using the error of the instrument was calculated using Mean Absolute Percentage error method.

$$\text{MAPE} = \frac{\sum_1^{50}\left(\frac{Tape\ measurement - Instrument\ measurement}{Instrument\ measurement}\right)}{n}$$

$$= \underline{0.043586625}$$

$$= \underline{4.36\%}$$

Where; n – Number of trees in the sample

The standard deviation was obtained as follows.

Standard deviation $\sigma = \sqrt{\frac{\sum \Delta_i^2}{(n-1)}}$

$= 5.5062$

Where; Δ_i^2 = (Tape measurement - Instrument measurement) ^{2}

According to the above results and calculations instrument has ±4.36% error.

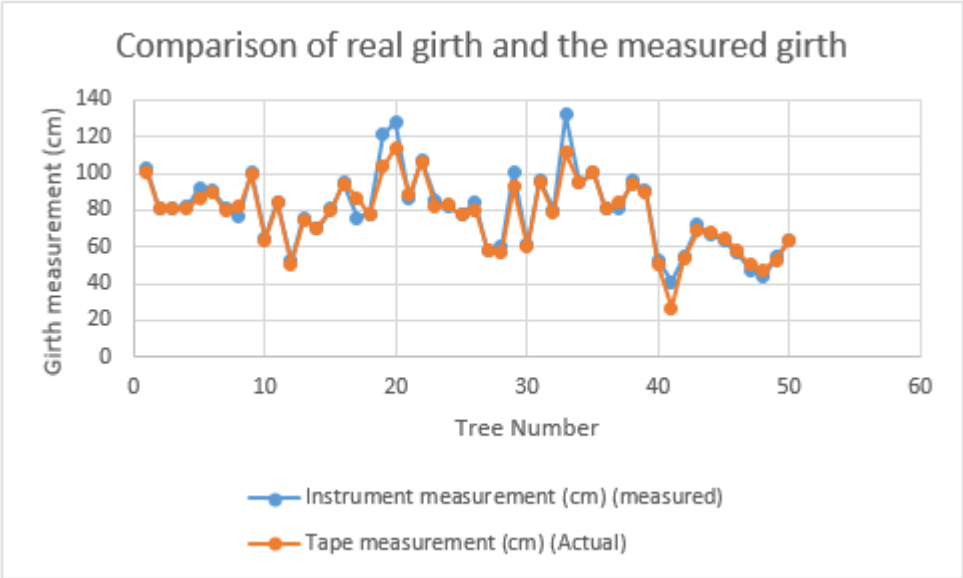

Fig. 3 Comparison of girth measured from tape and the girth measured from instrument

4. CONCLUSION

Automated tree girth measuring instrument was designed and developed to overcome the problems regarding the field of forestry will help to increase the profit margins by reducing overhead costs and labor cost. Government and other industries related to this field will be able to get long term benefits by adding this technology of electronic and process automation to their industry. This research and implementation of the project will help to overcome the issues they are facing when measuring and recording rubber tree girth manually.

Error of the instrument is 4.36% and it is very small error. It shows that the instrument can be used for the industry. The instrument was implemented to measure exactly circular shaped tree trunks and all most all the rubber tree trunks are circular shaped.

By using much accurate sensors and implementing a mathematical model for irregular shaped trees this can be further developed to measure all types of tree girths accurately.

ACKNOWLEDGEMENTS

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Department of Electronics – Wayamba University of Sri Lanka

IR BASED REMOTE CONTROLLER FOR SECTOR ANTENNA

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ABSTRACT

In mobile telecommunication, Base Transceiver Station (BTS) is the most important component. BTS sector antennas must have a good tilting and direction control capability to optimize their coverage. Tilting is the ability of an antenna to focus the main lobe to the desired direction. Many techniques had been developed by many researchers to have tilting control capability. In this study, the tilt and direction of a prototype antenna is controlled by an IR based remote controller. This system was designed with an IR remote and Arduino module to control stepper motors of the antenna. It was observed that the device developed in this study has good accuracy.

Keywords: BTS antenna, IR remote controller, tilt control

1. INTRODUCTION

Tilt and direction change of BTS antenna is somewhat difficult task, because it is done manually using tilt meter and compass. In the modification, a lot of problems may occur. Sometimes electrical tilt and direction cannot find the most accurate position. In Sri Lanka usually network providers change the tilt and direction by using a rigger. Rigger is a person who climb the site and change the tilt and direction manually. The accuracy of tilt and direction changing manually is low because it depends on the accuracy of the rigger.

Due to increasing complexity of mobile networks, the need to deliver high data rate services and the variation of mobile traffic put a high burden on operation and maintenance in terms of extra workload and additional costs. New approaches to network optimization and management should be taken into account to increase network performance and reduce operational costs. Antenna tilt and azimuth changing are powerful parameters for optimization

of a sector antenna. It has direct impact on shaping the boundary of the serving cell and hence on the coverage and interference parameters of the network [1].

In mobile telecommunication, Base Transceiver Station (BTS) becomes the most important component. BTS sector antennas must have a good tilting and direction control capability to optimize their coverage. Tilting is the ability of an antenna to focus the main lobe to the desired direction [2]. Many techniques had been developed by many researchers to have tilting control capability. In this study, the tilt and direction of a prototype antenna is controlled by using IR based remote controller. This system was designed using IR based remote with Arduino to control stepper motors of the antenna. The main purpose of this system is to divide the sector antenna angle to equal parts. If the sector angle is 90^0 it is equally divided into 30^0 parts and through the IR remote it is controlled to each angle divided. Electrical tilt was also divided into 6 parts and through the remote it was controlled. It was observed that the device developed in this study has good accuracy and effectiveness and efficiency is higher than the present available system.

2. EXPERIMENTAL

The block diagram of the proposed system is shown in the Fig. 1.

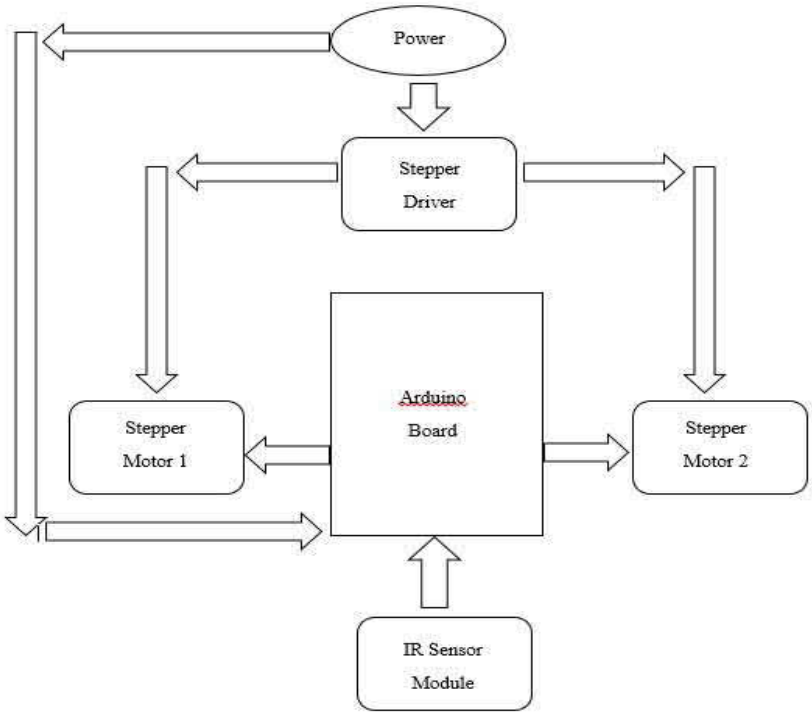

Fig. 1 Block diagram of the prototype

Fig. 1 shows the block diagram of the system developed. It shows an Arduino based sector antenna system. The proposed system uses IR sensor module to connect the IR remote and the antenna. Whenever the user needs to change the tilt/direction of the sector antenna, pressing buttons separately for the tilt and direction will be identified by the Arduino and stepper motors will rotate according to identified angles. Motor 1 rotates as declaration of direction angle and motor 2 as tilt angle. By using Arduino the total angle of a sector, 90^0 or 120^0, was divided into equal 30^0 angle sectors and each angle sector and tilt length was assigned a number in the remote. By observing the traffic variation using the software U2000 powered by Huawei, a decision can be made which angle and which tilt should be changed by observing the data for one month period.

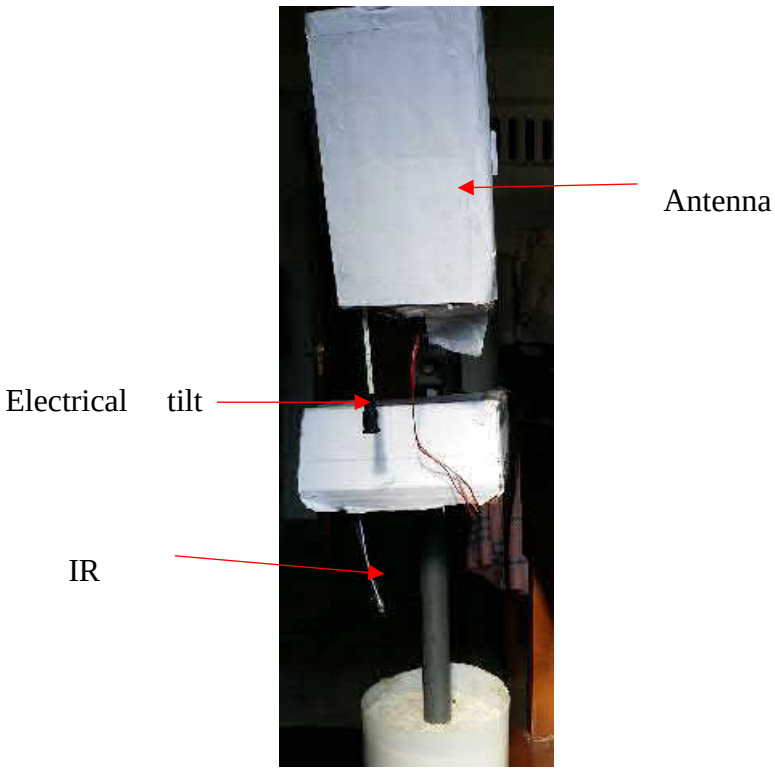

Fig. 2 Designed prototype

3. RESULTS AND DISCUSSION

The tilt and direction of an antenna can be changed accurately and efficiently using the designed remote controller. As a result labor cost and time consumption will be reduced. This antenna can change the way of optimization in coverage.

When Electrical tilt changes from 0 to 4 the coverage foot print becomes close. These days Sri Lanka does not have this resource to automate the tilt/direction change. Therefore, with low

budget and high accuracy the implemented model will give the country like Sri Lanka a better chance to overcome the problem which can take place at the work site.

The device that was implemented through this study has significant role to play in the industry of telecommunication. It also directly effects the customer satisfaction. There are many more situations where this device can contribute to the organization effectively and profitably. Identified strengths are, the tilt and direction can be changed accurately, man power needed for the tilt and direction change is reduced, and time consumed for the tilt and direction change is reduced [3]. Identified weaknesses are, IR is not sensing longer distance, mechanical tilt cannot be changed, too much installations because every sector should be implemented [3]. As a further development it is planned to use a Wi-Fi module in place of IR module to transmit signals much larger distance than IR module can.

4. CONCLUSIONS

In Sri Lanka there are different kinds of telecommunication activities and processes which need the precise installation. Most of those activities are done as manual process which leads to less accuracy situations. As there is no program or specific automated device to change tilt and direction of sector antenna, this study designed an IR remote sensor based sector antenna to change the tilt and direction by giving the relevant button for direction and tilt by a IR remote. By using this antenna, we can change the tilt and direction without going to the top of the tower. It was observed that the device developed in this study has good accuracy and efficiency than the present manual adjustments.

ACKNOWLEDGEMENTS

Authors would like to extend their sincere thanks to all the staff members of the Department of Electronics, Wayamba University of Sri Lanka and also extend their sincere thanks to the staff of Access Network Planning Department of Dialog Axiata. PLC, North Central Region, Anuradhapura.

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Department of Electronics – Wayamba University of Sri Lanka

RFID BASED VEHICLE RECORDING SYSTEM FOR COLOMBO PORT GATES

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ABSTRACT

This research was to implement an automated system to record all the details of arrivals and departures of the vehicles from port and store the data in a central database. Radio Frequency Identification (RFID), Arduino ang Wi Fi technologies were to design the system. The database was developed using My SQL server and php web page. The transfer of data from the system to the database was done via wi-fi technology. The device records the data and stores them in the database and we can access the data whenever it is needed. All the required records of the vehicles are included in the database and it makes the cargo movements faster and easier. Since the prevailing system is a manual system, replacing it by this device would be much advantageous and convenient.

Keywords*:* RFID, Arduino, Wi-Fi

1. INTRODUCTION

Colombo port is the main point where most of the import, export and other transportation goods are being received or sent. Therefore, a large number of cargos pass the port gates per single day. Presently, the recording of those cargo movement is being done via a manual system. In order to reduce the effort and time consumed in this process an automatic recording system was developed.

RFID based identification is very useful technology which cheap, power efficient and reusable compared to other alternatives. I have introduced an automated system for cargo and vehicle recording at Colombo port gates. This system is based on RFID, Arduino and Wi-Fi communication. A centralized database will handle all the details of the vehicles and let the authorities access it whenever it is necessary.

In this vehicle tracking system RFID technology is used for vehicle identification. RFID tags were assign to each vehicle that authorized to pass through the gates. In my prototype I considered only two separate Gates and there are two RFID readers been activated. We can receive data from gate to update the system. So, this will automatically record the vehicle entry data via this process.

2. EXERIMENTAL

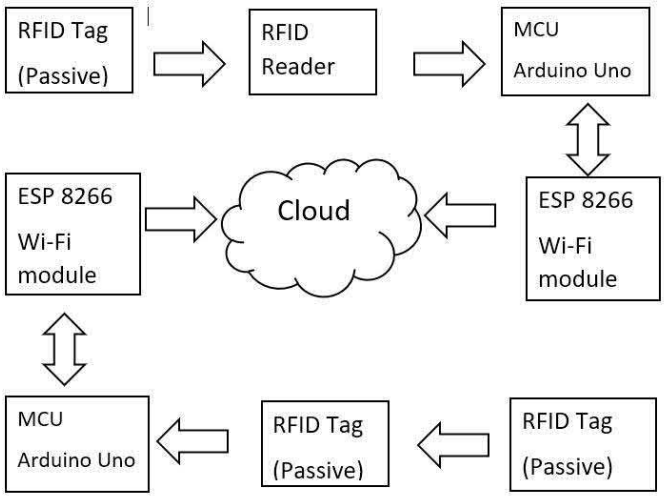

Fig. 1 Block diagram of the system

In the system, vehicle identification is done by using RFID reader. For that, MFRC522 based RFID Reader was used. Each vehicle will allocate a RFID card and vehicles which pass through the gate will detect by the RFID reader. When RFID reader gets a signal from a RFID tag it sends that signal to the Arduino Uno development board. Arduino Uno board act as the controller of the system. ESP 8266 Wi-Fi module connected to the Arduino development board. When a RFID reader send a signal through the Arduino board Wi-Fi module sends those data to the MYSQL database with the help of Wi-Fi network which is connect through a php page. Web server update the Tag details that RFID reader send in to the system.

RFID RC522 Reader and 13.56 MHz passive tags is being used in this system. Those identified tag details send to a MYSQL database through PHP server page via Wi-Fi module. ESP 8266 wi-fi module is used to this process. All the controls are doing from Arduino Uno development board. The web server records all those details and user can access and get those details.

Mainly Entry no, Tag no, Gate no, Vehicle registration no, Driver's name, License no, customs seal no, Vessel ID, Date and Time are included in this database.

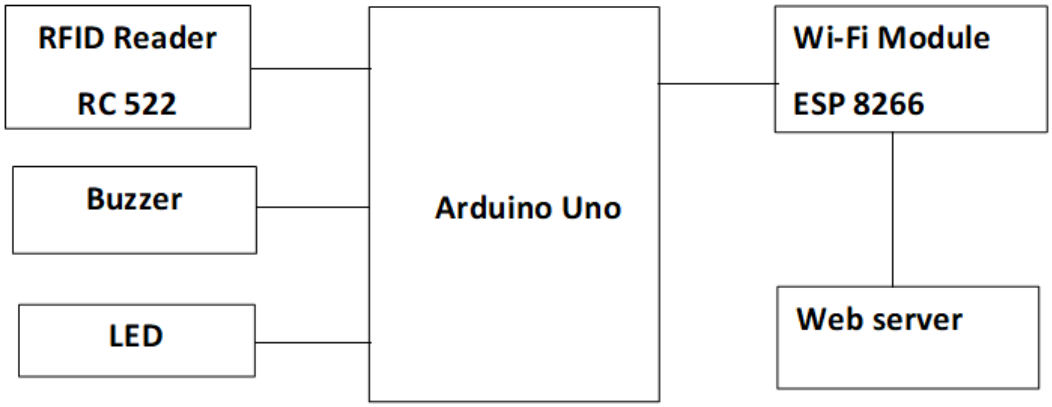

Fig. 2 Block diagram of the project design

3. RESULTS AND DISCUSSION

In this system, Registered RFID tags can identify and show the results in the data base server. For the real use of the system, Vehicle owners have to register by giving the necessary details about their vehicle to the system and we can add those details using primary key with the tag number. So, we can get any information as we add to the database. As the system work with only one gate, we can include all the gates by fixing this system at each gate and connecting via a central wi-fi beam to a cloud server. Arduino uno development board is enough to control proposed system.

In the system we use only the 13.56 MHz card reader, because of the size and the cost for a small prototype. It works accurately less than 3cm only, so the Tag must be that close to identify by the reader. Another problem that occur is that when two or more tags close, this reader not perform well. In a real world it should use more powerful RFID readers and monitoring systems. The delay can be occurred about 15 -25 seconds but it will not affect much.

This system has programmed only for sending the data through WiFi to update the main database. But we can add more functions and develop this to automate the gate clearance process of customs. Sri Lanka customs ASYCUDA clearance software can link with this database to get the data from the port gates. It will save more money and the time.

Fig. 3 Project implementation

Gate Record Details

10:33:05

Tag ID.	Vehicle Reg No.	Driver	Licence No	Custom's Seal	Vessel ID	Time
805D385D	LU 6855 / LX 1654	Mr.H.S.E.T.Samarajeewa	2258764	C 419356	6524	2018-02-12 13:05:17.135563
D59DAC79	LB 0513 / LX 1654	Mr.K.M.D.K.Dasanayake	1563546	C 419378	6235	2018-02-12 14:00:13.294088
805D385D	LU 6855 / LX 1654	Mr.H.S.E.T.Samarajeewa	2258764	C 419356	6524	2018-02-12 14:02:02.391053
D59DAC79	LB 0513 / LX 1654	Mr.K.M.D.K.Dasanayake	1563546	C 419378	6235	2018-02-12 14:02:24.947003
FE4BB479	LY 1964 / LX 2148	Mr.D.F.Mohommad	1654356	C 419376	4862	2018-02-12 14:05:12.150413
60F23E5D	LL 8876 / 67 - 2104	Mr.G.Kumaradasa	2467682	C 419312	6584	2018-02-12 14:08:05.304584
D59DAC79	LB 0513 / LX 1654	Mr.K.M.D.K.Dasanayake	1563546	C 419378	6235	2018-02-12 14:36:33.438702
651BB579	JU 5847 / LX 4516	Mr.R.G.T.M.Rupasinghe	2256354	C 419318	7452	2018-02-12 14:37:29.444557
805D385D	LU 6855 / LX 1654	Mr.H.S.E.T.Samarajeewa	2258764	C 419356	6524	2018-02-12 14:41:53.669834
805D385D	LU 6855 / LX 1654	Mr.H.S.E.T.Samarajeewa	2258764	C 419356	6524	2018-02-12 14:41:53.669834

Fig. 4 PHP web page interface

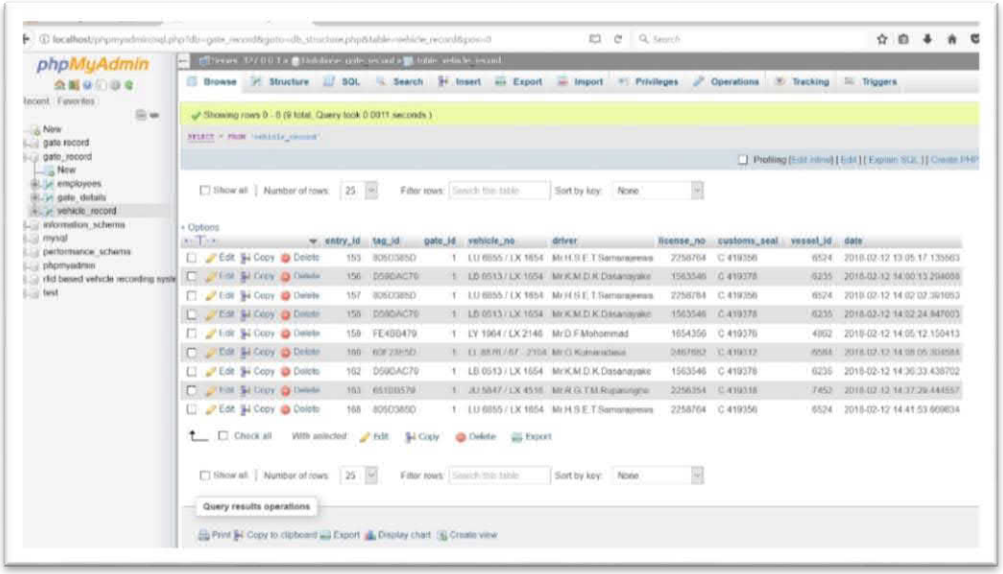

Fig. 5 MySQL database interface

4. CONCLUSION

The system automatically detects and stores the data relevant to all the registered vehicles and stores them in a database. The data can be accessed by authorities whenever it is needed. RFID based system is much reliable and efficient because of its power efficiency and the longer life span. The paper wastage and time wastage can be overcome by this system. It is difficult to record all the details manually because in a single day over 500 vehicles been passing through a port gate.

The details which store to a data base are easily accessible and can be sorted as needed. They are very effective collection of raw data for statistical purposes. My project collects mainly raw data in the data base, so we must use them accordingly. And this project is more valuable with further developments. Because projects like this can use to automate the process.

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Department of Electronics – Wayamba University of Sri Lanka

MOTOR CONTROL SYSTEM USING THE VACUUM PRESSURE SENSOR

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ABSTRACT

CCS Lanka (PVT) Ltd is ideally positioned for the global procurement of electronic and mechanical components. First the company get orders from customers and request chief officer (CO) to get the approval for each and every order. Then raw materials and resources are obtained from Switzerland as the customer requirements. Thereafter they are assembling the components by using surface mounting technology (SMT) and through hole technology (THT). The ends, or leads, are then affixed to pads on the opposite side with molten metal solder using wave soldering or selective soldering equipment. The wave soldering machine consists of a heated tank of solder. This is maintained at the required temperature for the particular printed circuit board (PCB). A problem was identified in the test system as less efficiency of the testing machines due to the man-made mistake when operating the AC Motors to keep the vacuum always at the high level. Switching to the automation is the one and only solution to reduce the man made errors. There are four AC motors direct connected with the vacuum chamber in the system. If the vacuum is go behind the certain level then motors were activated by an operator or in case if the efficiency of the testing machines were not in the expected range then the operator will called to start up the motors. Therefore as a trainee I was advised to make it to go for an automation process where the vacuum pressure will be controlled automatically by the AC motors using pressure sensor if the vacuum in the chamber is behind the certain level.

Keywords: Through hole technology, Printed circuit board, Automation, Vacuum chamber

1. INTRODUCTION

CCS Lanka (PVT) Ltd is a B.O.I Company established in Sri Lanka in September 1988 and registered as an industry undertaking by the Ministry of Industries and Technologies in Sri Lanka. It is situated 15 km north of the Colombo International Airport at Baseline Road in

kochchikade, Sri Lanka. The company commenced operations in Sri Lanka in 1988 and is considered today as a modern and a well-equipped industrial venture with an ISO 9001, 14001 QMS & EMS to cater Electronic Industry worldwide as an EMS (Electronic Manufacturing Service) and to assemble with testing of medical devices conforming to ISO 13485: 2003, under Swiss Management [1].

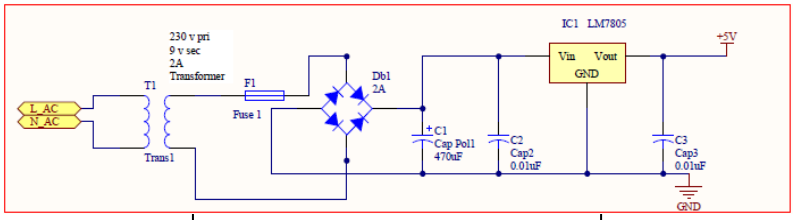
To ensure the high quality standard, Function Tests and In-circuit tests are carried out in their fully equipped test room with the latest technology. In order to test the outputs the testing department has well programmed testing machines called marconii and each machine supports variety of adopters where the PCBs and other component are placed and tested until achieving the necessary requirements [2-3]. And the accurate components are sent to the company effective customers. Also test components that fail the test are sent to the re-testing process. In case if the component continuously fails in the testing process then the particular component is added to the E-Wastes.

Here in the testing department, there is a big vacuum chamber which is directly connected with these marconii machines where these function test machines are giving the optimal output testing solution under the highest (peak) vacuum pressure range maintained in the vacuum chamber. When the vacuum pressure in the chamber decreases then the machine stops or the testing results are not linear to the expected performance.
To maintain the vacuum chamber always in an acceptable range, there are four AC motors connected parallel which start working in order to maintain vacuum chamber always in the highest vacuum pressure range.These four motors are operated by a labourer or the supervisor according to the necessary requirements.

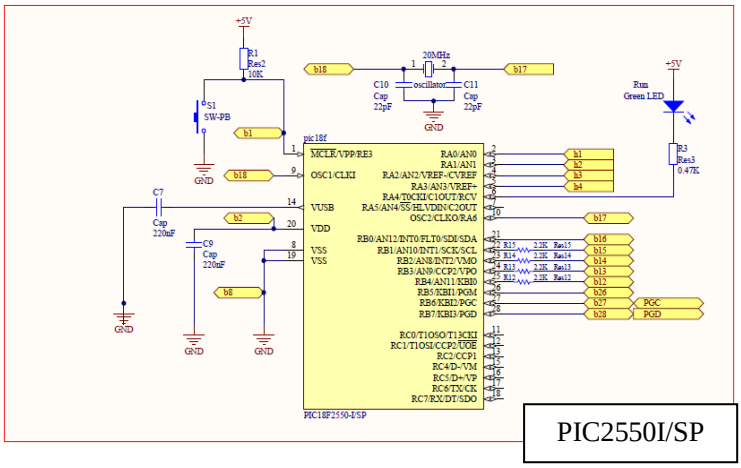
Because of AC motor works manually, I was instructed to automate the operations of the machine with some essential working condition by using the vacuum pressure sensor.

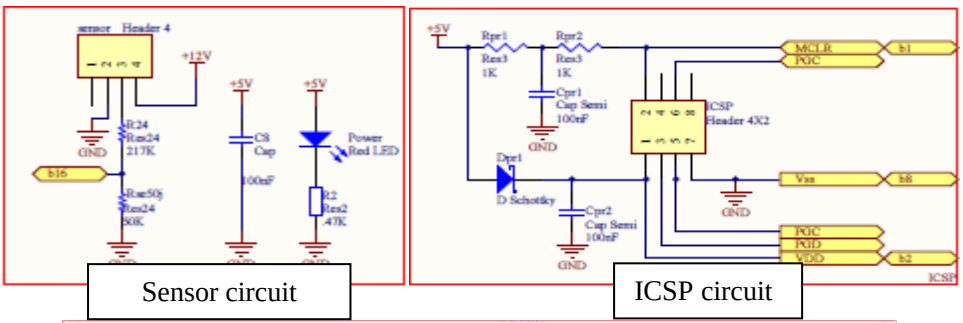
2. EXPERIMENTAL

CIRCUIT DIAGRAM



Power supply circuit





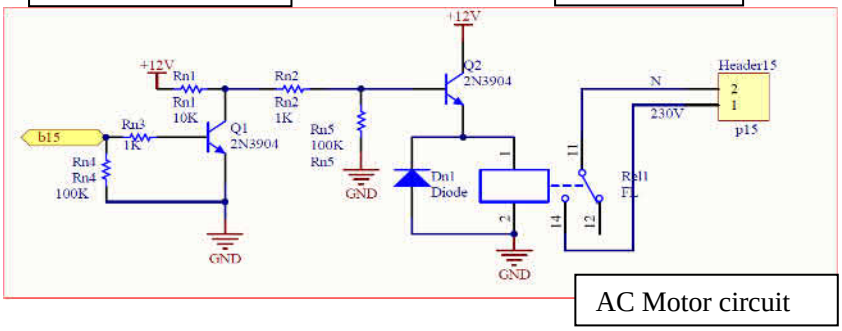


Fig. 1 Circuit diagram of the proposed system

3. RESULTS AND DISCUSSION

Working condition of all four motors were tested with this circuit by loading the .hex file to the PIC18F in the proteus S/W and by clicking the run button the results were analyzed and tested whether it is satisfying the necessary requirements

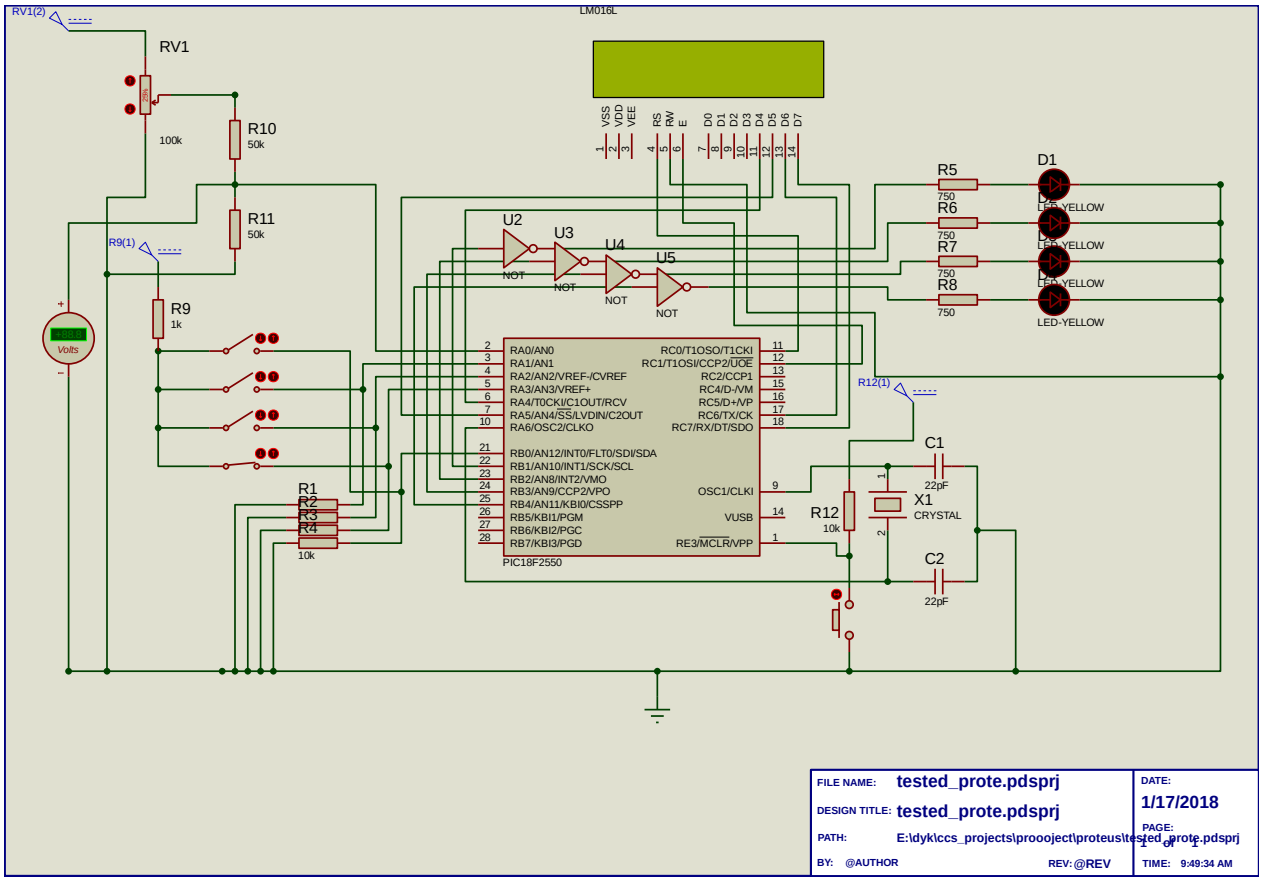


Fig. 2 The similar design used to test the code

REQUIREMENTS FOR OPERATION OF THE MOTOR

- Each motor goes to off stage when the respective switch state is off and vice versa
  - Switch1 => motor1
  - Switch2 => motor2
  - Switch3 => motor3
  - Switch4 => motor4
- When P > P4
  - Each motor - ON
- When P3 < P < P4
  - 3 motors - ON
- When P2 < P < P3
  - 2 motors - ON
- When P1 < P < P2
  - 1 motor - ON
- When P < P1

- All motors - Off

Every motor has a running time and if the motor usage cross the time then the next motor starts to operate and vice versa. If one switch is off then remaining three motors will balance the system like wise to the other switch states. If in any instance, a power failure occurs then after the power on stage the last active motor starts operation and the process continues as normal.

4. CONCLUSION

The above project is carried out in order to operate motors automatically when the motors working requirements are matched and turn it off when not in need. These motor requirements depend on the vacuum pressure range and in the switch on/off status positions.

After the implementation of the project there is no need of human interface to operate it to on / off. There will be an increase in the productivity than before upon implementing this set up. It may help to reduce labour cost.

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POWER HARVESTING SYNCHRONOUS BUCK SYSTEM AND DATA LOGGER FOR NANO SATELLITE

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ABSTRACT

Space application devices demands high efficiency with small size, low volume, low mass and reduced losses simultaneously in order to keep a low power consumption. The Nano satellite is a tiny electronic system about one to 10 kg in weight revolving round the earth in an attitude of about 400 to 500 km. The main units in a Nano satellite are, an electronic power supply subsystem, on board computer subsystem, a micro controller, an altitude determination and control subsystem, communication sub system and a payload subsystem. The need to save energy is mandatory in all systems due to low power generation and reduced size. This work focuses in the electrical power supply, system responsible to generate, store, conditioning and supply electrical power for the whole satellite. This paper present a comparison between a conventional voltage converter design and an optimization design methodology for boost power converters in order to improve efficiency, to reduce volume and mass. The design philosophy of synchronous buck converter as the electronic power supply subsystem for a Nano Satellite is presented in this paper.

Keywords: Synchronous buck converter, Data logger.

1. INTRODUCTION

The aim of this research is to make an assistive power Supply for a Nano satellite. In this case we are substitute Synchronous buck converter for a normal buck converter. This supply will improve the quality and the life time of satellite. So the power supply should be more efficiency, more accurate and should have long life time. During the life time of Satellite it is critical to get the details (data), voltage and current in the Power supply so the data Logger

is also important part of this. Therefore the project object is to build the power supply with data logger.

1.1 Power System of Nano Satellites.

The required size of the solar panels and batteries depends on the requirements for the payload(s) and the lifetime of the mission[4].A typical power system is composed of the solar array for producing power from the sun, the battery for storing energy for use during the dark portions of the orbit, the circuitry for controlling and limiting the charge and discharge of the batteries, and power filters, converters, and switches that distribute the raw or conditioned power to the spacecraft subsystem loads. Typically, one-third of the total weight of the spacecraft is taken by the power subsystem, with the batteries weighing one-third of the power system. The batteries not only supply energy during the dark portions of the orbit but provide the reserve energy. Selection of the power supply is a mission and it control the whole life of satellite. [3]

Table 1: The load power requirement

Load	Voltage	Current Max	Power
Control system	5V	300mA	1500mW
Onboard computer	5V	40mA	200mW
payload	5V	100mA	0.5W
Comm. System T(x)	3.3V	850mA	2W
Comm. System R(x)	3.3V	100mA	300mW

1.2 Synchronous buck converter

Choosing the right DC/DC converter for an application can be a daunting challenge. Designer has a myriad of trade-offs to consider, Typical power-supply issues are size, efficiency, cost, temperature, accuracy, and transient response. Buck converter is a DC to DC switching voltage regulator that reduces the input voltage. A nonsynchronous type is an older design and noted for power loss across the external Schottky diode. This power loss equates to compromised efficiency. A synchronous type is recommended here because it offers high efficiency and fits in a more compact form factor by integrating an efficient MOSFET. The main advantage of a synchronous rectifier is that the voltage drop across the low-side MOSFET can be lower than the voltage drop across the power diode of the nonsynchronous converter. If there is no change in current level, a lower voltage drop translates into less power dissipation and higher efficiency. [7]

1.3 Arduino Based Data Logger

A data logger is an electronic device that records data over time and it is a compact. Data loggers can be deployed in a variety of environments to record measurements at set intervals for up to years at a time. It is very critical to test the power system at last 3 months before launch the Nano satellite.

2. METHODOLOGY

As this research project was carried out in-line with the actual space engineering principles and practices, the bulk of the whole project was about planning the work, actual construction and conformity testing of the project.

2.1 Power System Overview

Figure 1 shows the block diagram of the designed power system. The output of the solar panels is first run through the power path control. While in sunlight operation, the power path will select the voltage from the panels based on its higher voltage. The output of the Power Path control is sent to charge the batteries and provide the power to the 5V and 3.3V buck converter .During the eclipse, the power path will select the battery and use the stored energy to provide power to the circuit components.

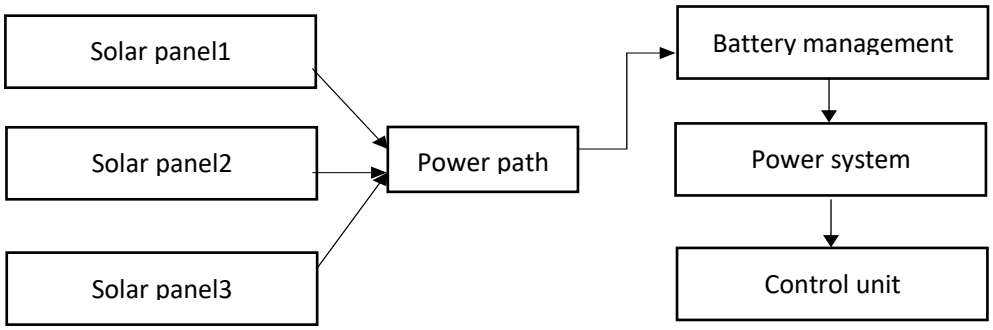

Fig. 1 Bock diagram of the system

2.2 Selection of Component and Construction

The main IC of the circuit was MAX796 it is a high-performance, stepdown dc to dc converters with single or dual outputs provide main CPU power in battery-powered systems. These buck controllers achieve 96% efficiency by using synchronous rectification Excellent dynamic response corrects output transients caused by the latest dynamic-clock CPUs within five 300kHz clock cycles. Unique bootstrap circuitry drives inexpensive N-channel MOSFETs. [6]

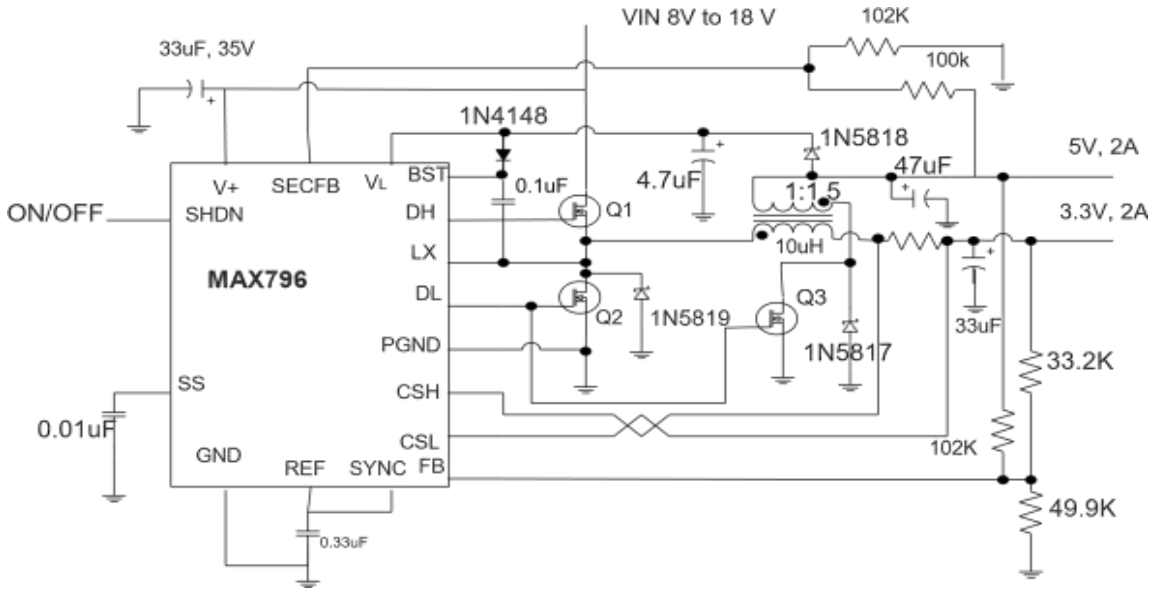

Fig 2 Main synchronous buck converter

96% efficiency, 4.5v to 30 V input range, 2.5V to 6 V adjustable output and +5V Linear Where Q1, Q2, Q3 – Si4812BDY

Regulator output are the basically considered features of the max796. The power system was behave with the charged batteries using solar cells. So the input voltage can be varying from7.2.V to 14.4V.

2.3 Graphical User Interfaces design

Eclipse Java Oxygen was used to create java based application to visualize the transmitted data from the sensors. The serial port was accessed and read the data line by line. Whole data set was splinted and separate parts were arranging within a hash map (used to store key and value pair). Several real-time graphs were plotted by using those data. All transmitted data were saved within the text file as a means of data backup.

Current sensors and high voltage sensors were used as the sensor which need to check the system.

The current sensor sense current on common-mode bus voltages that can vary from 0 V to 36 V, independent of the supply voltage. The device operates from a single 2.7 V to 5.5 V supply, drawing a typical of 330 µA of supply current. The device is specified over the operating temperature range between -40°C and +125°C and features up to 16 programmable addresses on the I^2C-compatible interface.

3. RESULTS AND DISCUSSION

Testing the voltage variation in the 3.3V output line

Table 2 Sensor values in 3.3V pin and sensor value in 5V output pin

	For 3.3V		For 5V	
Mean	1.990A	3.308V	1.929A	4.997V
Minimum	1.890A	3.270V	1.730A	4.980V
Maximum	2.110A	3.340V	2.040A	5.030V
Standard deviation	0.034A	0.011V	0.065A	0.014V
90^{th} percentile	2.028A	3.220V	2.020A	5.000V
80^{th} percentile	2.020A	3.320V	2.000A	5.000V
70^{th} percentile	2.010A	3.300V	1.988A	5.001V
60^{th} percentile	1.998A	3.300V	1.950A	5.001V
50^{th} percentile	1.988A	3.300V	1.920A	5.012V
40^{th} percentile	1.988A	3.321V	1.900A	4980V
30^{th} percentile	1.978A	3.299V	1.990A	4.980V
20^{th} percentile	1.988A	3.310V	2.001A	4.980V
10^{th} percentile	2.001A	3.301V	1.982A	4.990V

4. CONCLUSION

The proposed Synchronous Buck Converter with data Logger provides better voltage regulation, and receiving and transmitting and data storing. This report successfully provides a method to satisfy the objective of DC- DC converter to maintain a constant output voltage at a load side. The proposed circuit is simple, easy to understand and can be implemented with no additional components there by keeping size and cost of manufacturing the converter within considerable range and belongs to Nano satellite conditions.

The main task of the Power System module are to efficiently condition the available power from the solar cells, to safely charge the batteries, and to provide two regulated 3.3V and 5V power rails. The power subsystem design described in this paper is based on the MAx796. In spite of the variation of several conditions over the orbit like temperature and irradiation the allows to achieve the maximum efficiency in terms of power harvested from the cells and transferred to the output.

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Department of Electronics – Wayamba University of Sri Lanka

GOOGLE SHEET BASED DATA LOGGING SYSTEM

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ABSTRACT

The growing demand for intelligent embedded devices in day-to-day life has also increased the demand for monitoring and managing data provided by them. A solution to connect and store data on server space, which is linked to the user Gmail services, will be much more user-friendly. A solution was proposed to address the difficulties of logging, securing and accessing data by using the remote devices. In the proposed system, an embedded DHT22 sensor device is connected to the Google Sheet through a pushing box, an online application. The data, detected by the sensor will be uploaded to Google Spreadsheet using Arduino MKR1000. The uploaded data can then be viewed and edited across the world. The data can be easily analyzed and represented by using different Google featured tools linked to Google Drive. As Google interfaces are user-friendly and used by many people, it can be easily adopted. Further, the data can be linked with Cloud computing services for analyzing.

Keywords: Arduino MKR1000, DHT22, Data logger, Google drive

1. INTRODUCTION

NMI Communication is a sub contract company in telecommunications equipment and services sector to towers and fixed network operations. Lot of telecommunication companies in Sri Lanka give contracts to NMI Communication. Some of them are for tower generators, installations, site surveys, drive tests, and site optimizing in the two areas of Equipment services and Maintenance services. Generally, there are zonal manager, BSC engineer and technical officers for one branch office at NMI [1].

With the fast development of the information technology, more and more equipment in the telecommunication room are utilized for data transmission. Meanwhile, the number of corresponding auxiliary devices has increased. Along with the manufacture and management of the power system, the information technology is one of the critical supports. The

telecommunication rooms play an important role in the stable operation of the power system. In case any problem happened within the telecommunication room, it can be destructive to the management of the whole power system. It is imperative to guarantee the operation reliability of the telecommunication room.

The components of the electronic devices are significantly affected by the temperature and humidity. Monitoring and control of indoor climate conditions is thus crucial in keeping the stable state of equipment in the telecommunication room. Wireless, temperature and humidity sensor (DHT22) was employed in our system to monitor the temperature and the relative humidity. The temperature sensors provide a precise characterization of the fluctuations in microclimate environmental conditions. Continuous monitoring for a longer period of time will also be achieved as the sensor nodes will be configured to run in a low duty cycle operation, thus conserving battery life.

In the recent decades it has seen many types of Data logging systems. With the latest and advanced technological developments in cloud computing and cloud storage, there is a significant possibility in logging and viewing data for analysis and diagnostics in an accurate manner.

