ASRITE

Annual Symposium on Research and Industrial Training of Department of Electronics

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

03rd March, 2017

Department of Electronics

Faculty of Applied Sciences

Wayamba University of Sri Lanka

Kuliyapitiya, 60200

Sri Lanka.

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Foreword

Research thrives best in university environment due to the interaction of young minds with those of the experienced. The universities are also the fountainheads for technological and scientific innovations. They are the repositories of creative knowledge. Thus, the research carryout in this department can be harnessed for developmental programmes by the states and also for the formulation of policies and in training middle and higher level human resources for development. As a state funded university it is obligatory on the part of Wayamba University to disseminate its acquired advanced knowledge and research capabilities to foster such developmental plans. Thus organizing 4^{th} Annual Symposium of Research and Industrial Training of Department of Electronics (ASRITE-2017) in which the undergraduates of the department who have been trained to identify, investigate, produce optimal solutions and could present latest research to an intellectual forum and share their experiences is an important event.

This publication comprises 45 research articles presented by final year undergraduate students including both Special Degree and Joint Major Degree to reflect their findings from industrial training program and the research project conducted by the department. All the articles were improved by our senior staff members of the Department of Electronics.

On this occasion, I would like to express my sincere gratitude to the academic staff members of the Department of Electronics for their internal supervision, to the external supervisors from the industry for their external supervision and to the National Science Foundation for their financial assistance.

***Senior Professor* C. A. N. Fernando**
Head / Department of Electronics

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SESSION 03

CONSTRUCTION OF A SMART BULB OPERATED USING BLUETOOTH TECHNOLOGY

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ABSTRACT

With modern technology and the development of Android smartphones, smart living is gradually changing people's lives. Bluetooth technology aimed at wireless exchange of data over short distance. This short wavelength wireless transmission provides the necessary technology to create convenience, intelligence and controllability. In this study, we report a prototype smart bulb of which the status, color, bulb profile and the brightness can be controlled by using Bluetooth based Android smartphone. This system was design by using Bluetooth serial communication to control the Pulse Width Modulation (PWM) of the microcontroller. Bulb color, brightness and profile is depend on the PWM values produced by Android application. RGB LED cluster was shaped the output according to the PWM values. It is shown that Android Smartphone can provide a platform to implement Bluetooth-based application for a smart bulb.

Keywords: Android, Smartphone, Smart bulb

1. INTRODUCTION

Nowadays, smartphones are becoming more powerful with reinforced processors, larger storage capabilities, richer entertainment functions and more communication methods. Bluetooth, which is mainly used for data exchange, add new features to smartphones. In recent years, open source platform Android is widely used on smartphones [1]. Android has an operating system, middleware layer, it is a core application. Android is a common platform that contains many tools that are easily accessible. With the proliferation of these mobile devices, it is useful to understand how to set up and implement Bluetooth functionality in many applications [2].
Bluetooth technology was created by telecom vendor Ericsson in 1994. There are so many benefits of integrating with smartphones. It has changed the way of using digital equipment’s at home and office and transferred traditional wired digital equipment’s to wireless equipment’s.

The host Bluetooth device can communicate with up to seven Bluetooth modules at the same time through one link. Considering that the usual working area is within eight meters, it is particularly useful in home environment [3]. With dramatic increase in users, smartphones have gradually turned into an all-purpose portable device and provided people for their daily use [4].

At the moment light bulbs are losing favor. Currently, in most areas of the world, energy efficiency is low, so it is restricted to use normal light bulbs. There are various light bulbs that customers can choose, such as halogen, CFL, or LED. Comprehensively, LED bulbs are considered the best choice [4,5]. With the arrival of the network era, wireless connections are prevalent, smart LED bulbs seem to be a hot trend of the development of smart family life.

In this study, construction of a smart LED bulb that can be operated via Bluetooth technology is reported.