2. EXPERIMENTAL

In this study there are three important steps used to execute the project. They are design, fabrication and installation. Design is the crucial part. In this project, the prototype has been done using bread board. After completing the project prototyping, the materials that are suitable to fabricate were selected. On fabrication, it was divided into two sections, which are hardware and software. Arduino program was used in this project as the connector between the hardware and the software.

Fig. 1 and Fig. 2 illustrate the block diagram of the design and the corresponding prototype respectively.

The Google Sheets application is feature-rich, also hosts a programming language called Google Apps Script that is executed remotely on the Google cloud. Google define Google Apps Script as follows: “Google Apps Script is a JavaScript cloud scripting language that provides easy ways to automate tasks across Google products and third party services.”

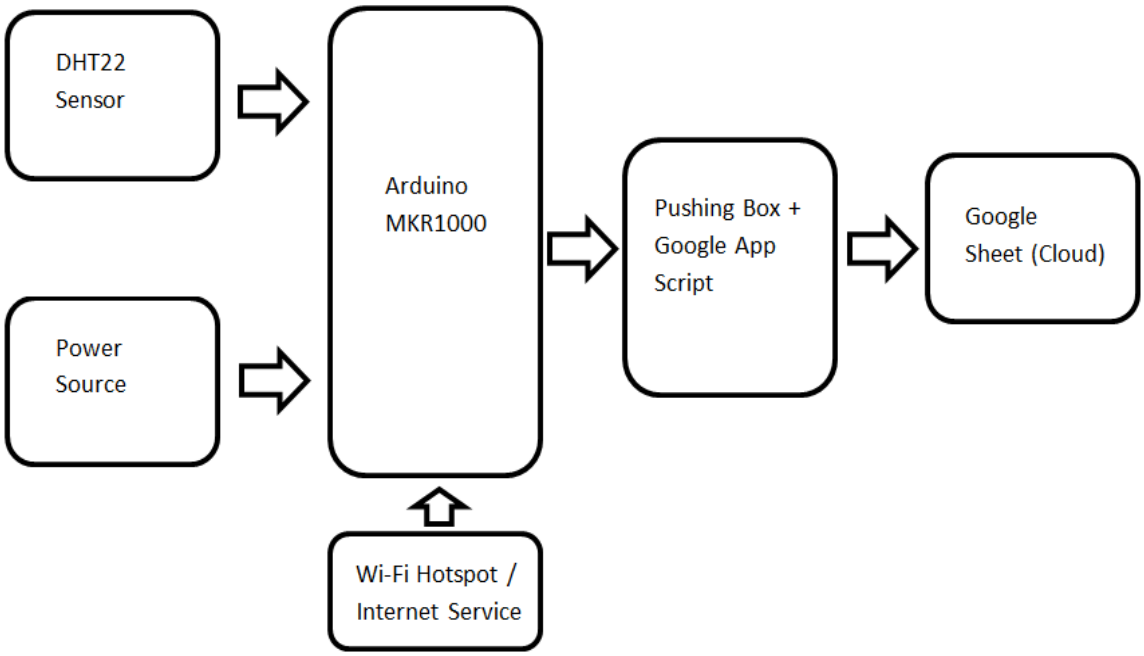

Fig. 1 Block diagram of the designed system

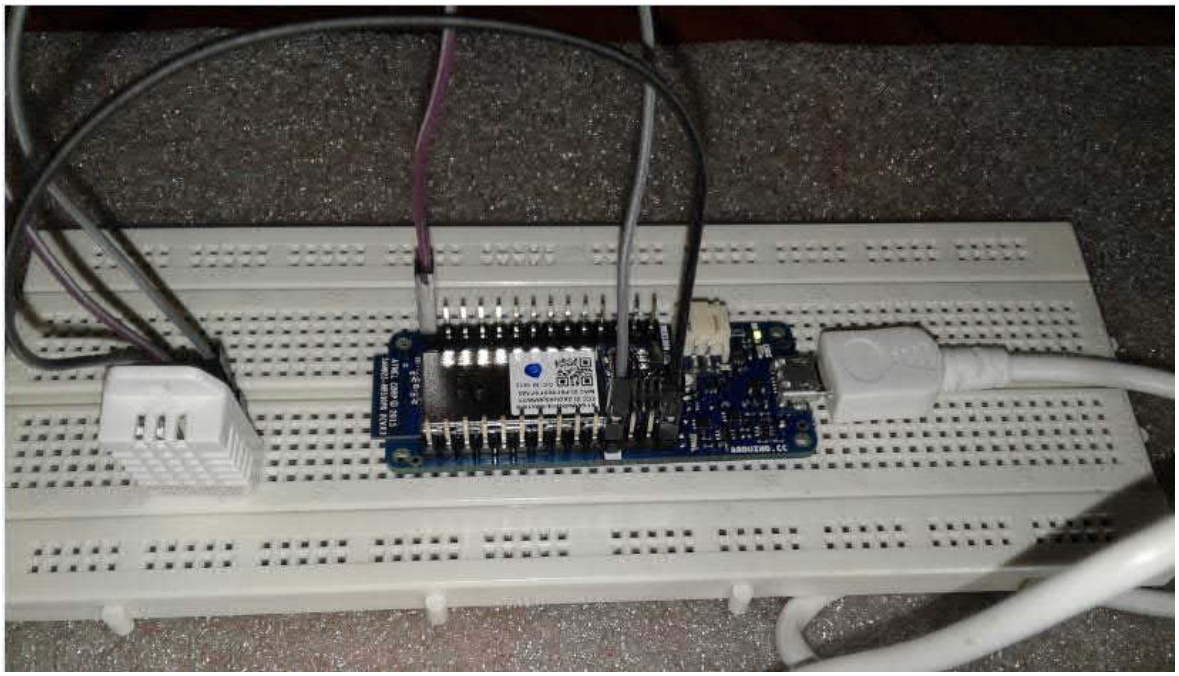

Fig. 2 Prototype of the system

DHT22 sensor utilizes exclusive digital-signal-collecting-technique and humidity sensing technology, assuring its reliability and stability and also its sensing elements are connected with 8-bit single-chip computer. The output of the DHT22 sensor is a calibrated digital signal. Every sensor of this model is temperature compensated and calibrated in accurate calibration chamber and the calibration-coefficient is saved in type of programme in OTP

(On-Time Programmable) memory. When the sensor is detecting, it will cite coefficient from memory. Small size & low consumption & long transmission distance (20m) enable DHT22 to be suited in all kinds of harsh application occasions. Single-row packaged with four pins, make the connection very convenient [2].

Pushing Box is a cloud service that sends notifications based on API calls. It can trigger the service by HTTP request (GET/POST) or email. Pushing Box is called from almost anything, e.g., Arduino, Spark Core, email, Smart Things, an HTTP request. Dozens of services, such as emails, Tweets, Smart Watch notifications, Push Notifications Windows8 Notifications and MacOS Notifications can be utilized [3]. The MKR1000 is used to send DHT's data through the web. It would be helpful to test that everything it has done thus far is correct. If wait to complete the hardware portion, then the cause of any error may be more difficult to track down. It has a simple method of testing code so far. It can just directly enter some hard-coded pseudo-data into web browsers address bar and check that Google sheet is being updated correctly [4].

3. RESULTS AND DISCUSSION

The monitoring results were obtained using temperature & humidity sensor, DHT22. This real time monitoring results were recorded on server. The temperature & humidity data are stored for different days & months of the year. Real time snap from Google cloud spreadsheet is illustrated in Fig. 3.

	A	B	C	D	E	F
1	Date	Humidity:	Temperature:(C)	Temperature:(F)	Heat index:(C)	Heat index:(F)
2	1/26/2018	74	27	81	29	85
3	1/26/2018	73	27	81	29	85
4	1/26/2018	68	28	82	30	86
5	1/26/2018	70	28	82	30	86
6	1/26/2018	67	28	83	30	87
7	1/26/2018	67	28	83	30	87
8	1/27/2018	73	26	80	27	83
9	1/27/2018	75	26	80	27	83
10	1/27/2018	72	26	80	27	83
11	1/27/2018	71	26	80	27	83
12	1/27/2018	72	26	79	27	81
13	1/27/2018	73	26	79	27	81
14	2/6/2018	68	27	81	28	84
15	2/6/2018	70	28	82	30	86
16	2/7/2018	74	28	83	31	89
17	2/7/2018	74	28	83	31	89
18	2/7/2018	66	30	87	34	95
19	2/7/2018	65	30	87	33	95
20	2/7/2018	61	31	88	35	95
21	2/7/2018	65	30	87	33	95
22	2/7/2018	62	31	88	35	96

Sheet1

Fig. 3 Google Sheet

The Heat Index, sometimes referred to as the apparent temperature, is a measure of how it really feels when relative humidity is factored with the ambient temperature as shown in the Table 1.

Table 1: Heat Index vs. Health Effects

Heat Index	**Classification**	**Health Effects**
$27^0 – 32^0$ C	Warm	Caution – fatigue
$32^0 – 41^0$ C	Hot	Extreme caution – heat cramps and exhaustion
$41^0 – 54^0$ C	Very hot	Heat cramps and sometimes heat stroke
$>54^0$ C	Extremely hot	Heat Stroke

4. CONCLUSIONS

A system was developed for remote sensing of humidity and temperature using DHT22 sensor, Arduino MKR1000 board and Google cloud service. The system was designed so that it can reduce the error in data sensing, using modified codes for humidity and temperature sensing. About 80% (normally having 75%) of the read requests were found successful by observing the cloud data. The proposed system will be very useful for the use with existing systems. The system could also be used for disaster management. The system will be cost effective, speedy for real time operation. Newest techniques could be used for remote monitoring using cloud logging.

The Data logger can successfully log to sensor-generated data over SD card and able to connect Google Spreadsheet to upload the same. With the use of the Google Driver tools, it is easy to represent data in graphical format and with formulas and hence analysis is possible.

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EFFECT OF POLYMERIZATION CURRENT DENSITY FOR PERFORMANCE OF POLY N METHYL PYRROLE BASED RECHARGEABLE CELLS

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ABSTRACT

In this study, performance of Zn rechargeable cells fabricated with conducting polymer Poly-n-methylpyrrole (PNMP) doped with $NaClO_4$ is reported. PNMP films were galvanostatically electro polymerized on to stainless steel disc and cells were assembled with a polyvinylidenefluoride based gel polymer electrolyte having zinc-trifluoromethanesulfonate as the salt. Cells having cathodes prepared with different current densities and same thicknesses were fabricated and were characterized using cyclic voltammetry, electrochemical impedance spectroscopy and continuous charge-discharge tests. Cells exhibited open circuit voltages between 0.9 -1.2 V. Cycling testes showed that cycleable capacity almost follows the current density variation of the cathode. Continuous charge-discharge tests revealed that the capacity decrease with the cycle number was higher in high current density films.

Keywords: Poly-n-methylpyrrole, rechargeable cell, charge-discharge

1. INTRODUCTION

Currently there exists a very high demand for electrochemical energy storage devices such as rechargeable cells and super capacitors due to massive increase in the use of portable electronics. At the moment this market is mainly covered by Li based cells [1]. However, Li is expensive, highly reactive and it becomes problematic in the disposal of the cell [1]. Therefore, attention has been focused on developing low cost non-Li based rechargeable cells. There are several substitutes such as Zn, Cu and Mg to replace Li.

Conducting polymers (CPs) have been identified as one of the most promising candidates for cathode material due to their interesting features such as appreciable electronic conductivity,

low cost, easy handling and environment friendliness [2]. Several conducting polymers have been tested for use as cathode materials such as polyaniline, polyacetylene, polypyrrole, polythiophene, and poly(p-phenlyene)due to some special features such as longer cycle life, lower self-discharge rate, endurance to over discharging, low manufacturing cost and shape flexibility[3]. Among them Poly-n-methylpyrrole (PNMP) is not very much used as the cathode material. In this study, the performance of a Zn rechargeable cell with a PNMP based cathode doped with sodium-per-chlorate ($NaClO_4$) is reported. A gel polymer electrolyte based on polyvinylideneflouride (PVdF), ethylene carbonate (EC), propylene carbonate (PC) and zinctrifluoromethanesulfonate (ZnTF) was used as the separator.

2. EXPERIMENTAL

2.1 Preparation of PNMP cathode

A circular shaped stainless steel (SS) dice with the area of 1 cm^2 was used to deposit PNMP films. Three electrode cell was set up with Pt electrode as the counter electrode (CE), Ag/AgCl electrode as the reference electrode (RE) and the SS electrode as the working electrode (WE). Electrolyte consist of 0.2 M NMP and slat ($NaClO_4$) of 0.5 M. Galvanostatic electrochemical polymerization was carried out by varying current densities in the values 1, 0.75, 0.5 and 0.25 $mAcm^{-2}$.

2.2 Preparation of the Gel Polymer Electrolyte (GPE)

Polyvinylidene fluoride (PVdF) (Aldrich), zinc trifluoromethanesulfonate (ZnTF) (Aldrich), propylene carbonate (PC) (Aldrich) and ethylene carbonate (EC) (Aldrich) in the optimized proportions of 0.5 PVdF: 1 EC: 1 PC: 0.8 ZnTF (by weight) was used prepare GPE. The mixture was magnetically stirred well and heated at 120 ^{0}C for 30 minutes. The hot mixture was pressed in between two clean and dry glass plates to obtain a bubble free thin GPE [4].

2.3 Fabrication of cells

A circular shaped sample was cut from the GPE to the size of the SS electrode using the sample cutter. Then the sample of the GPE was placed on the PNMP film. After that, Zn electrode was placed over the GPE, such that the GPE is sandwiched between the PNMP electrode and the Zn electrode. In this way, the cell was assembled in the configuration of Zn / PVdF:ZnTF:EC:PC/ PNMP:ClO_4. Several cells were fabricated having PNMP cathodes polymerized with different current densities.

2.4 Characterization of cells

As soon as the cells were assembled, OCV was measured using a digital multimeter. Electrochemical Impedance Spectroscopy (EIS) measurements were taken for the frequencies ranging from 400 KHz to 10 mHz using Metrohm Auto lab impedance analyzer. Cycling was carried out for different scan rates of 5, 10, 20, 50 and 100 mVs^{-1} for 5 cycles using Metrohm Auto lab Potentiostat . The potential window for the CV was 0.2 - 1.6V. Initially cell was galvanostatically discharged down to 0.2 V. Immediately after the discharge, cell was galvanostatically charged to 1.0 V and kept for equilibrium state. Similarly, continuous charge-discharge cycles were obtained under a constant charge-discharge current of 50 µA.

3. RESULTS & DISCUSSION

3.1 OCV values

Table 1 OCV values of cells with the configuration of Zn / PVDF:ZnTF:EC;PC / PNMP:ClO_4 having cathodes prepared with different current densities.

Current Density ($mAcm^{-2}$)	Open Circuit Voltage (V)
1.00	1.194
0.75	1.166
0.50	1.108
0.25	1.084

OCV values of the cells fabricated with PNMP cathodes prepared by varying current densities are given in table 1. The results indicate that there is no significant effect on the OCV with the current density used to polymerized the cathode. However this OCV is very much comparable with the results reported in early studies [4].

3.2 EIS test

Figure 1 shows the Nyquist plots of cells having different current densities.

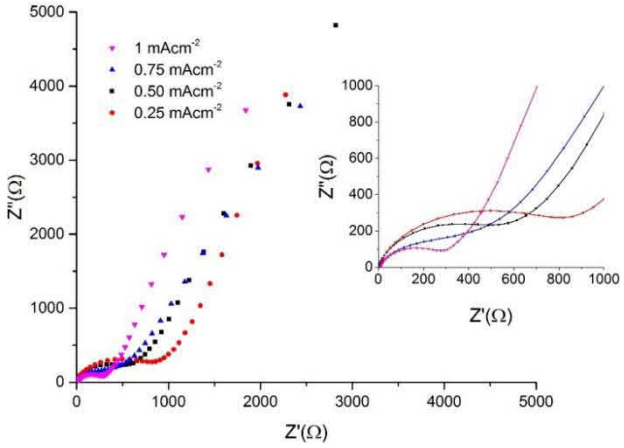

Fig. 1 Nyquist plots of cells with the configuration of Zn / PVDF:ZnTF:EC;PC / PNMP:$ClO_4$with the variation of current densities used to prepare cathodes from 1 – 0.25 $mAcm^{-2}$. Cathode (PNMP) thickness 1 µm.

According to figure 1, there exist a negative correlation between the current density and charge transfer resistance (R_{ct}). The lowest R_{ct} value was obtained for the cell having PNMP cathode prepared with 1mAcm^{-2} current density. The low value of R_{ct} implies that the performance of the cell is satisfactory [4].

3.3 CV Test

Figure 2 shows the cyclic voltammograms of the cells which having PNMP cathode prepared using different current densities.

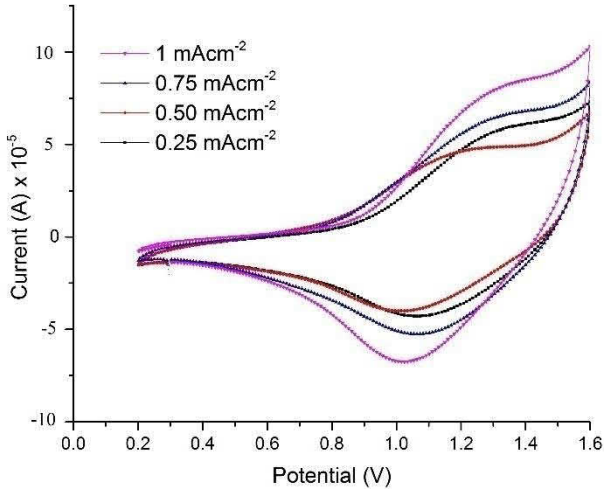

Fig. 2 Cyclic Voltammograms of cells with the configuration of Zn / PVDF : ZnTF:EC;PC / PNMP : ClO_4 with the variation of current densities used to prepare PNMP cathode from 1 – 0.25 mAcm^{-2} . Scan rate 5mVs^{-1}. Cathode (PNMP) thickness 1 µm.

According to the figure 2, peaks exist near the potentials 1.1 – 1.3 V are anodic peaks and peaks present near 0.9 – 1.1 V are cathodic peaks. These peaks represent the redox reactions take place in the CP. The anodic peaks occur due to oxidation of the PNMP electrode and cathodic peaks occur due to the reduction reaction in Zn [5].

3.3.1 Capacity calculation from CV curves

The "differential capacity" plots were obtained by dividing the current axis of the cyclic voltammogram by the scan rate. Differential capacity values were calculated by integrating the area of the curve.

Table 2 Differential capacity values of the cells with the polymerization current densities for different scan rates calculated for the 5th cycle.

Current Density	Differential capacity (F) x 10^{-3}				
	5mVs^{-1}	10 mVs^{-1}	20 mVs^{-1}	50 mVs^{-1}	100 mVs^{-1}
1.00	16.5	14.2	9.39	4.91	2.83
0.75	14.5	11.1	8.15	5.38	3.84
0.50	11.4	10.6	7.79	4.89	3.31
0.25	11.8	8.57	6.88	4.52	2.39

Table 2 shows the differential capacities of the cells having PNMP films prepared with different current densities for different scan rates. According to the table differential capacity was increasing with the change of current density. This can be attributed to change in the morphology of the films with higher current densities which shows more porous nature supporting the ion movement [5]. With the decrease of the scan rate the differential capacity increased. This may be due to increase of the amount of ions exchange with the slow scan rates. According to the results obtained highest capacity of $1.65x10^{-2}$ F was obtained for the cell with PNMP cathode prepared with 1 $mAcm^{-2}$ current density at the scan rate of 5 mVs^{-1}.

3.4 Galvanostatic Charge Discharge test (GCD)

Figure 3 shows the discharge capacities of the cells obtained from the GCD test. According to the figure, there is a slight capacity increase up to 50 cycles. This is due to re-arrangement of internal contacts between Zn, electrolyte and PNMP cathode. After that capacity decreases gradually. After 500 cycles, the highest discharged capacity of 1.1 $mAhg^{-1}$ was obtained with cell having PNMP film prepared at $1mAcm^{-2}$.

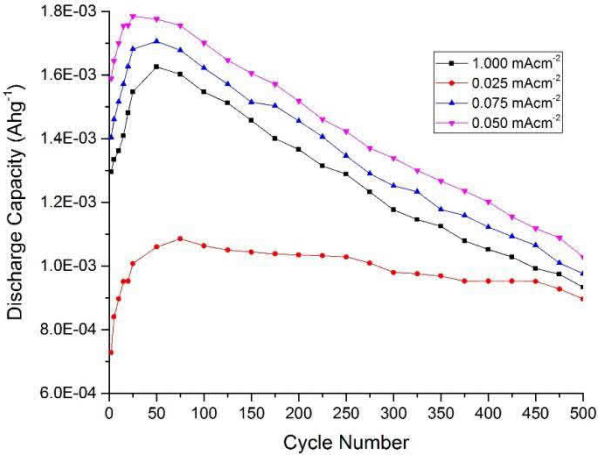

Fig. 3 Discharge capacity variation of the cells with the configuration of Zn / PVDF : ZnTF : EC : PC / PNMP : $ClO_4$with the variation of current densities from 1 – 0.25 $mAcm^{-2}$ with cycle number. Cathode (PNMP) thickness 1 µm.

4. CONCLUSION

Cell was tested by varying the current densities from 1, 0.75, 0.5 and 0.25 $mAcm^{-2}$. Open circuit voltages (OCV) of the cells showed an increasing trend from 0.9 V to 1.2 V when the current density increases from 0.25 to 1.00 $mAcm^{-2}$. Cyclic voltammetry results showed that with the increase of polymerization current density of PNMP films, differential capacity of the cell increased. It was also observed that higher capacities can be obtained with slower scan rates. This proves that there exist good interfacial contacts between the electrodes and electrolyte without any side reaction. After 500 cycles cell with PNMP cathode prepared with 1 $mAcm^{-2}$ gave the highest discharge capacity. According to the results of this study it

can be concluded that cells with higher capacities could be obtained when the PNMP film polymerized with higher current densities was used as the cathode in the rechargeable cell.

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Department of Electronics – Wayamba University of Sri Lanka

COST EFFECTIVE DUST MONITORING AND CLEANING SYSTEM

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ABSTRACT

This research introduces a dust monitoring and controlling system to calculate indoor air quality, and maintain it above the threshold level. Using the dust sensor, the system calculates air quality and displays it on liquid crystal display. Using this value user can identify the purity of air in a room. And also this dust level is also displayed by 3 light eminent diodes. If the dust density within the area is high, the dust collector is turned on to remove dust particles from the air. This system can remove very fine particles like cigarette smoke. Dust collector uses high voltage air ionizer and high efficient particulate air (HEPA) filter to remove dust. PIC16F887 microcontroller unit was used in this device to control functionality. This system is very useful in several areas of healthcare including operation theatres, outpatient departments, maternity wards, intensive care units, children wards, nursery etc. And also this is very useful to persons who have undergone bypass operations or with respiratory conditions like asthma. Nevertheless, this system can be fitted to any closed environment where a high level of air purity needs to be maintained.

Keywords: Indoor air quality, Dust sensor, High voltage air ionizer, Microcontroller unit, Healthcare

1. INTRODUCTION

Air pollution is a major problem of recent decades which has a serious toxicological impact on human health and the environment [1]. Every material in the air which could affect human health or have a profound impact on the environment is defined as air pollutants [2]. According to the World Health Organization (WHO), particle pollution, ground-level O_3, CO, sulfur oxides, nitrogen oxides, and lead (Pb) are the six major air pollutants which harm human health and also the ecosystem. There are many pollutants of suspended materials such

as dust, fumes, smokes, mists, gaseous pollutants, hydrocarbons, volatile organic compounds, polycyclic aromatic hydrocarbons (pahs), and halogen derivatives in the air which at the high concentrations cause vulnerability to many diseases including different types of cancers [3].

Dust particles vary in size from visible to invisible. The smaller the particle, the longer it stays in the air and the further it can travel. Large dust particles fall out of the air relatively close to where they are created.. Fine dust particles are more likely to penetrate deeply into the lungs while ultrafine particles can be absorbed directly into the blood stream [4]. The type and size of a dust particle determine how toxic the dust is.

Long-term effects of air pollution on the onset of diseases such as respiratory infections and inflammations, cardiovascular dysfunctions and cancers are widely accepted. Hence, air pollution is linked with millions of deaths globally each year [5, 6]. Air pollution has now emerged in developing countries as a result of industrial activities and also increase of emission sources such as inappropriate vehicles [7]. About 4.3 million people die from household air pollution and 3.7 million from ambient air pollution, most of whom (3.3 and 2.6 million, respectively) live in Asia [8].

An air purifier or air cleaner is a device which removes contaminants from the air in a room. Some are installed in the ductwork of a home's central heating, ventilating and air-conditioning system to clean the air in the entire house. Portable room air cleaners can be used to clean the air in a single room or in specific areas, but they are not intended to filter the air in the whole house. Air cleaning devices are categorized by the type of pollutants, particulate and gases that the device is designed to remove or destroy [9].

2. EXPERIMENTAL

In this system (figure 1) Optical Dust Sensor- GP2Y1010AU0F is used to monitor the dust level in the area. An infrared emitting diode and a phototransistor are diagonally arranged into this device to allow it to detect the reflected light of dust in the air [10]. According to the dust density, it generates an analog voltage which is captured by PIC16F887 microcontroller. A digital value is generated according to the dust sensor output using ADC module in the microcontroller. That value is used to calculate air quality. Calculated air quality, time and date are displayed on LCD and stored in the memory module.

According to the calculated air quality, few decisions are taken by the microcontroller. If the calculated level is high, red LED and the dust collector are turned on. If the level is medium, dust collector and orange LED are turned on. If the calculated level is low, the dust collector is turned off and green LED is turned on.

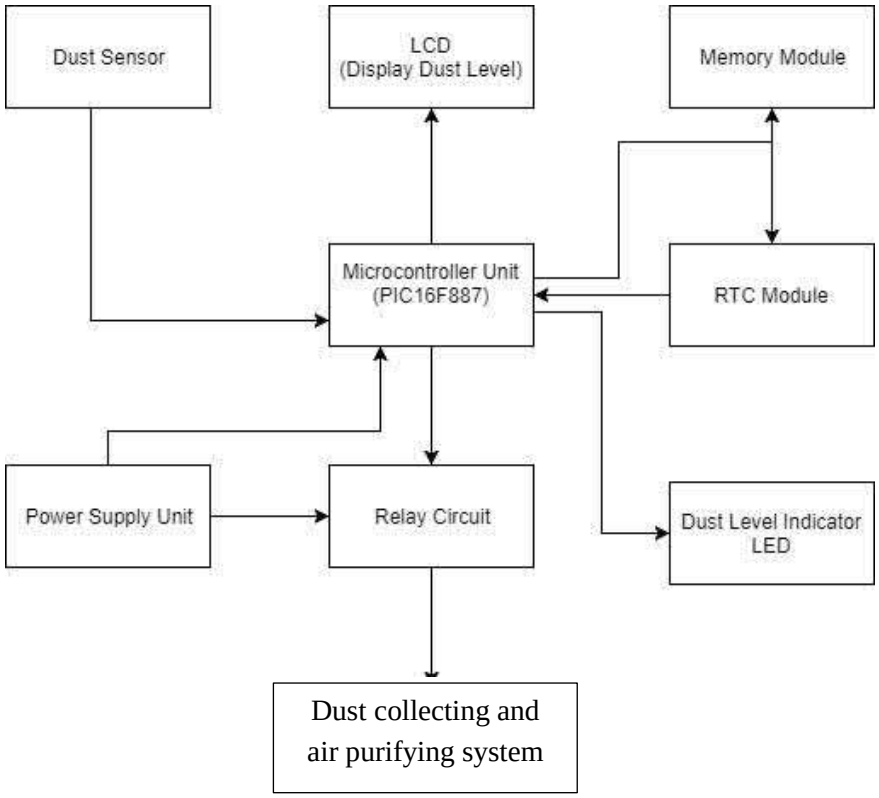

Fig. 1 Block diagram of the system

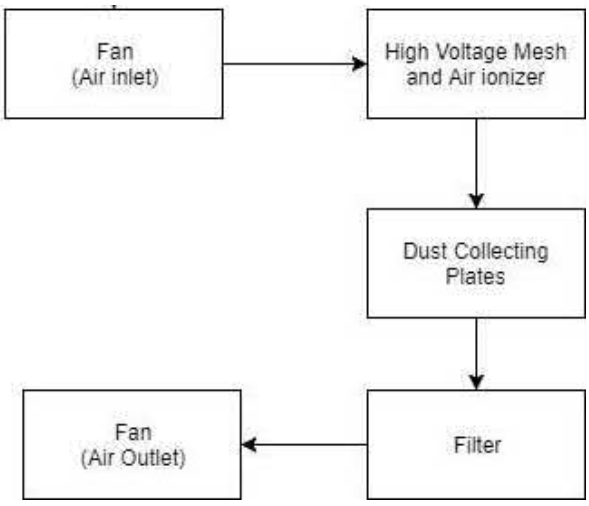

Fig. 2 Block diagram of the dust collecting and air purifying system

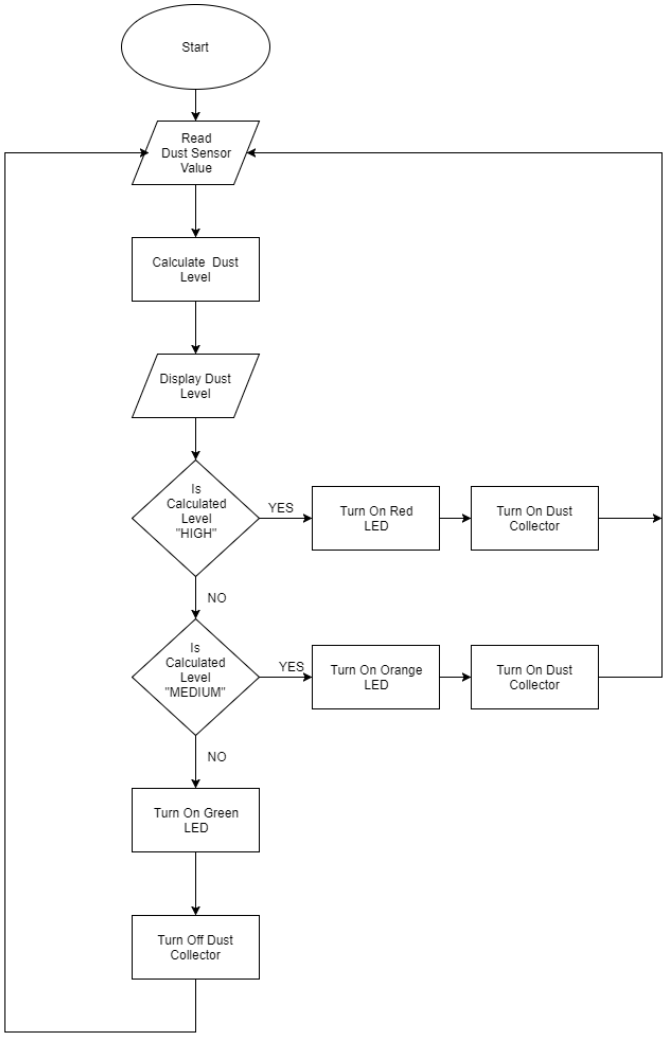

Fig. 3 Flow chart of the system

Dust collecting system consists of few parts (figure 2). A fan is installed in it to absorb air into the dust collector. The air which is absorbed into the dust collector is ionized using high voltage mesh and negative ion generator. There are few steel plates arranged in dust collector to attract ionized particles. These ionized particles go through the electric field and attached to plate which is at a high voltage. Then dust-free air goes through high efficient particulate air filer to filter air further. The fan fixed in air outlet releases fresh air to the room.

3. RESULTS AND DISCUSSION

Flow chart in figure 3 shows the operation of design. Input and output dust density was measured in every 5 seconds in a room for evaluating the quality of the dust removing system and readings are shown in the following table.

Input and output dust density was plotted against the time. It is shown in the following graph.

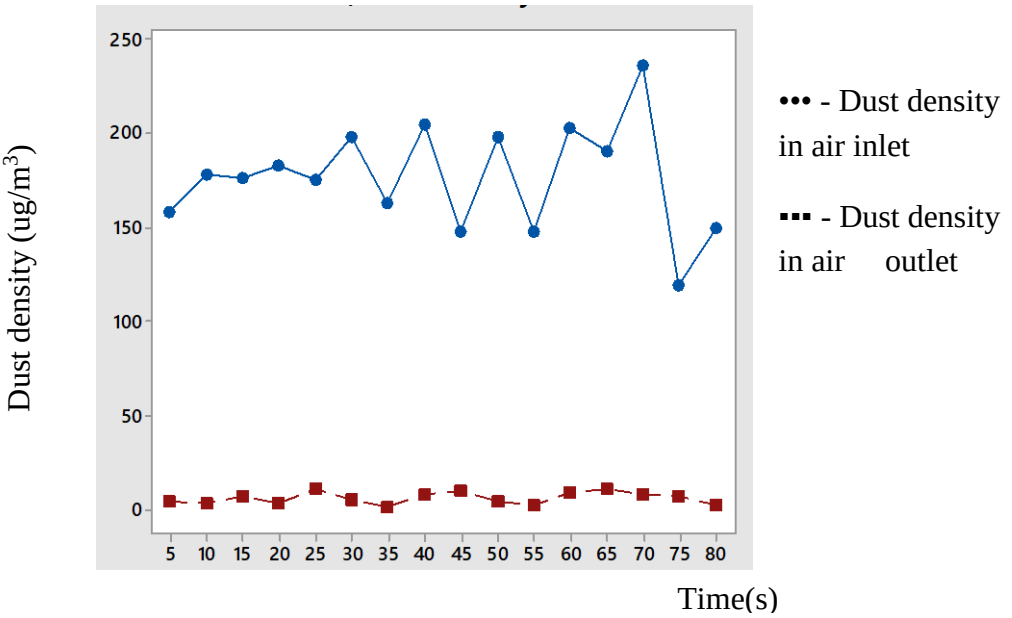

Fig. 4 The graph of input and output dust density versus time

According to the graph it is seen that the system removes dust particles contain in air. There is a considerable difference between two readings. This is evidencing the fact that the system removes dust in the place. Comparing with other air ionizing air purifiers this cost is low. According to the current market prices of components this system can build within LKR 5000.

4. CONCLUSION

Air pollution is a major problem of recent decades which has a serious toxicological impact on human health and the environment. This system was implemented to monitor and remove dust particle contain in air. To remove the dust from the air, proposed system plays a major role. This system is very helpful to several areas of healthcare. And also this system is low cost, consumes low power and it has higher cleaning capacity.

ACKNOWLEDGEMENTS

Authors would like to extend their sincere thanks to all the staff members of the Department of Electronics, Wayamba University of Sri Lanka, Kuliyapitiya, Sri Lanka.

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Proc. Annual Symposium on Research & Industrial Training, 05(2018) 65-69
Department of Electronics – Wayamba University of Sri Lanka

SAFETY SYSTEM FOR LP GAS LEAKAGES IN SMALL INDUSTRIES

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ABSTRACT

This project proposes developing a low cost and flexible device to detect and notify the LP gas leakage. Currently, LP gas serves as an energy source for both domestic and industrial use in Sri Lanka and most of the other countries. The Gas leakage is a major problem in the industrial sector and residential premises. One of the preventive methods to stop accidents associated with the gas leakage is to install a gas leakage detection device at vulnerable places. The aims of this project are to develop such a device that can identify the LP gas leakage, indicate the risk to the user and minimize the hazard. Implemented system uses a MQ-6 sensor for identifying the LP gas leakage, a buzzer as the alarm system and a LCD display to indicate the position of the gas leakage and the GSM module to send a massage to an authorized person. Thus, the system can identify a hazardous situation and convey usable information to the user immediately and accurately. In an event of a leakage, the system automatically shuts off the main gas valve to mitigate fire risk. Therefore, the proposed system is cost effective and safe.

Keywords: ATMEGA328P microcontroller, MQ-6 LP gas sensor, Buzzer, GSM module, Solenoidal valve

1. INTRODUCTION

The use of liquefied petroleum gas (LPG) is rapidly increasing in developing countries like Sri Lanka as it produces low smoke and less soot. The LPG is a flammable mixture of hydrocarbon gases like propane and butane. LP gas cylinders are safe but they are prone to gas leakage due to mishandling and over filling of the gas cylinder. In general, there are some LPG safety system for the industries. According to this existing safety system, it has sense a leakage and sounds an alarm for Sri Lankan industries.

Another safety system available in foreign countries. It is turning off the main power and gas supply. But it is not suitable for our country. Because foreign countries use pipe line to supply gas, but our country use gas cylinder for supply gas. Another main problem for domestic people is that there is no one in the domestic place, there is no way to know if a gas leak occurs. However, there is a serious problem about gas leakage in the air. Further the existing devices are so expensive that they cannot buy for small industries.

Generally, the main goal of the project is to detect the LP gas leakage and inform about that problem to neighbors and authorized person. Therefore, to achieve goal, there are three main units for the circuit. They are sensor unit, microcontroller unit and GSM module unit. The scope of this project is about the usage of the device, hardware and electronic circuit basis and the programming part of the device.

The first scope of the project is the usage of the system. The system can apply for small industries and domestic sectors, a fire has been to avoid from LP gas leakage.

The project is on hardware and electronic circuit basis techniques. The electronic basis involves on design the related circuit such as sensor unit and control unit. The processes are continuing with simulation, modification and construct the circuit to the board. This project involved in PCB and casing design.

The important part is about the programming part of the device. In this project, an ATMEGA328P ATMEL microcontroller is used as controlling unit. For programming the microcontroller was used Arduino UNO board was used as a programmer.

2. EXPERIMENTAL

In proposed system has been developed to detect the LP gas leakage and notify the user with low cost device. The completed unit has been designed and implemented according to the below block diagram in Fig. 01.

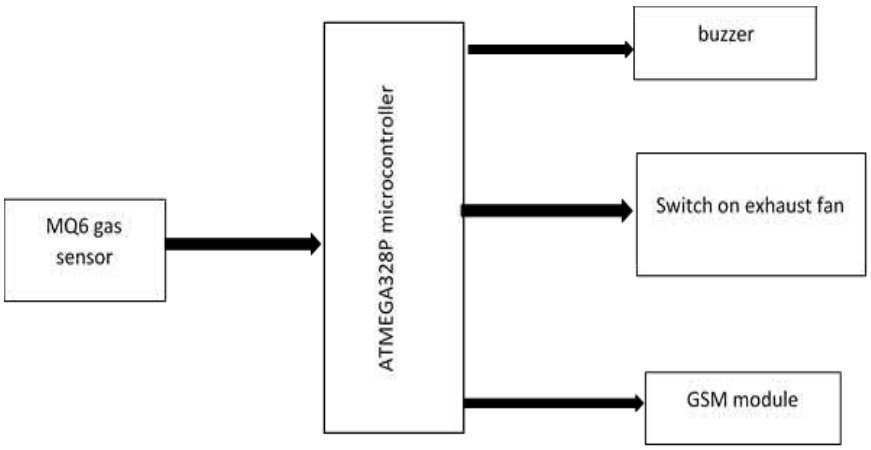

Fig. 1. The block

According to this project of following three major units.

1. Sensor Unit
2. Main Controlling Unit (microcontroller unit)
3. GSM module Unit

In this system, LP gas leakage was identified by MQ 6 sensor. After detect the leakage, that output give to the ATMEGA328P ATMEL microcontroller of the main control unit. ATMEGA328P microcontroller

Was used to implement the solution. LCD display was used to show Gas leakage and also an alarm was utilized to indicate the gas leakage.

Additionally, if the system identifies a LP gas leakage by the sensor system, a solenoid valve was used for main gas line to shut off the gas leakage and the SIM900D GSM module was used for receive a massage with the location of the gas leakage to the authorized person.

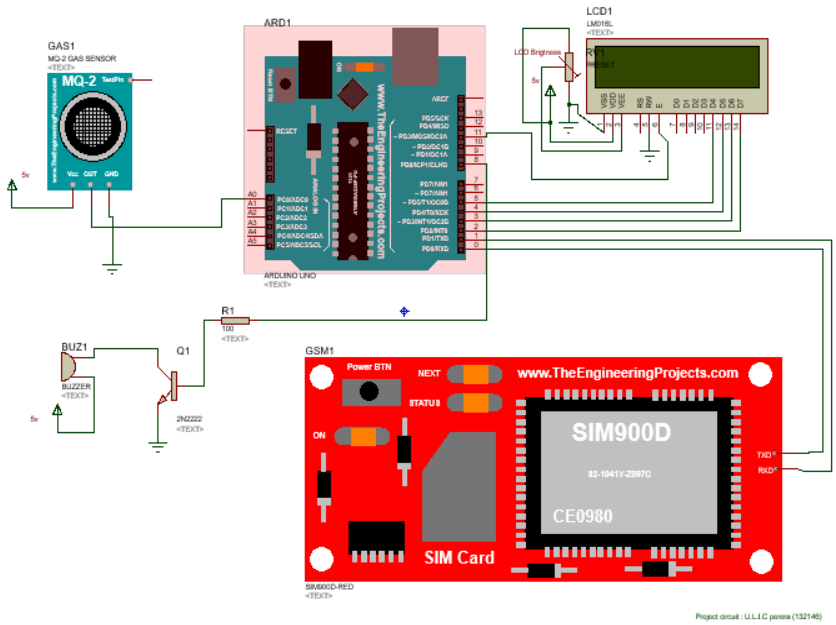

Fig. 2 The circuit diagram

3. RESULTS AND DISCUSSION

The developed system was designed and tested by a small number of LP gas near gas sensor module and the system operated as expected and result was observed. In here, an ATMEGA328P ATMEL microcontroller was used with Arduino UNO board for controlling the overall system of the developed system.

Never use lighter when checking the LP gas sensor. Because if it does, the sensor will be damaged. Since LP gas has more weight than air. The gas detector (sensor) should keep below the neck of the gas cylinder, to detect the gas efficiently. [3]

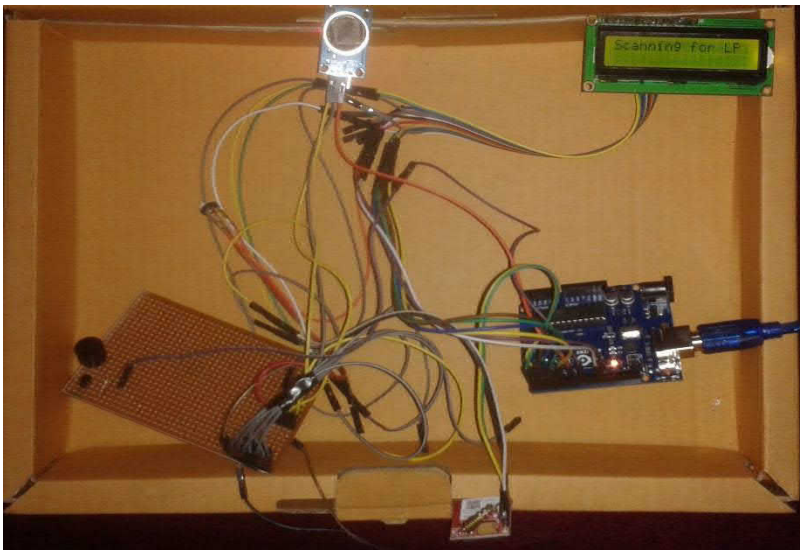

Fig. 3 The prototype of the device

4. CONCLUSION

The proposed system has three main function of identify the LP gas leak, indicate the leak and minimize the hazard. It uses MQ-6 LP gas sensors for identifying the LP gas leakage, and a buzzer as the alarm system and a LCD display to indicate the position of the gas leakage, thus allowing the system to identify a hazardous situation and convey usable information to the user immediately and accurately. Finally, GSM module give the massage to the authorized person to notify that gas leakage. In an event of a leakage, the system automatically shuts off the main gas valve to mitigate fire risk from the gas cooker. After activating the previous functions, the system requires a personal to rest the system manually; this feature was implemented as a safety system to prevent any personal from reopening the valves without being aware of a leakage before the rectification of the problem.

ACKNOWLEDGEMENTS

Authors would like to extend their sincere thanks to all the staff members of the Department of Electronics, Wayamba University of Sri Lanka. Authors wish to convey their sincere thanks for all, those supported in this project's success.

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Department of Electronics – Wayamba University of Sri Lanka

HEIGHT MEASURING DEVICE FOR TELECOMMUNICATION INDUSTRY USING A PRESSURE SENSOR

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ABSTRACT

Most of the telecommunication service providers in Sri Lanka use Technical Site Survey Report (TSSR) to decide future installations. During a site survey, it is very important to note down antenna details and measure heights to different tower levels by using a low cost, high speed, high efficiency and high accuracy method. The site survey is very important to the entire network because fault of the survey information may cause the sites out of control. Normally measuring heights of different levels of the tower in the technical site survey is done by using a tape. Digital height measuring sensors are not been used by most of the telecommunication companies because of their highcost and complexity. The objective of this study is to find a solution to this issue. Use of a barometric pressure sensor as the distance measuring sensor and Atmega328p microcontroller as the main control system is proposed in this paper. With the proposed mechanism, distance can be directly measured. The developed device displays the relevant height with the help of a LCD (Liquid Crystal Display).

Keywords: Technical site survey report, Distance measuring sensor, Barometric pressure sensor

1. INTRODUCTION

Presently most telecommunication subcontractors use tapes to measure distances to various location of the tower during the technical site surveys. There exist some types of digital height measuring sensors. But they are not been used by most of the telecommunication companies because of their cost and complexity. In the present method, a rigger should tie one end of the tape at the bottom of the tower and then one should climb the tower with the other end of the tape. The rigger should also note the tape readings to the relevant levels of

the tower. But obtaining measurement using the tape is not accurate and also there may be misreading of the values. Also this is a time and money wasting technique. So there exist a need to enhance the accuracy and the efficiency of the measurements. Also the solution should be a time consuming and cost effective technique. This paper reports construction of a digital meter to measure tower height and antenna heights as a solution to all above.

2. EXPERIMENTAL

The block diagram of the proposed system is shown in the following figure 1.

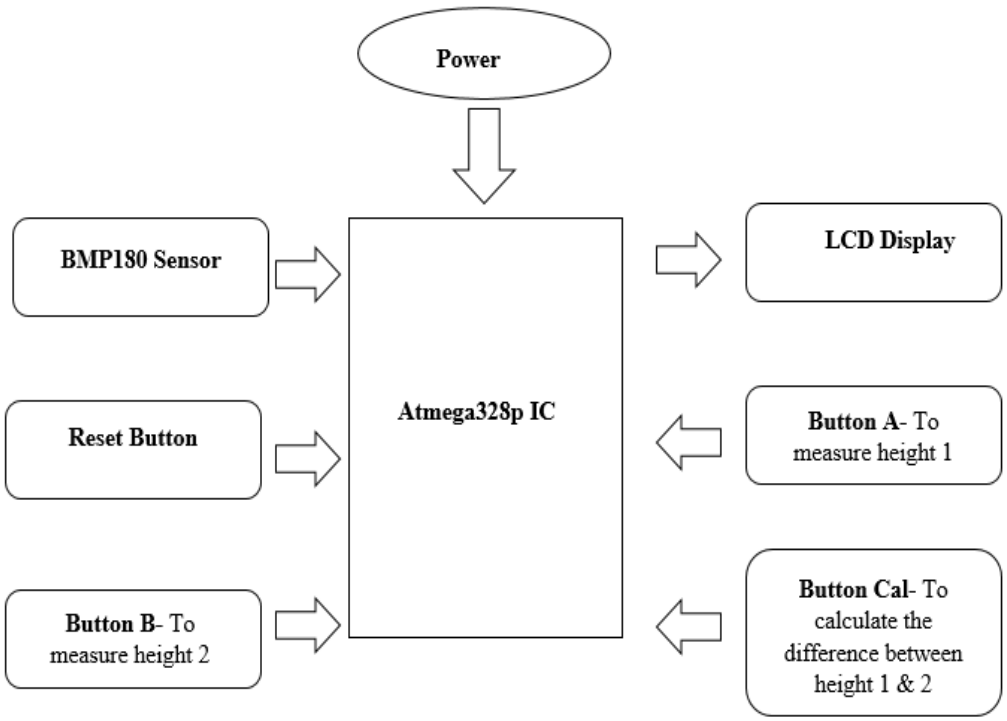

Fig. 1 Block diagram of the system

The BMP180 barometric pressure sensor, LCDdisplay and buttons were connected to the atmega328p microcontroller using relevant pins. The atmega328p microcontroller was programmed using arduino language to obtain the distance. ALCDdisplay was connected to the microcontroller to display the height of antenna or tower. Also a RESET button was connected to the microcontroller to reset the entire device. A and B buttons are used to save the different heights for measure the distance. CAL button are used to calculate the difference of above A and B values.

Figure2 shows the flowchart of the propose system.

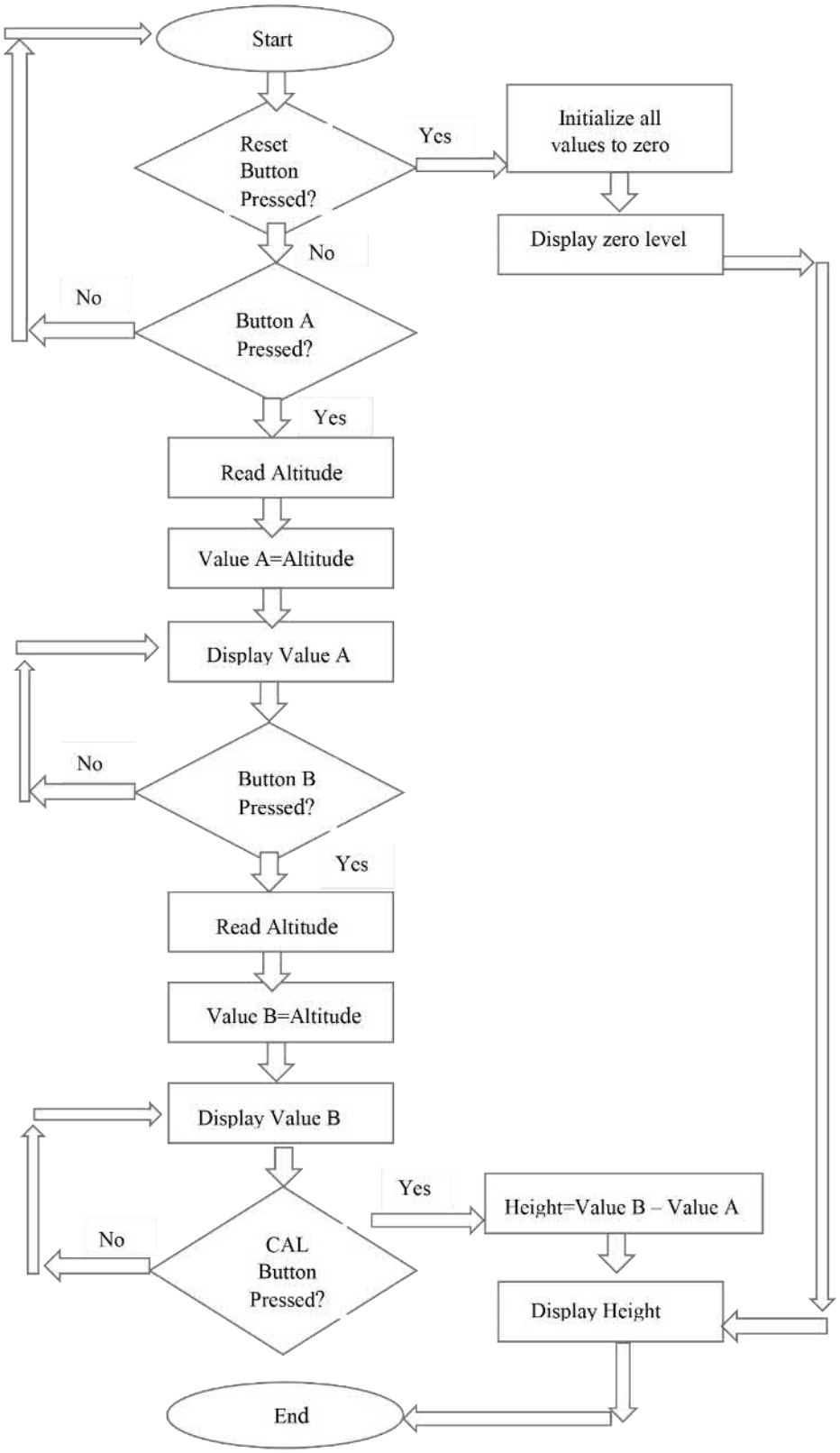

Fig. 2 Flowchart of the system

The circuit diagram of the proposed system is shown in figure 3.

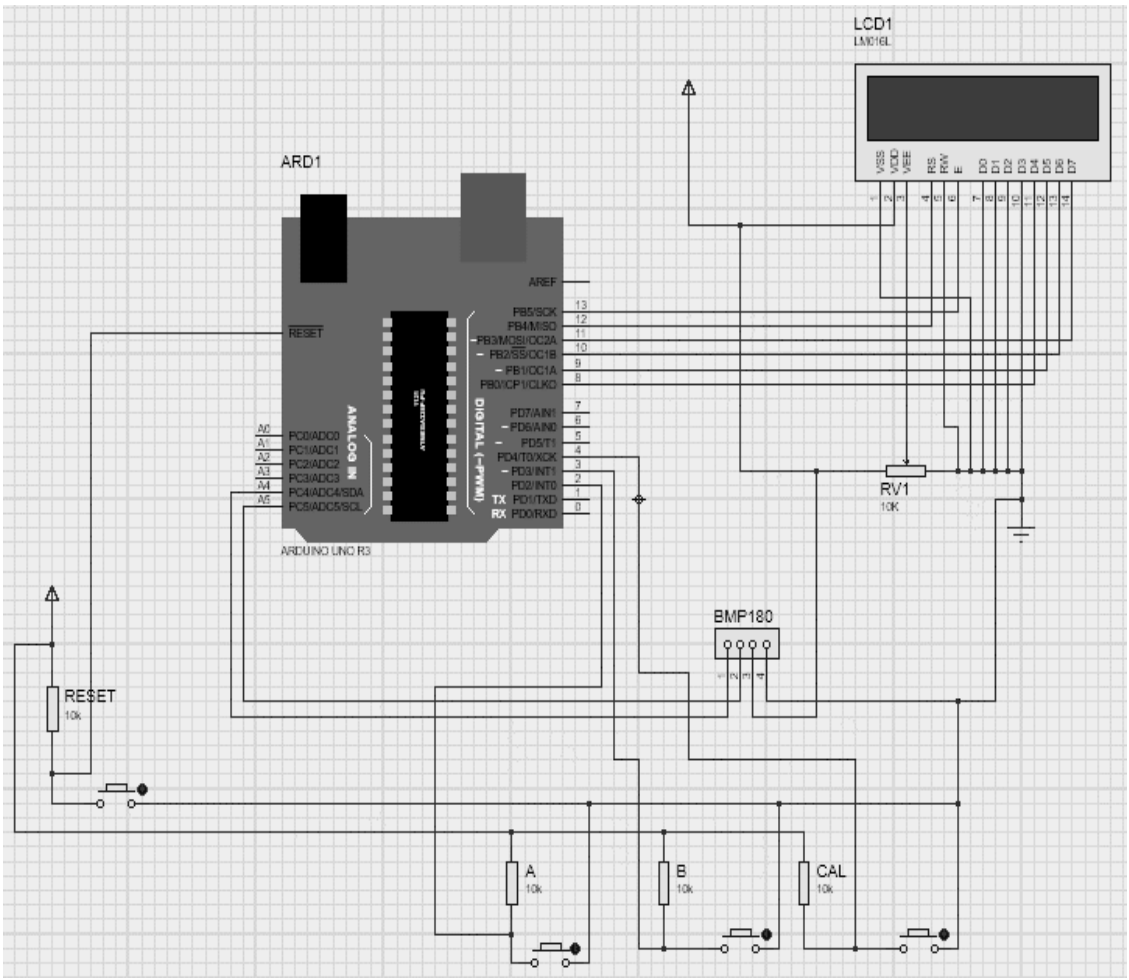

Fig. 3 Circuit diagram of the system

3. RESULTS AND DISCUSSION

The device was reset at ground level and moved upwards along a measuring tape which has been pasted vertically on the wall with 0m reading at ground level. The reading of the device was compared with the actual value on the tape. And the values read as shown in the table 1.

The read values were very much closer to actual readings. But when the device was kept at the same position for about 30 seconds, due to the atmospheric pressure change due to wind, the readings can vary and deviate about 20 cm upwards or downwards. To avoid this, the device would take more reading of the same position within 5seconds and the mean value is displayed as the height.

The reading may be ± 20cm deviated from the actual reading. In telecommunication towers, we measure the height in meters and therefore a little deviation of 20 cm from the actual

would do no harm to the survey reports. The minimum height that can be measured from this device is 10cm and the maximum value is 3000m.

Table 1: Measuring values with actual heights at different heights

Actual value (m)	Time period (s)	Readings (m)				
		Wattala	Alawwa	Kuliyapitiya	Ampara	Kandy
0	1	0.0	-0.1	0.0	0.2	0.0
	2	0.1	-0.2	-0.1	0.2	0.3
	3	-0.1	0.2	0.1	0.0	-0.1
	4	0.1	0.0	0.3	0.0	-0.1
1	1	0.8	1.0	1.3	1.3	0.1
	2	0.9	1.0	1.2	1.2	0.8
	3	1.1	1.2	0.8	1.2	0.9
	4	1.2	0.8	1.0	0.8	1.1
	5	1.1	0.8	1.1	0.8	1.2
2	1	1.8	2.0	1.7	2.1	1.7
	2	2.0	2.2	2.3	2.3	1.9
	3	2.1	1.7	1.9	1.9	2.0
	4	2.0	1.9	1.8	1.9	2.0
	5	2.3	2.0	2.0	2.0	1.9
5	1	4.7	5.2	5.1	5.0	5.0
	2	5.1	4.8	4.9	5.0	4.7
	3	5.1	5.2	4.7	5.2	4.8
	4	4.8	4.9	5.0	5.2	5.0
	5	5.0	5.4	5.0	5.1	5.1
10	1	9.7	9.8	10.3	10.2	10.0
	2	10.1	10.2	10.0	10.4	10.1
	3	10.2	10.2	9.8	10.0	10.4
	4	10.0	9.8	9.7	10.0	10.0
	5	10.3	10.0	9.9	10.0	9.9

4. CONCLUSION

The aim of this project is a low cost, user friendly solution was developed to measure the height of a communication tower and antennas. For that, BMP180 barometric pressure sensor were used. The actual distance is calculated with the help of Arduino program. The device is low cast and has an accuracy of 25cm and the highest value that can be measured is 3000m. There can an error of ± 20cm, but it can be neglected compared to the heights we use to measure with this device, in telecommunication industry. This error, due to the pressure changes due to wind, can be avoided by adding more features to this device which leads to more cost.

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Department of Electronics – Wayamba University of Sri Lanka

GSM BASED POWER CONSUMPTION INDICATOR FOR SHARED TELECOMMUNICATION SITES

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ABSTRACT

In general, most of telecommunication service providers in Sri Lanka share the communication towers or sites among them to cover more ground by reducing the cost for the infrastructures. The site has one electrical power supply and it is shared among all the site users. As there is no protocol or specific device to identify and inform the electrical power consumption of network providers who are sharing the same telecommunication site. Therefore, this study was carried out to build a GSM based instrument that capable of sending electricity current, voltage and power consumption level notifications of a fixed period via a short massage. In addition, the proprietor of the shared site is also get the benefit of monitoring the site user's electrical power usage lies on the agreed levels. The developed system consist with a 20×4 character LCD to display the current, voltage and total power of the electrical usage by each network provider while allowing authorized persons to receive electrical usage reports via a short massage on demand.

Keywords: Electricity current, Power consumption, PIC microcontroller, Short message service

1. INTRODUCTION

According to the recent developments it has been predicted that the price of electricity and demand for power are going to be increased exponentially in the on coming years. In fact, the world's demand for power is rising faster that it has become difficult to meet the demand. Consequently, industries and businesses are already taking power saving measures to save money and to become more environmental friendly. Powers saving techniques seem to have a small impact on each individual, but as the price and demand for electricity rises, the collective power saving actions of everyone will make a significant difference. Therefore this research project aims to produce an electronic device which continuously monitors current, voltage and

power consumption and warns network providers about their current situation of the electricity usage. Nowadays the electricity usage of the public has increased so much that they themselves have forgotten to check which telecommunication sites are being commonly used and how to save energy through a more effective electricity usage. Thus by introducing this kind of a research design this system can be applied to know real power consumption level of network providers and minimize the extra payment which is paid monthly for the proprietor.

Wireless telecommunication providers in Sri Lanka such as Mobitel, Dialog, Airtel and Hutch share their sites in some region with other network providers. In these sites, electricity power is also shared with other operators. It is shared by using circuit breakers. Electricity power is distributed by main power supply of the proprietary provider's using circuit breakers according to their requirements. Therefore, electricity current, voltage and power consumption cannot be measured easily for each network provider. And also proprietor of the site cannot measure electricity current rating of all other users in a site. In this case, other network providers who is sharing the site are payed some monthly constant payment for the site proprietor according to the agreement.

This is a disadvantage for site proprietor as well as other operators paying monthly constant payment without knowing monthly electricity usage. All network providers face this problem since begin. By using this GSM based Power Consumption Notification System, they can determine electricity current, voltage and power usage of each user in constant time periods for sharing sites by the Short Message Service (SMS) without visiting the site. This device will be important to all network providers for efficient process with saving time and money.

2. EXPERIMENTAL

2.1 Block diagram

According to the following block diagram of the system developed, it shows a microcontroller based power consumption notification system. This system has been included a GSM module to connect through a mobile phone. Whenever the user needs to know their current, voltage ratings and power consumption level of any network provider in any of the sites, these details can be notified in any time period by a SMS. These details are also displayed in a LCD display to notify any other persons in a site.

The block diagram of the studied system is shown in the following figure.

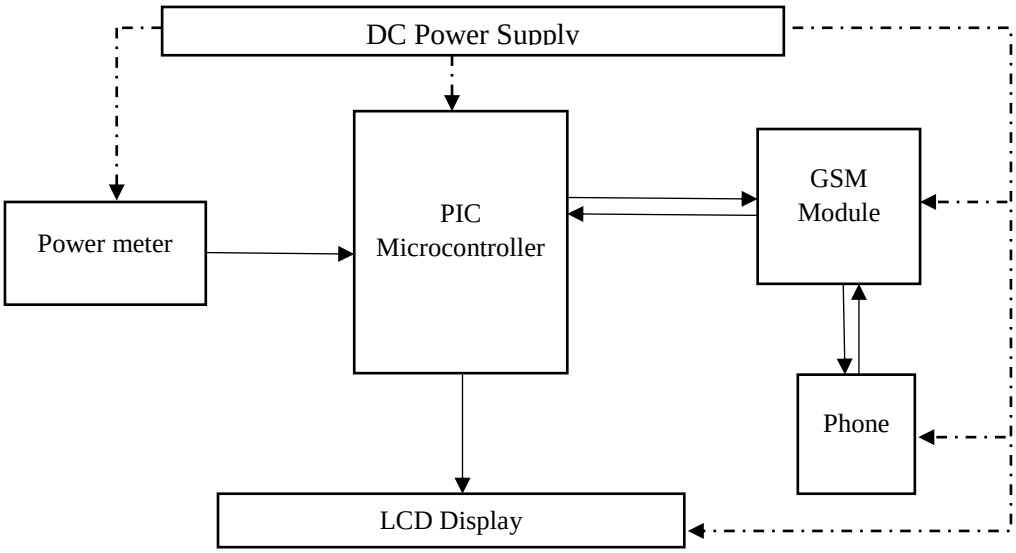

Fig. 1 Block diagram of the proposed system

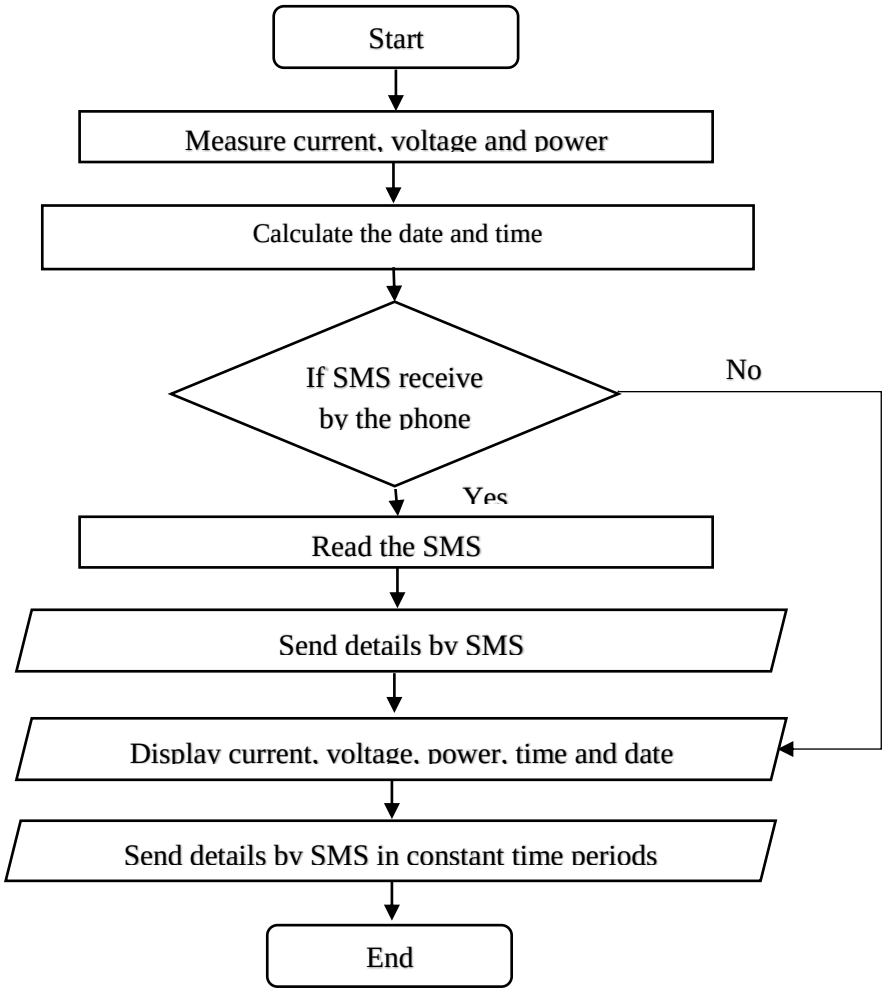

Fig. 2 The process of the proposed system

2.2 Voltage and Current Sensors calibration

The output of the current sensor varies from 2.5 V to 5V DC voltage with respect to the input current. The ADC output of the sensor at 0 input current is 512 (digital output value with respect to the 0 input current). Hence if 512 to 1024 was allowed to reflect 0 to 20 A range. A variable current was applied to the sensor and through the MicroC program, maximum and minimum values of the ADC were measured against each input current. Then, a relationship was constructed between the peak to peak input current and peak to peak ADC output for the analysis.

The ADC output of the voltage sensor at 0 input voltage is 512 hence if 512 to 1024 was allowed to reflect 0 to 1000 V range. Then 512 to 640 will be suitable to scale 250 V range. In this regard with 250 V connected to the sensor the maximum ADC was adjusted to be 640 using the sensor trim pot. A variable voltage from variable transformer was applied to the voltage sensor and through the microC program, maximum and minimum values of the ADC were measured against each input voltage. Then, a relationship was constructed between the peak to peak input voltage and peak to peak ADC output for the analysis. The microC code sampled the voltage 1000 times and obtain the minimum and maximum ADC values from the samples.

3. RESULTS AND DISCUSSION

This project was designed to notify the power consumption level and price of all network providers in a sharing site automatically. A PIC 16F877A microcontroller was used to implement this circuit because it was very familiar and easy to handle. And also it had enough features for implementation of the project.

In this system, ACS712-20A current sensor was used to measure the current. But it can be used for only up to 20A range electrical equipment or main power supplies. Therefore, this sensor cannot be used for machineries or main power supplies which are flowed huge current in any industry to detect the power consumption level. In this device, ACS712 current sensor and ZMPT101B transformer module voltage sensor successfully detected current and voltage. And also their readings were accurate when compared with a multi-meter readings. Following Fig. 3 shows the DC output waveform of the ACS712-20A current sensor when the current did not flow through the sensor. Therefore, it was deduced that it was given 2.5V DC output voltage while the current did not flow through the current sensor.

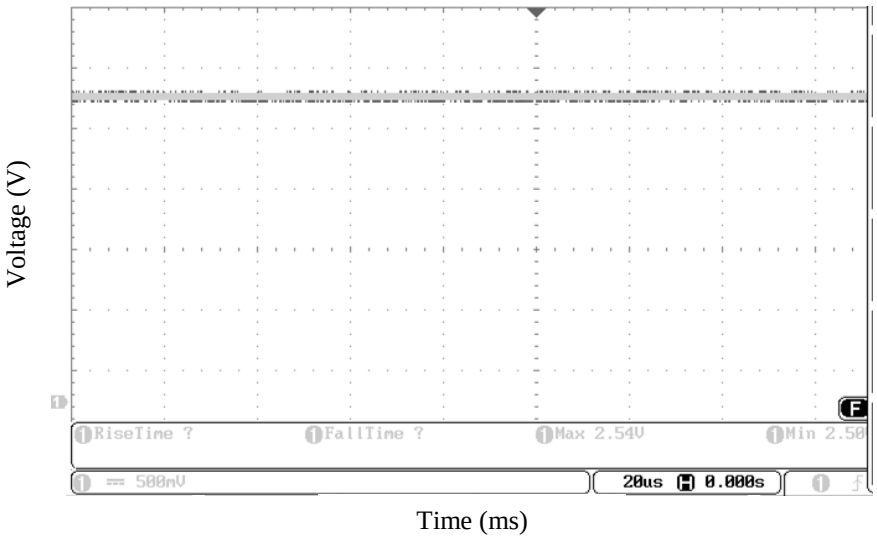

Fig. 3 Output waveform of the ACS712-20A current sensor when current does not flow through the sensor

Fig. 4 shows the AC output voltage waveform when a 0-250 V range input AC voltage was applied to the voltage sensor.

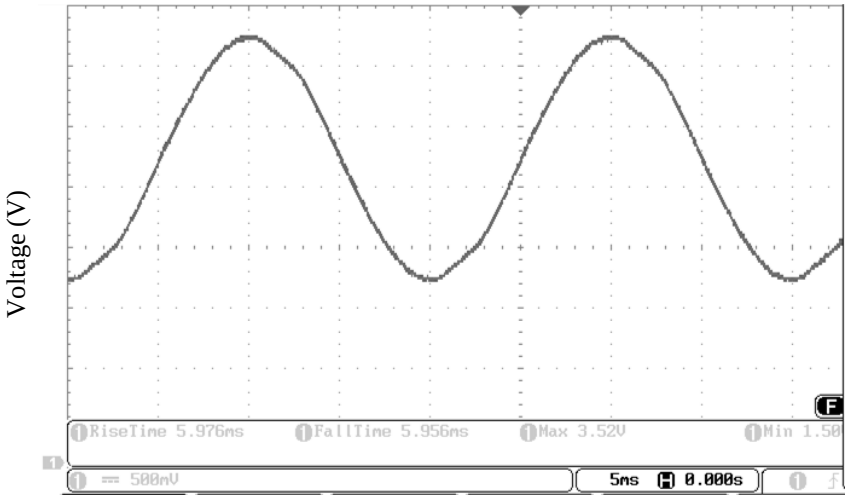

Fig. 4 Output waveform of the ZMPT101B transformer module voltage sensor

4. CONCLUSION

This device is very useful for telecommunication network providers in Sri Lanka to detect their electricity current, voltage and power usage in each sharing site. And also this device is very useful for other providers who shares their network sites with other network providers to check the current, voltage and power usage in constant time periods by a SMS. It is very important for economical electricity usage. By using this device, we can detect power consumption level at any time. Then, they can decide how to vary this electricity usage with all network providers in a site. This device can also be fixed with each electrical equipment in a site and they can decide which equipment's power consumption level is very high. And also, it can be categorized these equipment from higher power consumption equipment to low power consumption equipment depending on their electricity usage. Then, they can maintain each equipment separately to minimize the power consumption rate.

Electricity usage can be notified in any time by SMS even if we stay away from the system. It is always very important for every citizen to be aware of their power consumption usage for future existence. This system constantly reminds the users about their power consumption. Thus, it leads the user for a more economical electricity usage.

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Department of Electronics – Wayamba University of Sri Lanka

GSM BASED MULTIPLE PHONE LINE IDENTIFICATION SYSTEM WITH DATA STORAGE

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ABSTRACT

Phone number identification method currently used at the Main Distribution Frame (MDF) and Multi-Service Access Node (MSAN) of Sri Lanka Telecom (SLT) is a manual method. This is time consuming and there is no proper method to store these data. If the company wants to get details of several phone lines at the same time it has to be done using the above manual method one by one. It is also difficult to display all the numbers at same time. Main objective of this research project was to develop a system to provide an automated approach to identify phone numbers at Main Distribution Frame and Multi-Service Access Node. This system uses a GSM module to receive phone numbers and LCD to display the numbers and a data storage unit to save data on a database. This paper discusses a GSM based multiple phone line identification system with data storage. This identification facility along with GSM based communication and microcontroller was designed using ATMEGA328P microcontroller which stores data in a SD memory card periodically for reference.

Keywords: Main distribution frame (MDF), Multi-service access node (MSAN), Global system for mobile (GSM)

1. INTRODUCTION

Main Distribution Frame (MDF) and Multi-Service Access Node (MSAN) are the main component in the wired telecommunication field. Inside view of the MSAN and MDF is quite similar. Most of them have 10 lines at each block. Each line is connected with copper wires. Both have hundred or thousand numbers of lines running from them. Both consist of voice, data, and ADSL lines. Each phone line can be check at the MDF or MSAN. It can be done by connecting a phone to the MDF or MSAN. Technicians do this check manually by connecting each phone line individually to test whether customer phone line works properly

or not. And also if the company wants to get details of several phone lines at the same time in the MDF or MSAN, it also has to be done by using above method one by one. It is difficult to display whole numbers at the same time. If the company can store these data in a database it is can be important to their system. But testing all the line things manually is not an efficient task.

Therefore it was clear that there was a need of developing an efficient method to identify each phone number and displaying all the numbers at the same time and save them in a database.

2. EXPERIMENTAL

In this project, a GSM based multiple phone line identifying system with data storage is presented. The system consists of the following major units. The diagram below describes the flow of operations in the system as well as their interconnection.

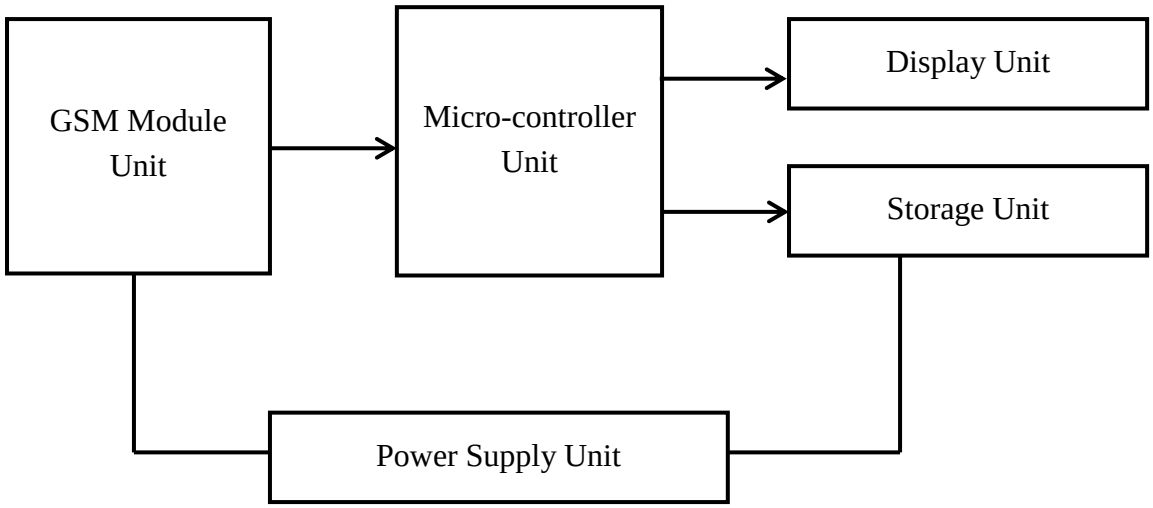

Fig. 1 Block diagram of the designed system

GSM module

To implement this project a GSM (Global System for Mobile) module is used to receive a phone call from the transmitting unit. GSM module has several functionalities. Here SIM800L GSM has used module and its specific functions were used. This GSM Modem can accept any GSM network operator SIM card and act just like a mobile phone with its own unique phone number [1]

Micro-Controller Unit

All the controlling part of the system is done by the microcontroller. Here ATMEGA328P microcontroller has been used. The basic operation of control unit is the controlling of GSM

module, Display unit and Memory unit. These modules were controlled by ATMEGA328P microcontroller which is programmed by a particular program. Microcontroller takes signals of transmitting unit which gives to the GSM module as input signals and gives the output signal to the Display and memory units which were connected to the pins of microcontroller. [2]

Display Unit

This unit consists of LCD display. The function of this unit is to display the phone number which received from transmitting unit one by one. This LCD module interfaced with 2 lines by 16 characters. LCD modules amount of wiring requires time and patience to wire it up correctly - and also uses a lot of digital output pins. Additionally, it has a converter unit which can be easily connected to the microcontroller. [3]

Memory Unit

Memory unit consists of micro SD card and SD module to interface with the micro controller. This unit was used to save the phone number details on a database in a proper and easy way. MicroSD cards combine flash memory, similar to the on board flash memory of the arduino, with an intergraded controller. The controller communicates with the arduino. [3]

When power on the circuit as the first stage of the design, it initializes the configurations. To identify the phone number, transmitting unit should dial the phone number of the SIM which is inserted in the GSM Module that used in the receiving circuit. GSM module can identify the phone number of the received call.

Then the I2C LCD Display can display the corresponding phone number on the display. After displaying one number LCD screen clears after some delay. After that transmit unit connect into the second line on the block and again GSM identify the number. And second number is displayed on the screen. Likewise this system can identify several numbers in a very easy way. While displaying the phone numbers of the block in MDF or MSAN, these details are saved on a SD card. The details of the phone number are stored in a database via micro SD card.

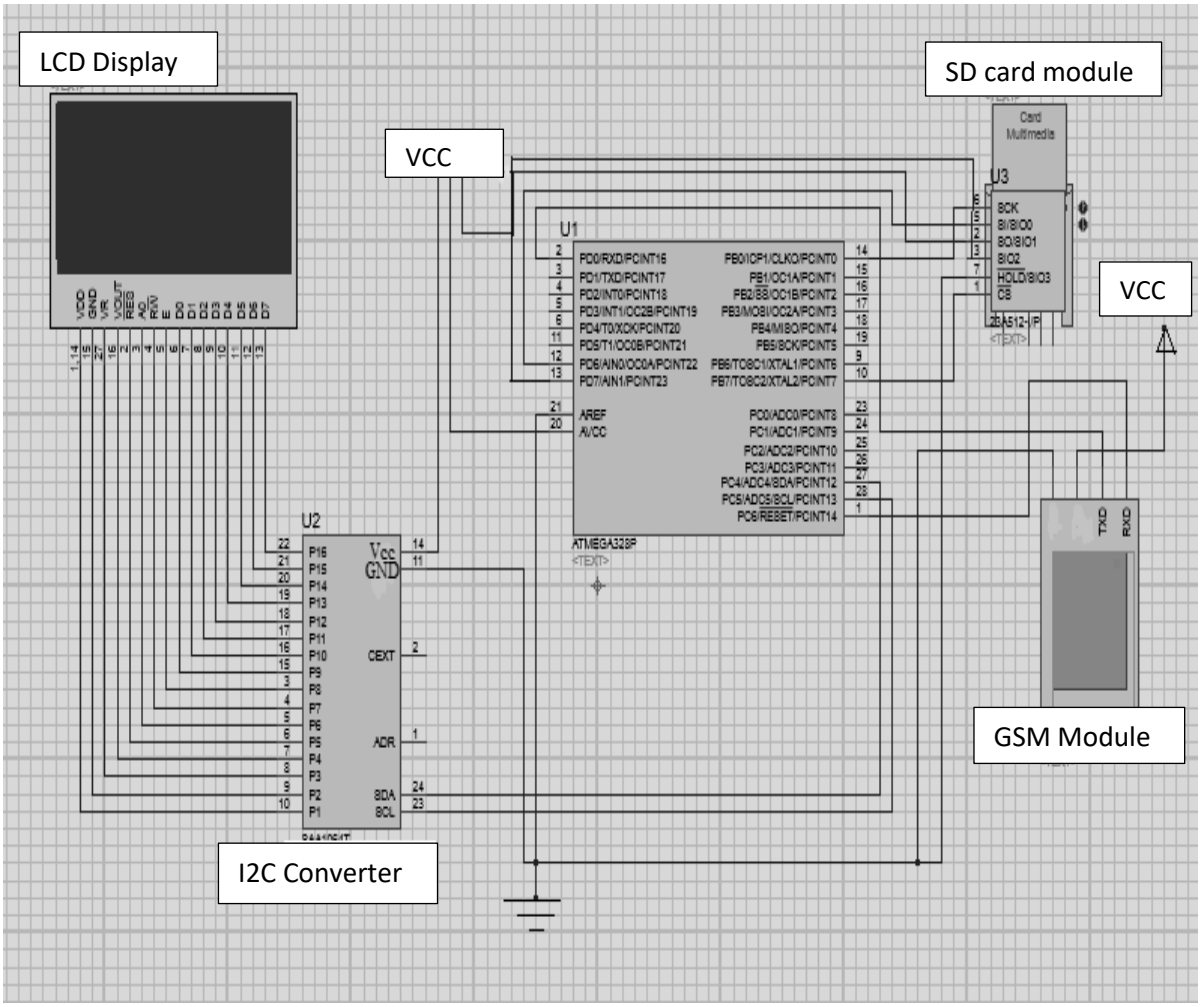

Fig. 2 Circuit diagram of the designed system

3. RESULTS AND DISCUSSION

The system designed to identify, display and store multiple phone numbers at MDF or MSAN could decrease the time taken for checking fault phone lines one by one. LCD of the system displays the receiving phone number. The data is saved on a SD card and can be observed by using Excel spread sheet.

This system is an innovative design and easy to develop. And it can be used to save data for further analysis. This system can obtain data via GSM with low cost. Basically this system is designed for one block of MSAN or MDF. But it can be implemented to identify whole blocks of MSAN or MDF.

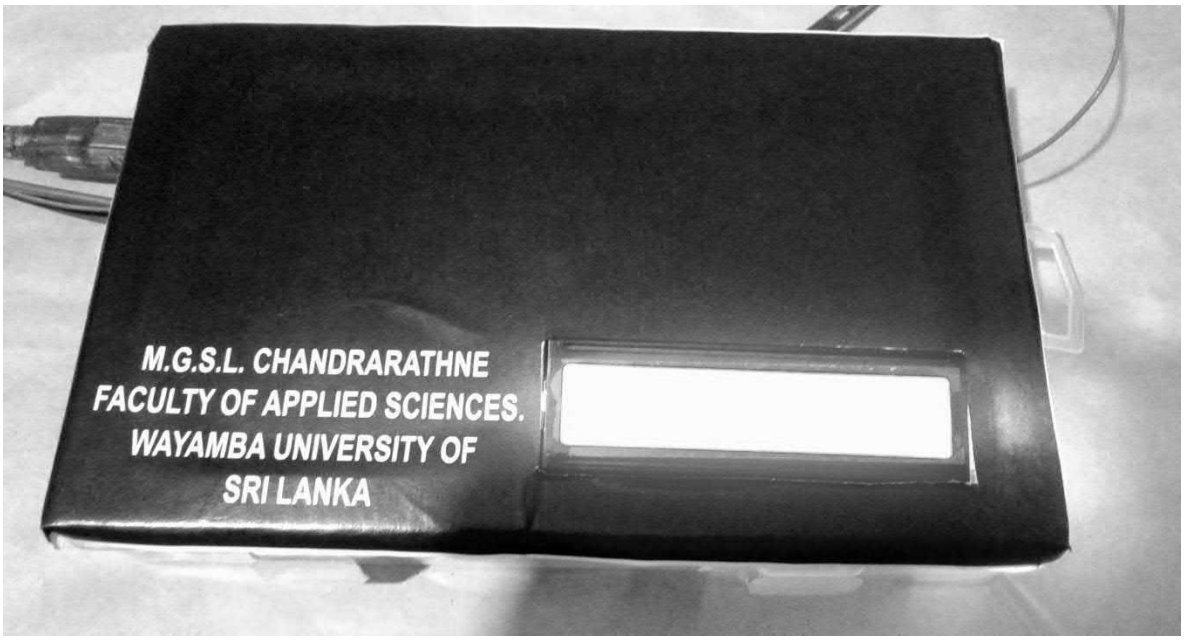

Fig.3 Prototype of the designed system

And also, this system can be used to identify numbers at the DP (Distribution Point), because in the DP also technicians have to use manual system. In this system, GSM module has been used to identify phone numbers. The system can be further developed to send SMS to engineer or relevant person and send details of faulty phone lines to the system before receiving complaints.

4. CONCLUSIONS

The study and implementation presented in this paper was an attempt to solve one of the problems existing in the telecommunication system at Sri Lanka Telecom. The developed system helps identify the multiple telephone lines and at the same time display the numbers and store details.

ACKNOWLEDGEMENTS

Authors would like to thank all who supported to complete this project successfully and also would like to express gratitude to the staff of the Department of Electronics, Faculty of Applied Sciences, Wayamba University of Sri Lanka and all the staff of Sri Lanka Telecom, Kandy.

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Proc. Annual Symposium on Research & Industrial Training, 05(2018) 89-93
Department of Electronics – Wayamba University of Sri Lanka

BATTERY MANAGEMENT SYSTEM FOR EXTENDING ELECTRIC VEHICLE BATTERY PACK LIFETIME

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ABSTRACT

A cell level control approach for electric vehicle/ hybrid vehicle battery pack is presented such that it enhances traditional battery balancing goals to not only provide cell balancing but also achieve significant battery pack lifetime extension. These goals can be achieved by a control algorithm that biases individual cells differently, based on their state of charge, voltage and temperature of the battery pack. In this project, the equalization of cells is done in order to increase its durability. This battery management system will manage the battery cells of the battery pack by identifying the high charging/discharging cells while optimizing the usable energy of the battery pack. The designed system with the Raspberry pi control unit will be more efficient and it will help to identify the problems in the battery pack since it monitors the individual cells and the temperature of the battery pack.

Keywords: Battery management system, Electric vehicle, Raspberry pi

1. INTRODUCTION

Nowadays energy efficiency is a top priority, boosted by major concern with climatic change and by the soaring oil prices in the countries that have a large dependency on imported fossil fuels. A great part of oil consumption is currently allocated to the transportation sector and a large portion of that is used by the road vehicles. The current transportation systems come along with a wide range of problems including global warming, environmental degradation, health implications and emission of greenhouse gases. According to the international energy outlook report, the transportation sector is going to increase its share in the world's total oil consumption by up to 55% by 2030[1].

Aiming an improvement in energy efficiency, a revolution of the transportation is being done. The bet is in the electric mobility, mostly supported by the technological developments in different areas such as power electronics, mechanics and information systems.

In an effort to reduce the dependence on fossil fuels and make vehicles more environment friendly, car manufacturers and consumers have stepped in to several options like hydrogen fuel cells, electric power vehicles and hybrid power vehicles. Electrification is the most viable way to achieve clean and efficient transportation that is crucial to the sustainable development of the whole world.

The biggest drawback of an electric/ hybrid vehicle is the battery system. Lifetime of the battery pack is a risk to the electric/hybrid vehicle owners and buyers. Battery lifetime reduction is due to the uneven cell degradation caused by battery chemistry, temperature differences and other physical factors. Therefore, the mismatch among the battery cells will take place and that causes significant reduction in the effective lifetime of the battery pack. [2]

A Battery Management System (BMS) is introduced where the cells are monitored separately to overcome this problem.

There are three main objectives common to all Battery Management Systems

1. Protect the cells or the battery from damage
2. Prolong the life of the battery
3. Maintain the battery in a state in which it can fulfill the functional requirements of the application for which it was specified.

Battery packs in electric vehicles (EV) and plug-in hybrid electric vehicles (PHEV) consist of large number of battery cells connected in series to form a high voltage (HV) DC bus. The individual battery cells of EV/PHEV battery pack exhibits mismatch in capacity, self-discharge rate, series resistance and voltage [3].

Cell balancing can be done in three methods.

i. Dissipating energy from the cells of higher State of Charge (SOC) to shunt resistor
ii. Shuffling energy from the highest SOC cell to the lowest SOC cell
iii. Incremental cell balancing through series connected cells in stages

By considering the above three methods, this research project on battery management system was designed to balance the cell voltages and to control the temperature of the battery pack. Raspberry pi was used as the control unit of the system.

2. EXPERIMENTAL

The battery management system was designed to balance the cell voltages and to control the temperature of the battery pack. For this system 3.7 V Li ion batteries were selected as they have high specific energy, lower self-discharge rate and long lifespan compared to the other batteries such as NiMH, NiCd and lead-acid.

Battery cells of the battery pack were connected in a series-parallel connection where one series connected cell line was subjected to monitoring at a time. The fig. 1 shows the basic block diagram of the designed system. The processor used to monitor and control the system was Raspberry pi 3. Temperature sensor (DHT 11) was used to monitor the temperature of the battery pack and temperature is controlled using a 12V fan in this prototype system.

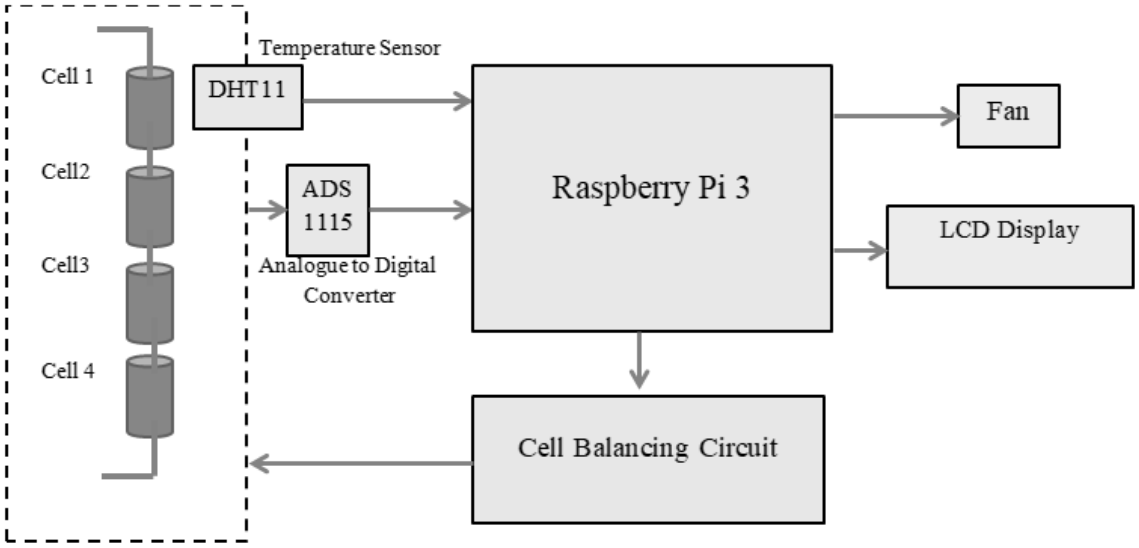

Fig. 1 Block diagram of the battery management system

Cell voltages were monitored individually and according to the voltage of a cell overcharged and lower charged cells were identified. For the overcharged cells it was reduced as heat through a load and for the lower charged cells 4.2 V supply was given. MOSFETs have been used to isolate the cells from other cells connected in series when charging and discharging. Fig. 2 shows the circuit diagram of the cell balancing circuit.