2. METHODOLOGY

2.1 Block diagram

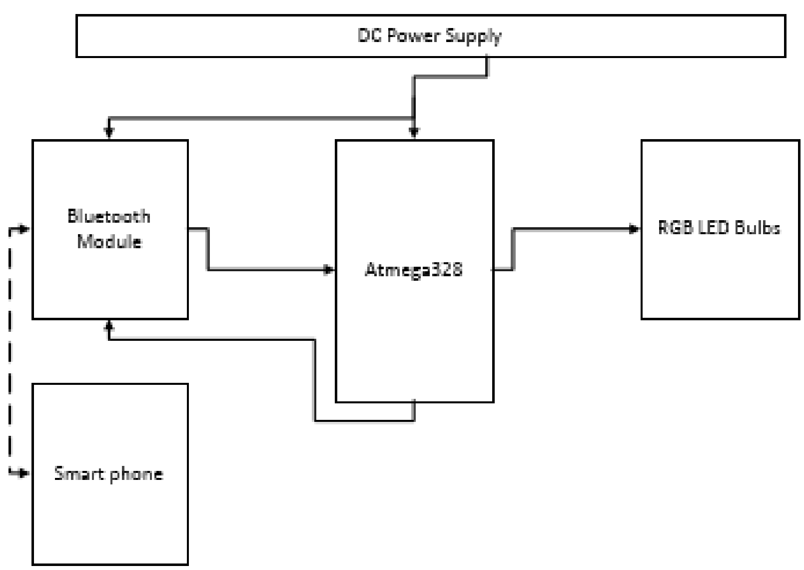

Figure 01: Block diagram of the designed system

Figure 01 shows the block diagram of the system developed. It shows a microcontroller ATmega328 based smart Bluetooth bulb system. The proposed system uses Bluetooth module to connect the smart phone and the bulb. Whenever the user needs to connect the bulb, Bluetooth module should be online and should connect it by using the android software. Then it will appear in the software connection list. If it's not online the software will displays 'Not Connected' in the contact status. After the connection, user can change the status of the bulb (ON/OFF) by using the home screen button in the software. Other features of the software appears in the bottom of the screen. There are another four features in the software related to the smart bulb. In first tab gives the color picker feature from that the bulb can get any color that user define from the color picker canvas in the screen two. Second tab define for the brightness change in the bulb and it's done by using scale bar for the red, green and blue colors. Third tab, can add predefine profiles for the bulb. The final tab is to connect the whole bulb that are available in the system.

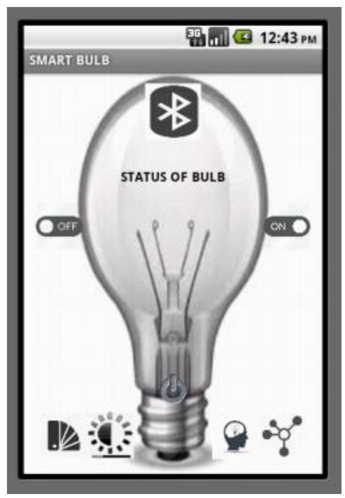

Figure 02: Home screen of the Application

2.2 System Architecture

In the proposed Smart bulb controlling system, a small "piconet" is established using a microchip ATmega328 and several Bluetooth modules HC-06 [1,3]. The system is developed under Android platform to monitor and control bulb via Bluetooth-enabled application. A master-slave structure is adopted in the system architecture where a Bluetooth-enabled Android phone is served as a host controller with the other Bluetooth devices. The microchip controllers set in a polling status and constantly checks any input command every 500 millisecond from the Android phone application. If it receives a command to instruct the microchip to change the bulb status, color, brightness and profile, the microchip sends a command to the master controller through Bluetooth.

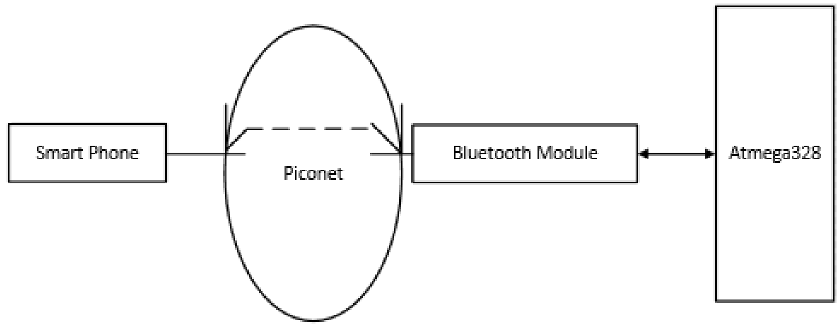

Figure 03: System architecture

2.3 Hardware Design

The overall hardware design is shown in Figure 4. The slave Bluetooth module HC-06 communicates with Bluetooth-enabled phone through the SPP channel, each slave module is interfaced with the bulb controlling system with the microchip controller which aims to decode the commands transferred from the host controller to control the bulb, and on the other side, tries to gather bulb status and encode it to send a feedback to the master controller [5].

UART interface D1 (TX) and D0 (RX) of the microchip is directly linked to UART_TX and UART_RX which provides the function of exchanging data.

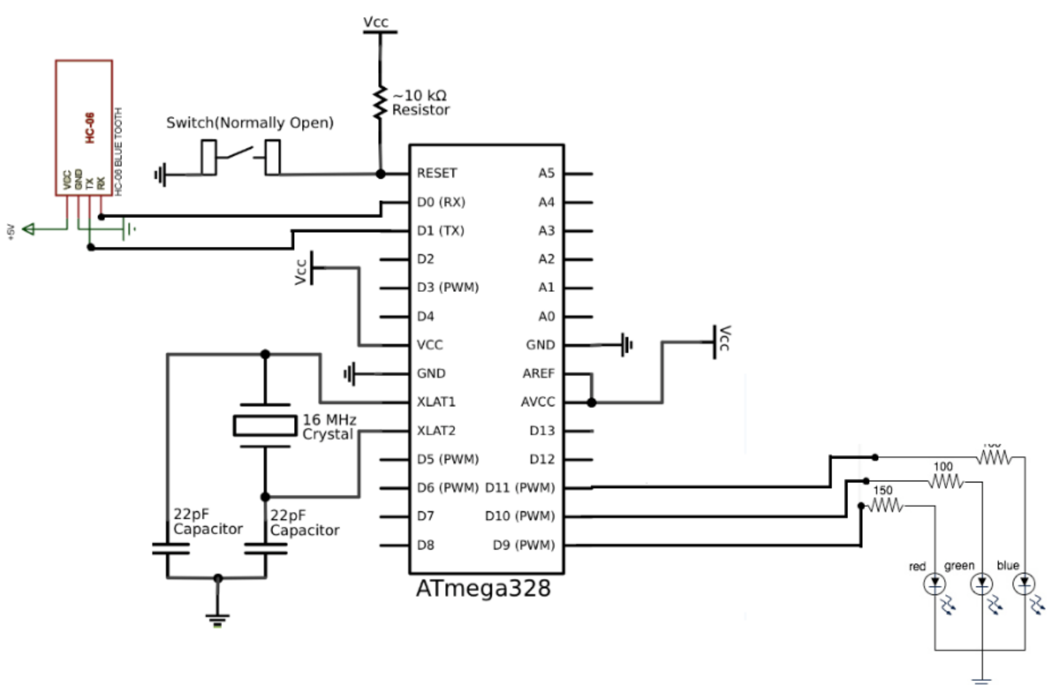

Figure 04: Schematic diagram of design

The microchip is used to assist gathering status of the lighting and provides interface to control the Smart Bulb. The Bluetooth module sends and receives commands from the Bluetooth-enabled phone and android software is used in communication among Bluetooth devices. Android Studio is used to develop the Android Software, which is proved to be very efficient and convenient.