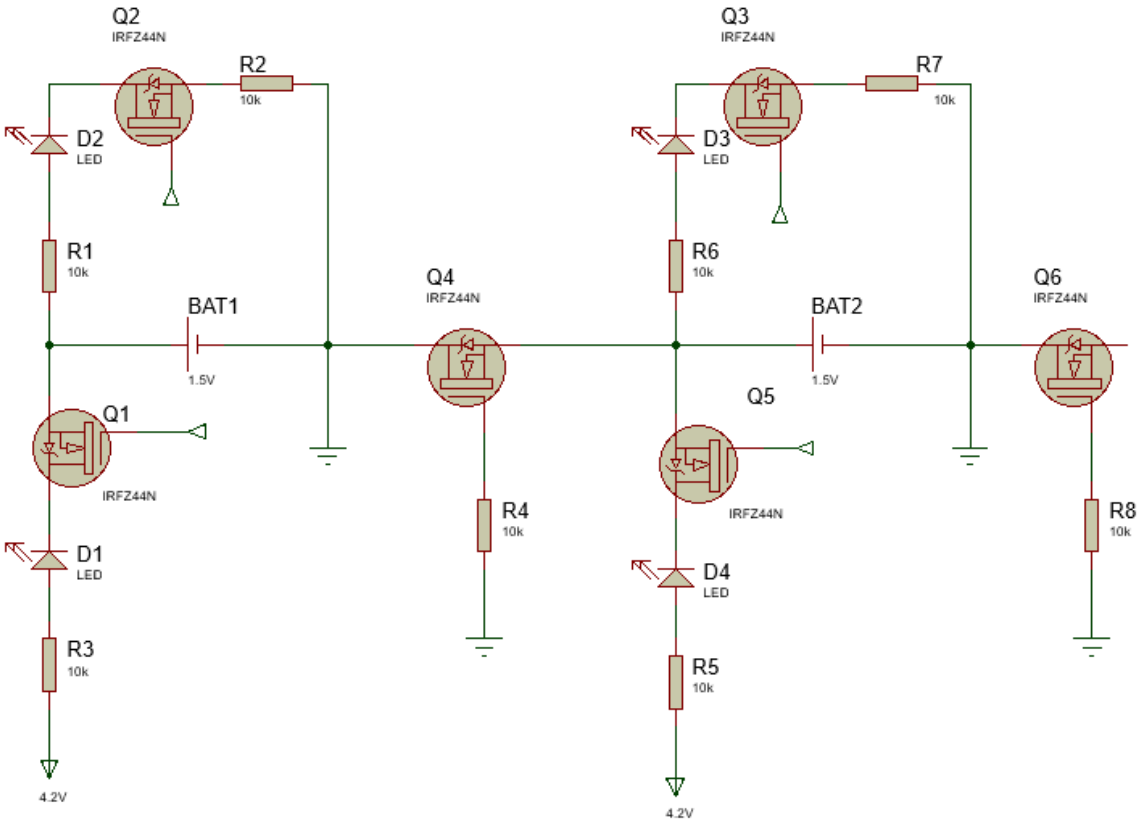

Fig. 2 Cell balancing circuit

The battery state determines the charge time, discharge strategy, cell equalization, and thermal management among the cells, while the state will be displayed on the LCD display as well.

3. RESULTS AND DISCUSSION

The cells were maintained in the range of 3.5 V-3.8 V. If the voltage of a cell is more than 3.8 V (overcharged), that will be reduced to 3.7 V by dissipating the excess amount through a load. If the cell voltage is less than 3.5V, the supply of 4.2 V is given to the cell by isolating that cell from other cells.

The total voltage of the battery pack will be displayed on the LCD display. Individual cell voltages are displayed in the terminal as well. The temperature of the battery pack is measured, and controlled using a 12 V fan connected to the battery pack.

Raspberry pi module was used here as it is easy to use and has high performance for a reasonable price. It works as a general-purpose computer, and it has the ability to run

multiple programs. Also it supports IoT and therefore it is smarter than other microcontrollers.

Cell balancing is not a simple process. Therefore, monitoring of the system has given a time period with time intervals. Then the monitoring and charging will not mess up with each other and that helps to receive errorless readings.

4. CONCLUSION

The Li ion battery cells can be managed to stay in the range of 3.5 V -3.8 V using this simple battery management system designed with Raspberry pi. This leads to overcome afore mentioned problem of the electric/hybrid vehicles by helping to extend the lifespan of the battery pack.

ACKNOWLEDGEMENTS

Authors wish to extend their gratitude to the staff of Department of Electronics, Wayamba University of Sri Lanka.

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Department of Electronics – Wayamba University of Sri Lanka

REMOTE VEHICLE INFORMATION MONITORING SYSTEM

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ABSTRACT

There are several types of vehicle information and security systems developed by the vehicle companies. They try to provide best solutions as much as possible for special requirements. Most of these systems and equipment are allocated or installed in the vehicle and all the details and states can only be collected by the driver. Present study was carried out to provide such information remotely to the vehicle owner through a SMS. The device developed in the current study is capable of providing mainly three major information. Those are, the distance traveled by the vehicle, current temperature level of the inside the vehicle and the alcohol percentage inside the vehicle. The proposed device can be installed in all types of vehicles as an external device. It is very tiny and easy to install as a hidden device without any sense to the driver.

1. INTRODUCTION

Presently available vehicle information systems in the market, such as alcohol detectors, speed control systems provide information to the driver by giving a warning by a light or a buzzer [1]. In the current study a system was developed to provide the information about the conditions inside the vehicle on the request of the owner of the vehicle by sending a SMS.

The device developed in the current study is capable of providing mainly three major information. Those are, the distance traveled by the vehicle, current temperature level of the inside the vehicle and the alcohol percentage inside the vehicle. All these information can be collected remotely using a mobile phone within just few seconds. The only thing that the user supposed to do for receiving the information is sending a message to the device. After that device sends the reply SMS with the information of distance, speed, alcohol level and temperature, allowing to monitor the information of the vehicle remotely.

2. EXPERIMENTAL

Fig. 1 shows the block diagram of the project design. In this design there are three sensors used to collect three major information. They are Hall Effect sensor, LM35 temperature sensor and MQ3 gas sensor. There are two different types of Hall sensors available namely, digital hall sensor and the analog hall sensor. The digital hall sensor can detect only if the magnet is present or not (0 or 1), but the output of the analogue chamber sensor is different depending on the magnetic field around the magnet which can detect the magnet's strength or range. Hall Effect sensor module is being used to detect the wheel rotation and it produces a signal to the Arduino chip over the data line. So the Arduino chip is coded to calculate the distance wheel traveled, and memorize it sequentially. It also calculates the RPM value to provide the speed of the wheel in $Kmph^{-1}$. Hall Effect sensor module being processed throughout from the moment the system is switched on [3-4].

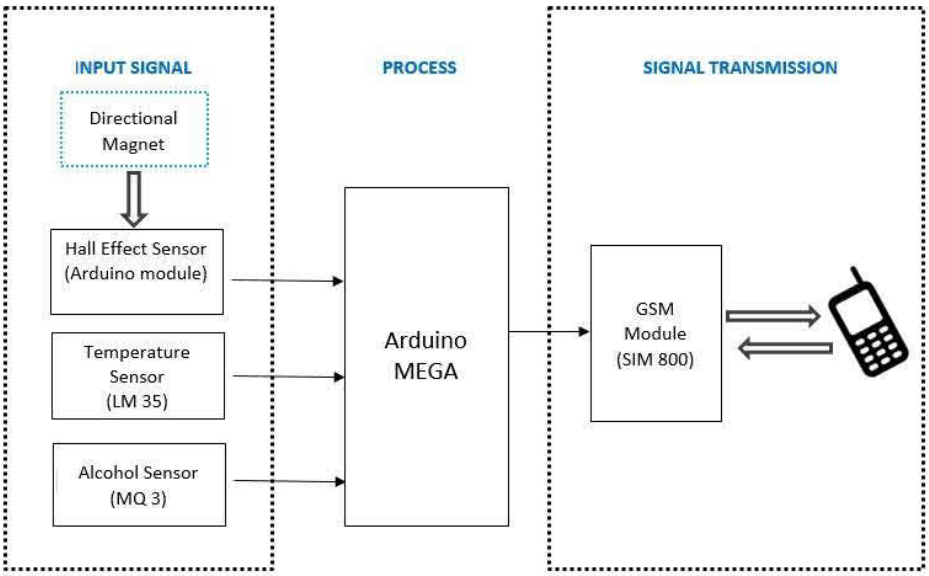

Fig. 1 Block diagram of the proposed project

LM 35 temperature sensor sense the environment temperature due to the situation behaviors of the vehicle as well. It just provide the measurement to the Arduino chip if the chip request the temperature measurements, else it doesn't send any signal.

The MQ series of gas sensors use a small heater inside with an electrochemical sensor that change sensitivity for a range of gasses. When sensor works in the clean air, its conductivity is lower than when gas exists. The conductivity increases with the gas concentration rising.

The MQ 3 gas sensor sense the alcohol percentage inside of the vehicle and provide it to the Arduino chip the same way LM 35 senses [2].

Arduino chip collects all these signals and measurements from the above discussed actuators to calculate the necessary calculations. After that it will prepare and converts the output signal as a SMS that can be sent through the GSM module to the user's mobile phone.

3. RESULTS AND DISCUSSION

Experimental level circuit is shown in fig. 2, where the components are not properly connected. Final product will be a tiny device.

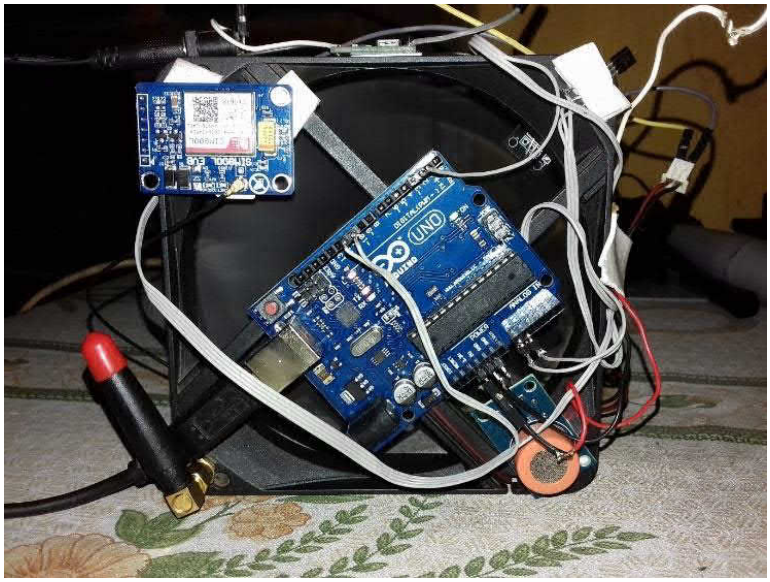

Fig. 2 Experimental level circuit of the product

All the sensors send the input measurements to the Arduino-nano board which processes them in to data. It was bit difficult to take gas sensor value while exposing to alcohol near to the MQ 3 gas sensor. It accurately reads when the air near it with high concentration of alcohol. Therefore it was bit difficult to have digital value as the MQ 3 provides an analog value in to the system.

LM 35 reads the temperature and send information to the Arduino board. LM 35 provides a quite accurate readings with compared to the other sensors especially MQ 3 gas sensor.

The sensors established in the device are easily removable, in case of a damage, it will not be difficult to re replace the faulty sensor and repair the device. The durability of the device will depend on the weather conditions and the vehicle condition.

This device is also capable to provide a special message when the vehicle exceeds the speed level and alcohol percentage that are recognized by the unit as high speed and high alcohol percentage that are not suitable to drive the vehicle. A vehicle service remainder alert also can be collected after completing a particular distance. These alert messages can be received when pre-set values were detected and the user do not need to send a request SMS.

Since the mobile networks are available all around the country, it is not difficult to connect with the device. The mobile network will not send the SMS when the device is not connected to a network due to network failure. However, SMS will reach the user as soon as the network is re-connected and the result can be collected in a while [5].

4. CONCLUSION

The proposed device provides the information such as distance, speed, alcohol percentage and service remainder alert remotely via SMS. As this is a smaller device, it is really easy to install to the vehicle as a hidden device under the vehicle near to the wheel. This is a cheaper and compatible device which can be easily installed to any type of vehicle.

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Department of Electronics – Wayamba University of Sri Lanka

SAFETY VEHICLE DOOR LOCKING SYSTEM WITH MOVING VEHICLE APPROACH DETECTION

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ABSTRACT

The safety door locking system is designed to prevent accidents happening while opening the car door and to provide safety to passengers. To prevent accident due to passenger's carelessness, it is designed to control the vehicle door locking automatically using distance measuring system, child lock and ultrasonic sensors. Due to this passengers can't open their vehicle door from inside while object is moving towards the vehicle. The entire system is controlled with the help of Arduino. Due to this, if any object approaches the vehicle, the signal gets reflect and received by the receiver. Due to quick return of the signal, the atmega328p microcontroller sends signal to the child lock and it get activates according to the program performed on the microcontroller. The sensor works for 4m distance and therefore the device can identify any object as close as 4m and lock up the doors of a vehicle, which is this system installed. The distance can be increased by introducing a more sensitive sensor. Due to low cost any individual can install this device into their vehicle and a thousands of road accidents can be avoided by this system.

Keywords**:** Arduino, Vehicle security, Ultrasonic sensor, Vehicle detection, Accelerometer sensor

1. INTRODUCTION

With the expansion of road facilities, motorization and urbanization of the country, the number of road accidents have surged. Road traffic distresses (RTD) and fatalities have emerged as a major public health concern, with RTDs having becoming one of the leading causes of deaths, disabilities and hospitalizations which impose severe socio-economic costs across the world. People carelessly open the door of vehicles and get crashed with vehicles arriving from behind. This problem has become a major problem on roads today.

The designed project applies to the problem mentioned above. When a vehicle is parked by the road the system decides whether it is safe to open the door or not. If not, the door will be automatically locked.

Previously vehicles were designed with the monitoring system which could measure the distance between the two objects form few centimeters to a few meter. The distance between the vehicles were generally calculated using time of flight technique. It was used to warn the driver to avoid accident. But warning systems are not much effective hence in this approach the occurrence of accident is eliminated as early as possible. To achieve such a system the sensors are preferred which is having timely manner action. The electronic system microcontroller performs this function.

Nowadays more efficient warning systems are available in the market. But they are only warning systems. They do not take any actions. The system proposed here is not just a warning system. It automatically locks the door whenever it is dangerous. Hence more reliable.

The potential customers of this project will be either individual owners or vehicle manufacturing companies. This system can be introduced to the market and can be made available for anyone at reasonable price.

2. EXPERIMENTAL

The block diagram of the proposed system is shown in the fig. 01.

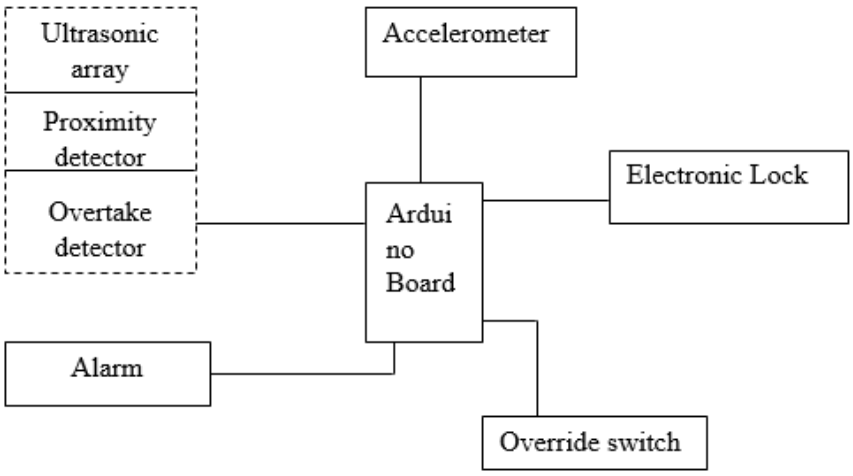

Fig. 1 Block Diagram of the System

In the designed system,

Proximity Detector Ultrasonic Sensor

Proximity detector detects the presence of a vehicle 4m from the behind of the owner's vehicle. If it detect a presence, then it check whether that vehicle is moving or not.

Overtake Detector Ultrasonic Sensor

It detect that the incoming vehicle is passed the owner's vehicle or not.

An Accelerometer

It is use to check whether the owner's vehicle move or not. An accelerometer is an apparatus, either mechanical or electromechanical, for measuring acceleration or deceleration - that is, the rate of increase or decrease in the velocity of a moving object.

Override Switch

The passenger can unlock the door by pressing the override switch in a case of an emergency.

Alarm

When the owner's vehicle is parked, and a vehicle presence 4m behind the owner's vehicle this alarm will be activated.

Electronic Lock

The signal will be sent to the lock through the body control module. Body control module is the central system which is used for sending signal to different doors. The microcontroller will send the signal to body control and then it sends to the corresponding doors.

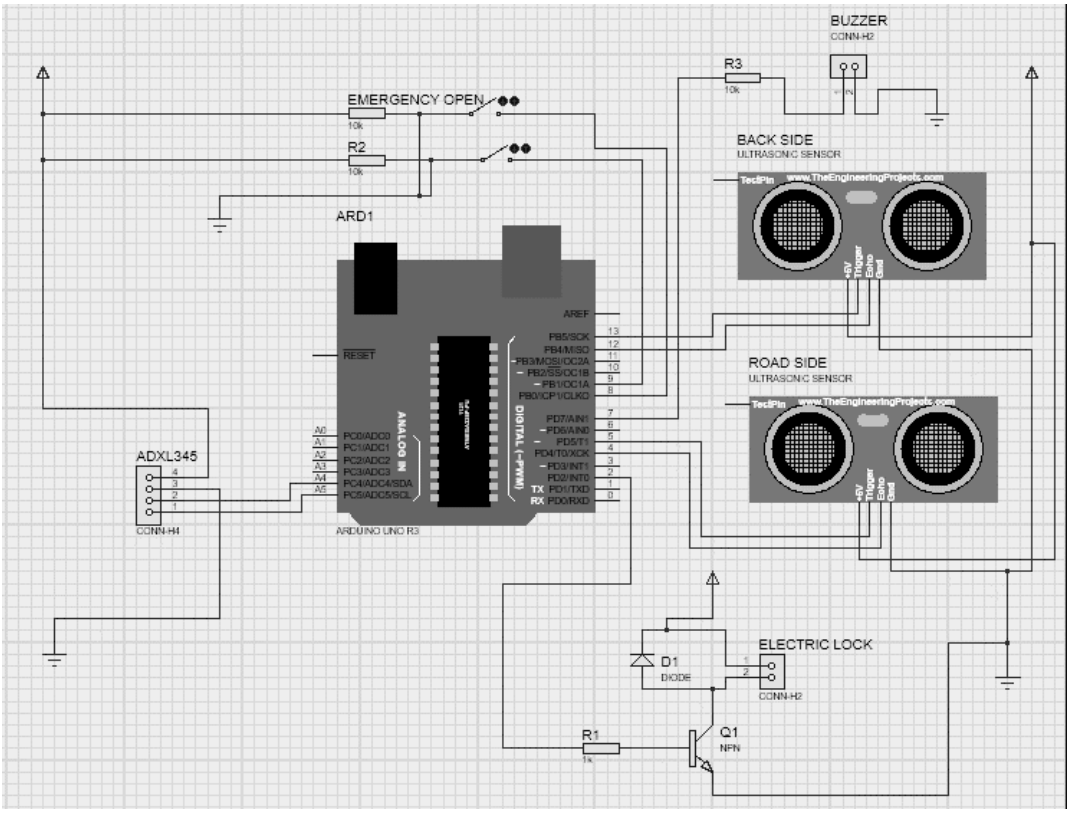

Fig. 2 The simulated circuit diagram of the System

3. RESULTS AND DISCUSSION

The device can identify vehicles coming from up to 4m of distance. The ultrasonic sensor used for the device works in that specific distance and there are also sensors which can track vehicles even more distant from that. But as per this research project, this sensor have been used. Whenever the vehicle which has this device installed, is moving. The doors are automatically locked. The vehicle cannot move with its door open. When the vehicle is stopped, the doors will only unlock after checking whether if there is any vehicle approaching close by. If there are vehicles coming frequently, to avoid the lock to be kept locked throughout, there is an emergency switch. With this emergency switch the door can be opened safe.

In vehicles like BMW and Audi this facility is available, but in middle market vehicles, there are no systems like this. Therefore this system would be very useful for middle class customers. Sometimes at a little movement also the sensors might work and the doors may be locked. Therefore, the emergency switch is very useful. There is an alarm which buzzes at every moving vehicle is detected, that gives a signal to the passengers that there is a vehicle coming towards them. That is also one of very important features of this device.

4. CONCLUSION

This device is very essential to avoid many road accidents because most of the time drivers or passengers are less concern about getting down from a vehicle at stationary, in the middle of a crowded area. This system can be developed further by adding cameras and other components to increase the accuracy and the sensitivity. The 4m distance range can be increased by including a high sensitive ultrasonic sensor which can be a bit costly. The device can be customized according to the needs and the abilities of anyone interested and the customers can decide whether what is the range of the distance they want to watch.

ACKNOWLEDGEMENTS

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Department of Electronics – Wayamba University of Sri Lanka

LOW-COST BOOST CONVERTER CIRCUIT USING PID CONTROLLER

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ABSTRACT

This paper describes a booster converter with a PID controller using ARM cortex M4 Launchpad. A PID controller proposed and applied to the boost converter to improve the operating performance of the boost converter under large transient variations in dc input voltage range. There are many methods available for the improvement of the functionality of the boost converter. In this work we consider a PID controller as control path. The proposed circuit is simple, easy to understand and can be implemented with no additional components thereby keeping size and cost of manufacturing the converter within a considerable range.

Keywords: Boost converter, PID controller, ARM Cortex M4

1. INTRODUCTION

The power Electronics is usher in a new kind of industrial revolution due to its multidisciplinary in terms of fields of application like energy conservation, electric and hybrid vehicles and industrial automation [1]. Boost converter is a dc-dc converter shown in fig. 1 which the output voltage is always greater than the input voltage which depends on switching frequency [2]. It becomes either steps up or steps down the source voltage, according to the requirement of the load connected. In this paper proper voltage regulation of Boost converter is achieved employing PID controller, tuned using manual method to find appropriate values for the proportional, integral and derivative gains, thereby improving converter performance.

1.1 Basic Function of Boost Converter

The DC/DC boost converter is a simple power electronic circuit which contains four components, an inductor, switch, diode and a capacitor as show in fig. 1. The converter can therefore operate in the two different modes depending on its energy storage capacity and the relative length of the switching period. Mode 1 begins when switched on at t = 0 and terminates at t = t_{on}. The equivalent circuit for the model is shown in fig. 1.The inductor current i_L (t) greater than zero and ramp up linearly. The inductor voltage is V_i [2].

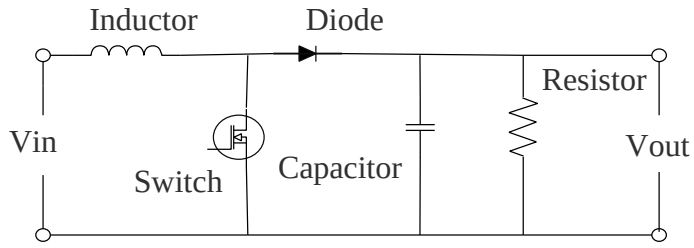

Fig. 1 Schematic of the boost converter

Mode 2 begins when MOSFET is switched off at t = t_{on} and terminates at t =t_s .The inductor current decrease until the MOSFER is turned on again during the next cycle. The voltage across the inductor in this period is V_{in} - V_{out} . In steady state time integral of the inductor voltage over one time period must be zero [2]. By controlling the switching frequency of the switch (MOSFET) in circuit, it is possible to change the DC voltage level across the load. Hence, in order to maintain a constant voltage at the output terminals, it is required to have an intelligent controller which measure the input continuously and change the switching frequency accordingly. This can be achieved by a PID controller.

1.2 PID Controller

As the name suggests, PID algorithm consists of three basic coefficients: proportional, integral and derivative which are varied to get optimal response.

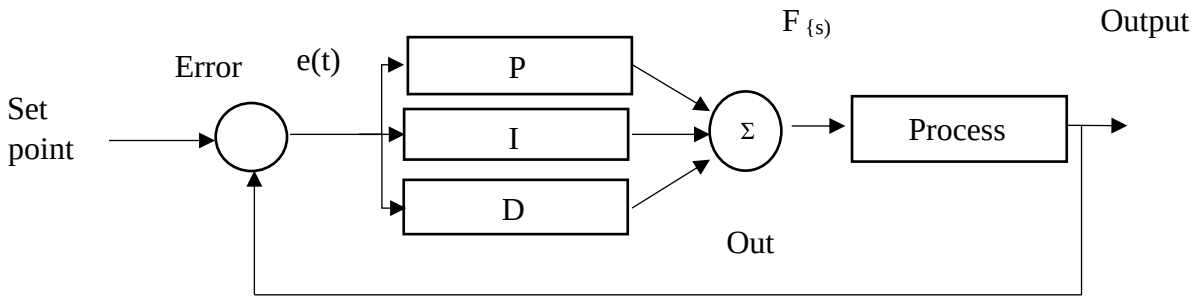

Fig 2: PID controller

Where,

P – Proportional I – Integral D – Derivative $F_{(S)}$ – Control signal

The tracking error is fed on to the PID controller which computes the derivative and integral of the signal provided. The output of the PID controller F(s) to be applied to the plant is equal to the proportional gain (K_P) times the magnitude of the error signal plus the integral gain (K_I) times the integral of the error signal plus the derivative gain (K_D) times the derivative of the error signal [3].

2. EXPERIMENTAL

Fig. 3 below shows the main operation of the Boost converter with PID controller. With the output voltage being monitored and feedback to the ARM Cortex M4 Launchpad. The circuit would use a 3.3 V input which would then be boosted to either 12 V to 30 V, this was controlled via a state machine running on the ARM CORTEX M4.

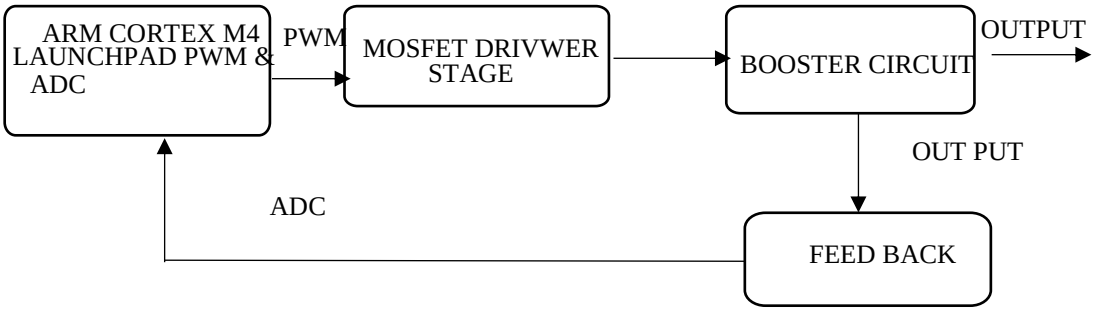

Fig. 3 Block diagram of the booster circuit

The proposed converter is shown in fig. 4. The driver circuit for the mosfet which is shown in fig. 4 uses 2 transistors in a totem pole configuration, and a 3rd transistor is to ensure a small current is sourced from the Launchpad.

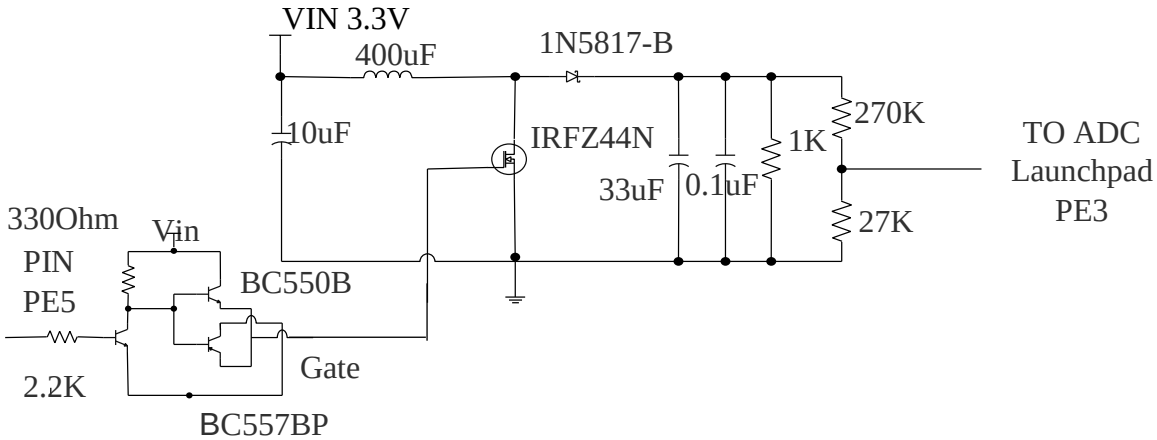

Fig. 4 Proposed circuit diagram

The boost converter was originally set-up to measure voltages between 2.5 V and 5 V. So the feedback arrangement ensures the sampled voltage range uses almost the full range of the ADC. For the PID testing, the output voltage will be regulated to 12 V, which is equal to1350 on the ADC which is also the set point value. The sampled output voltage connected to the ADC pin PE3 in cortex M4 Launchpad. The ADC will be used to measure the amplitude of analog signals and will be important in data acquisition systems. The analog comparator takes two analog inputs and produces a digital output depending on which analog input is greater.

2.1 Tuning and Evaluation

The setpoint was set to 1350 as mentioned, which produced 12 V give. The load was fixed and set to 1 KΩ. Initially, the proportional gain constant Kp was set very low around 0.001, this was too low so it was increased over a few steps until 0.01. At this point, the output voltage was observed to be approximately 7.5 V, and the duty cycle waveform was observed to have a small amount of jitter, as the duty cycle fluctuated 0.5%. The Kp value was again increased until the output voltage read approximately 8 V, the duty cycle was again observed and found to be fluctuating by a greater amount, by approximately 5%. The increase in jitter on the PWM duty cycle can be equated to greater oscillations on the output voltage, the multimeter was not suitable for observing these. It would have been possible to see them on the oscilloscope but this probably would have involved a stop capture then restart method.At this point, the Kp value was backed off, to the previous level of 0.01 so the output voltage was at 8.6 V. The initial value chosen for Ki was 0.01.This was then loaded on to the TM4C123GH6PM microcontroller and the output voltage on the multi-meter was immediately observed to read 10.92 V, 9 mV. The oscilloscope was also observed to have minor jitter as before of only a few half percent. The integral value was not tweaked any further, but in most cases tuning the Kp and Ki and K_d values would take a greater time and under a wide range of conditions [3].

3. RESULTS AND DISCUSSION

Incorporating a PID controller with the converter improves the dynamic response and reduces the steady-state error. The derivative controller (K_D) improves the transient response and the integral controller (K_I) will reduce the steady state error of the system. Our proposed system maintains an output of 12 V when the input is in the range of 3.3 V. After Tuning the PID, the system will reduce the steady state error and the stable the output for a range of

input voltages, as shown in the fig. 5. Our proposed system maintains an output of 12 V when the input is in the range of 2.5 V-5 V which makes it quite feasible to apply in different industrial purposes

Table 1 : Simulation parameters

Parameters	Values
Input voltage	2.5 V-5 V
Output voltage	12 V
Boost Inductor	400 mH
Kp	0.1
Ki	0.1
Kd	0.01

For proper voltage regulation and overshoot reduction the proposed Boost converter as shown in fig. 4, was simulated for input voltage 2.5 V – 5 V, and output wave shapes observed as shown in figs 5 and 6. It can be observed that the output voltage remains constant at the desired voltage of 12 V and does not vary with variation of input voltage.

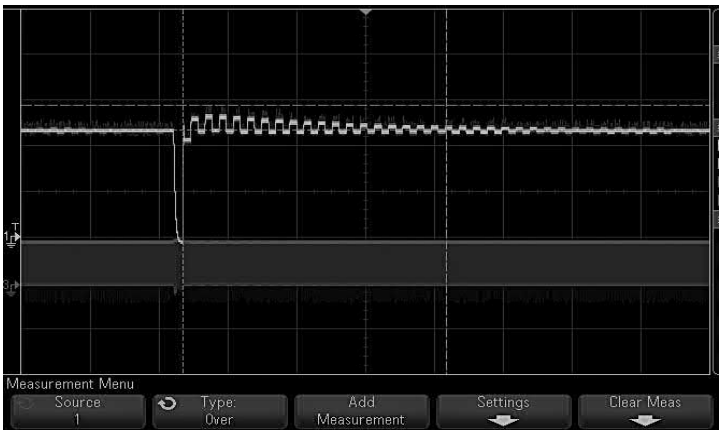

Fig. 5 Graph of texting the pid and the result of the output wave

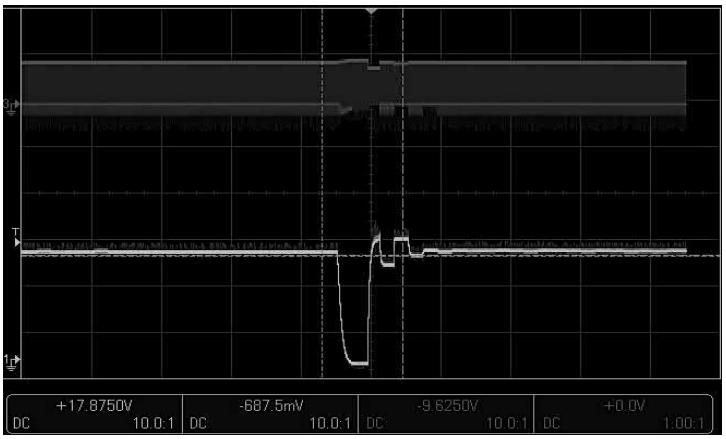

Fig. 6 Graph of texting the pid and the result of the output wave

4. CONCLUSION

This paper presents the state-space model implementation of boost converters. Result obtained from both the converter provides the dynamic behaviour in open loop. The DC-DC converter will be designed for a specific line and load conditions. But in practice due to changes in the source, load and circuit parameters, there is deviation of the circuit operation from the desired nominal behaviour. To overcome this problem a proper controller or compensator needs to be designed. Hence PID controller is designed and modelled for (2.5 V-5 V) input variation to get constant output 12 V, such that non-linearity and un-stability of power converters can be improved with connecting with TM4CGH6PM Launchpad. The proposed Boost Converter with PID controller provides better voltage regulation, overshoot reduction and improves the converter performance compared to the conventional boost converter. This report successfully provides a method to satisfy the objective of DC-DC converter to maintain a constant output voltage at a load side. The proposed circuit is simple, easy to understand and can be implemented with no additional components thereby keeping size and cost of manufacturing the converter within a considerable range.

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Department of Electronics – Wayamba University of Sri Lanka

PATIENT MONITORING SYSTEM DURING SLEEP

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ABSTRACT

The need for developing a patient protecting and monitoring system during sleep is to provide a better control over the sleeping conditions of the patients who need special care. The main objective of the proposed system is to evaluate the diagnostic accuracy of variations in sleeping movements of a patient. For the controller circuit part, Arduino Mega 2560 board has been used whereas for purpose of the motion detecting Motion Detector PIR (Pyro-electric Infrared) sensor has been used. Another important feature of this project is detecting the movements automatically and displaying those detected movements in graphical terms in order to understand the current status of the patient by the care person. As this system is capable of sending the results to the physician in SMS (Short Message Service), it helps to maintain a better communication between the user and the physician. Furthermore, the system detects the temperature and air pressure. A history of movements during past 20 days will be shown on a Nokia 5110 LCD (Liquid Crystal Display) display. That feature eases the physician to analyze the behavior of the patient in an efficient manner.

Keywords: Arduino mega 2560, Nokia 5110, Motion detector, PIR sensor, SMS

1. INTRODUCTION

Health care is one of the major industry sector with a wide scope. This has become a requirement of human beings as this sector evolves time to time with advanced technological changes, increase of domestic, road accidents, increase in natural victims and also with the spread of different types of virus as well as bacteria. Therefore, during the past decade, numbers of unidentified diseases have been increasing [2]. Thus there was a boost in the number of infected humans. So, all most all those infected humans may seek for medical consultation to get rid of diseases like viral infections.

Simply, people who seek for medical consultation can be introduced as 'patients'. In other words, patient is any recipient of health care services. The patient is most often ill or injured and in need of treatment. But sometimes there are patients in need of much more than treatments, special care of them even when they are sleeping. In such situations it is important them to maintain a good quality sleeps and also monitoring them.

The current method of monitoring patients in hospitals keeps patients tied to their beds and can be uncomfortable for them. Patients and elderly people, who are under the care of their children or relatives, are not given more attention, which is required with regard to their illnesses or the maturity, due to the busy schedule. Therefore, this scenario will lead some other psychiatric disorders due to negligence and loneliness. Otherwise they may have to face physical disorders due to falling, accidents etc. So sleep quality measurement system for patients will be helpful in monitoring their variations of movements taken place while they are sleeping or laying on the bed, as well as in maintain a good quality sleep.

The main objective of this project was to produce a patient monitoring system that could allow patients to behave comfortably in their environment. Hence, this system can be used by physicians, care person of the patient. The graphs and charts of variations in movements while sleeping will be useful to the physician whereas the care person can work according to the warnings given and messages sent through this system to his or her mobile phone.

2. EXPERIMENTAL

In general, the system consists of two parts namely, monitoring and communication. The general structure of the system, PCB (Printed Circuit Board) design and the prototype of the system are illustrated by fig.s 1, 2 and 3 respectively. In this project the PIR sensor detects the number of movements made by the patient. RTC (Real Time Clock) ds1307 is there to set the real time. Hence the PIR sensor can detect movements for a given period of time. BME 280 is used to detect the temperature and air pressure of the room where the patient is living. Also it can be used for further improvements like automation of the system. 4 x 4 Keypad is used to enter the inputs to the system and to erase memory etc. The quantity of movements will be displayed in both numerical and graphical terms on the Nokia 5110 display.

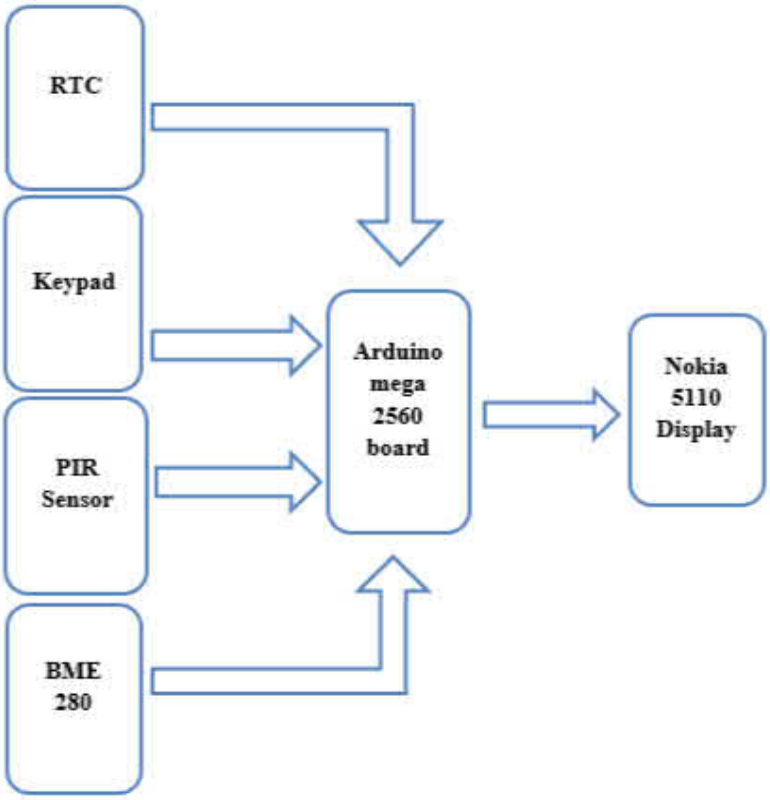

Fig. 1 General structure of the system

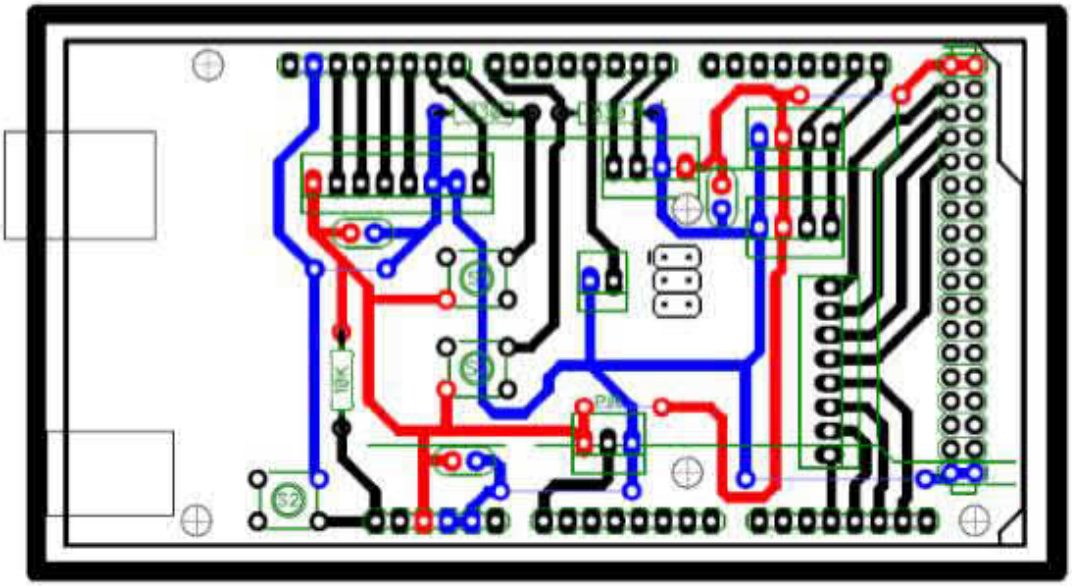

Fig. 2 PCB design of the patient monitoring system

Fig. 3 Prototype

3. RESULTS AND DISCUSSION

Table 1: Results

Command	Observations
*	Select / Change
#	Confirm
0	Logo
1	Quantity of movements
2	Insert time
3	Settings
4	Sleep time
5	Movements in graph
6	Insert time graph
7	Set the time
8	Sleep graph
9	Temperature
A	Send message

The above commands were performed successfully. Initially, when the time was set using RTC the PIR sensor started to detect the movements and sent to the system to be processed. Then the number of movements will be automatically displayed on the LCD display and that amount

of movements was sent to the given mobile phone in the format of SMS. Similarly, by the commands given in the table, the mentioned results were obtained.

4. CONCLUSION

In this system the major component used is, the PIR sensor which can classify the direction of movement, the distance of the body of the patient from the PIR sensors and the speed level of movement during two-way, multi-directional, back-and-forth walking and even identify the walking subjects near the patient. Therefore, with that capabilities, the system can be implemented to perform more as per the users' requirements. If this system is connected to a cloud-based system, records can be stored for years. Thus a history of the patient can be obtained for further analysis. By adding more features like alarms, android systems, detecting the heart rate, breathing rate, body temperature etc., this system can be improved further to be commercialized as a medical application which can be used in both industrially and domestically.

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Department of Electronics – Wayamba University of Sri Lanka

LOW-COST TILT ANGLE MEASURING SYSTEM FOR ANTENNAS AND ANTENNA POLES

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ABSTRACT

This paper presents a development of a tilt measurement system using an accelerometer-based detection device. The accelerometer, ADXL345 was chosen as a detection sensor because of its high sensitivity and resolution. Arduino Uno board was used as controlling circuit. During some installation like antenna and antenna pole installations, it is required them to be installed vertically, while other situations antenna and pole installation are not vertical. Therefore, it is essential to measure angle of the pole or antenna. The proposed system measures the tilt angle and helps to antenna and antenna pole installation process easy.

Keywords: Accelerometer, Tilt angle, Arduino

1. INTRODUCTION

To maintain the quality of work it is very important to install all parts under given conditions. During antenna installations, azimuth, mechanical tilt, and electrical tilt should be kept to given values correctly. Sometimes we have to install a pole for the antenna. These poles should install vertically. It is difficult to identify, is pole vertical or not. And also in some situations, the mechanical tilt of the antenna should kept to zero. If the pole is not vertical, the error effects to the mechanical tilt of the antenna. So it is very important to measure tile angle of the poles. The tilt measuring device is very useful in these situations. From this device user can directly read the angle.

Ball and bubble inclinometers

Fig. 1 Ball and bubble inclinometers

These tilt meter devices are used for indicating angle using a bent tube with either a ball or a bubble. In the ball type, the ball moves to the lowest point of the curve under the effect gravity. In the bubble type, the bent tube is inverted and the bubble will move to the highest point [1].

Mechanical inclinometers

Fig. 2 Mechanical inclinometer

A range of high precision mechanical inclinometers and clinometers for use in a wide variety of engineering applications where high accuracy angle measurement is required [1].

Applications and Features

- Range of measurement up to 360°
- Absolute accuracy to within 1 arc minute
- For use in metrology, workshops, aircraft etc.

Digital Inclinometer

Some of these systems are stand-alone devices, battery powered with the inclinometer and display built into the same product. Others have a separate sensor and remote display unit. Some also have programmable tilt switch functionality built into the display [2].

2. EXPERIMENTAL

A tilt sensor is an instrument that is used for measuring the tilt in multiple axes of a reference plane. Tilt sensors measure the tilting position with reference to gravity and are used in numerous applications. They enable the easy detection of orientation or inclination. Similar to

mercury switches, they may also be known as tilt switches or rolling ball sensors. The functionality of tilt sensors is influenced by factors such as gravity, vibration, temperature, zero offsets, linearity, cross-axis sensitivity, acceleration/deceleration, shock, clear line of sight between the user and the measured point, and calibration of tilt sensors [3, 5].

Tilt calculation

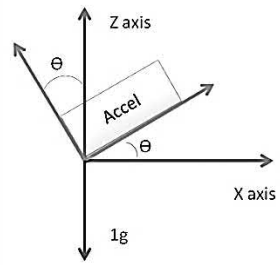

Fig. 3 Tilt calculation

To have the best accuracy when measuring tilt, you must use all three axes to determine the angle. Basically, the same arctan equation is used, but instead of simply dividing by one axis, we calculate the magnitude between other two axes.

$$\theta = arctan\left(\frac{x}{\sqrt{z^2 + y^2}}\right)$$

With the equation above we would calculate the angle between the gravity vector and X-axis. Depending on how you accelerometer is placed on the board; it can either be pitch or roll. The Block Diagram of the system is shown below. It is consist of ADXL345 Accelerometer, Arduino UNO Board, LCD and power supply unit. ADXL345 was used to sense angle and from written sketch ATmega328 IC calculate tilt angle and displays it on LCD.

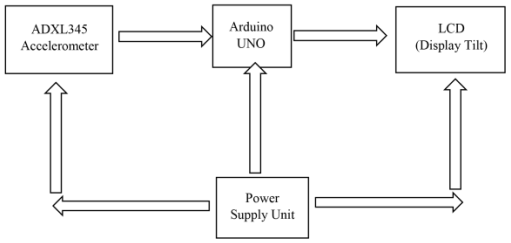

Fig. 4 Block Diagram

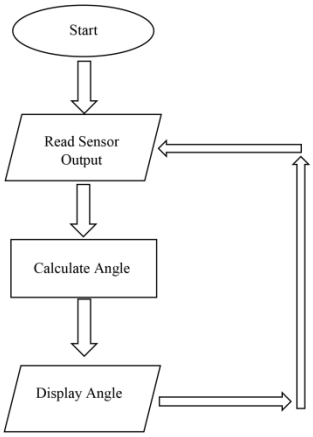

Fig. 5 Flow chart

According to the flow chart when turn on the device ADXL345 read the x, y, z coordinates. By using these values arduino sketch calculate the angle of the device and it is displays on the LCD.