2.4 Software Design

Software design includes the main functions of the Android application that uses to control the smart bulb. The application is designed with Android version 2.2 with Android Studio and MIT App Inventor. The application is designed in low Application Programing Interface level so that the devices with higher version are compatible with it [7]. Figure 02 illustrate the Android application tested on smart phone with version 4.0.4. The application is simple to use, user can simply touch on the icon to turn on/off the appliances after connected to the main control board by using Bluetooth.

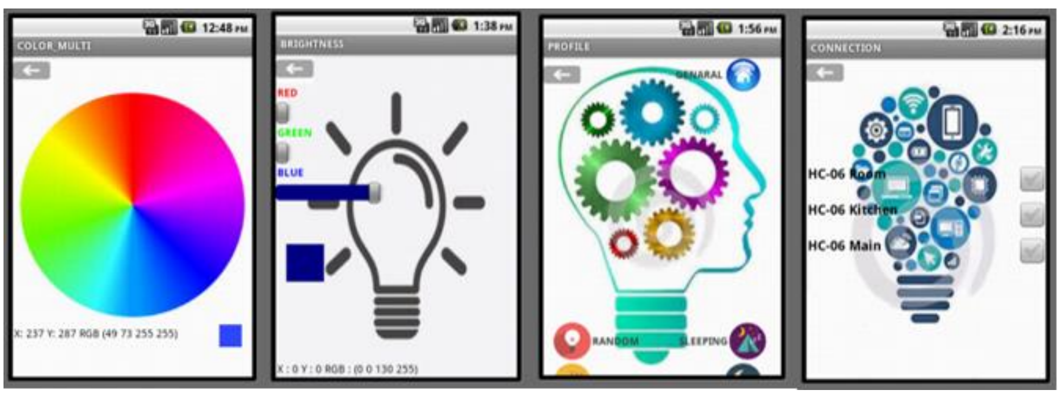

Figure 05: Tabs of Android application

Figure 05 shows the entire graphical user interfaces of the user application. In the second screen user can obtain any color dine in the color chart. When the user drag the color picker in the screen the dragged color appears on the Smart bulb. Second tab gives the brightness change feature and it basically depend on RGB LED main colors. User can change the brightness of red, green and blue colors. There are three scale bars to control the brightness of each color. There is a third tab to control the bulb profile. User can predefine the profile of the bulb. In profile, user can define the behavior and the color of the bulb. In last tab connection of the bulbs displays.

3. RESULTS AND DISCUSSION

For every feature that generate by the android application mainly depend on the PWM. When changing the PWM values, RGB LED changes the color. For example, a duty cycle of 20% would need to be set at a value of 51. The output of this duty cycle is shown in Figures 7 below.

Figure 07: Pulse width of 20% duty cycle

Sometimes color of the LED cannot be identified instantly because of the PWM range. PWM has 256 different values but the smaller difference of PWM cannot be identified by the human eye. So there may be several colors of the LED appears as same to the human eye. In brightness controlling user cannot obtain colors in the lower PWM values. The voltage signal across the bulb define by the pulse width duty cycle and if it’s too small then LED is not going to produce any color.

4. CONCLUSION

The aim of this study was to develop smart bulb which can be controlled using Bluetooth technology. The system has been successfully designed and prototyped to monitor and control the light status, brightness, color, profile using an Android Bluetooth-enabled phone and Bluetooth modules. It can be concluded that with this smart bulb consumers can control their home lighting system remotely and wirelessly.

5. ACKNOWLEDGEMENT

The authors wish to express their gratitude to the staff of the Department of Electronics, Faculty of Applied Sciences, Wayamba University of Sri Lanka for the assistant that they gave to succeed this project.

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Department of Electronics - Wayamba University of Sri Lanka

HUMAN ACTIVITY RESPONDING SMART LOWCOST MULTIMEDIA CAMERA SYSTEM FOR ADVANCED SECURITY APPLICATION

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ABSTRACT

The project is to designed human activity responding multimedia camera system for security purposes. The proposed system can be utilized to play an essential role in many surveillance and robot applications. Multiple cameras are needed to cover large environments for monitoring activity. To track people successfully in multiple perspective imagery, one needs to establish correspondence between objects captured in multiple cameras. General systems are very expensive but our proposed system is low cost. Such system was developed with the aid of three techniques; Image processing, motion detection and wireless video transmission which were introduced in the system for detecting human motions. After detecting, the CCTV camera head is rotated toward the object and the video output is transmitted to the display. This makes it possible to design and construct online human tracking system that is robust to background and lighting changes in addition to shadow removal of the human movement. This system does not require special hardware components. The cost wise comparison of our proposed multimedia security camera system to such commercially available system gives 10% low cost advantage.

Keywords: Multimedia camera system, Image video processing, Wireless video transmission

1. INTRODUCTION

In the speed running world everyone are considering the time factor as an important issue. Most of the modern manufacturing industries that use security camera system consist of highly automated workstations. Such response system for human activities plays a critical role in many important applications such as monitoring robot applications. In tracking situations with the moving camera, the tracking process becomes more complex and takes time, especially with real-time implementations[1]. Because of the importance of this work is for improving the above system proposed to deal with the data capacity camera moving with real time performance indoor and outdoor. Using ordinary personal computer which is web camera and the CCTV camera together, such predefined conditions. As video transmission is through wireless network, the cost of infrastructure is greatly reduced. The different applications in which the above system can be used are people counting camera server surveillance, traffic lights controlling, real-time security surveillance camera system and home automation system[3]. The major disadvantage of this implantation is that the camera has a fixed radius of coverage and each transmission camera requires a central server.

2. EXPERIMENTAL

2.1 Methodology

The general system such consists of three major techniques. They are;

- Image Processing Technique
- Object Tracking/ Movement Tracking Technique
- Wireless Video Transmission Technique

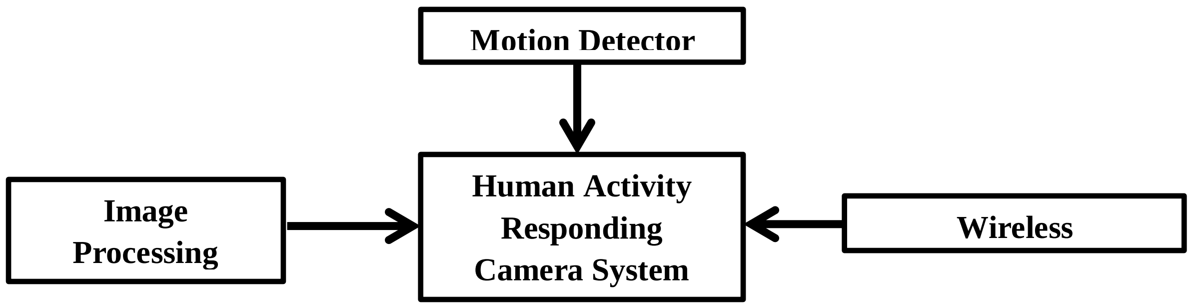

Figure 2.1: General Human Activity Responding Camera System

A flow chart of the proposed human activity responding camera system is shown in Figure 2.2 and Figure 2.3. According to flow chart the observe movement signal is pass through Arduino and Wi-Fi module then finally going to display.