3. RESULTS AND DISCUSSION

In this system, ADXL345 Accelerometer is used to sense vertical tilt angle. The SCL, SDA pins of accelerometer should connect to analogue pins of the Arduino Uno board. From written sketch ATmega328 IC calculate tilt angle and displays it on LCD. The same angel was measured using a protractor and designed device.

The same angel was measured using a protractor and designed device. The result is shown in the following table.

Table 1: Manual measured Angle and angle measured with device

Index	Angle Measured With Protractor(degree)	Angle Measured with Device (degree)
1	0	0
2	5	5.41
3	10	10.58
4	15	15.32
5	20	20
6	25	25.61
7	30	30.43
8	35	35.31
9	40	40.54
10	45	45.33
11	50	50.25
12	55	55.45
13	60	60
14	65	65.1
15	70	70.35
16	75	75.12
17	80	80.42
18	85	85.4
19	90	89.48

Using readings, the graph was plotted. It is shown in fig. 6. In the graph, the continuous line represents manual measured angle with protractor and dotted line represents angle measured with device.

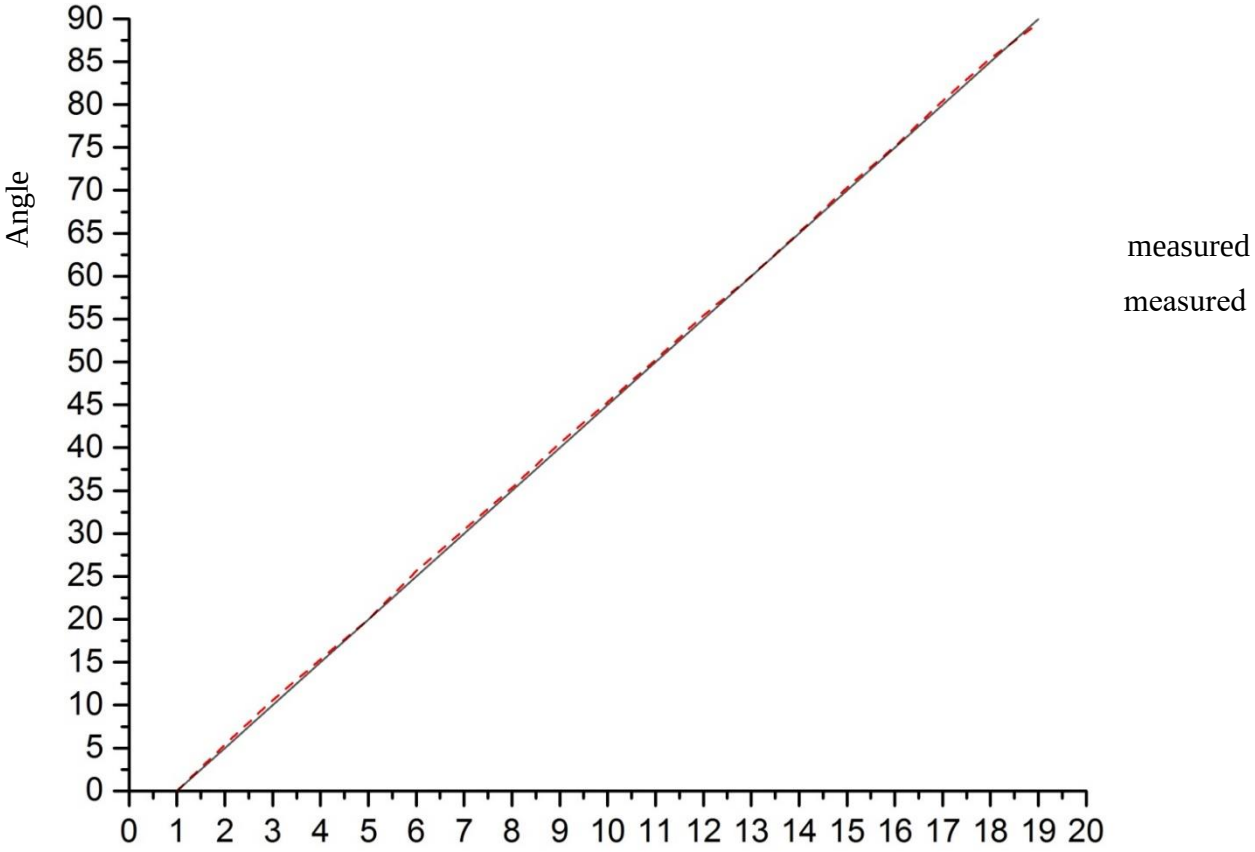

Fig. 6 The graph of manual measured angle and angle measured with system

The actual value and calculated values are nearly equal and the device has good resolution and sensitivity. Accelerometer sensors measure the difference between any linear acceleration in the accelerometer's reference frame and the earth's gravitational field vector. In the absence of linear acceleration, the accelerometer output is a measurement of the rotated gravitational field vector and can be used to determine the accelerometer pitch and roll orientation angles. The orientation angles are dependent on the order in which the rotations are applied. The most common order is the aerospace sequence of yaw then pitch and finally a roll rotation. Accelerometer sensors are insensitive to rotation about the earth's gravitational field vector. The equations for the roll and pitch angles, therefore, have mathematical instabilities when rotation axes happen to become aligned with gravity and point upwards or downwards. A workaround is presented to prevent this instability occurring. The most common application of

accelerometers in consumer electronics is switching between portrait or landscape display modes.

4. CONCLUSION

This paper discussed the development of tilt measurement using Arduino microcontroller board. The system developed has features like lower production cost, directly measured tilt angle can be read out, and it is portable. This kind of system provides huge benefit for antenna and antenna pole installation, where the angle of antenna and antenna pole is required to be measured.

ACKNOWLEDGEMENTS

Authors would like to thanks, many individuals who helped and guided to complete industrial training at Etel Solutions (Pvt) Ltd. Successfully. Gratitude is also conveyed to the staff of Department of Electronics, Faculty of Applied Sciences, Wayamba University of Sri Lanka.

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Department of Electronics – Wayamba University of Sri Lanka

AUTOMATED MULTIPLE TELEPHONE LINE DETECTOR

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ABSTRACT

This paper describes the design of automated multiple telephone line detector for MDF (Main Distribution Frame) which is used to distribute telephone lines to the users. The system can automatically identify more than one telephone line, placed in MDF. At present, this process is done by plugging the PSTN (Public Switched Telephone Network) telephone to MDF and checking the line connection and identifying the phone line number. There are many difficulties in currently available system while checking multiple lines in MDF. Designed system is a solution for the time consumed multiple lines checking. The designed system works as a transmitter that can be used to identify many phone numbers automatically. The identified numbers can be displayed and stored in the data base by receive circuit. This solution was developed based on DTMF (Dual tone multi frequency) technology which uses dialing numbers by phone line. Here, tone generator IC was used to generate different frequencies for each number.

Keywords: Main distribution frame, Dual tone multi frequency, Public switched telephone network

1. INTRODUCTION

Sri Lanka Telecom (SLT)is one of the leading wired telecommunication service provider in Sri Lanka. It provides voice, ADSL, PEO TV connection to the customers. There is Main Distribution Frame (MDF) that available inside in telecom Office. MDF is used to distribute phone lines to customer's places. Nowadays MDF is replaced by Multi Service Access Node MSAN which is more advanced than MDF.

MSAN and MDF consist with more telephone line connections. Normally there are 10 lines in one raw in both MSAN and MDF. The internal architecture is similarly in MSAN and MDF.

At present Public switched telephone Network (PSTN) telephone is plugged in to MDF to check the line connection and to identify the phone line number. Above method is also used to identify the free loop in PSTN. There are many difficulties in currently available system while checking multiple lines in MDF. Such as time consumed multiple lines checking, service provider is unable to recognize the problem without customer participation etc. But this proposed system provides solutions for those difficulties. It is an automatic system that can find numbers in all lines at one plugging. It is essential to know about free loops in distribution points prior to new connection is given. The designed system automatically detects whether there are free loops available or not.

2. EXPERIMENTAL

2.1 System design

Fig. 1 shows the block diagram of the designed system.

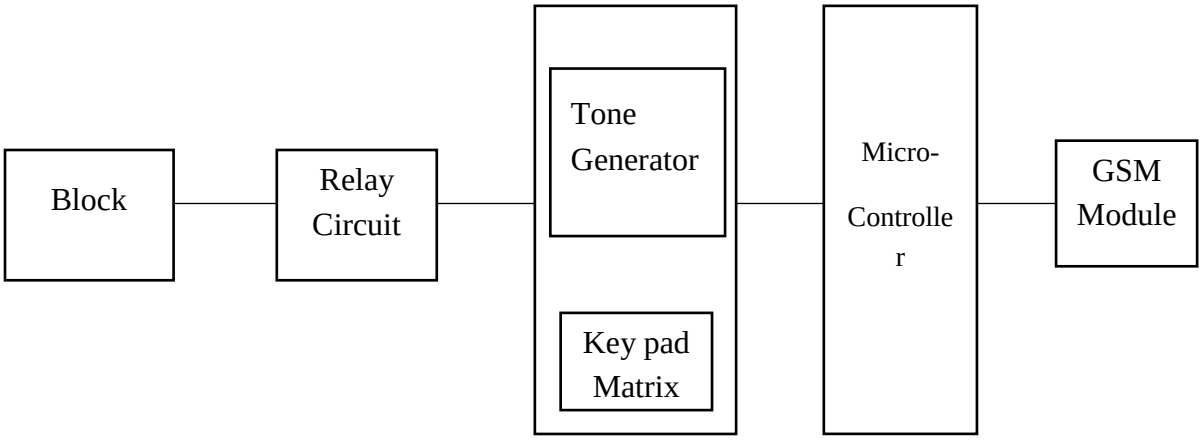

Fig. 1 Block diagram of the designed system

2.2 Block

The block is used to make connection between MDF and the designed system.

2.3 Relay circuit

The relay circuit is used to switch the connection from line to line. A relay is an electromagnetic switch operated by a relatively small electric current that can turn on or off a much larger electric current. It switches on with a tiny current and it switches another appliance on, using a much bigger current. Relays bridge the gap, making it possible for small currents to activate larger ones. That means relays can work as switch [1].

2.4 Tone generator IC

The tone generator IC generates the tone according to the frequency that is necessary to dial a number. Then it should be connected to the tone generator IC(UM91214/15). It provides dialing pulse (DP) or dual tone multi-frequency (DTMF) dialing. A Standard 4x4 matrix keyboard can be used to support either DP or DTMF modes [2].

2.5 Matrix key pad

A standard 4x4 matrix keyboard can be used to support DP or DTMF modes, up to 32 digits can be saved in the on chip RAM for redialing. Fig. 2 shows the matrix key pad that connected to the tone generator IC [3].

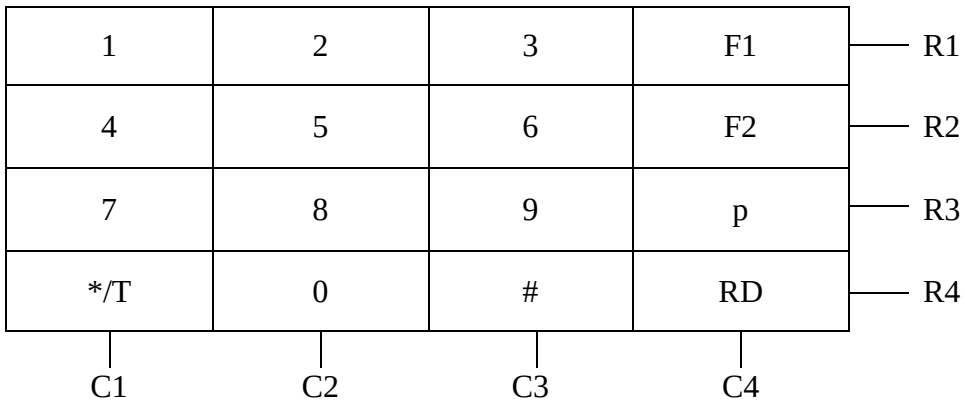

Fig. 2 Internal structure of matrix key pad

2.6 ATmega 328 microcontroller

To implement the solution as an automated system, Arduino Uno board was used. The Arduino programmer is low cost, consists of more functions and easy to program .The special feature in Arduino is that it can control GSM module using Arduino programming. Those are some of the reasons for selecting Arduino programming board for this project. [4]

Fig. 3 gives circuit diagram of the designed system.

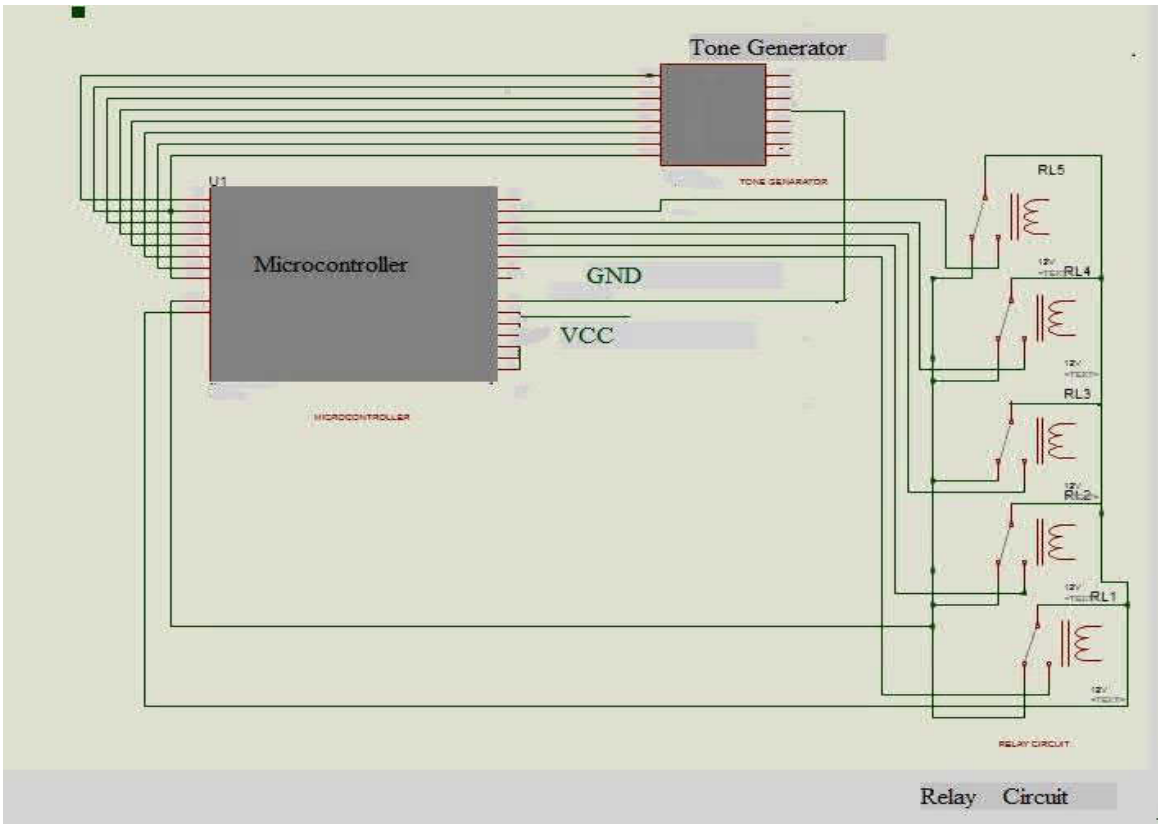

Fig. 3 Circuit diagram of the proposed system

3. RESULTS AND DISCUSSION

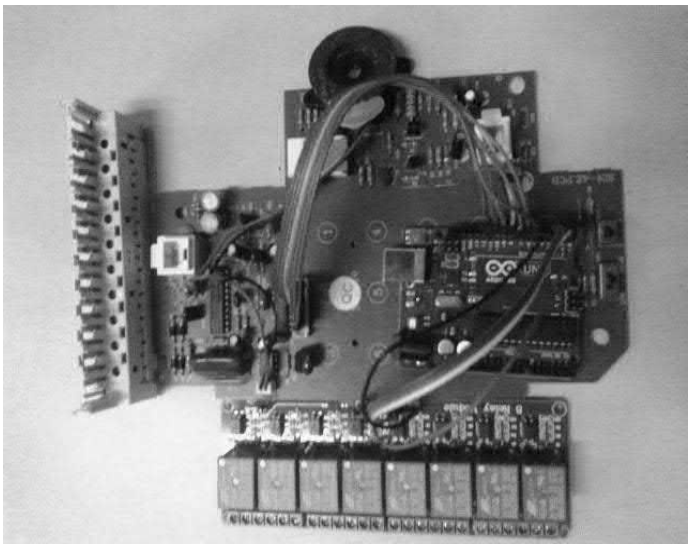

Fig. 4 Prototype of the designed circuit

Fig. 4 illustrates the automated multiple telephone line detector. The first part of the system is automated multiple telephone line detector which is used to contact (or dial) multiple

telephones lines automatically and identify the line number of each telephone line. The displayer circuit displays the numbers as the other part of the system.

When automated multiple telephone line detector is connected to a telephone line, that particular line automatically makes a call to the GSM module of the displayer circuit. Then the line number of that telephone number is displayed on the display circuit. When multiple lines are connected, the relay circuit in the device automatically switches between the multiple lines and the line numbers will be displayed on the display continuously with a delay of 30 sec.

4. CONCLUSION

The designed system can be used to identify phone line numbers in a MDF. It can check the identity up to 5 lines at once. Presently there are no automatic systems to perform this task. Therefore replacing available manual system by this device would save a lot of time and effort. This device can be further developed to identify line numbers of MSAN or DP by making slight modifications to the surface.

ACKNOWLEDGEMENTS

Authors would like to extend their sincere thanks to all the staff members of the Department of Electronics, Wayamba University of Sri Lanka and staff of Sri Lanka Telecom, Kandy.

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Department of Electronics – Wayamba University of Sri Lanka

AUTOMATED SERVICE INDICATOR FOR INDUSTRIAL SEWING MACHINES

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ABSTRACT

Industrial Sewing machines of different types are used widely in apparel manufacturing factories for performing variety of operations. The service of machines is still based on a procedure that only takes dates, they were installed in the manufacturing floor into consideration. This procedure Leeds to key problems in malfunctioning of machines which is a wastage in terms of money and human effort. In order to solve this problem, this paper describes a new system that facilitates the maintenance of Industrial sewing machines in a systematic way by taking their respective exact running times into consideration. When the sewing machine is in operation, foot pedal is pressed downwards resulting the inductive proximity sensor, which senses the downward motion and starts counting the running time. when the machine reaches their standard running times, this system indicates through an LCD screen as well as a network-based notification is also provided by using Google Firebase Real-time database. Warning Indication also provided when the machines are running over their standard running times, enabling on time maintenance services.

Keywords: Service of industrial sewing machines, Inductive proximity sensor, Firebase real time database

1. INTRODUCTION

Currently the service of the sewing machines is done according to the dates they were used in the production floor, but the operations of machines differ from one another. There are instances some machines are in extreme use and some machines are not taken into a usage. therefore, servicing all the machines according to assigned dates have been identified as an improper operation. As a solution servicing the machines according to their running times

have been identified as the solution. Through this systematic approach, three main objectives can be achieved. They are

- Identification of the machine runtimes.
- WIFI Based Notifying System.
- Indication of over running machines.

Proximity metal sensor was used to identify the motion of foot pedal to start the runtime counting [1]. ESP8266 is used as the MCU in this project. LCD display was used as the interface which shows the place of existing running time. An alarm and a bulb signals were used to indicate the overrunning condition.

Previously there were measures taken to count the running time of sewing machines by counting the needle up and down times as machine running times, but this method only suits the single needle type industrial sewing machines. The newly invented system overcome all these problems as the running time is calculated by taking the foot pedal pressing time as the input and as foot pedal is common to all the types of industrial sewing machines the same device can be used in different types of Industrial sewing machines.

Figure 1 shows how the inductive proximity sensor is mounted to get the accurate reading of machine running time.

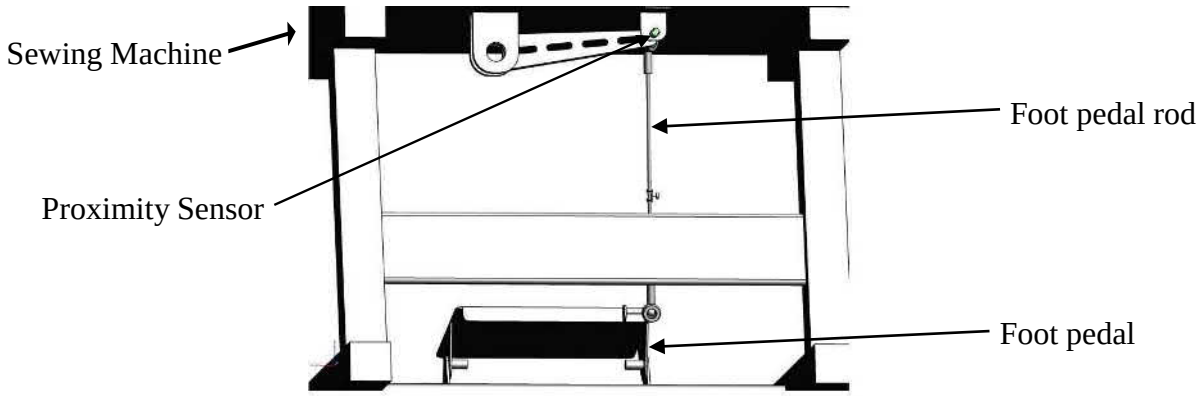

Fig. 1 Mounting the inductive proximity sensor on the sewing machine

2. EXPERIMENTAL

The block diagram of the proposed system is shown in the figure 2. Inductive proximity sensor used to detect the metal and the signal is send to ESP8266 module where it starts counting the running time when proximity sensor is in the “ON” State. Three LEDs used to indicate the machine running status- a green LED Indicates the machine’s working status and a yellow LED

Indicates when a machine nears a service and overrunning condition is indicated using a red LED. Network based indication is provided to machine maintenance by using Node-RED and Google firebase. Separate router is used for this purpose.

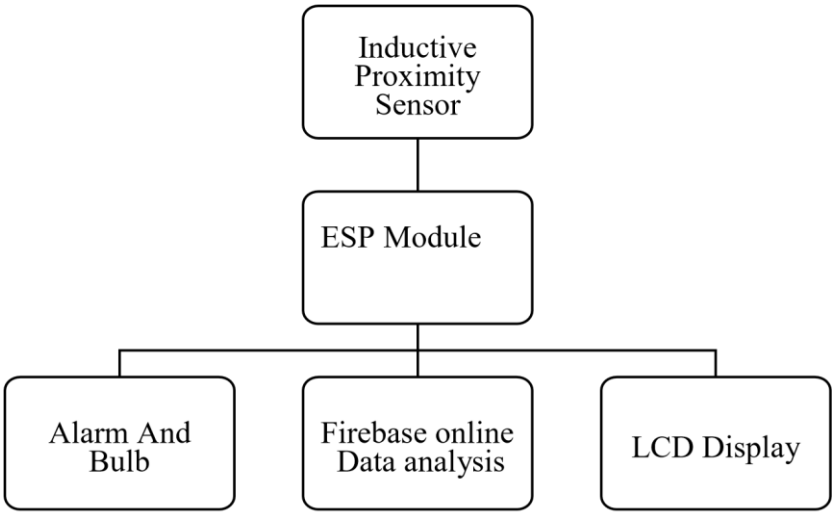

Fig. 2 Block diagram of the system

ESP 8266 (nodemcu 1.0 12 E) Module

Fig. 3 Pin diagram of the nodemcu 1.0 12E Module

The ESP8266 is a low-cost Wi-Fi microchip with full TCP/IP stack and microcontroller capability produced by Shanghai-based Chinese manufacturer Espressif Systems. ESP8266EX integrates a Tensilica L106 32-bit microcontroller unit (MCU), which features extra-low power consumption and 16-bit RSIC, reaching a maximum clock speed of 160 MHz With the Real Time Operation System (RTOS) enabled and a functional Wi-Fi stack [1].

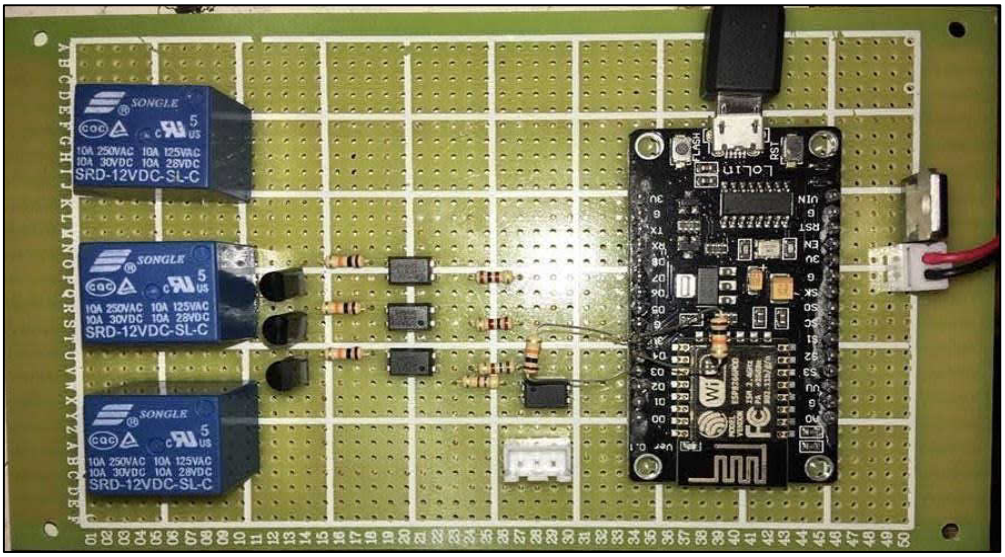

Fig. 4 Circuit diagram of the system

Figure 4 shows the Circuit assembly in the breadboard. Proximity sensor signal is inputted to the nodemcu (GPIO5) pin and the respective outputs are given from (GPIO 2, GPIO12, and GPIO14) Pins. PC817 Optocoupler IC's are used to prevent the affecting of high voltages to output signals.

Fig. 5 Control box of the system with LED indicators

Figure 5 shows the control box of the system with fixed LED Indicators this control box is powered by a 12 V Power supply and all the related circuitry is kept inside the control Box. This design is flexible to use and in case of a repair or else in a situation where this system must be removed from the sewing machine it takes a very short time due to the design of this control box.

In the proposed system, the downward motion of foot pedal or pressing the foot pedal downwards is considered as the running of the machine as pressing the foot pedal is compulsory for doing any sort of a performance through an Industrial sewing machine. An Inductive proximity sensor which is the best way to detect the motion of metallic materials was used to sense the downward movement of the foot pedal and the Signals obtained by the sensor is processed in the ESP 8266 which integrates a built In Wi-Fi module's 8266 Was used as it is capable in remote accessing by connecting to a router and this MCU favours Real-Time data management which adds a greater value to the project. LCD Display was used to indicate the current running times and an Indication of over running conditions was provided using a Buzzer and a Bulb [3].

3. RESULTS AND DISCUSSION

In this system, First the perfect Service times given in the respective modules of industrial sewing machines were identified. An WIFI Integrated ESP8266 module was used in the project. Proximity sensor was mounted to the rod that drives by the foot pedal which also interconnects the foot pedal to the motor which controls the up and down movement of needle point. Proximity sensor identifies the downwards motion and signal is sent to the ESP8266 and starts counting the running time whenever the machine is in operation. When the foot pedal is not pushed counter states in a "Pause" state. Threshold values are set depending on the type of the machine and when the machine pass the threshold value it starts to indicate in the system and on the LCD screen. "Node-RED" software gives the ability to dashboard indication of the sensor data, which facilitates the data analysis processes [2]. Further, this system can be also used to get an idea about Machine workers efficiency as running time per a day can be compared with a Standard running time per a day.

4. CONCLUSION

Industrial sewing machines need to undergo maintenance services based on their running time. Since there is no a system to measure the running time, industries only consider machine installation dates for maintenance. In this paper we proposed a system that solve this problem measuring the exact running time of industrial sewing machines and providing other valuable information for the timely maintenance of machines. Further, this system facilitates the remote data accessing while contributing to a large cost saving that occur due to the inappropriate service mechanism. This system follows the lean enterprise theories as this standardize the whole procedure while eliminating wastages in Time, Transportation, and Inappropriate

Inventory etc. This system can be also used to get an idea about Machine workers efficiency as running time per a day can be compared with a Standard running time per a day. This system can be further developed to get the accurate positioning of the sewing machine because it will make the identification of respective sewing machines easier.

ACKNOWLEDGEMENTS

Authors would like to extend their sincere thanks to all the staff members of the Department of Electronics, Wayamba University of Sri Lanka and extend their sincere thanks to the staff of the Research and Innovation Department of MAS Intimates Slimline, Pannala.

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Department of Electronics – Wayamba University of Sri Lanka

SOLAR PV INSTALLATION PROJECT

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ABSTRACT

Now a day's electricity is a most needed facility for human being in the world. All the traditional energy resources are depleting day by day. This work is a development of a renewable technology solar power system that harnesses the renewable energies in the sun to generate electricity. This system can give uninterrupted electric power by using solar energy system. Basically, this system involves the electric energy system that will give continuous power. Solar panels are used for converting solar energy into electricity. This electrical power can be utilized for various purposes. Here, the electric power produced from photovoltaic and transported to the inverters. The inverter is provided current to a storage bank of battery. At the same time produce generated AC power to AC loads. This study aims to explain the solution for decreasing electricity cost. The main idea of the project is decreasing electricity bill cost using generation solar power and paper deals with leads to generate electricity with affordable cost without damaging the nature. Finally, the practical part, the calculation part and solar pv installation system have been discussed.

Keywords: Solar panels, Invertor, Transformers, Cables, Electricity, Solar power

1. INTRODUCTION

Electricity power is most needed for human day to day life and electricity power has two ways of electricity generation by traditional energy sources and non-traditional energy sources. Electrical energy demand is increasing in the world. Now a day's electrical energy is generated by diesel, nuclear coal etc. The main disadvantage of this sources is that it produces waste. For an example, nuclear waste in nuclear power plant and taking of this wastage is very costly and it is also damage the nature. [3] Therefore, that resources are depleting day by day. The new sources should be reliable and environmentally friendly. The renewable energy resources should be good energy resources in the world. There are many renewable energy resources like

wind, geothermal, tidal, Solar etc. Solar and wind energy easily available and it can be good optional sources.

Solar Energy

The sun is ultimately the source of supplies and solar energy is freely supplier. This energy comes from within the sun itself. Solar energy is considered as a reliable energy source for renewable energy. Therefor now solar power energy is a trend of this generation. Because, solar energy can also be used to produce electricity. According to the solar energy can reduce the cost of electricity bill. It has low maintenance cost and it only need initial investment and it has long life. Sri Lanka like most other countries is blessed with sunshine all the year. Solar charged battery systems and on grid connection provide power supply for complete 24 hours a day. [2]

2. EXPERIMENTAL

For design of the Solar energy system, need to find the data as follows;

- Annual daily electrical capacity
- Daily Solar radiation
- Roof area
- Generation capacity

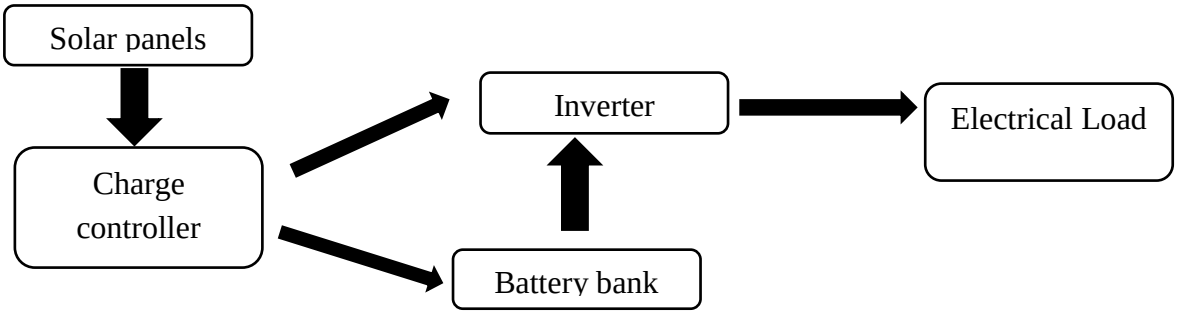


Fig. 1 Block diagram of energy generation system

According to the above diagram, electrical power generation system using solar power and it includes following items.

- Solar panels
- Charge controller
- Battery bank
- Inverter

Solar panels

It is used to convert solar radiation to the electrical energy. Solar panels are made in photovoltaic cells. The common photocell is made of silicon, which is one of the most abundant elements of earth. Solar panels are made up of several solar cells designed in weather proof unit.

Charge controller

This item is controlled the source which is to be active or inactive. It normally charges battery and also give power to the grid. It has short-circuited protection and automatic disconnect the load function. And when power is not generating it should power from battery.

Inverter

Inverters take care of four basic tasks of power conditioning:

- Converting the DC power coming from the PV modules or battery bank to AC power
- Reducing voltage fluctuations
- Ensuring that the shape of the AC wave is appropriate for the application, i.e. a pure sine wave for grid-connected systems [1]

2.1 Proposed Calculations

The total power generated by the solar PV panels. Mathematically it can be presented as below;

$$\text{Total power generated} = \text{The power generated by solar panel} \times \text{No. of solar panels used}$$

When using the solar panels, 21 solar panels were used. In this way, eight sets wrer used for one inverter and only one set had 21 Solar panels.

Therefore, calculation part of inverter;

$$\text{Power capacity of inverter} = \text{Maximum power of single solar panel} \times \text{No. of solar panels used}$$

Maximum power of single solar panel = 340 Wp

No. of solar panels used = 21 × 8

The total cost of the solar energy system was based on total no. of solar panels used. So, the total cost can calculate as follow; [3]

$$\text{Total cost} = \left(\begin{array}{c}\text{No. of}\\ \text{solar}\\ \text{panels}\end{array} \times \begin{array}{c}\text{Cost of}\\ \text{single solar}\\ \text{panel}\end{array}\right) + \left(\begin{array}{c}\text{No. of}\\ \text{inverters}\end{array} \times \begin{array}{c}\text{Cost of}\\ \text{single}\\ \text{inverter}\end{array}\right)$$

2.2 Calculation part

When install the solar panels, firstly the roof area was measured and decided what is the capacity to generate a roof area.

Roof Area (m^2) = 4976.956

Using Roof Area (m^2) = 4976.956 × 0.75

= 3732.717

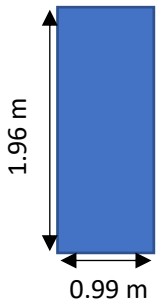
Generation capacity as per roof capacity (kWh) = roof area × 18.74

= 3732.717 × 18.74

= 69951.12

$$\text{Electric power(kW)} = \frac{\text{Generation capacity}}{10\times 30} = 233.17\text{kW} = 233\text{kW}$$

2.2.1 Total power calculation per panel



Maximum power of single solar panel = 340 Wp

Total solar pv panels = 686 Nos

Total power of all solar panels = 340× 686 W

= 233240W

= 233.24 kW

2.2.2 Fix inverter for solar panels

Total Power of 21 x 8 Solar Panel Set = 57 120 W = 57.12 kW

Total kW of solar panels = 233.24 kW

Inverter Power = 50Kw (+20%)

Number of inverters = 233.24 ÷ 57.12 = 5 Nos

According to these calculations, 5 inverters were needed and connected parallel in to the main panel

2.3 Project layout

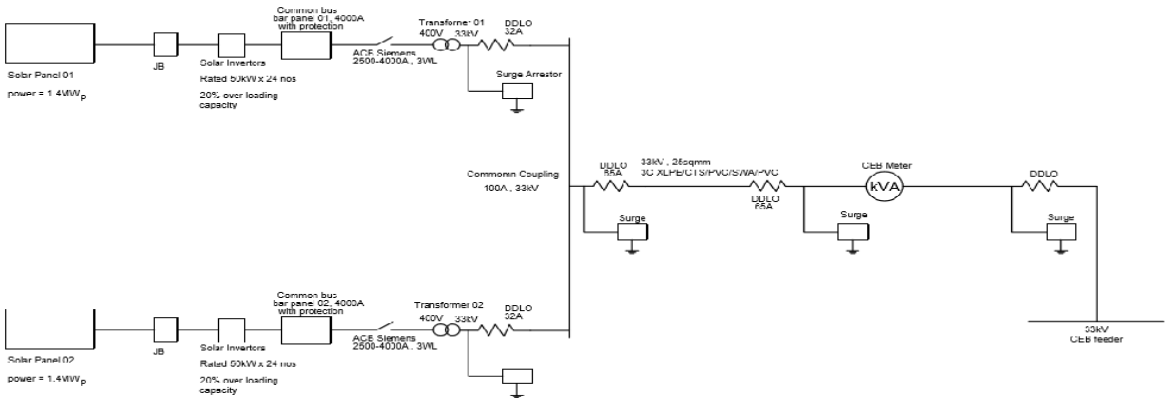


Fig. 2 Circuit diagram of the solar installation

3. RESULTS AND DISCUSSION

To achieve a solar power capacity of 233.17 kW (kilowatts) the capacities of solar panels controlling panel and inverter were determined. All the values and calculation were based on CEB and their ratings and specification had to be determined through any calculation. For this design 12 hours was assumed for the duration of working period.

3.1 Solar panels

Total load = 233.17 kW

Maximum power of single solar panel = 340 W

If solar panel of 340W is to be use the no. of panel to arrange 233,170W will be;

$$no.\ \text{of panels} = \frac{233{,}170}{340} = 685.79 = 686\ \text{Nos}$$

This shows 686 of 340-watt solar panel will be installed for the design.

Since the total power was 233,170W. It was appropriate to size the required inverters to be 233,240W as designed for solar panels. But the current inverter had a capacity of 50kW + 20%. That was to have 5- inverters for this design. It can be referred to as disadvantage here. Because, the power generated by solar is losses in addition to increasing the no. of inverters.

kW	Cost for produce LKR	Standard Generation-kWh	Earn from CEB(22 LKR for 1kWh)	Earn per year
1	289,159.85	120	2,640	31,680
233.24	67,443,643.41	69951.12	1,538,924.64	18,467,095.68
Payback time				4.6 years

The total solar installation cost is 67,443,643.41 (LKR), and the total amount spent can be invested in 4.6 years. So solar installations were successful.

4. CONCLUSION

Solar power generation system is a good and effective solution for power generation. It has more efficiency and the power can be utilized. It will reduce the cost of human budget from electricity bill and it is a cost-effective solution for this generation. People should motivate to use that renewable energy resources, it is highly safe for the environment. Overall it is good and reliable solution for electricity generation.

It has also a long life. When using long-term solar panels, the panels will be damaged. It will take up to 7 years for the damage to influence the efficiency of the panel's task. For even seven years, solar panels are generating electricity power effectively. After some years, the sun's impact on the solar cell will be damaged. As soon as the power cannot be generated well, then there is a decrease in the yield.

The solar is installed using on grid system, it takes electricity through the grid, in every case where there is no power generate by solar. This is sometime disadvantage. Therefore, installing hybrid solar makes it is good way to install solar.

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Authors would like to extend their sincere thanks to all the staff members of the Department of Electronics, Wayamba University of Sri Lanka and thank all who have supported to make this project success.

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Department of Electronics – Wayamba University of Sri Lanka

AUTOMATED GREIGE INSPECTION MACHINE FOR INSPECT SELVEDGE

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ABSTRACT

All textile industries aim to produce competitive fabrics. The competition enhancement depends mainly on productivity and quality of the fabrics produced by each industry. Machine vision automated inspection system for textile defects has been in the research industry for a long time, Recognition of patterns independent of position, size, brightness and orientation in the visual field has been the goal of much recent work. However, there instil a lack of work in machine vision automated system for recognizing textile defects using a neural network pattern recognizer was developed.The aim of this project was to design and implement a automated machine for inspect selvedge of fabrics for MAS Fabric,Noyon Lanka(pvt)LTD.the objective of this project is to develop a machine that can automatically identify faults and inform the mahine operator.This system enhance the efficient of inspection and reduce health issues regarding the machine operators.For developing this device,SIM800L GSM/GPRS shield,Diffuse sensor,laser module,laser detector,stepper motor ,12v 5A power supply unit and an arduino cicuit were used.Laser module was used to identify faults.A sim card installed GSM shield provides the connectivity between operator and the machine.The arduino circuit was used to control the whole system.

Keywords: Automated system, GSM (Global System for mobile communication), Arduino, Diffuse sensor, Laser module

1. INTRODUCTION

Grey fabric inspection is the process of identifying weaving faults in the fabric just after the greige fabric production in the knitting process.use equipment are Inspection table and Fabric inspection machine.also safety measures are Smoking inside the inspection area is strictly

prohibited,. Fire extinguishers are placed in the inspection area and all are trained to use it ,No fabric stack is placed in front of electric panels.

Method of greige inspection :

- As the fabric reaches its "set cut length" in the loom the cloth is cut and the cloth roll is doffed off from the loom.
- The cloth roll might also be cut and doffed off before the preset length
- According to set rule the "cloth doffer" cuts and doffs off cloth roll and record the doff length in the loom quality.
- The roll is then unrolled over the inspection table where it is visually checked yard to yard
- (100%) against light and repaired or mended for any smaller extent of faults like protruding or projecting yarn, yarn naps, slubs, crack, floats, oil stains which can't be repaired,
- the fault area is identified by putting yarn tails or laces in the selvedge area.[1]

In the inspection table, the operator finds out faults in the fabric and analyses their intensity by visual inspection. Some of the common weaving faults are:

1. Pick faults, e.g.-miss pick and double pick.
2. Wrong density /drawing
3. Pattern or design break
4. Selvedge faults, e.g.-lashing in, cut selvedge.[1]

The developed system can be divided into two basic sections. First section to identify the selvedge faults and other section is identify new web, and then inform the operator. If this machine identify selvedge faults, then the machine will be automatically stop and a text message will be sent to operator's mobile phone until it repair. After that new web will be, identify and make a noise-using buzzer.

2. EXPERIMENTAL

The block diagram given in Fig. 1 describes the system.

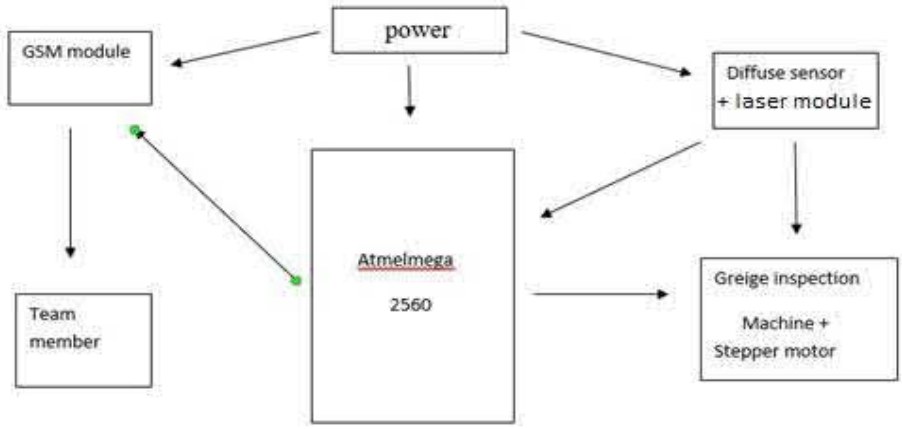

Fig. 1 Block diagram of the proposed system

In this project, mainly use Arduino Atmel mega 2560 board. In this project basically use GSM module, Diffuse sensor and stepper motor .[2]Firstly laser module and laser detector identified selvage errors and send a signal to the board then GSM module activated and send message to the machine operator. Otherwise, if there is not any error stepper motor will rotate. Although the diffuse sensor identify new web but there is not any stop but make noise to inform operator. This is brief idea about the project is going on.

The flow chart given in Fig. 02 describes the functionality of the system. When the power supply is on, system will be initialized. System will require signal from laser detector to continue the process. In addition, diffuse sensor give the signal to process continue.

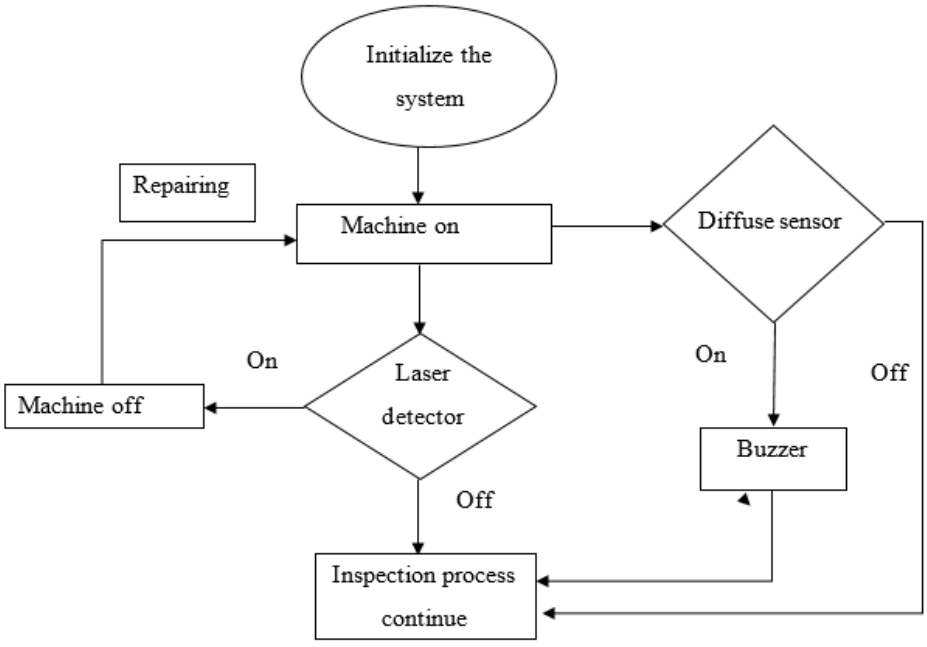

Fig. 2 Flow chart of the system

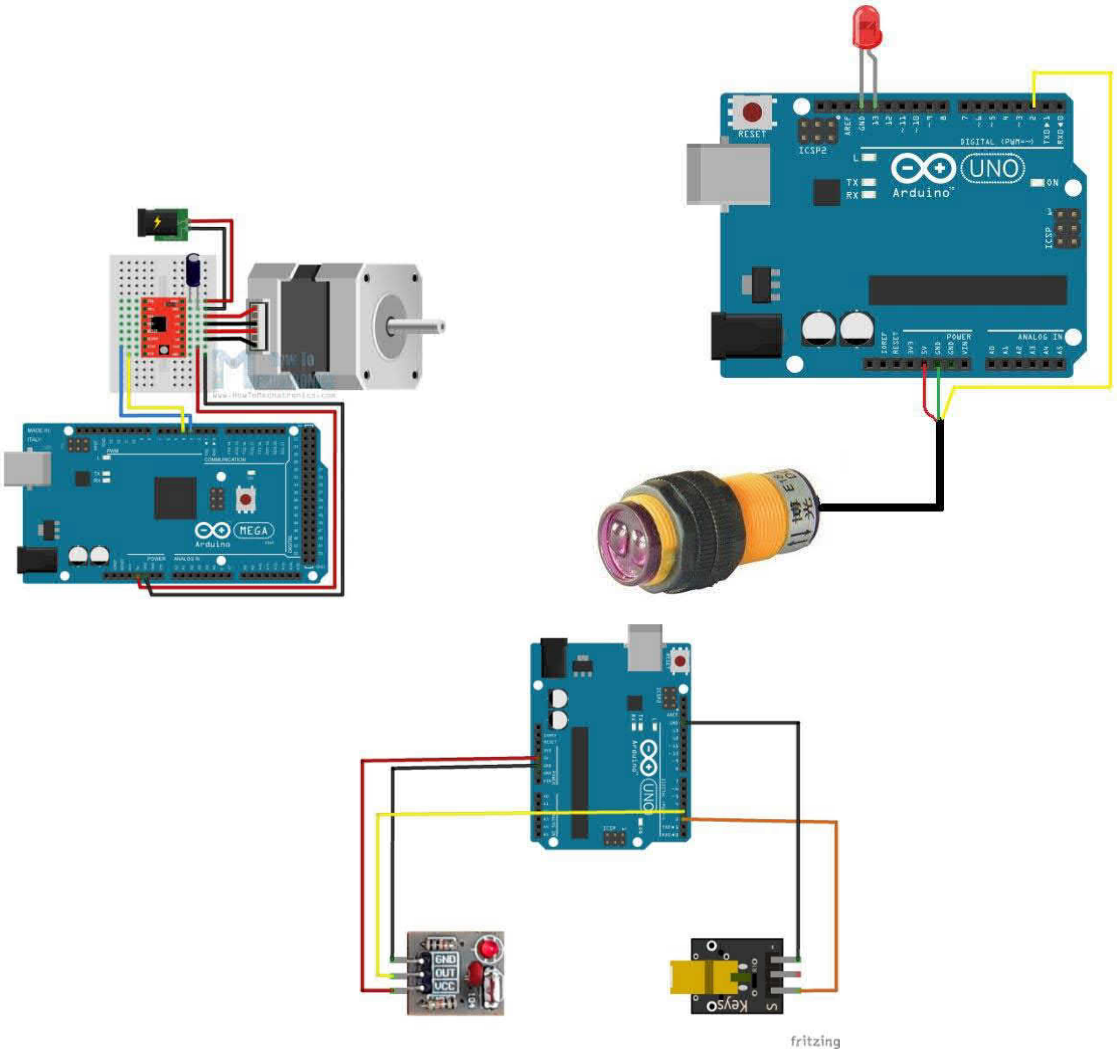

Fig. 3 The circuit diagrams of the automated machine [4]

3. RESULTS AND DISCUSSION

During the six months training period, overall system was designed and tested by making a prototype of the system with real applications. It was worked but some parts may be developed. In the industrial usage there are so many noises will be added so that so many sensors are not work properly.so that design a system for avoid noises. Also some other advantages can get using this machine.

- Improve productivity
- Enhance efficiency
- Ease of use
- No need to stay and check in every minute
- Reduce health issues

4. CONCLUSION

In the Fabric, manufacturing industry automation takes a vital place the inspection machine follows lean enterprise theories. This machine automatically detects the errors and indicate it to the authorized persons this reduces the waste time, waste transportation and reliable information is send so that this system enables the data analysis.

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Authors would like to extend their sincere thanks to all the staff members of the Department of Electronics, Wayamba University of Sri Lanka. Moreover, extend their sincere thanks to the staff of the Research and Innovation Department of MAS Fabric Noyon Lanka, Biyagama.

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Proc. Annual Symposium on Research & Industrial Training, 05(2018) 147-151
Department of Electronics – Wayamba University of Sri Lanka

DEVELOPMENT OF FILTER FOR WATER PURIFICATION USING KUMBURU SEEDS ACTIVATED CARBON

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ABSTRACT

Nowadays water quality, has become a burning issue, as best quality water is needed for daily lives. Numbers of purification methods were developed to overcome the environmental problem and currently. In this study, Adsorbent used was produced from kuburu charcoal using H_3PO_4 as activating agents. The purpose of this study was to identify the effectiveness of activated carbon for the reduction of chemical oxygen demand (COD), total dissolved solids (TDS) turbidity from tank wastewater The maximum percentage removal of COD, TDS, and turbidity with Kuburu activated carbon are up to 80%, 58%, 70% and 90% respectively. While using coconut shell charcoal reduced the impurities i.e. COD 72%, TDS 50%, and Turbidity 83% respectively. The Kuburu based activated carbon was found more efficient than Coconut shell charcoal based activated carbon for the removal of COD, TDS, and turbidity. After the treatment of wastewater, its quality was found to be suitable for direct discharge into streams, lakes, rivers. The water could be used for irrigation and drinking purpose.

Keywords: COD, Adsorption, Activated carbon, Kumburu,

1. INTRODUCTION

Water quality, nowadays, has become a huge problem for world, as best quality water is needed for daily lives [1]. Absorption of activated carbon is used to many applications including water treatment various physical and biological methods, membrane filtration and reverse osmosis have been widely used for removal of contaminant of waste water [2,3]. The advantage and disadvantages of every removal technique have been extensively used. Adoption is very

difficult separation technique in term of capital cost. Activated carbon is most efficient adsorbent for water purification. During past time number of non-conventional low cost adsorbent sawdust, coconut shell, sugarcane bagasse activated carbon [4]. Kuburu is the herbal tree, one of them is adsorption .Kuburu is one of the main herbal produced in Sri Lanka that plays an important role in the national economy. In this study, Adsorbent used was produced from kuburu charcoal using H_3PO_4 as activating agents. The purpose of this study was to identify the effectiveness of activated carbon for the reduction of chemical oxygen demand (COD), total dissolved solids (TDS) turbidity from tank wastewater.

2. EXPERIMENTAL

Mature Kuburu seed shell was collected from a North Central province in Sri Lanka. Initially, Kuburu seed removed from the shell and then shell was cut into small pieces. The shells were washed several times with distilled water and soap flex to remove adhered impurities from its surface. kumburu shell granular were treated with 0.5 M phosphoric acid pyrolysis at 290 $^{\circ}$C heat rate of 20 $^{\circ}$C min^{-1} in under nitrogen atmosphere for 15 minutes and until it is cool down to room temperature. After pyrolyzed carbon were wash with distill water and dried at muffle furnace at 105 $^{\circ}$C for 1 hour.

Samples of wastewater were collected from the tank at university premises. Different samples of 150 ml wastewater were collected. Individually sample of the wastewater was placed into the magnetic stirrer and different dose of adsorbents was mixed using agitator with 300-350 rpm speed for 60 min. After agitation, each sample was kept for sedimentation for about 40 minutes to settle down the particles. After the sedimentation, each sample was filtered through multi-media bed filter. The multi-media bed filter was made from gravel, sand and nylon fabric. After filtration of samples, backwashing of the filter was done each time. Each sample filtrated was analyzed by using multiparameter (HI98194), TDS meter. COD was determined by standard titration method.

3. RESULTS & DISCUSSION

Fig. 1 shows the SEM micrograph of Kuburu activated carbon at 290 °C. This figure clearly shows that micro level pore is developed on to the surface. Some place of activated carbon surface is irregular pore is formed. Activated carbon is pyrolysis at temperature profile 250-290 °C. In this stage, the surface pore is slowly developed. After 290 °C pore walls are collapse due to heat treatment. It is confirming by MB test shown in table 1.

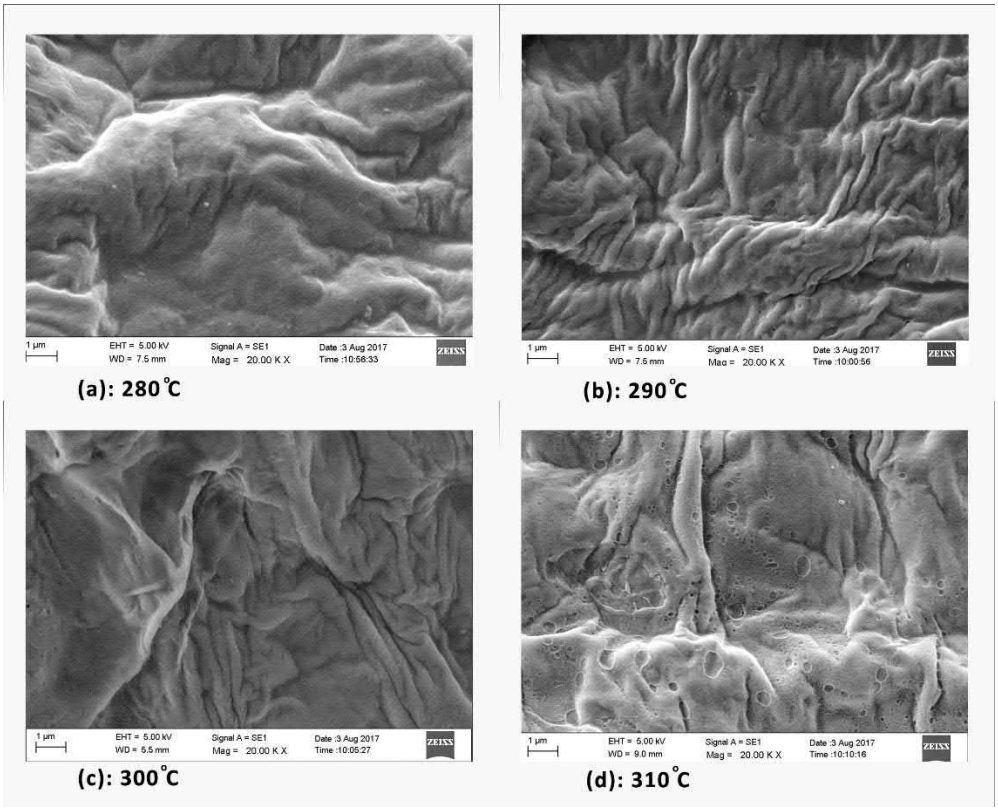

Fig. 1 Kuburu carbon activated at (a) 280 ˚C, (b) 290 ˚C, (c) 300 ˚C, (d) 310 ˚C

Table 01: Methylene Blue absorption capacity

Sample number	**Pyrolysis temperature (^{0}C)**	**Absorption (mg/g)**
1	310	1.226
2	300	0.793
3	290	0.439
4	280	0.577

Effect of the activated adsorbent while changing the dose was studied using a particle size of the Granular level. Experimental results obtained from kuburu shell shown in Fig. 2a. The COD, and TDS percentage removal increases as the dose of adsorbent increases. The turbidity removal increased as the dose of adsorbent increases. The maximum reduction of COD, TDS and turbidity are up to 80%, 58%, and 90% respectively.

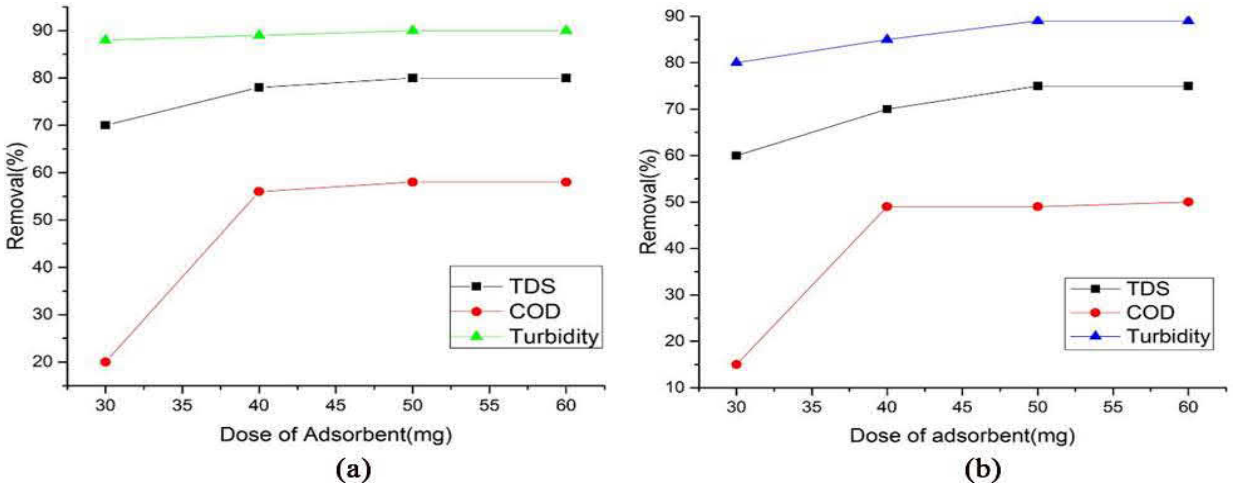

Fig. 2 Removal of COD, TDS and turbidity with (a) Kuburu Activated carbon using Granular (b) coconut shell activate carbon using granular

Activated adsorbent coconut shell activated carbon with a dose of 30, 40,50 and 60g and using a particle size of granular level are studied in these experiments. Experimental results are shown in Fig. 2b. It is observed that percentage reduction of COD, TDS, and Turbidity when the dose of adsorbent increases. The Maximum removal for COD, TSS, TDS, turbidity is up to 72%, 50% and 83% respectively. Kuburu and coconut shell charcoal are investigated. Overall, the Kuburu shell based activated carbon has a better reduction efficiency than coconut shell charcoal based activated carbon. The reduction of TSS is same for both activated carbons. With coconut shell charcoal the maximum reduction of COD, TDS and turbidity are up to 72%, 50% and 83%while with Kuburu based activated carbon is up to 80%, 58%, and 90% respectively. COD can be a measure of dissolved organic matter concentration in wastewater. Consequently, the dissolved metal concentration should increase with increasing COD due to the formation of non-absorbable complexes [5]. But in this study COD level is remarkably decreased.in other ward said heavy metal content of wastewater goes down.

4. CONCLUSIONS

The adsorbents produced from Kuburu seed shell activated carbon. It can be, effectively, used to treat wastewater for the reduction of COD level and heavy metal level. These can be used for irrigation purpose and drinking water systems of the rural area. These adsorbents have the potential to become a source of the eco-friendly and for the treatment of wastewater.

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Department of Electronics – Wayamba University of Sri Lanka

CHARACTERIZATION OF REDOX CAPACITORS BASED ON POLY-N-METHYLPYRROLE ELECTRODES

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ABSTRACT

In this study, performance of redox capacitors utilizing conducting polymer, Poly-n-methylpyrrole electrodes with gel polymer electrolyte is reported. The gel polymer electrolyte consists with ethylene carbonate, propylene carbonate, Zinc Trifluoromethanesulfonate and Polyvinylidene fluoride. Redox capacitors were characterized using Cyclic Voltammetry, Electrochemical Impedance Spectroscopy and Continuous Galvanostatic Charge-Discharge tests. Minimum values of bulk electrolyte resistance and charge transfer resistance of 49.12 Ω and 125.27 Ω respectively were obtained with the redoxcapacitor fabricated with PNMP film polymerized using 1 $mAcm^{-2}$ current density. Maximum specific discharging capacity of 12.46 F/g was obtained for the same redox capacitor.

Keywords: Redox capacitor, Gel polymer electrolyte, Poly-n-methylpyrrole

1. INTRODUCTION

Supercapacitors provide higher specific power than batteries and higher specific energy, than conventional dielectric capacitors because of the high capacitance of the electrode materials. Many researchers are currently investigating two types of supercapacitors namely, electric double layer capacitors (EDLC) and the redox capacitors. For redox capacitors, conducting polymers or electroactive oxides are used as the active electrodes and for EDLCs, different carbonaceous materials are employed [1]. Conducting polymers (CPs) provide higher capacitance and higher power capability than carbon based electrodes [1]. Charge storage mode is different in each type. Transition metal oxides or CPs can be used as electrode materials for redox or pseudo capacitors. The use of CP materials for redox capacitors has several advantages over other systems. The materials have good intrinsic auto-conductivity and are relatively cheap [2]. CP, Poly-n-methylpyrrole (PNMP) has attracted much attention

among researches because it process higher environmental stability, controllable electrical conductivity and easy processability [2]. In this study, fabrication and performance evaluation of PNMP based redox capacitors are reported.

2. EXPERIMENTAL

2.1 Preparation of NMP/SDBS monomer solution

To prepare a 0.05 M Sodium Dodezylebenzenesulphonate (SDBS) solution, required amount of SDBS was measured using an electronic balance. The weighted amount of SDBS was poured into a beaker and deionized water was added. The solution was magnetically stirred well for 30 minutes and required amount of n-methylpyrrole (NMP) monomer was added and magnetically stirred well for 10 minutes [3]. Here the NMP concentration was 0.01 M.

2.2 Preparation of PNMP electrodes

FTO glass plates having an area of 1 cm^{-2} were used to deposit PNMP films. Three electrode cell consist with Pt electrode as the CE, Ag/AgCl electrode as the RE and the FTO glass plate as the WE was used for electropolymerization. Electrolyte contains 0.01 M NMP and 0.05M SDBS. Galvanostatic electrochemical polymerization was carried out for current densities of 1.00, 0.75 and 0.50 $mAcm^{-2}$. Thickness of PNMP was maintained at 1 µm. After polymerization, PNMP film were rinsed with distilled water and vacuum dried at room temperature[3].

2.3 Preparation of GPE

Polyvinylidene fluoride (PVdF) (Aldrich), zinc trifluoromethanesulfonate (ZnTF) (Aldrich), propylene carbonate (PC) (Aldrich) and ethylene carbonate (EC) (Aldrich) were used to prepare the GPE with optimized proportions by weight. Composition of the optimized GPE was 0.5 PVdF: 1 EC: 1 PC: 0.7 ZnTF (by weight). Hot pressed method was used to obtain a bubble free thin GPE [4].

2.4 Fabrication of the redox capacitor

Redox-capacitors were fabricated in the form of PNMP : DBS / PVdF: EC: PC: ZnTF / PNMP : DBS. Several capacitors were fabricated by varying the polymerization current density.

2.5 Characterization of redox capacitor

2.5.1 Electrochemical Impedance Spectroscopy (EIS)

EIS measurements were taken for the frequencies ranging from 400 KHz to 10 mHz with a single sine wave of 0.01 V amplitude having logarithmic frequency step. A computer controlled Metrohm Frequency Response Analyzer (M101) was used to perform EIS measurements.

2.5.2 Cyclic Voltammetry (CV) test

CV tests were carried out in the potential window of -1.2 V to 1.2 V in the sacn rate of 5 mVs^{-1}. This procedure was repeated for different current densities 1, 0.75, 0.5 $mAcm^{-2}$ and scan rates 5, 10, 20, 50 and 100 mVs^{-1} respectively.

2.5.3 Galvanostatic Charge-Discharge (GCD) test

Redox capacitor was first charged to 0.5 V and immediately after it was discharged to zero potential. Charge-discharge current was kept at 0.1 µA. In a similar way, continuous charge-discharge cycles were carried out for 150 cycles.

3. RESULTS AND DISCUSSION

3.1 Electrochemical Impedance Spectroscopy (EIS)

The impedance plots obtained for the redox capacitors fabricated using PNMP electrodes having different polymerization current densities are shown in Fig. 1. The ideal impedance behaviour of a pure capacitor is a straight line parallel to the imaginary axis (Z") whereas in practical capacitors, a steep rising capacitive impedance response is observed in the low frequency region[5]. In the resulting plots, slanted straight lines were observed in the lower frequency range. This exhibits the capacitive behaviour of the redox capacitors. The important feature is the tendency of the lines to become more parallel with the imaginary axis when the polymerisation current density increases. Then, it can be elucidated that the capacitive behaviour of the redox capacitors enhances with the use of PNMP films prepared at high current densities.

With the results obtained, it is clear that values of bulk electrolyte resistance (R_b) and charge transfer resistance (R_{ct}) reduces when the polymerization current density increases. The lowest values of 49.12 Ω and 125.27 Ω for R_b and R_{ct} were obtained for the capacitor with PNMP film polymerized with 1 $mAcm^{-2}$ current density.

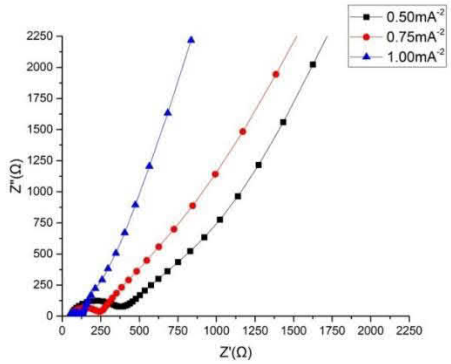

Fig.1 Impedance plots for the redox-capacitors in the configuration of PNMP : DBS / PVdF: EC: PC: ZnTF / PNMP : DBS within the frequency range of 0.01Hz to 400kHz at room temperature

3.2 Cyclic voltammetry test

Cyclic voltammograms obtained for the fabricated redox-capacitors are shown in Fig. 2. The shape of the cyclic voltammograms indicates the capacitive nature of the redox-capacitors and fast switching rate of ions at the sites of electrode-electrolyte interfaces [5]. Cyclic voltammograms obtained during charging-discharging processes of redox-capacitors showed almost symmetric current responses. This may be due the fact that the fabricated redox-capacitors have a good electrochemical reversibility within the potential window used.[5]

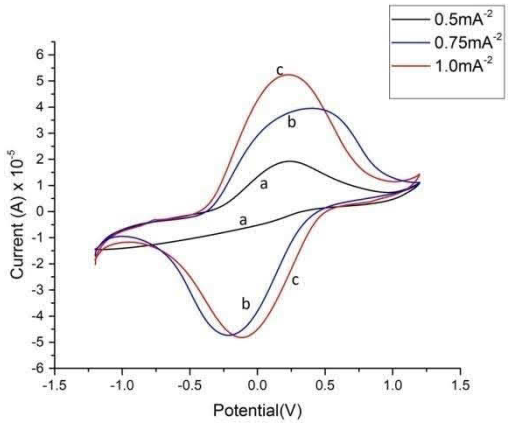

Fig. 2 Cyclic voltammograms obtained with the scan rate of 5 mVs^{-1} for the redox capacitors with PNMP film polymerized at different current densities. a – 0.5$mAcm^{-2}$; b – 0.75 $mAcm^{-2}$; c - 1.00 $mAcm^{-2}$

The specific capacitance(C_s) values were calculated using the following equation, $C_s = (2 \int I.\mathrm{dv}) / m.\Delta V.S$. where $\int I.\mathrm{dv}$ is the integrated area of the cv curve, m is the single electrode mass, ΔV is the potential window and S is the scan rate.

The calculated specific capacity values according to the three current densities with respect to scan rates are shown in Fig. 3.

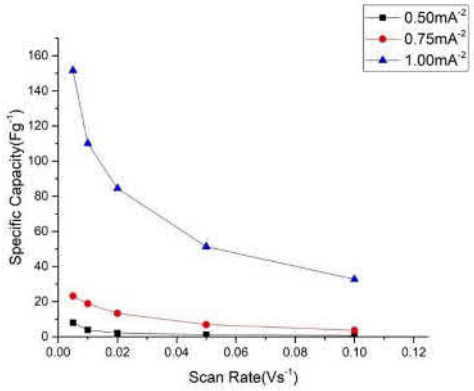

Fig. 3 Variation of specific capacitance of the redox capacitors with the scan rate calculated from cyclic voltammetry test for three current densities

3.3 Galvanostatic charge-discharge tests (GCD)

Discharge characteristics are found to be almost linear and symmetric, which symbolise a good capacitive behaviour. Specific capacitance values were calculated from the linear part of the discharge curves using the relationship $C_s = 2\ i\ /\ m\ (dv/dt)$, where m is the mass of PNMP electrode, i is the discharge current and dv/dt is the slope of the discharge curve [6]. Calculated specific capacitance values varied from 3.58 to 12.46 Fg^{-1},when polymerization current density varied from 0.5 to 1.0 $mAcm^{-2}$. Fig. 4 shows the variation of specific capacitance with cycle number for three capacitors having PNMP electrodes polymerized at different current densities. Initially, the capacitance value has increased upon cycling. This may be the result of irreversible charge consumption due to some reactions associated with possible oxidation and reduction of loosely bound surface groups at the electrode-electrolyte interface [7].

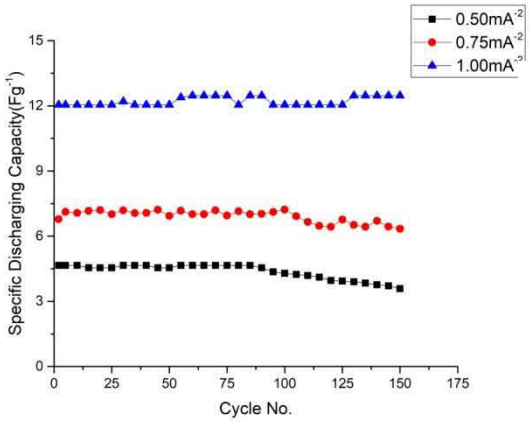

Fig. 4 Variation of specific capacitance of the redox capacitors with the cycle number calculated from galvanostatic charge-discharge test for three current densities

It is also evident that the specific capacitance values are maintained at a steady level after sometime. This is one of the most important and special features of the redox-capacitors when compared to rechargeable cells [7]. It is also clear that the specific capacitance value increases with the increase of current density as also observed with cyclic voltammetry.

4. CONCLUSION

In this study, effect of polymerization current density of the PNMP electrodes on capacity of the redox capacitors was investigated. Although, PNMP is poorly soluble in aqueous mediums, it was able to successfully polymerize NMP monomer in aqueous monomer with the help of surfactant. The highest specific capacity of 12.46 F/g was obtained with the capacitor having the PNMP film polymerized with 1 mAcm-2 current density. It can be concluded that polymerization current density has a significant effect on the capacity of PNMP films when they were used as electrode in redox capacitors.

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Department of Electronics – Wayamba University of Sri Lanka

PORTABLE VEHICLE SECURITY SYSTEM

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ABSTRACT

Driver drowsiness is recognized as an important factor in the vehicle accidents. This system is totally an embedded system which provides a unique method to curb drowsy people. This system has an eye blinking sensor embedded in the vehicles. Whenever the driver start vehicle the sensors senses the eye blink and automatically sends the signal to buzzer, warning indicator, liquid crystal display (LCD) and to the motor. In this system the outputs of sensors are given to the Microcontroller for comparison. If the value reaches to fixed limit then automatically engine will stop running, while buzzer will produces sound, warning indicator will start glowing on the back of the vehicle at the same time LCD will display near to the warning indicator where the other drivers on right back of that vehicle will see the warning message and the indicator and drive safe according to that situation. If the compared value reaches to low then immediately engine will start to the normal function while the buzzer and the warning indicator will set to off stage at the same time the LCD will display some cool messages to the peoples on right back of that vehicle.

Keywords: Accident, Microcontroller, Motor, LCD, Signal indicator, Eye blinking sensor, Buzzer.

1. INTRODUCTION

Now a day's accidents are increasing at a large pace, and various technologies are being introduced to reduce the accidents. vehicle accidents are most common if the driving is inadequate. In recent years, driver drowsiness has been one of the major causes of road accidents and can lead to severe physical injuries, deaths and significant economic losses. But the life lost once cannot be re-winded. Statistics indicate the need of a reliable driver drowsiness detection system which could alert the driver before a mishap happens [2]

The main purpose of the project is considering the safety of humans (passengers) by preventing them from road accidents. These happen on most factors if the driver is drowsy and etc. Driver drowsiness is recognized as an important factor in the vehicle accidents.

In case if the driver lost his control in a high ways it is not only affect him and his passengers' lives but its affects the vehicles which behind him on the same road. Therefore this system has an another advanced feature is looking safety of the other vehicles which is in behinds of the sleeper's vehicle in the same road.

Solution for the above case is as the system detects that driver is in the sleeping mode, immediately the back side indicator will be turned on with the noise alert, still the back vehicle driver is not alerted the **danger sound** by the indicator there is another option that the LCD unit which is in the back side of the sleeper vehicle will start to give the warning message automatically as "**Attention, Sleep Alert**" at the same time parallel with the indicator sound with the visible color [4]. Therefore the vehicles behind to the drowsy vehicle will identify the situation in the front vehicle, and can take the necessary step at that instance.

Also the project has the ability to fix in all types of vehicles(portable) and in case if the system fails to work due to the damages in the pic or in any component then when starting the vehicle then automatically buzzer will produces sound even the driver is not in the sleep mode therefore the driver can identify the system is not working well so he drives safely [2].

2. EXPERIMENTAL

This circuit contains PIC18F2550I/SP, Voltage regulator, Comparator circuit, Eye blink sensor circuit, Motor system, Buzzer system, LCD display system, Warning indicator system.

Important methodology in this system if in case the PIC or any other component fails to functions properly then when On the system it will automatically beep the buzzer that alerts the driver as the system is not working properly therefore he realize that security system is not working and take much care during the driving hours.

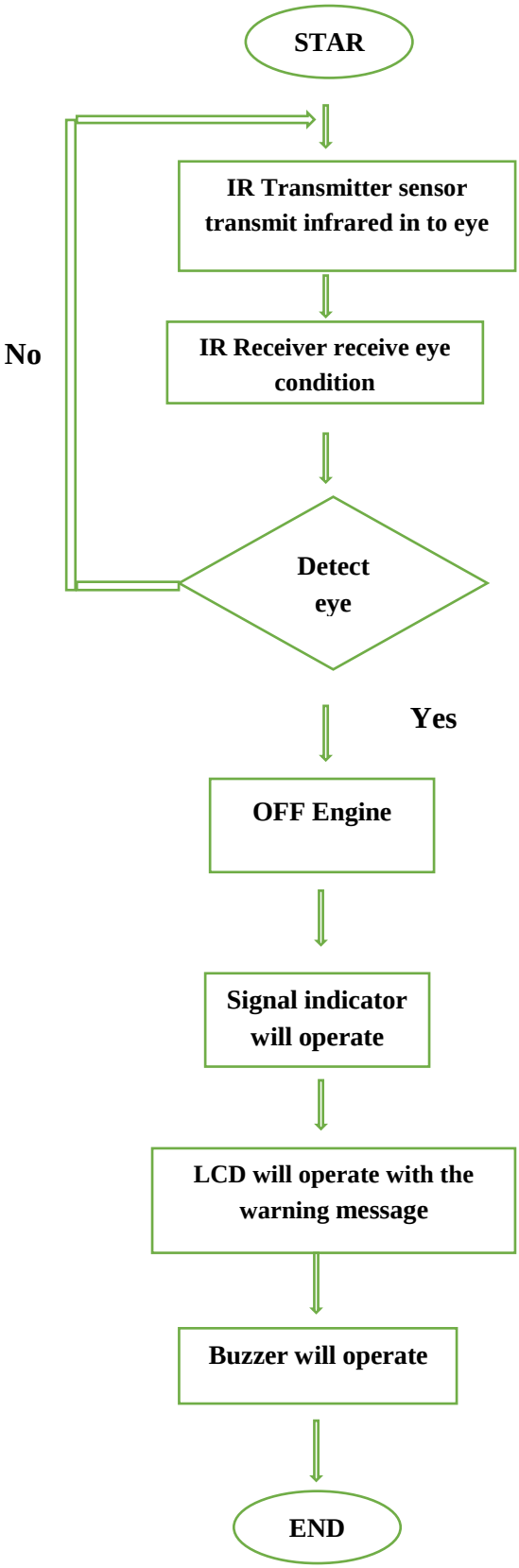

Fig. 1 Flow of the proposed system

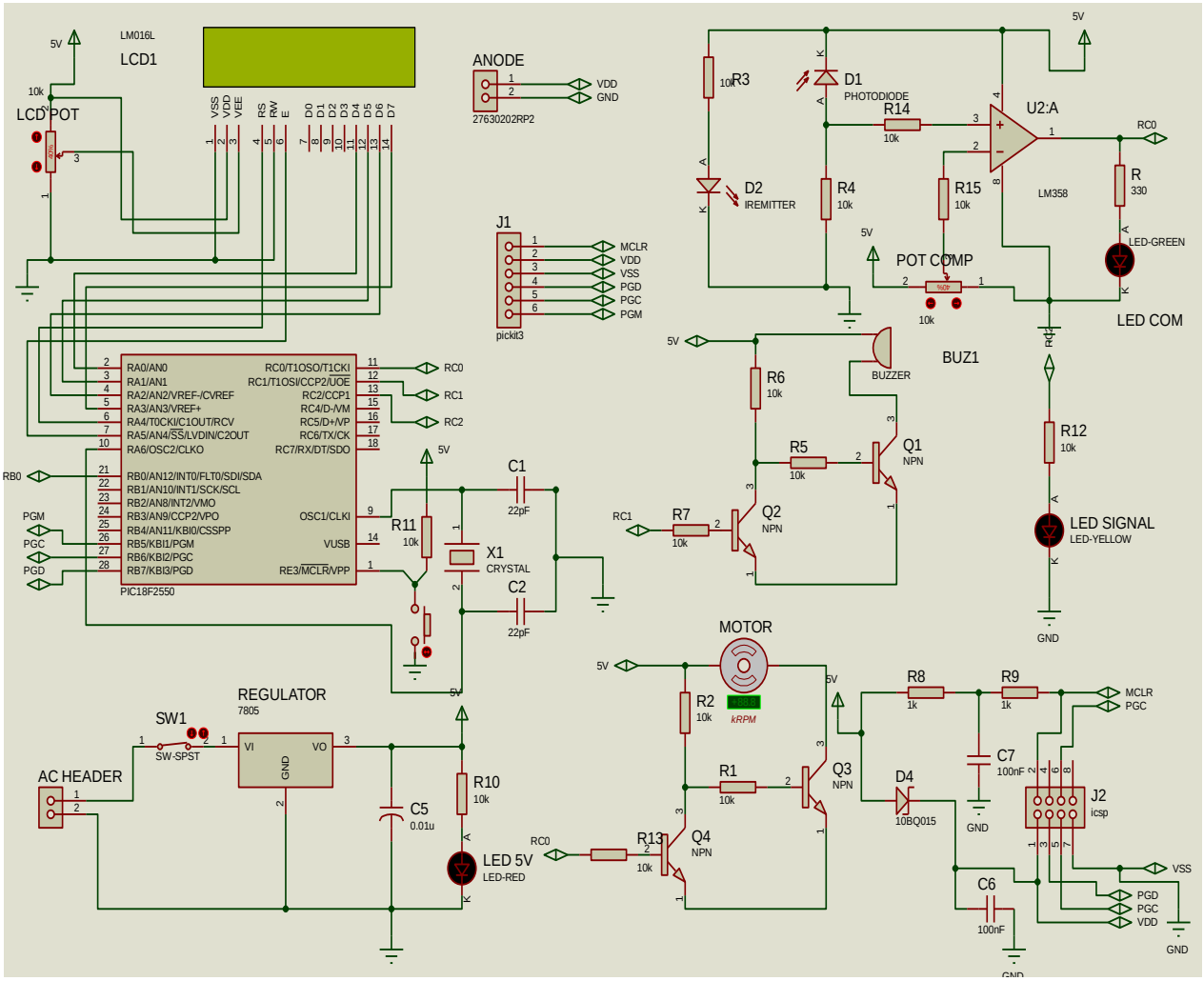

Fig. 2 Circuit diagram of the proposed system

3. RESULTS AND DISCUSSION

The design given below is used to test the code in real time and this test design consists of motor circuit, alarm circuit, the warning signal indicator circuit and the push button circuit connected to the interrupt port bit to the PIC microcontroller 18F2550I/SP.

The push button connected to the interrupt port bit to the PIC and other terminal is given to the pulse of 5V trail and when pushing the button the signal of 5V is feed to the PIC that time PIC programmed as eye blink occurs that means vehicle is in safe mode and when push button is in the OFF stage for a more than 3 second time, PIC programmed as driver is not in the normal position.

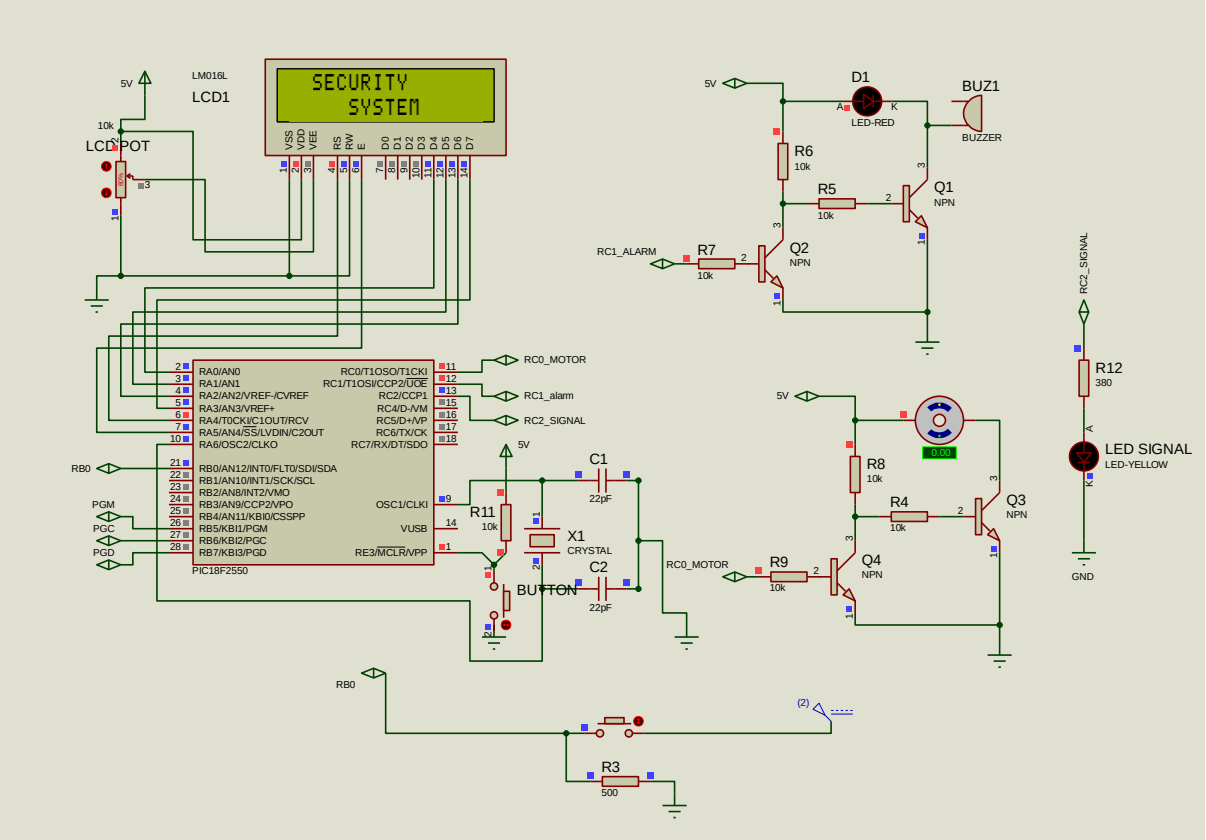

Fig. 3 Design used to test in real time.

Drivers who have been driving for long hours wouldn't have to worry even if they fall as sleep suddenly and therefore passengers are also safe. Also drivers don't need to worry if the system is working or not because if in case the system fails to work properly then immediately the system produce some warning sound as well as warning message displays in the LCD.

Picki2/3 is used to proram the PIC and to protect the PIC18F as well as the pickit programmer from the high current the ICSP protected circuit is linked in the complete circuit diagram.

4. CONCLUSION

Nowadays, people have become more prone to accident. For the safety of the human being some automation is made. The purpose of such a model is to advance a system to detect fatigue symptoms in drivers and control the speed of vehicle to avoid accidents. This project involves measure and controls eye blink using IR sensor, there are too many precautions made in the system to alert driver as well as the passengers and also the vehicles in the same track on the road (near vehicles).

The main purpose of this study is to produce an embedded base prototype system to save human lives from road accidents. Also the drivers as well as peoples can travel anywhere to the world with this protective system.

ACKNOWLEDGEMENTS

Authors would like to extend their sincere thanks to all the staff members of the Department of Electronics, Wayamba University of Sri Lanka. Authors wish to convey their sincere thanks for all, those supported in this project's success.

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Department of Electronics – Wayamba University of Sri Lanka

USE OF SRI LANKAN RAW MATERIALS IN THE FIELD OF ENERGY AND TECHNOLOGY

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ABSTRACT

This paper describes about a natural rubber-based polymer electrolyte (NRPE) to be used in a Mg rechargeable cell. At the moment, there is a huge global concenrn about clean and efficient energy storage sources. It has happened as a rsult of idenfying the harzardous nature of materials mainly. Li and liquid electrolytes have been well recognized as having so many safety issues. Therefore, in this study, it was attempetd to fabricate a cell having Mg and graphite electrodes with NRPE. This approach in another provision to use Sri Lankan raw materils in energy and power sector. The optimum composition of the electrolyte was 63% natural rubber, 27% magnesiumtrifluoromethanesulfonate and 10% ethylene carbonate (by weight) with the highest room temperature conductivity of 2.83 x 10^{-4} Scm^{-1} . The DC polarization test proved that the electrolyte was a pure ionic conductor. The open circuit voltage of the fabricated cell was 1.57V.

Keywords*:* Natural rubber, Polymer electrolyte, Cells

1. INTRODUCTION

Energy storage has been the most challenging and complex issue in the present-day world. There are various devices that have been used since long ago for the purpose of energy storage. Cells are one of the commonly used class of energy storage devices. Some of the recent challenges with the cells are increasing the storage and using environmental friendly materials and technologies in manufacturing.

Today, most of the rechargeable cells are based on Lithium **(**Li**)** which is a very hazardous element and no proper safety regards or safety measures to avoid the accidents occur due to Li based cells. The use of liquid electrolytes cause leakage, spilling and sometimes bursting effects [1,2]. There are a plenty of natural raw materials in Sri Lanka. But at present, there is

no a satisfactory value given to them though they possess so many attractive features to be used in energy technology. This study is aimed at using natural raw materials to fabricate rechargeable cells**.** Sri Lankan raw materials were used to prepare the electrolyte as well as the cathode and Mg was used as the anode for the rechargeable cell [3]. The results of the present study can be used to demonstrate the potential suitability of Sri Lankan raw materials in the field of energy and technology.

2. EXPERIMENTAL

2**.**1 Preparation and characterization of the rubber-based polymer electrolyte **(**RPE**)**

Five RPE samples were prepared using solvent casting technique by varying the amounts of natural rubber, magnesium trifluromethanesulfonate (MgTf) ($Mg(CF_3SO_3)_2$), ethylene carbonate (EC) according to the equation 01 [1]. First, the required amount of rubber was dissolved for 24 hours. Then, the solution was stirred using a magnetic stirrer until the complete dissolution of rubber. The required amounts of MgTf, EC were added and magnetic stirring was continued further. The mixture was poured in a glass petri dish and left in the vacuum oven.

X% [Rubber (70%) + MgTf (30%)] + y% EC

An electrolyte sample with 14 mm diameter was cut from each film and they were sandwiched in between two stainless steel (SS) electrodes in a spring loaded brass sample holder. Micrometer screw gauge was used to measure the thickness of the film. The impedance measurements were taken for each sample in the frequency range 16 MHz to 10 mHz at room temperature and the conductivities were calculated using Electrochemical Impedance Spectroscopy (EIS) technique. Sample which showed the highest conductivity was characterized by conducting a full temperature conductivity scan. DC polarization test was done for the optimum sample under the blocking mode with a DC bias potential of 250 mV to identify the charge carriers responsible for the conductivity. The variation of current across the sample were measured with time and the ionic transference number (t_i) was calculated.

2**.**2 Fabrication and characterization of the cell

The cathode material was prepared by mixing graphite, polyvinylidene fluoride (PVdF) and MgTf with some acetone in weight ratio of 18:3 :1. The sample mixture was stirred in a magnetic stirrer for 3 and 1/2 hours continuously. Magnesium electrode was used as the anode. The rechargeable cell was assembled in a spring-loaded sample holder having the

configuration, Mg / PE / graphite electrode. Initially, open circuit voltage (OCV) of the cell was measured using a digital multimeter. EIS measurements of the cell were carried out for the frequencies ranging from 16 MHz to 10 mHz using Metrohm-AUTOLAB M101.Cyclic voltammetry(CV) tests were carried out within the potential range of 0 to 1 V at the san rate 5 mV/s using a three electrode electrochemical setup. The discharging test was done for the cell through 100 kΩ resister for about 3 1/2 hours.

3. RESULTS AND DISCUSSION

The conductivity of the electrolyte **(**σ**)** was calculated using the given equation [3].

$$\sigma = (1/R_b)(l/A)$$

where l and A are thickness and area of the sample respectively**.**

Fig. 1 shows the variation of room temperature conductivity with the rubber concentration (by weight %).

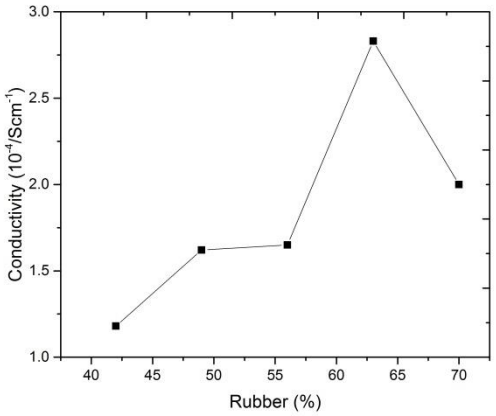

Fig. 1 Room temperature conductivity variation for different rubber compositions

Initially, conductivity increases with the increase of rubber concentration. Further increase of rubber anyway lead to reduction of conductivity. Having a polymer structure, rubber may assist ion motion at the beginning. So, when the concentration of rubber increases, ion conductivity may increase [4]. Higher amount of rubber in the system may raise the viscosity of the system. High viscosity disturbs ion motion and as a result, conductivity may go down. The highest room temperature conductivity of 2.831×10^{-4} Scm^{-1} was obtained from the composition, 63% natural rubber, 27% MgTf and 10% EC) by weight %Also, it was noted .(that this composition was having a good mechanical stability and the film was very thin. At

low concentrations of rubber, films were having a liquid nature and also, at very high .concentrations of rubber, they are very hard

Fig. 2 is the graph showing the variation of conductivity with temperature. It shows a linear behavior suggesting that conductivity follows Arrhenius behaviour explained by

$$\sigma = A exp(-E_a / k_B T)$$

Here, A is preexponential factor, E_a is the activation energy, k_B is the boltzmann constant and T is the absolute temperature.

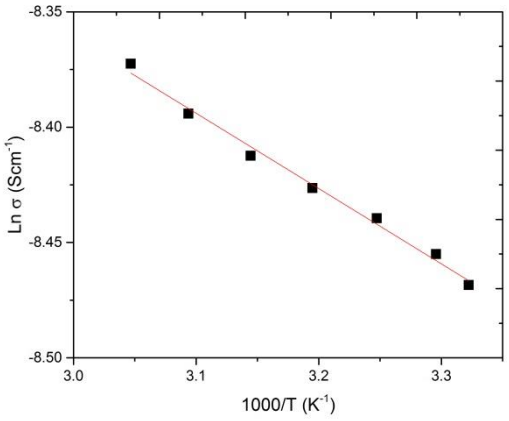

Fig. 2 The dependence of the conductivity on temperature for the rubber based electrolyte

DC polarization curve for the assemble SS/RBPE/SS is given in Fig. 03.

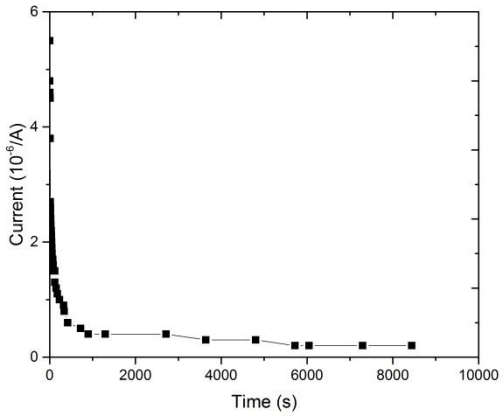

Fig. 3 DC polarization curve taken with SS electrodes

The ionic transference number, t_i was calculated as

$$t_i = (I_t - I_s) / I_t$$

where I_t is the total current and I_s is the saturated current.

The value of t_i was 0.96. This well proves the fact that the sample is a pure ionic conductor [5].

The rechargeable cell showed an open circuit voltage of 1.57V. This is a very sutable value for normal applications.

The Nyquist plot obtained from the EIS test of the cell, from 16 MHz to 10 mHz is shown in Fig. 4. The first intercept of the semicircle on the real axis was taken as the electrolyte resistance, R_b**.** It was found that R_b of the electrolyte was 69.6 **Ω**. In the lower frequency range a spike can be seen. It represents diffusion control kinetics.

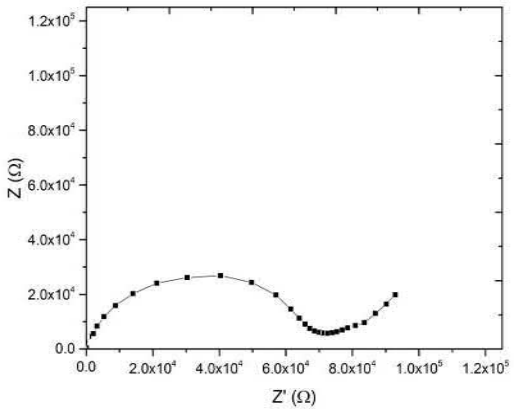

Fig. 4 Nyquist plot of the rechargeable cell

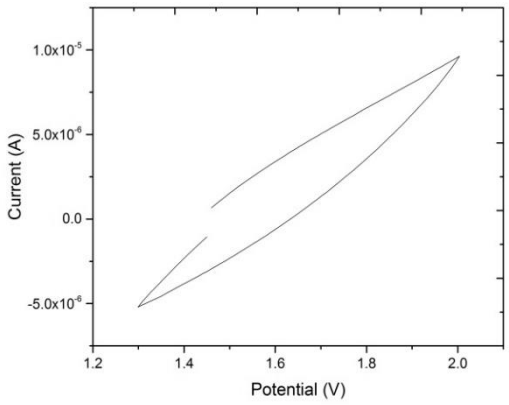

Fig. 5 Cyclic Voltammogram (CV) of the rechargeable cell

CV in Fig. 5 was used to calculate the specific charge. It was found to be 9.14 x 10^{-2} Ah/g.

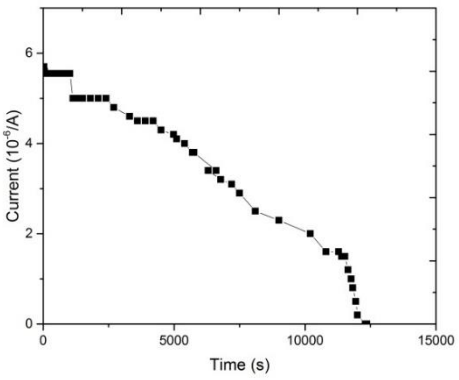

Fig. 6 Discharge characteristic curve obtained under a constant load of 100 kΩ

Fig. 6 depicts the curve obtained for discharge characteristics of the cell under a 100 kΩ constant load. The time taken for a full discharge is about 12500 s. The discharge capacity was 5.32 x 10^{-3} Ah/g.

5. CONCLUSION

The optimum (RPE) sample having the composition, 63% rubber: 27% MgTf: 10% EC (by weight%) possesses the highest room temperature conductivity which is equal to 2.83 x 10^{-4} Scm^{-1}. Rubber concentration affects the conductivity and the mechanical properties of the electrolyte. The rechargeable cell of the form, Mg/RPE/Graphite+PvdF +MgTf had an open circuit voltage of 1.57 V. Specific capacity values are not very high but, with further investigations, they can be improved. Based on the results obtained in the study, Sri Lankan raw materials can be used to fabricate non Li rechargeable cells.

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Department of Electronics – Wayamba University of Sri Lanka

MODIFIED VOLTAGE REGULATOR BASED HP 6200 POWER SUPPLY

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ABSTRACT

The usual power supply is designed to provide various output voltages such as 3.3 V, 5 V, 12 V etc. They are also designed with different types of output pins to provide those different voltages. The regular 24-pin power supply has a SATA port, a HD port and a 4-pin port as well. This 24pin power supply is very cheaper in the current market. The HP 6200 power supply is also a power supply that does not resemble other power supplies. They are designed for special HP panels. The output pin configurations are also quite different from the regular 24 pin power supply. The research that was developed in the current study is finding a solution to install a regular power supply instead of the 6200 power supply by adding an additional adjustment circuit. After adding the modified circuit it will not be difficult to install the power supply in the CPU as it has not changed by the physical size and shape.

Keywords: Regulator, Power Supply

1. INTRODUCTION

In this study, it is supposed to provide a special kind of solution for the HP 6200 power supply. In the case of failure of the HP 6200 supply, there is no option to replace instead with comparing other regular power supply.

The computer motherboard and power supply connects to using a VBS signal wire which is colored in purple. There are no purple color wires available except the VBS signal. So the adjusting circuit must be coupled with the purple color wire of the power supply.

There are several 3.3V orange, 5V red color wire available in 24-pin power supply but are eliminated as the HP6200 power supply does not provide those two voltages to motherboards. There is another special wire which is gray called a good signal strength. It also provides 5V to mother board.

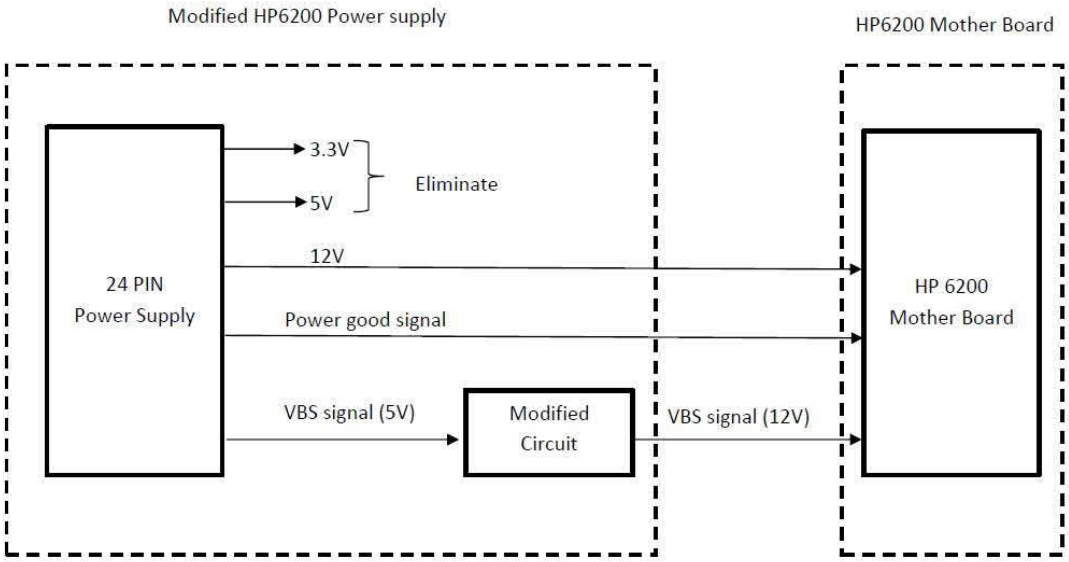

Fig. 1 Block diagram of proposed circuit

The difference of these two kind of supplies are not only the output pin configuration, the internal circuit is totally different. So the proposed solution is to change the internal flow of the current necessarily to the HP 6200 power supply.

2. EXPERIMENTAL

LM2577 step up voltage regulator

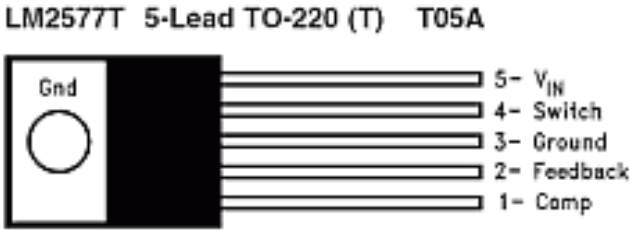

Fig. 2 LM2577 voltage regulator

The LM2577 integrated circuit from National Semiconductor is a useful IC that provides all of the power and control functions for a simple boost (step-up), fly back, and forward converter switching regulator. The IC has a wide input voltage range (3.5V to 40V) and is available in different output voltage versions: 12V, 15V, and adjustable.

LM 2577 Schottky Rectifier diode

Schottky rectifier uses the schottky barrier principle of the barrier in a large area of metal to silicon diode power. It is ideally suited for use as components in low voltage, high frequency inverters, freewheeling diodes and polar protection diodes.

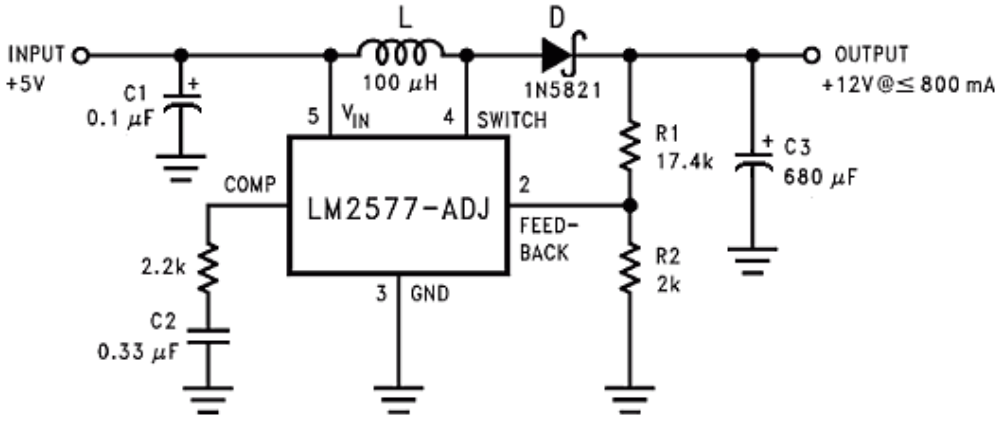

Fig. 3 Proposed circuit diagram for the regulation circuit

By specifying different values for R1 and R2, it is possible to use LM1577-ADJ / LM2577-ADG to produce different voltages. The output voltage is given by the following formula:
VOT = 1.23 V (1 + R1 / R2)
The input capacitor (C1) must be of good quality, low ESR, 0.1µF condenser with short cut leads as much as possible. If the IC is located away from the filter capacitor supply source, a larger electrically capacitor is required (eg 10µF-100µF). Select the low-type capture capacitor for the output filter (C3), with the working voltage at least 20% higher than the output voltage. Low values can be achieved by capturing using larger value capacitors or by parallel to multiple smaller value capacitors [1].
The output voltages remain within the measured regulation bands at the end of the load for the output connectors under each line, load, and environmental conditions. The voltage regulation

limits must be kept under continuous operation for any constant temperature and operating conditions.

3. RESULTS AND DISCUSSION

The circuit result can be measured by digital multi-meter by checking all the output voltages. 3.3V, 5V, 12V respectively, orange, red, yellow / brown wire are set.

Moreover the purple color for 12V signal wire and blue color wire for -12V value.

Here the modified circuit is attached to the purple color wire which is given as 12V / 5V signal feedback from the Bessy mother board.

A regular power supply is to get those feedbacks via the 5V line and the adjustment is to do this particular line to accelerate the voltage to 12V as it receives an HP 6200 only 12V display to carry the feedback signal [5].

The circuit shown in Fig. 2 was designed on the PCB board and attached into the power supply circuit and the coupled with all the output wires.

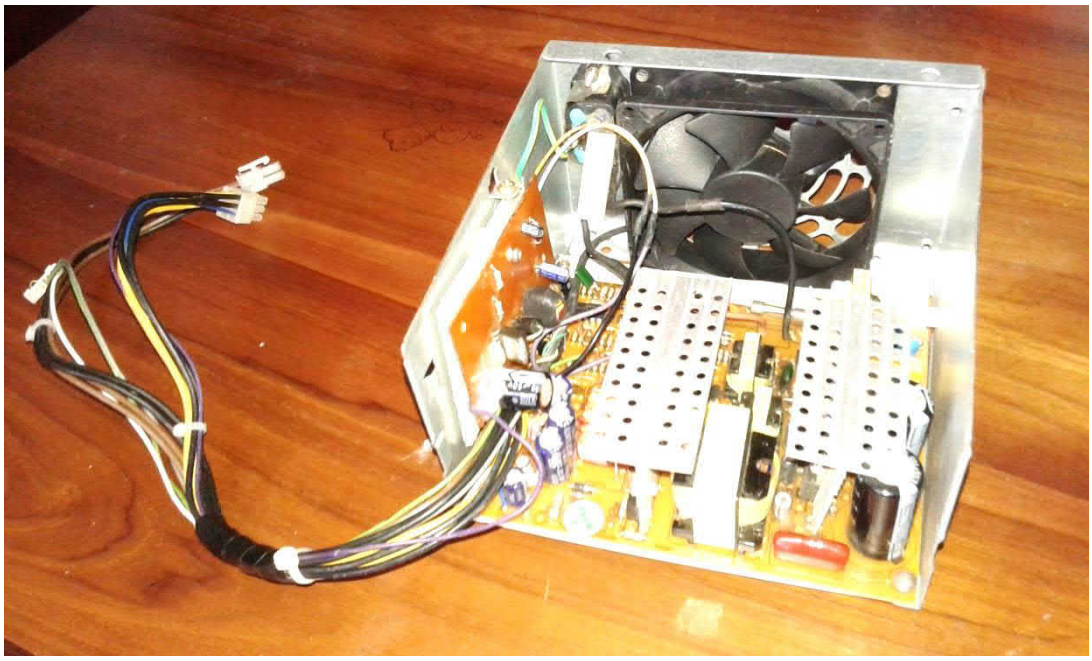

Fig. 4 Final product inside view

4. CONCLUSION

This is going to be a good solution for the industry because the HP 6200 power supply is quite expensive, it is usually cost Rs 12,000/- nowadays. The other 24 PIN power supply is cost

about Rs 750/- in the market. So, for the proposed modified circuit and components are not more than Rs 500/-. It is not difficult to add the circuit in to HP6200 power supply.

Also if an organization which is using over 25 computers that are only HP 6200 power supplies, can be easily used this product directly instead of their disposed power supplies. It will reduced the cost about 50% of the PCB designing when the mass production. Else it's better to prepare two or three power supplies as backup power supplies and just replace them when the supply failure happen.

ACKNOWLEDGEMENT

Author wish to extend sincere gratitude and deep appreciation to the staff of the Department of Electronics, for providing guidance and support.

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Department of Electronics – Wayamba University of Sri Lanka

AUTOMATED HYDROPONICS SYSTEM FOR INDOOR FARMING

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ABSTRACT

Traditional farming methods in agriculture will not be sufficient to feed the increasing population in the future. Indoor farming with automated hydroponics will be a solution for the increase in the population and limited land area. A hydroponic system is a soil less farming system where nutrient solution is used for the growth of plants. An automated hydroponics system monitors the factors required for the growth of plants by controlling the nutrients in the solution. This study reports on automation of a hydroponics monitoring system which is capable of checking and maintaining the pH and electrical conductivity (EC) levels of nutrient enriched water solution. The EC and the pH values of the solution are measured while controlling the water levels of the tank to maintain the nutrient level of the solution. Water flow rate, temperature, humidity and light intensity of the system are also measured. Circulation of the water pump and dosing pumps are automated. Necessary requirements for the growth of the plant are monitored and fulfilled by the system.

Keywords: Hydroponics, Raspberry pi, Sensors

1. INTRODUCTION

The agricultural and food industry is facing huge challenges all around the world. The world's population is growing but the amount of farmland available per head is shrinking. Agricultural productivity will have to increase to safe-guard the food supply in thelong term. It has to feed a rapidly growing world population while at the same time ensuring the best-possible conservation of scarce natural resources [1].

With the increasing need to address world's key problems as mentioned above, it is important to identify the best and the easiest way to overcome the problem. As a solution, hydroponics indoor farming systems which can help to deploy resources efficiently and sustainably, enabling to get the best out of crops with minimal environmental impact can be introduced.

Hydroponics is a method of growing plants in soilless culture using mineral nutrient solution. There are different techniques used in hydroponics farming like grow bag culture and Nutrient Film Technique (NFT) where coir peat and rock wool are used as substrates. It is highly productive, conservative of water and land, and protective of the environment.

In this study, an automated indoor farming system which is similar to a mini version of a hydroponics greenhouse was constructed.The system environment and the nutrient solution are monitored by this design to figure out the optimum growth cycles by ensuring the right amount of water, nutrients, temperature and humidity. Water circulation take place with a time interval and the lights will be switched on for a certain time period of a day. The Fig. 1 shows the NFT system which has been used in this automated indoor farming unit.

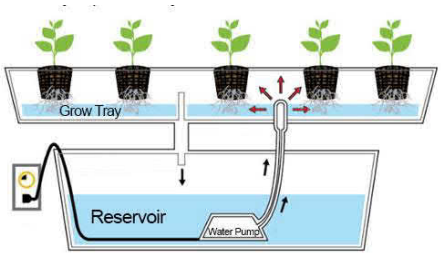


Fig. 1 Hydroponics NFT system

2. EXPERIMENTAL

2.1 Project Methodology

The project was designed by considering the factors, functions and other necessities needed for the hydroponics system. The factors that are monitored in this home unit system are environment temperature, humidity, electrical conductivity (EC) and pH of the nutrient solution, light intensity and the flow rate of the solution. EC and the pH value of the nutrient solution are monitored and according to the values Albert solution and the acid are added. This nutrient solution should be flow through the roots of the plants. Therefore according to that the sensors were selected and project of hydroponics home unit system was designed.

Sensors used in the system are EC sensor, pH sensor, Flow meter, temperature/humidity, Light intensity, water level sensors

The following Fig. 2 shows the block diagram of the system.

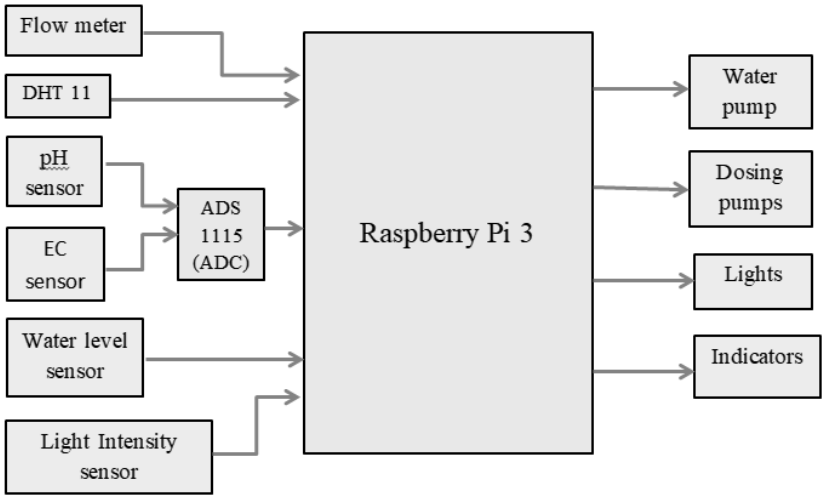


Fig. 2 Block diagram of the system

The function of the system is as follows.

I. Measure the water level of the nutrient tank and indicate the water level.

Water Level of the nutrient tank is displayed in three instances; the upper level, middle level and the lower level with indicators. When it comes to the lower level a message is sent to the user by informing that the tank is empty.

II. Measure EC and pH value

According to the EC and the pH values read by the sensors, the two dosing pumps will switch ON or OFF.

The EC value should be maintained in the range of 1500 -2500 mS/cm. If it is below 1500mS/cm, Albert solution should be added to the system.

The pH value of the nutrient solution should be in the range of 5.5 - 6.5, if it more than 6.5, an acid should be added. That means the dosing pump in the acid tank should be switched ON.

III. Read temperature and humidity

As it is important to maintain a congenial surrounding and to have an idea about the room temperature and humidity, DHT11 temperature/humidity sensor has been fixed. The readings are sent to the server.

IV. Circulation of nutrient solution

The circulation pump is set to work 30seconds with a time interval of 10 minutes. Therefore the plants' roots get wet with the nutrient solution with the circulation of the solution. Circulation will stop when the tank gets empty.

V. Lighting the system

Three LED lamps are set at the top of the system where the plants can receive enough amounts of lights. Warm LED lamps are used in this system. These lamps are set to be ON during the day time and OFF at 6.00 p.m.daily.

VI. Measure the light intensity

A light intensity sensor is used to measure the intensity of light that the plants are receiving. The reading of the sensor is sent to the server.

2.2 Circuit Diagram

Fig. 3 shows the circuit of the system.

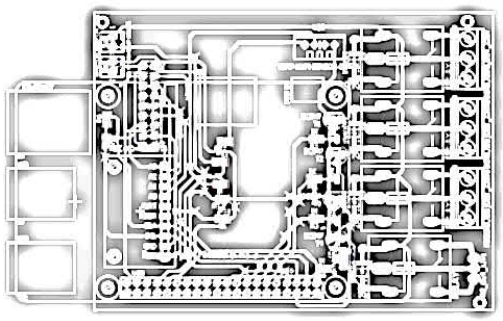


Fig.3 Circuit board of the system

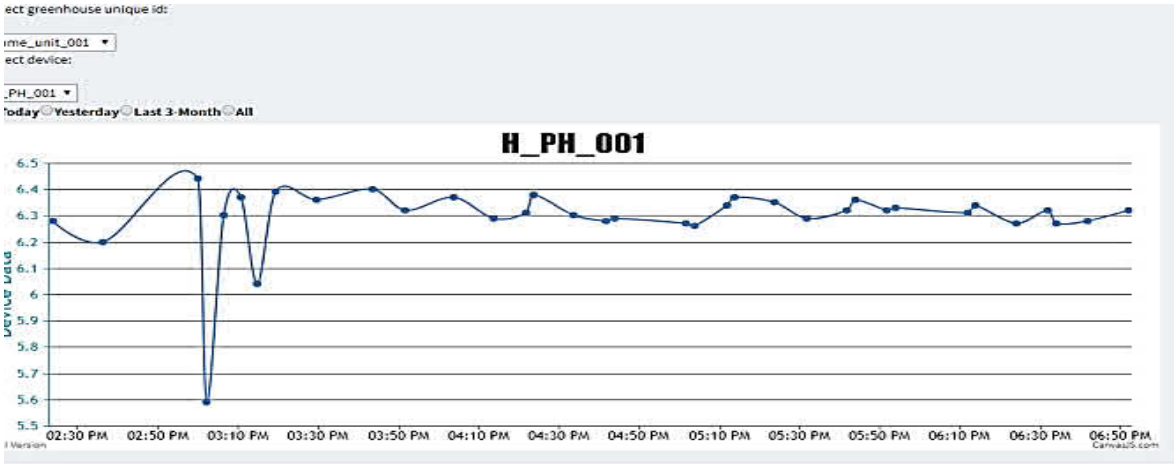
3. RESULTS AND DISCUSSION

3.1 Results

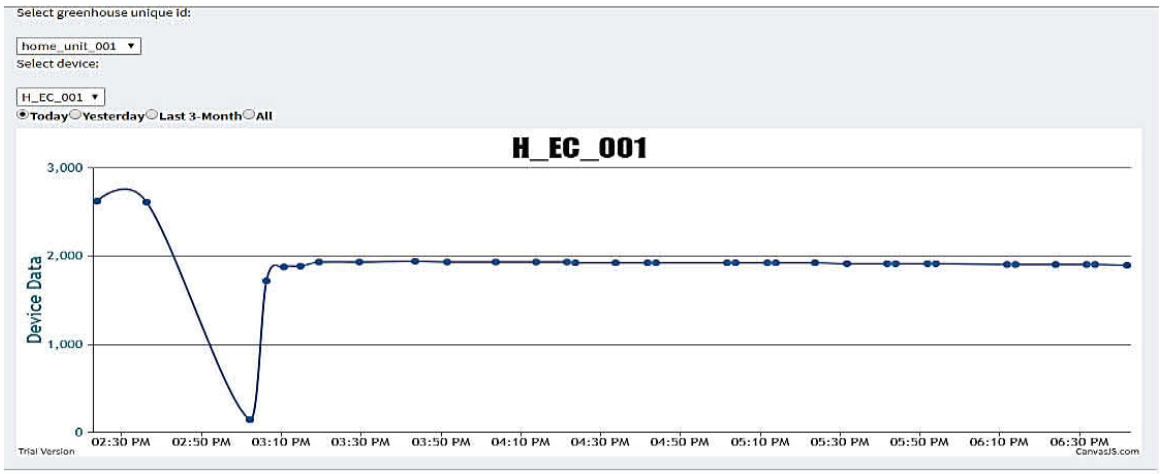
The objective of the system is to have healthy plants at the end. As the results,growth of the plants could be observed visually.

The data collected from EC sensor, pH sensor are graphed as shown in Fig. 4.

Graph (a) shows the pH values collected with pH sensor from the nutrient tank for testing. pH value was maintained in the range of 6.0-6.5. Graph (b) shows the EC readings of the tank. EC value was maintained in the range 1500 - 2500 mS/cm and maintained. The drop of the both (a) and (b) graphs is due to the addition of new water sample for the tank.



(a) pH readings



(b)EC readings

Fig. 4 Graphs of data collected from pH (a) sensor and EC sensor (b)

3.2 Discussion

According to the EC and pH values of the solution acid and Albert solutions are added to the nutrient solution with dosing pumps. Water pump worked starting with the given time interval. (30 seconds ON, 5 minutes OFF). EC and pH values cannot be measured at the same time as the interference of ions gives faulty readings. Therefore two relays were used to switch the EC and pH sensors.

4. CONCLUSION

It can be concluded that with the introduction of automated hydroponic system, essential levels of EC, pH, temperature and light intensity could be maintained precisely at indoor farming.

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Department of Electronics – Wayamba University of Sri Lanka

PRACTICAL DEMONSTRATION SYSTEM FOR RADIATION PROTECTION PRINCIPLES

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ABSTRACT

Radioactivity is a natural phenomenon and natural sources of radiation are features of the environment. Radiation and radioactive substances have many beneficial applications, ranging from power generation to uses in medicine, industry and agriculture. The radiation risks to workers and the public and to the environment that may arise from these applications have to be assessed and, if necessary, controlled. Sri Lanka Atomic Energy Board (SLAEB) is the responsible government body for facilitating the utilization of Nuclear Technology within in the different sectors all over the country and providing radiation protection services to meet regulatory requirements of the country. In Sri Lanka, nuclear technology is used in various industries. But still the nuclear science education has limited to the theories because of the high complexity and high cost of nuclear instruments. As the local governing body of the Nuclear Technology, Sri Lanka Atomic Energy Board has initiated number of projects to develop low-cost, simple educational and exhibition tools to demonstrate Nuclear Science concepts practically to students as well as general public. The goal of this project was to enhance the public awareness on Nuclear Technology and to improve the practical knowledge among undergraduate students and school children. It is expected to launch this long-term projects in collaboration with Ministry of Education and other educational authorities. As the major component of the project, a Geiger Muller counter unit has been developed to demonstrate radiation protection principles.

Keywords: Nuclear awareness, Nuclear instrumentation, Radiation protection

1. INTRODUCTION

Nuclear technology is widely used in modern industrial and research activities. In Sri Lanka, the use of nuclear science for Medical Sciences, non-destructive testing, environmental monitoring and other research areas are growing exponentially. Due to the possible hazards and risks, it is necessary to educate the technicians and general public about the practical uses of the nuclear science [1].

Regulating safety is a national responsibility. However, radiation risks may transcend national borders, and international cooperation serves to promote and enhance safety globally by exchanging experience and by improving capabilities to control hazards, to prevent accidents, to respond at emergencies and to mitigate any harmful consequence [2].

ALARA principle

ALARA is an acronym for "As Low As Reasonably Achievable". It is a concept that takes into account the dangers of radiation but also the economics and practicality of radiation protection. ALARA can be achieved by three methods:

As radiation dose is dependent on the time exposed, it makes sense to limit the time a person is exposed to radiation. This can be accomplished by practicing the handling of radioactive materials with dummy runs or by placing infrequently used facilities in areas with a potentially higher radiation exposure. Radiation loses its intensity over distance as per the inverse square law. The ALARA principle in this scenario is that radiation sources should be kept distant from the public and staff, but not so distant that it becomes too difficult to reach them. Radiation is attenuated by shielding. By placing shielding in the path of radiation, the dose on the distant side of the shield will be significantly reduced (depending on the radiation quality and the shield thickness) [3].

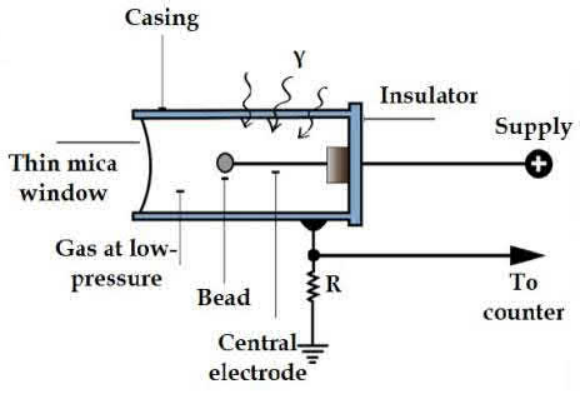

Fig. 1 Geiger – Muller Tube

Geiger-Müller (GM) Counter is a basic detector used to investigate radiation. It is generally comprised of two major components; a GM probe and a Scalar. The scalar unit is consisted of a high-voltage (HV) driver, a pre-amplifier, a discriminator and a counter.

A GM tube/probe can detect ions produced when an ionizing radiation (α, β, γ or X-ray) interact with the gas at low pressure. Each ionizing burst produces a voltage pulse across the grounding resistor R (Fig. 1). Higher sensitivity to the low radiation doses is a key advantage of the GM detectors [4, 5, 6].

2. EXPERIMENTAL

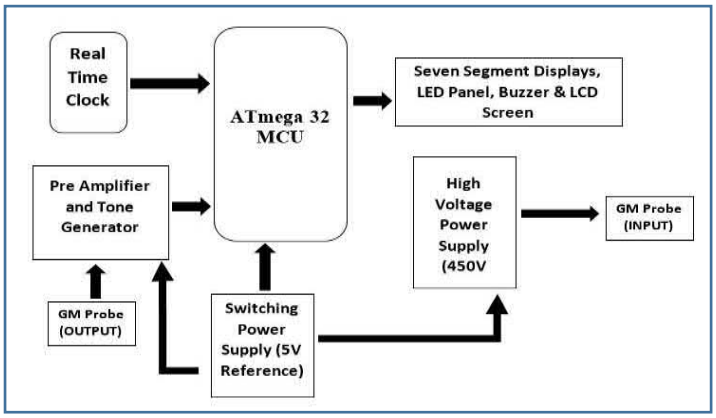

Fig. 2 Block diagram of the system

This project was basically carried with a control unit, high voltage power supply unit, real time clock timer unit, pre – amplifier and tine generator unit, switching power supply unit and ZP1490 - Geiger Muller tube as the pulse detection unit as shown in Fig. 2.

The control unit is the brain of the system. It controls and coordinates the system functions. The control unit is consisted of a micro-controller, an LCD module, seven segment displays, LED panel and an RTC timer module. AT mega 32 microcontroller plays a major role in the proposed project. It is the unit that controls and processes the inputs and outputs. Coding part was done with AVR programming.

The HV unit is a CMOS 555 timer driven, low power step up regulator. The HV unit is capable of producing low power voltage up to around 1000 V. But in this project the HV is fixed to 575 V because it is the recommended supply voltage of the ZP4190 GM tube.

In the GM scalar unit, the pulse generated at the GM probe is buffered using a MOSFET and then filtered to omit any unnecessary DC offset. Then, it is sent to the MCU for counting. Later, this signal is stretched using a Schmitt triggered inverters before transferring it to the

tone generator. As a traditional feature, GM counters are often found with an ionic alarm sound that is used to indicate an identification of radiation. In the device, the same alarm sound has been implemented by modulating the stretched pulse with a 2 kHz carrier signal.

The device is operated on DC power. Board contains switching power supply that creates stable voltage and current levels necessary for powering each part of the board. Power supply section contains specialized MC34063 power regulator which creates 5 V power supply, thus making the board capable of supporting 5 V microcontrollers.

3. RESULTS AND DISCUSSION

The device was tested using a low-energy gamma and beta sources. This is essential because the use of high-dose radiation sources is not safer in educational environments and exhibition environments. If they are exposed to high energy radiation sources, it will be a high health risk. Thus the system was designed to be sensitive for very small radiation sources such as beach sand. Practical tests were done using a Monazite sample (low energy dose). The following chart (Fig. 3) shows the count rate as counts per minute at the respective trial, for 20 trials [7].

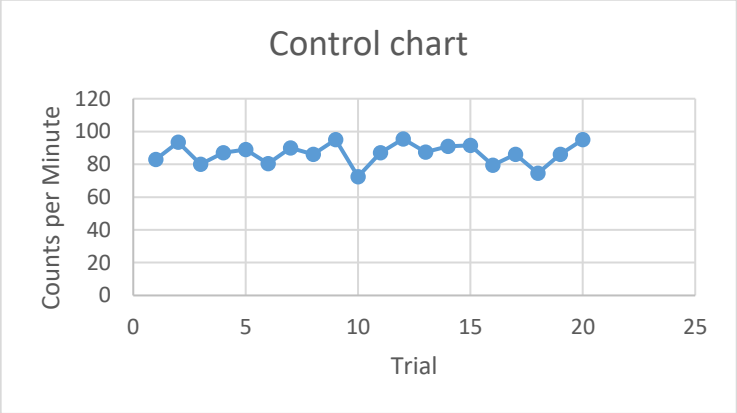

Fig. 3 Control chart for 20 trial data

To make sure the device was operating successfully, there is a statistical test called Chi-square (χ^2) test. The probability of χ^2 should lie along the P=0.5 line of the graph in Fig. 4. This proves that the device is operating perfectly. If not, it should show there are some errors in the system.

- Procedure of evaluating χ^2 value

Chi-squared $\chi^2 = \frac{\sum \Delta_i^2}{\bar{n}}$ ---------- (Eq.3.1)

Where; $\bar{n}$ – Mean value of the data set (Average value)

$$\Delta_i^2 - (n_i - \bar{n})^2$$

n_i – Number of counts in the i^{th} trial and i - 1, 2, 3, …, 20 [8]

According to the results, the $\chi 2$ of the test is 18.96 and it lies on very closer to the P=0.5 line as shown in the Fig. 4. The degree of freedom of this experiment is 19 (20-1).

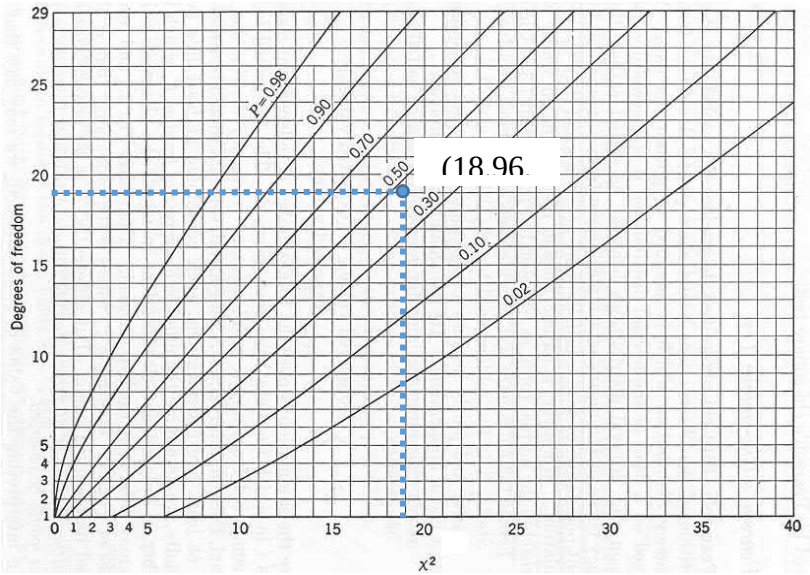

Fig. 4 Obtained Chi-square value after the test, plotted on the Chi-square graph

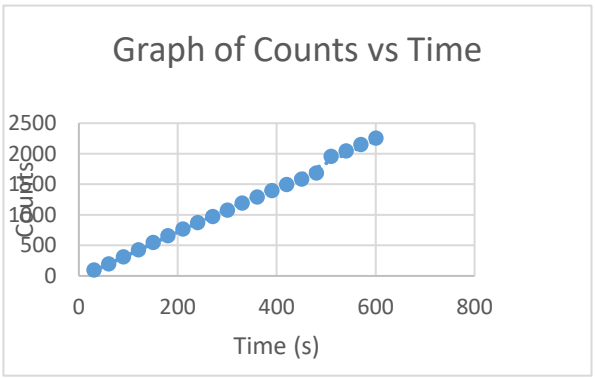

Fig. 5 Graph of counts vs time

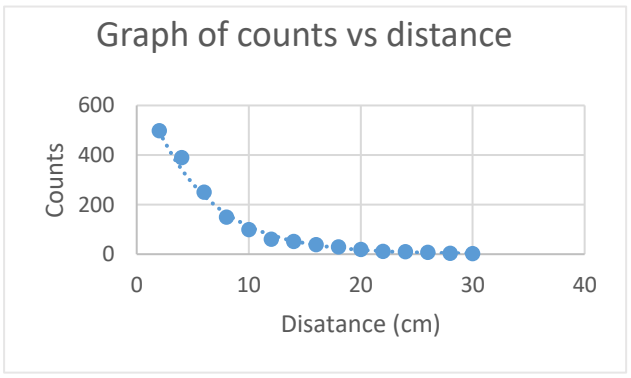

Fig. 6 Graph of counts vs distance

The Fig. 5 shows the relationship of pulses detected (counts) and the time, when increasing the exposure time by 30 s intervals (distance between the detector and the source fixed) and the Fig. 6 shows how the number of pulses detected varies when the distance (in cm) between the source and the detector varies (time kept as a constant at 30 s)

4. CONCLUSION

As an advance research educational and industrial institute, Sri Lanka Atomic Energy Board plays a key role in public scientific context. Since most of our Sri Lankan people have no proper idea and knowledge about nuclear science and radiation, it is necessary to educate people about nuclear sciences and also about the institute's involvement to the growth of economy by using nuclear sciences. These objectives can be easily fulfilled by this kind of research work. As an advance technology, Nuclear Science has numerous benefits that can be used for the economic and social development of the country. But it is not an easy task to handle these with the unavoidable high risk of the radiation. So it is very much important to enhance the awareness on radiation and nuclear science. The device was fabricated at an affordable cost (less than 20,000 LKR) which is bearable by educational institutes and government. It is fully automated and has simple operation and it can be used for several demonstrations. Finally, this project will be beneficial for the local educational sector, military officers, radiation protection officers in hospitals and general public.

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Department of Electronics – Wayamba University of Sri Lanka

HIGH DIRECTIVITY HEXAGONAL FRACTAL ANTENNA WITH MODIFIED GROUND PLANE FOR WLAN APPLICATIONS

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ABSTRACT

A high directivity hexagonal fractal antenna with modified ground plane is presented in this paper. Finite Element Method based simulation is carried out to study the resonant behaviour, directivity, gain and radiation pattern of this antenna. The antenna is fabricated on a FR4 substrate. It has a maximum directivity of 11.38dB along broadside direction between 5.0-6.24GHz with 22% bandwidth. The proposed fractal antenna can be used for WLAN applications. It makes a single element suitable for a compact, low profile fractal antenna array to replace the bulky parabolic antennas used in fixed satellite communications.

Keywords: Fractal antenna, miniature, WLAN, 5G, Satellite communication, High directivity, Fractal array

1. INTRODUCTION

Antenna size and performance have become decisive factors in the exponential growth of wireless communication systems. Physical dimensions and geometry of the antenna influence largely on its radiation performance. Thus, immense attention is put in optimizing the design to achieve highest performance. B. Mandelbrot first theorized fractal geometry to characterize geometries that are not defined in standard Euclidean geometry[1]. Fractal antenna is a blooming field of interest in antenna engineering which is based on fractals, geometric shapes that repeat itself over a variety of scale sizes, so the shape looks the same viewed at different scales. Fractal antennas have outstripped Microstrip Patch Antennas (MPAs) for number of reasons such as multi-frequency operability, high gain/directivity, improved bandwidth and miniature physical dimensions [2-4]. A compact hexagonal fractal geometry with a highly directive radiation pattern is presented in this paper. Due to fabrication constraints only two

iterations are considered. Variation of its characteristics from one iteration to the other are also presented. Finally, a comparison of characteristics is made between the rectangular Microstrip patch antenna and the second iteration of the designed antenna, both having the same patch area.

2. EXPERIMENTAL

2.1. Overview

A regular hexagonal shape was taken as the generator. Two fractal iterations were done on the generator patch. The ground plane(GP) was modified to improve antenna properties as shown later in the paper. A comparison of results was then done. Finally, the proposed antenna was compared with existing research work for a better understanding.

2.2. Design Specifications

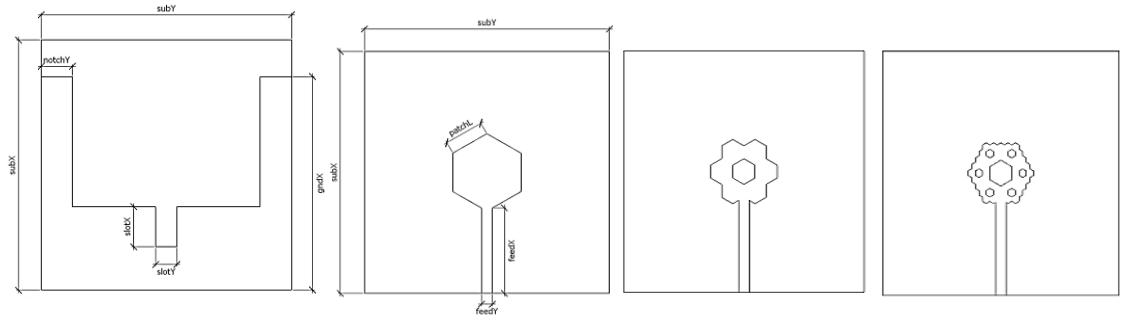
The presented antenna is mounted on a dielectric layer over a ground plane. FR4 Epoxy substrate having 1.6mm thickness, a relative permittivity of 4.4 and a Dielectric Loss Tangent (δ) of 0.02 was chosen. The patch was fed by a 50Ω Microstrip line. The antenna was modelled using Ansoft High Frequency Structure Simulator (HFSS) 13.0 Finite Element Method (FEM) [5] based simulation tool. Driven Terminal solution type was used along with a lumped port at the edge of the Microstrip for excitation.A Discrete Frequency Sweep with Linear Steps of 100MHz between 1 through 10GHz was used for observation.

The return loss-S_{11} Plot, Far field radiation pattern, Gain/Directivity Sweep along broadside direction, 2D radiation pattern at Phi=0º and Phi=90º and Surface Current Density plot of the Patch were generated for each design using HFSS 13.0. Bandwidth for resonance bands, with a higher directivity was calculated.

2.3. Designing the patch

The substrate size was set to 50mm x 52mm. The research objective is to design a compact patch to maximize the directivity utilizing minimum area. Side-length of the generator hexagon was set to 8mm. First a full Ground Plane with no slots was designed and simulated. Then different slots and extensions were added to the Ground Plane to improve the performance. Its results are summarized in Fig. 3 and Fig.4. In order to obtain the 1st Iterated Design, a smaller hexagon, 1/3 of the size of the generator was removed from the centre. Then six more similar hexagonal shapes slots were removed from the generator such that the centre of each hexagon lies at the corners of the generator hexagon. The same procedure was again executed to the

new hexagonal shapes formed after iteration 1. The smaller hexagons, each of a side length 1/9th of that of the generator were removed from the 1st iterated structure to obtain the 2nd iterated design.



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

Fig. 1 (a) Ground Plane (b) Generator Patch (c) 1st Iteration (d) 2nd Iteration

The dimensions of the three candidate structures are summarized in Table 1.

Table 1 Dimensions of the Fractal Antenna

Parameter	subY	subX	notchY	gndX	slotY	slotX	patchL	feedX	feedY
Dimensions (mm)	50	50	6.25	42.67	4.2	8	8	19	2.2

3. RESULTS AND DISCUSSION

3.1. Generator Patch

(a) (b) (c)

Fig. 2 (a), (b) Fabricated antenna and a two rupee coin (c) Rectangular Microstrip Patch antenna (MPA) of same area

The Generator patch with the full ground plane showed very low resonance characteristics around 6GHz. Thus the modified ground plane was considered for the next steps. The gain and directivity also improved dramatically with the modification of the ground plane.

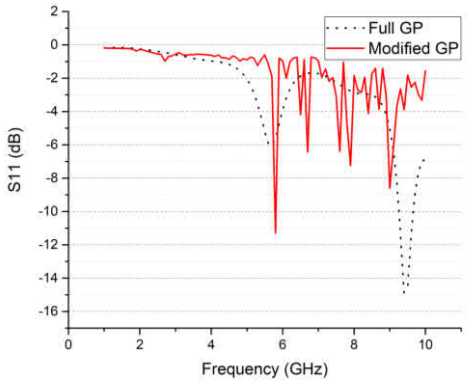


Fig. 3 S_{11} plot for the design given in Fig 3.2(a) Full GP, (d) Modified GP.

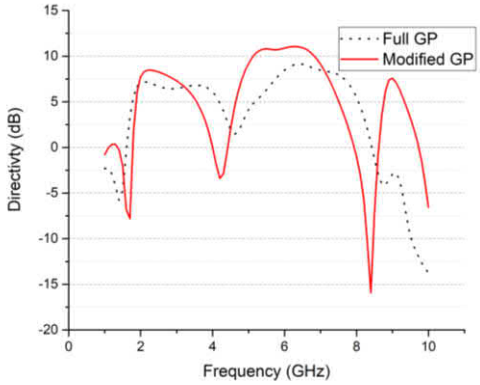


Fig. 4 10.4dB Directivity at 6.24GHz for the generator patch with modified GP.

3.2. Iteration 1

At the iteration 1, the patch shows very good resonance (S_{11}<-25dB) around 5.3GHz with a peak directivity of 10.6dB.

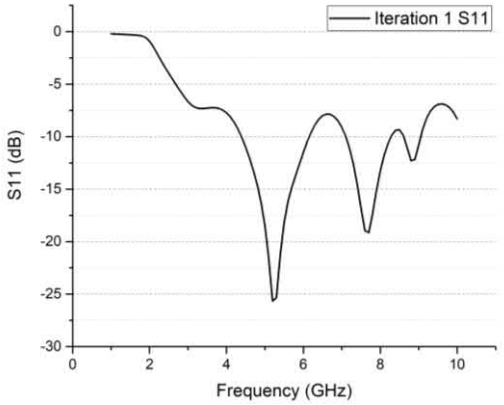


Fig. 5 Reflection Coefficient plot for the Iteration 1.

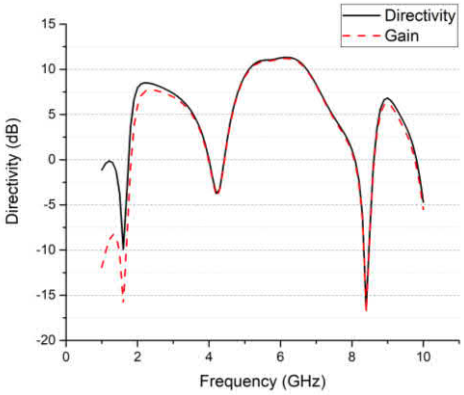


Fig. 6 10.6dB directivity at 5.3GHz resonance for iteration 1.

3.3 Iteration 2

At the 2nd iteration, the patch exhibits a resonance band between 4.35-6.24GHz. But the directivity variation was not uniform over the entire resonant band. A high directivity of >10dB was seen in the region of 5.15GHz through 6.75GHz.

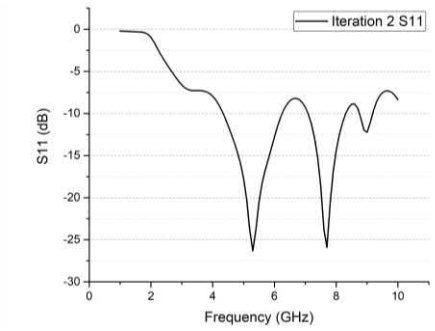


Fig. 7 S_{11} Plot for the Iteration 2.

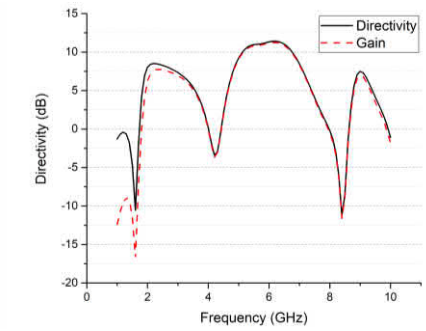


Fig. 8 Peak Directivity (11.388dB) at 6.24GHz for iteration 2.

Thus, the region 5.0GHz-6.24GHz was selected as the optimum high directive resonant band.

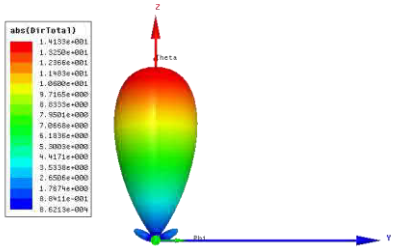


Fig. 9 Absolute 3D Directivity plot for resonant frequency.

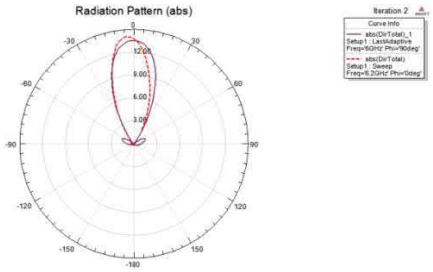


Fig. 10 2D radiation pattern at Phi=0º and Phi=90º.

The radiation pattern shows broadside nature at this higher order mode. It radiates directionally on θ= 0º, Φ=180º. The VSWR is well below 1:2 over the range 5.0GHz-6.24GHz.

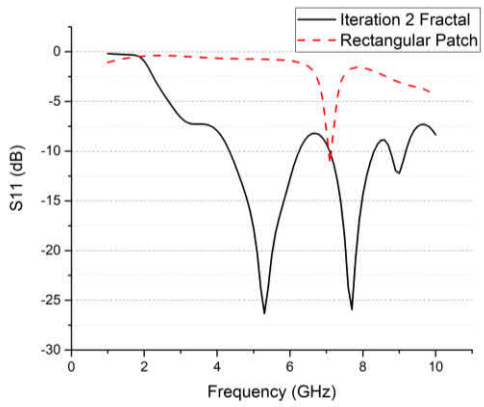


Fig. 11 Rectangular MPA shows poor resonance around 7.1GHz

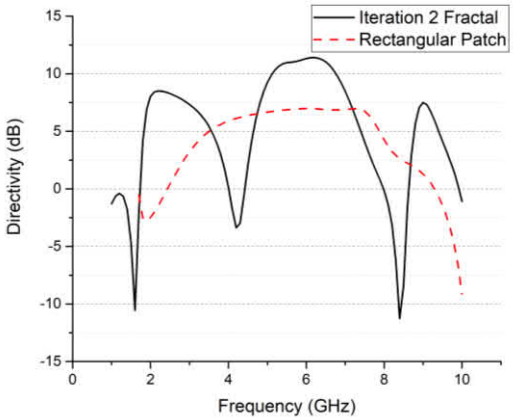


Fig. 12 Directivity comparison (MPA and Hexagonal Fractal).

Table 2 shows a summary of results for each design. It is clearly seen that using fractal geometry has been successful in miniaturizing the antenna, while maximizing the directivity.

Table 2 Summary of results

Design	Frequency Range (GHz)	Peak Directivity (dB)	Gain (dB)	Radiation Efficiency
Rectangular Patch	7.1GHz	6.9	5.2	75%
Generator (Full GP)	9.26-9.60	-7.8	-10.2	-
Generator (Modified GP)	4.5-6.24	10.6	10.5	99%
Iteration 1	4.8-6.1	10.6	10.6	99%
Iteration 2	5.0-6.24	11.38	11.25	99%

4. CONCLUSION

It is evident that fractal geometry increases the electrical length of the patch, shifting the resonant frequency down, allowing the physical dimensions to be made smaller. The maximum directivity obtained is 11.38dB, with a maximum antenna dimension of 50x50x1.6mm^3. The antenna can be used in a 22% bandwidth from 5.0-6.24GHz. Radiation efficiency, Gain and bandwidth are significantly higher in the fractal antenna than the rectangular MPA. Contemporary research publications in fractal antennas for 4-6GHz band are scarce. The proposed 2nd iteration Hexagonal Fractal Antenna with the modified Ground Plane is a promising replacement to horn or parabolic antenna if it is used in an array. This antenna can be used for 5GHz WLAN, 5G Band n79 (4.4-5.0GHz), and Fixed Satellite (Earth to Space) communications over 5.925-6.7GHz.

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WIDE BAND PRINTED CIRCUIT BOARD (PCB) BASED LOG PERIODIC ANTENNA

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ABSTRACT

The log periodic antenna is able to provide directivity and gain while being able to operate over a wide bandwidth. The log periodic antenna is used in a number of applications where a wide bandwidth is required along with directivity and a modest level of gain. This research carries out the step by step design procedure and simulated performance investigation of a printed log periodic dipole antenna(LPDA) that is able to operate over the frequency range of 1800 MHz.The advantage of this antenna is compact and easy to integrate with planar circuits which is suitable for applications that need wide bandwidth and high gain antenna. The dimension of designed antenna has initially been calculated by considering the upper frequency as 1885 MHz and the lower frequency as 1805 MHz then modeled using a HFSS-13 electromagnetic simulation to optimize the effect of dielectric properties of substrate on the width and length of dipole elements. To validate the designed antenna, it is fabricated and measured to carry out its S_{11} and radiation patterns. The designed antenna exhibit a total gain of 7.9dB and a wide bandwidth.

Keywords : Printed log periodic dipole antenna, S parameters, Bandwidth, Gain

1. INTRODUCTION

Log periodic antenna is an array of driven dipole elements designed to work over a wide bandwidth with an acceptable level of directivity. Electrical properties of a log- periodic antenna such as input impedance, pattern, directivity, side lobe level, beam width variations are periodic with the logarithm of the frequency. The alternating elements of this type of antenna are driven with 180◦ phase shift from each other. Planar implementation of Log-Periodic antennas is a good choice to enhance the bandwidth of the planar antennas. At a particular frequency of operation, the dipole elements having lengths near to quarter the

wavelength radiate and all the other dipole elements act passive. The active region of the antenna shifts according to the frequency shift. Log periodic antennas are useful in applications such as ultra-high frequency terrestrial television, high frequency communications, and electromagnetic coupling measurements. This paper illustrated the step by step design procedure of a LPDA design to operate in the frequency range of 1800 MHz.The obtain initial dimensions were optimized in order to obtained a high gain and it was investigate by a electromagnetic simulator. The antenna is the fabricated and measured to validate the design.

2. EXPERIMENTAL

2.1 Log Periodic Antenna Design Procedure

The step-by-step design procedure of the LPDA in free space condition is initially started by finding τ and σ from the intersection point between the straight line σ = 0.243τ − 0.05 called optimum σ and the desired gain . After set the values for τ and σ , the value for the cotangent of the half apex angle α can be determined using the bellow equation; where α ,τ and σ Half apex angle, Design constant (scaling constant) and Spacing constant respectively. [3,4]

$$tan\ \alpha = \frac{1-\tau}{4\sigma} \quad [1]$$

$$B_S = B \times B_{ar}$$

Then, the number of required dipole elements N is calculated in,

$$N = 1 + \frac{log\ B_S}{log\frac{1}{\tau}} \quad [2]$$

The longest dipole element can be determined by substituting the lower frequency (f_L) by using the equation [3]. The spacing between the longest dipole element and the adjacent dipole elements can be calculated from the equation [4]. The lengths and spacings of the remaining elements are respectively calculated by using equation [5] and [6].

$$l_1 = \frac{C}{2f_L} \quad [3]$$

$$d_{12} = \frac{(l_1 - l_2)}{2}\ cot\ \alpha \quad [4]$$

$$l_{n+1} = \tau\ l_n \quad [5]$$

$$d_{n+1} = \tau\ d_n \quad [6]$$

Where C, f_L, d_{12} is Velocity of the space, Lowest frequency and Spacing between the first and second elements respectively.

The width of the dipoles can be calculated by considering the matching impedance as shown in Equation [7]. By using the Equation [8] the successive widths can be calculated.

$$Z_0 = 120 \times [ln\frac{L_n}{a} - 2.25] \quad [7]$$

$$W_n = \Pi \times a \quad [8]$$

$$W_n = \tau\, W_{n+1} \quad [9]$$

Here Z_0, L_n, a *and* W_n are respectively Matching impedance, half length of the largest dipole radius of the dipole and width of the dipole.In this work, the LPDA is designed to operate cover the frequency of 1800MHz with a high gain. Thus, the parameters of antenna as aforementioned in the step by-step design procedure are σ = 0.16, τ = 0.93, Bar = 1.446 $\times 10^6$ Hz, B_s = 1.5096$\times 10^6$ Hz, N = 7. The calculated length and spacing of dipole elements obtained from above equations are the initial dimension to be modeled in the simulation to optimize and investigate the antenna performance.

2.2 Simulation set up

The dimension of LPDA was initially designed in the case of free space conditions, but its dimensions might slightly deviate when operating on PCB due to the effect of the dielectric lines. It is quite difficult to determine the conductor width of both feed line and dipole elements so that the characteristic impedance is equal to 50Ω.Thus, in order to validate the designed antenna and investigate the antenna performance a sample structure was carried out by means of the simulation.

2.3 Fabricated antenna design

In this project a low-cost FR-4 substrate whose dielectric constant and loss tangent are respectively 1.4 and 0.002 is used. The above simulated antenna was fabricated using the normal PCB making method as shown in figure 1. Spectrum Analyzer was used to validate whether it was tuned to correct frequency. As shown in Figure 02 within 1700-1900 MHz frequency the peaks can be obtain.

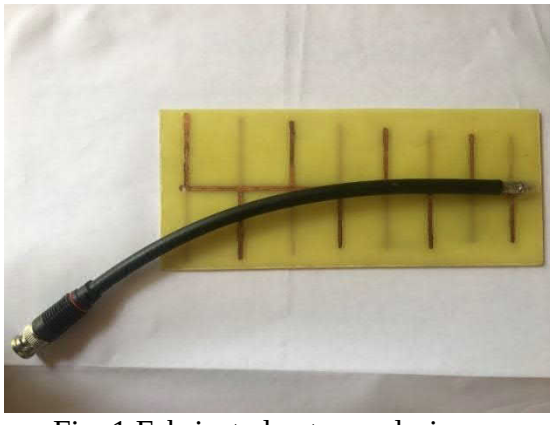

Fig. 1 Fabricated antenna design

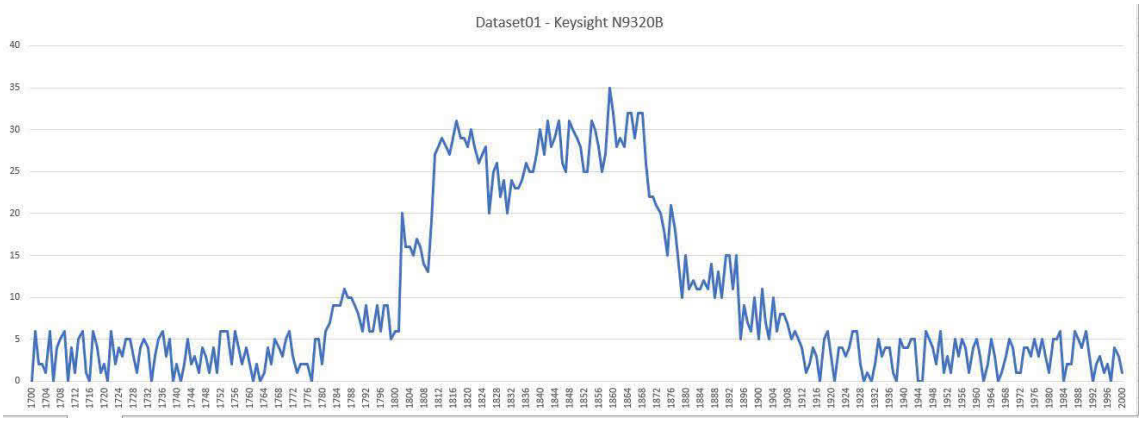

Fig. 2 Data obtained from the spectrum analyzer

3. RESULTS AND DISCUSSION

3.1 Simulation Results

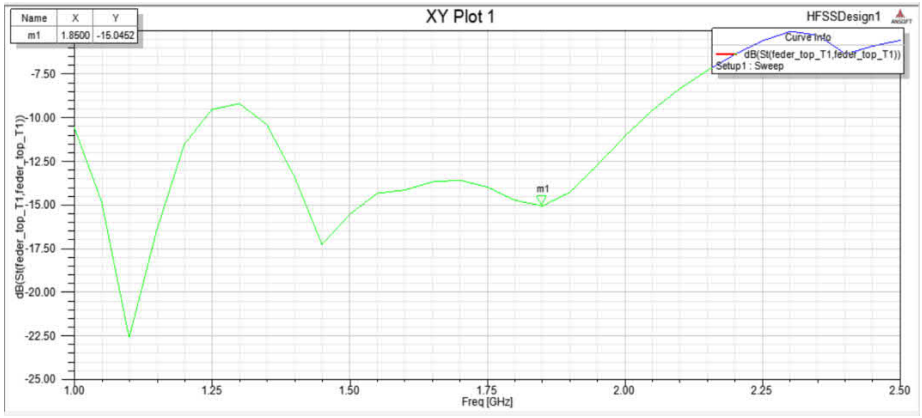

Fig. 3 Frequency vs. VSWR curve for the designed antenna

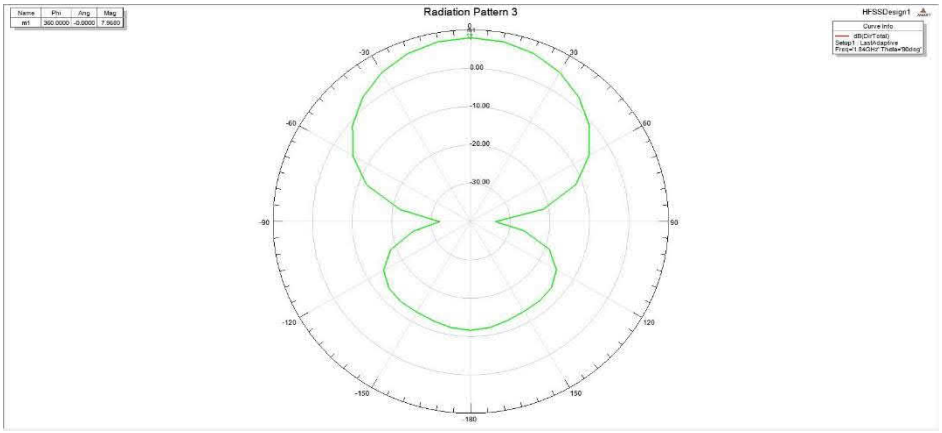

Fig. 4 Radiation patterns for directional gain

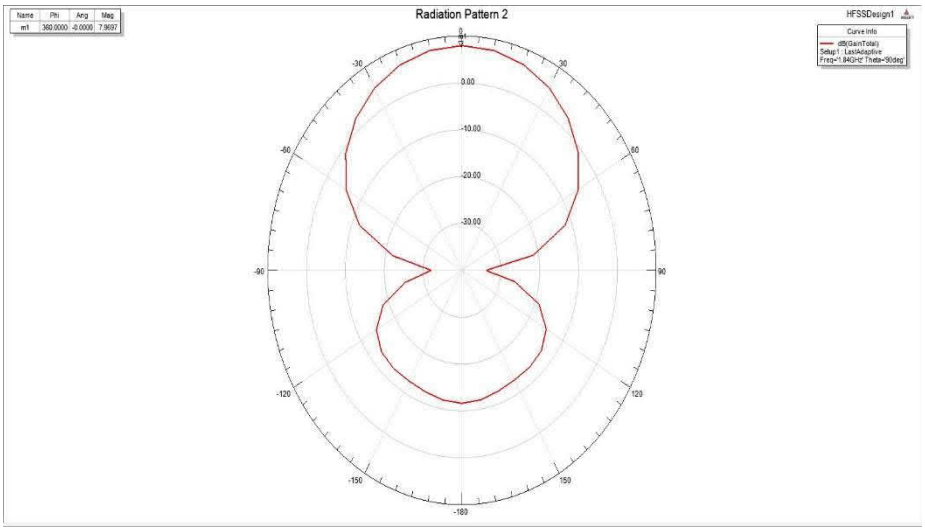

Fig. 5 Radiation patterns for total gain

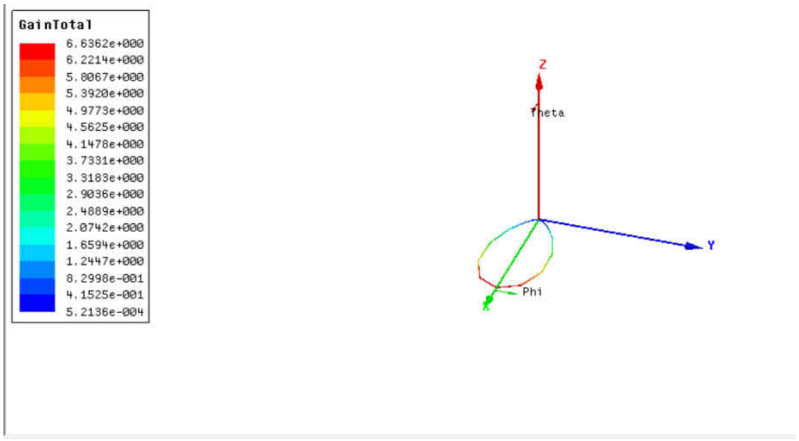

Fig. 6 3D polar plot for total gain

The initial dimensions were calculated in free space conditions, then HFSS-13 simulator was used to optimize the gain to obtain 7.9 dB as shown in figure 5 so the dimensions of some dipoles were deviated from its calculated value. Figure 4 and figure 6 illustrate the directional gain and the 3D polar plot for the designed antenna. In this design the LPDA antenna was fabricated using FR-4 substrate. FR4 epoxy glass substrates are the material of choice for most PCB applications. The material is very low cost and has excellent mechanical properties, making it ideal for a wide range of electronic component applications.

4. CONCLUSION

The concept of Log-Periodic Dipole Array antenna has been studied and have seen that for wideband application log periodic antennas are used. Based on given specifications and for

assumed values of Scale Factor (τ) and spacing factor (σ) Log Periodic Dipole Array antenna has been designed. In this report a log-periodic dipole antenna covering a frequency range of 1800 MHz with required high gain and wide bandwidth is designed and then simulated by HFSS simulator. In the HFSS, the antenna was drawn using the calculated parameters. The main goal was to improve the performance of the existing antenna and theoretically the aim was achieved by designing a high gain, wide bandwidth log periodic dipole antenna (LPDA). For this project FR-4 pcb material was used which has a high dielectric constant of 1.4.

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DEVELOPMENT OF A LOW COST HOME AUTOMATION SYSTEM USING ARM CORTEX M4

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ABSTRACT

This paper describes development of a low-cost home automation system that consists of an ARM Cortex M4 microcontroller. In a home automation system appliances and devices are connected into a single network such that users can control them seamlessly. They provide security, energy efficiency, power saving, convenience and comfort to the user. The proposed system has features of controlling home appliances and monitoring security features from anywhere through the Internet.

Keywords: Home automation, ARM cortex m4, Wi-Fi, ESP 8266

1. INTRODUCTION

The home automation systems are used for controlling electrical and electronic appliances with little or no manual control. Home automation systems provide various advantages such as energy efficiency, power saving, convenience, and comfort. Investment on home automation is worth for users with busy life. Most of existing home automation systems use wired communication systems and they have limitations [1]. Recent developments in wireless technology makes home automation more user friendly [2]. Even though wireless technology is rapidly expanding all over the world, most people in low income countries like Sri Lanka consider home automation is unaffordable mainly due to the high cost for such systems. In addition to higher cost, most home automation systems in the market have limitations like expanding or adding new features [4].

In this paper we describe development of a low-cost home automation systems that provide many features similar to the expensive similar systems in the market. The system uses an

ARM Cortex M4 microcontroller as the main processing unit and a Wi-Fi module. The system is capable of controlling and monitoring all appliances connected to the system through the Internet from anywhere. It has flexibility of expanding easily by adding more appliances to the system. A prototype system has been developed to demonstrate all these features.

The paper is organized as follows. The section 2 describes the methodology of developing the prototype system with the system architecture. Results and discussion is provided in the section 3, and summarize the paper in section 4.

2. EXPERIMENTAL

The system consists of two main components - an ARM Cortex M4 microcontroller and an ESP8266 Wi-fi module. The microcontroller controls the electrical appliances connected to the system, and the Wi-fi module acts as the interface to connect the microcontroller to the Internet. The communication between the microcontroller and the wifi module is implemented through UART protocol. A web interface has developed to monitor and control electric appliances through internet.

As the figure 1 shows that microcontroller is the one of the main controlling unit of this system. The TM4C123GH6PM microcontroller combines complex integration and high performance with the following features. 32-bit ARM Corte M4F architecture optimized for small-footprint embedded applications, 80 MHz operation, 100 DMIPS performance, and outstanding processing performance combined with fast interrupt handling. We used Keil uVision 5 IDE to program the microcontroller. Sensors, appliances and Wi-Fi module are interfaced to the microcontroller. Through the web interface controlling commands can be given to the microcontroller, and it controls electric appliances accordingly. Further, the microcontroller reads the status of electric appliances and recorded to the web interface through the wi-fi module.

Using sensors microcontroller get input to check with threshold values. While gas sensor and rain water sensor give digital output and temperature and humidity sensor give analogue output. LDR circuit and IR sensor module also give their corresponding output.to demonstrate prototype only use above sensors. Beyond that it can connect many more hospitality sensors. All doors, main gate, lights, fan, water pump, clothes hamper, buzzer, switch and all appliances interface to the microcontroller. All output activities of microcontroller are done by appliances in this prototype. ESP 8266 Wi-Fi module used to

connect with web interface. It was programmed through the Arduino IDE. A USB to TTL adapter was hooked up to the module, and talk to it using a serial port terminal application.

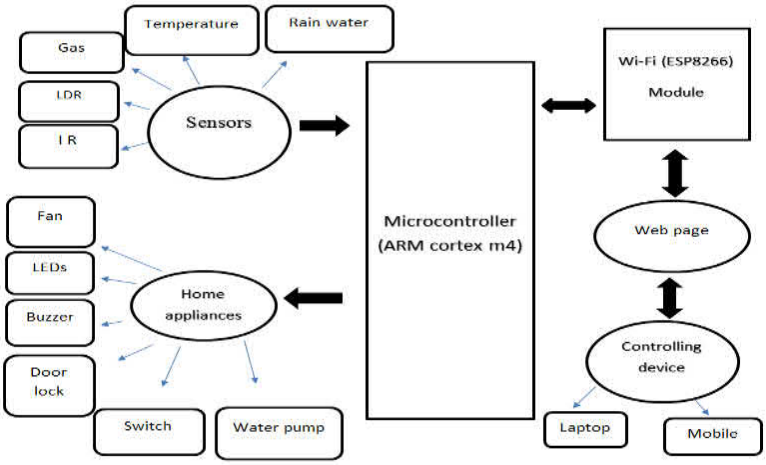

Fig. 1 System architecture

There are main 2 web interfaces. Main control interface which fullfill with all control tables such as door, light, and sensor values. Home owner control appliance's status using this control panel. Using sensor values check and then control require appliances. This webpage contain three tables, there are light, door and sensors with other control part. Add and remove interface used to add or remove any component as owner's preference. This is one of significance in this system. It is user friendly page for any kind of client. In this page two type of table for add component and remove component. In this system can add or remove door, light or sensors only.

A model house is built for the home automation system and is as shown in the figure 2.

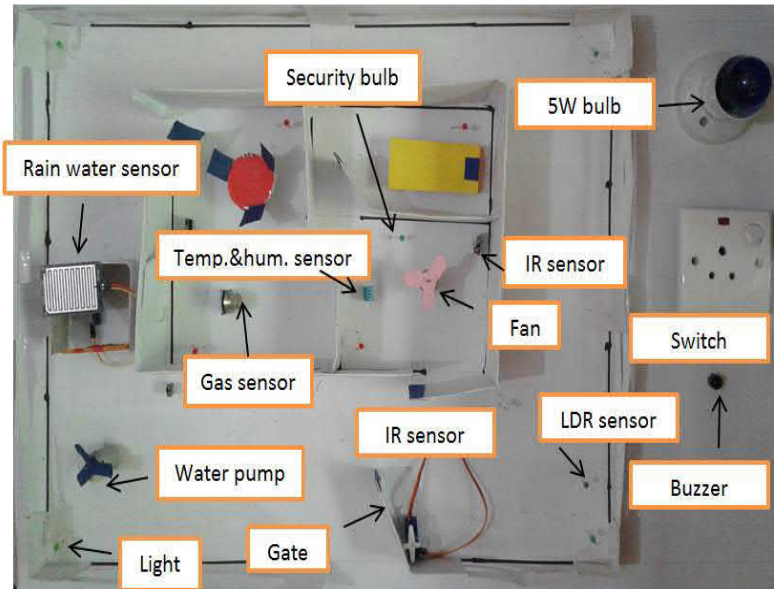

Fig. 2 Experimental setup of the system

Light in the garden will turn on automatically when light sensor detects the darkness. A cooler/Fan will turn on when the room temperature exceeds the set threshold and in turn reduces the room temperature. The gas sensor is placed in the kitchen to detect any gas leakage, if any leakage is detected the buzzer in the home is raised. Relay is used to switch the electrical appliances like light, fan etc.

3. RESULTS AND DISCUSSION

Figure 3 shows a picture of the prototype of the low-cost home automation system. This system has capability to read ten input sensors and can control twenty output appliances as shown below. Here opto-couplers used for the security reason for both side.

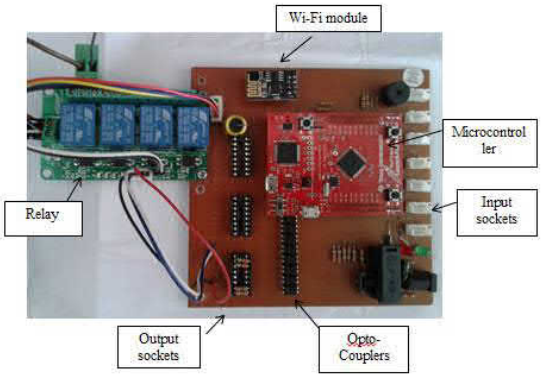

Fig. 3 Picture of the low cost home automation system

Created web interfaces show in below figures. Support with free hosting company was developed this group of webpages. After the successful connection to the server, the data of sensor are sent to the web server for monitoring of the system. Web interface that control entire system shows in figure 04.

Status	Turn On	Turn Off	Lamp Name	Description
ON	ON	OFF	Living Room	Near the book shelf
ON	ON	OFF	Dining Room	Near the Table
ON	ON	OFF	Bed Room	Near the bed
ON	ON	OFF	Kitchen	Near the kitchen door
ON	ON	OFF	5W Bulb	5W Bulb
ON	ON	OFF	Garden Lights	Garden Lights
ON	ON	OFF	Fan	Fan in living room
ON	ON	OFF	Water Pump	Water Pump
ON	ON	OFF	Buzzer	Buzzer

Fig. 4 Web interface that control entire system

It has main three columns named component name, its status and brief description of that component. In status column has two switches for ON or OFF the component and display current status of the component.

The web server gives the information about the sensors reading in different places of the house and security state in the house. It also gives the status of the various sensors reading as 1 and 0. As shown in figure 5 sensor reading display also has three columns with sensor name, description and sensor status.

Status	Sensor name	Description
0	Temperature Sensor	Temperature in home
0	Gas Sensor	Gas leakage
0	Wet Sensor	It is raining
0	Security sensor home front	Security sensor home front
0	Security Sensor home inside	Security Sensor home inside
0	Door Lock	Door Lock
0	LDR Circuit	LDR Circuit

Fig. 5 Sensor readings display

Client can add or remove component of the system as his preference. As in figure 6 control panel to add and remove item it has main four text box to fill with name component type,component name, discription and action ADD or DELETE.There is a restrict for component it can remove or add only door, light or sensor.

The system can be expanded to include various other options which include home security feature like capturing the photo of a person moving around the house and storing it onto the webpage. This will reduce the data storage than using the CCTV camera which will record all the time and stores it. This kind of a system with respective changes can be implemented in the hospitals for disable people. As the bill of materials the total cost around Rs.10000.00. According to the existing system with this feature it is extremely low cost system as name implies “Low cost Home Automation system”.

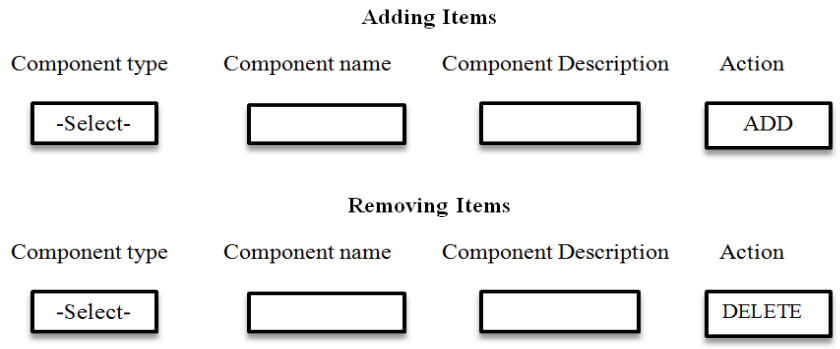

Fig. 6 Control panel to add and remove item

The system also such a smart power saving system is suggested that can save power and increase comfort level of the user with minimum expenditure. Using triac instead relay that can be provided low power consume and given the more efficiency. Using IC 7221 can expand the functionality by multiplexing and in future. This system generally does not have alert facilities against occurrence of abnormal conditions.

4. CONCLUSION

We described the development of a low-cost home automation system using ARM Cortex M4 microcontroller that allows use to control and monitor electric appliances through the Internet from anywhere. It has flexibility of adding additional appliances easily enabling scalability. This kind of system is affordable for many people and it will provide features to save energy, keep houses safe, and make life easy.

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Department of Electronics – Wayamba University of Sri Lanka

SYNTHESIS OF A NANOCOMPOSITE BASED ON ACTIVATED CARBON AND Fe_2O_3 AND ITS SUPERCAPACITIVE PROPERTIES

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ABSTRACT

Nanocomposites are in recent research interests due to their number of applications. In this research, Activated Carbon (AC) and Fe_2O_3 based nanocomposite was synthesized and it was applied in a supercapacitor (SC) with the intention to increase capacitance of the supercapacitor. The supercapacitor based on composite of AC: Fe_2O_3 ratio 3:1 showed an increased area in Cyclic Voltammetry (CV) curves, which resulted in specific capacitance increased than that of Activated Carbon-based supercapacitors. The discharge time for AC based supercapacitor and the composite based capacitor was 220 s and the discharging capacitance obtained by the discharge curves showed a higher capacitance of 0.337 F for the supercapacitor based on the nanocomposite of AC: Fe_2O_3 ratio 3:1.

Keywords: Super capacitors, Activated carbon, Fe_2O_3

1. INTRODUCTION

Storage of electricity, is a very critical area in the concept of rechargeable energy. Components and devices like batteries and capacitors are the solutions available for the energy storage requirements. Batteries require a lot of time to charge. But, capacitors can charge in an instant, unlike the batteries but, hold a very little amount of power. Supercapacitors break the gap between conventional capacitors and batteries. They can store and release a large amount of power very quickly [1-3].

Iron oxides have been considered as one of the most promising electrode materials for SCs, due to their suitable electrochemical performance, natural abundance and environmental compatibility. Activated Carbon has an incredibly large surface area per unit volume, and a network of submicroscopic pores where adsorption takes place [4-6].

This research work was carried out to observe the supercapacitor properties of a nanocomposite based on AC and Fe_2O_3. AC and Fe_2O_3 are both porous materials which comprise of larger surface areas [4,5]. Molecular level interaction between these two materials is expected to show much interesting properties.

2. EXPERIMENTAL

2.1 Synthesis

Fe_2O_3 was prepared by boiling and stirring 0.1 M $FeCl_3$ aqueous solution for 1 hour, at 100 ^{0}C and heating in a muffle furnace for 4 hours, at 550 ^{0}C, followed by centrifuging and drying for one hour at 100 ^{0}C.

The composite was synthesized in different weight to weight ratios of AC and Fe_2O_3 and applied in the supercapacitor in order to find out the best ratio which resulted in the highest capacitance. By keeping the total weight of powder 20 mg for each electrode, AC to Fe_2O_3 ratios were varied from 1:1, 3:1 and 4:1. The mixture of AC and Fe_2O_3 powder was grinded well, using mortar and pestle in order to synthesize the nanocomposite.

2.2 Supercapacitor testing

The stainless-steel electrode surface of a supercapacitor sample holder was well cleaned with distilled water and acetone respectively. 20 mg of AC was mixed with 50 µl of distilled water and a fine paste was prepared. The paste was applied evenly, on the well-cleaned surface of the stainless-steel electrode and let dry completely. Both electrodes were covered with the carbon paste of 20 mg each. 1 M solution of KOH was used as the electrolyte. A filter paper equal in shape with the electrode surface was cut and soaked in 100 µl of KOH and used as the separator.

In the same procedure stated above, supercapacitors were prepared by using 20 mg of Fe_2O_3 and nanocomposites of AC: Fe_2O_3 ratios 1:1, 3:1 and 4:1.

2.3 Characterization

2.3.1 Material Characterization

X-Ray powder Diffraction (XRD) patterns were obtained for the prepared Fe_2O_3 sample using Rigaku Ultima IV X-Ray powder diffractometer, before and after heating in the muffle furnace. XRD patterns were obtained for the samples of composites of AC: Fe_2O_3 ratios 1:1, 3:1 and 4:1.

The particle sizes of Fe_2O_3, AC and composites of AC: Fe_2O_3 ratios 1:1, 3:1 and 4:1 were obtained by using FRITSCH ANALYSETTE 22, particle size analyzer.

2.3.2 Device Characterization

Characterization of the supercapacitor was done using the Metrohm Autolab instrument. Cyclic Voltammetry (CV) tests were done for each capacitor with two-electrode potentiostat configuration, within the voltage window of -0.5 V to 0.5 V. CV curves were obtained for each capacitor for scan rates 0.002 V/s, 0.0025 V/s, 0.003 V/s, 0.004 V/s, 0.005 V/s and 0.0075 V/s and the specific capacitances were calculated for each case. The stability of the supercapacitor with highest capacitance was checked for 1000 cycles. Electrochemical Impedance Spectroscopy (EIS) tests were performed for each capacitor and the Equivalent Series Resistances (ESR) were observed. The frequency range used was from 10 MHz to 1 mHz. Galvanostatic Charge Discharge (GCD) tests were performed for each capacitor with 0.05 A/g current density and the discharge capacitances were calculated.

3. RESULTS AND DISCUSSION

3.1 XRD patterns

XRD pattern obtained for Fe_2O_3 powder is shown in figure 1. It indicates that Fe_2O_3 has been made. The XRD pattern of the composites prepared at different weight to weight ratios of AC and Fe_2O_3 showed the same XRD pattern corresponding to Fe_2O_3 as shown in figure 3.1, which shows that no other compound has been made in the process of grinding or annealing the two materials.

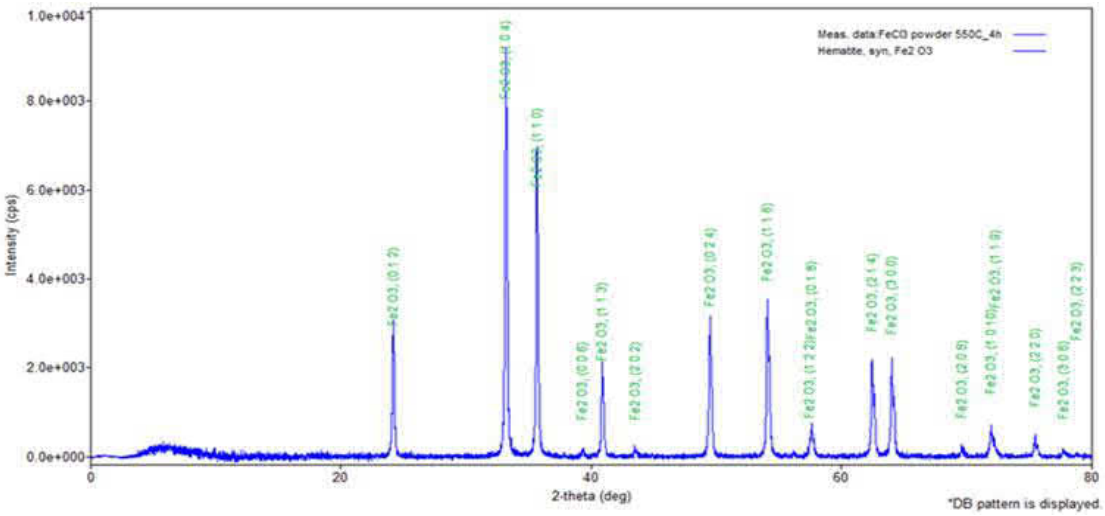

Fig. 1 XRD pattern of Fe_2O_3

3.2 Particle Size Distribution

Particle sizes obtained for Fe_2O_3, AC and the composites of AC: Fe_2O_3 ratios 1:1, 3:1 and 4:1 were 0.09 µm, 3.6 µm, 5.3 µm, 4.99 µm and 4.22 µm respectively. Particle sizes have been increased after grinding than that of AC and Fe_2O_3 separately. According to the XRD results, it indicates that no any other material has been made after grinding the two materials and according to the particle size results, it can be confirmed that much smaller Fe_2O_3 particles have interacted with pores of AC and hence the particle sizes have been increased.

3.3 Electrochemical Results

Impedance curves obtained for each supercapacitor are shown in figure 2. ESR values obtained are nearly equal for the capacitors with AC and composites of AC: Fe_2O_3 ratios 4:1 and 3:1. For the capacitor with AC: Fe_2O_3 ratio 1:1 a much higher ESR value was obtained than supercapacitors with AC and composites of AC: Fe_2O_3 ratios 4:1 and 3:1. The specific capacitances were calculated and plotted against the scan rate as shown in figure 3. The specific capacitances reduced gradually with scan rate. For the capacitor with composite of AC: Fe_2O_3 ratio 3:1, showed the highest specific capacitance of 13.01 F/g. Its specific capacitance was higher than that of AC based capacitor for scan rates 0.002 V/s and 0.0025 V/s and for scan rates higher than that, the specific capacitance of composite of AC: Fe_2O_3 based capacitor was below the specific capacitance of AC based capacitor.

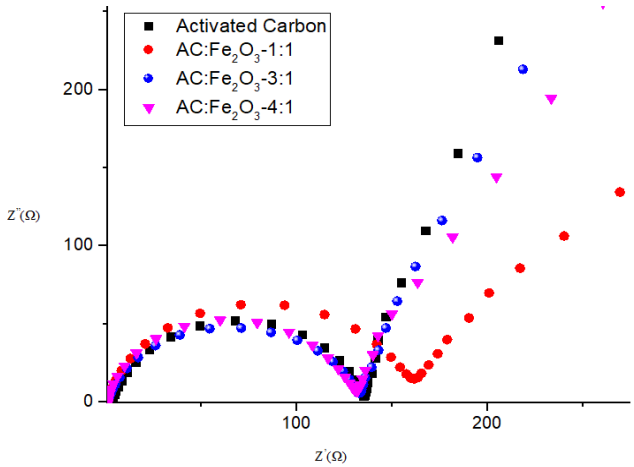

Fig. 2 Impedance plots obtained for Activated Carbon, Composites of AC: Fe_2O_3 ratios 1:1, 3:1 and 4:1.

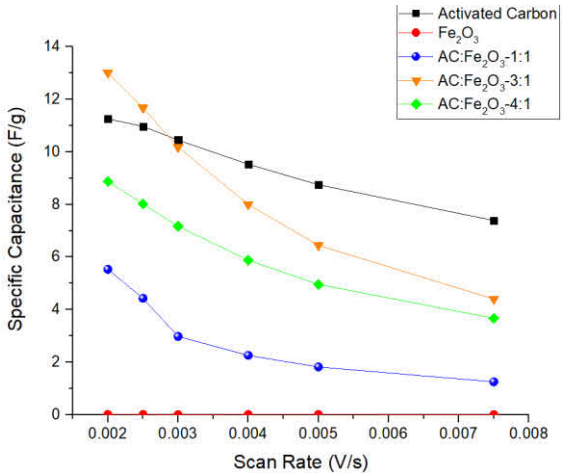

Fig. 3 Specific capacitance values plotted against the scan rate

The stability of the capacitor which showed the highest specific capacitance was checked using 1000 cycles of cyclic voltammetry test at scan rate 0.002 V/s. The capacitance reduction was 8.93%. The galvanostatic charge discharge characteristics for current density of 0.05A/g showed discharging time of 220 s for AC based capacitor and for the capacitor based on the nanocomposite of AC: Fe_2O_3 ratio 3:1. The discharge capacitances were calculated using the discharge curve of each capacitor and plotted against the AC percentage of the composite. The highest discharge capacitance of 0.337 F was shown for the capacitor based on the nanocomposite of AC: Fe_2O_3 ratio 3:1. Based on specific capacitance variation and the capacitance variation, the best weight to weight ratio AC: Fe_2O_3 is 3:1, for the synthesis of the nanocomposite. The capacitance variation with AC percentage is shown in figure 4.

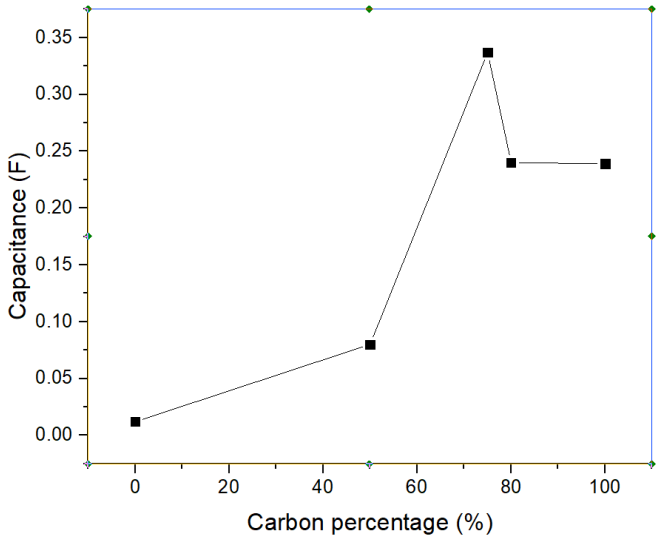

Fig. 4 The capacitance plotted against the percentage of carbon in the composite

4. CONCLUSION

It was found that Fe_2O_3 can be made by boiling $FeCl_3$ aqueous solution and annealing the filtered powder at 550 ^{0}C for 4 hours. There are many scientific methods to prepare Fe_2O_3 but, this novel method seems much easier and reliable. Nanocomposites based on AC and Fe_2O_3 shows better results for supercapacitors at weight to weight ratio of 3:1, than AC alone. The specific capacitance observed for the best composite based capacitor was 0.337 F/g which is higher than that of AC alone. The capacitance observed using discharge curves, also showed higher capacitance for the capacitor based on nanocomposite of AC: Fe_2O_3 ratio 3:1. The capacitance reduction was less than 10% for the capacitor based the nanocomposite and it shows a good stability for 1000 cycles.

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