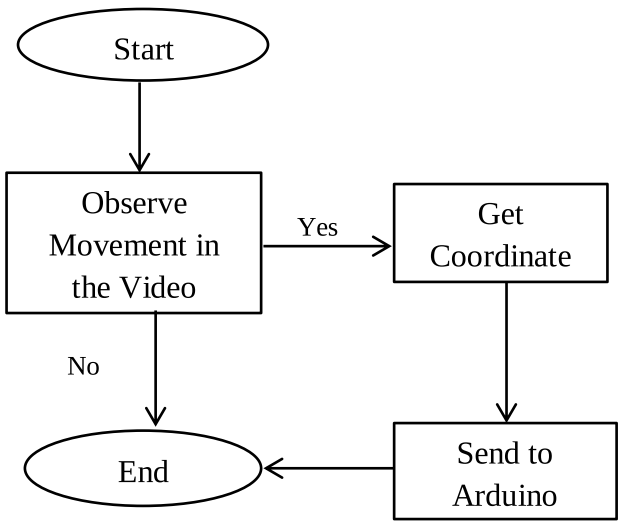

Figure 2.2: Flowchart of the proposed Movement Tracking

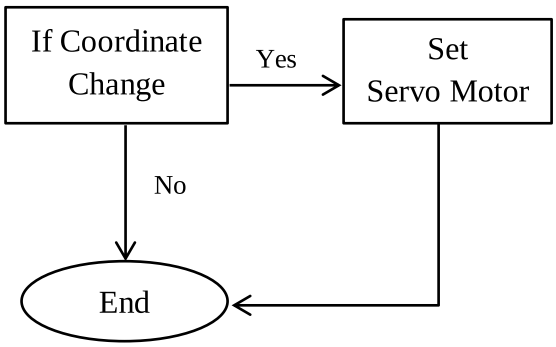

Figure 2.3: Flowchart of the proposed servo controller

A block diagram of the proposed human activity responding camera system is shown in Figure 2.4. The proposed system is divided into three techniques and it can be described as follows;

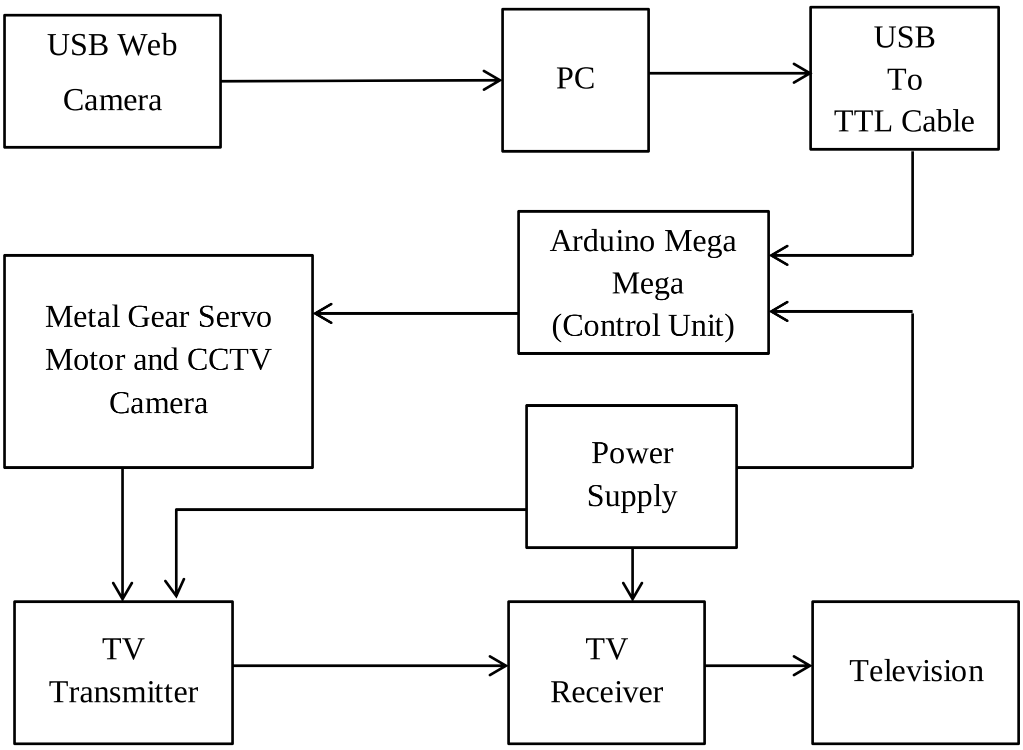

Figure 2.4: Block Diagram of the proposed and implemented system

2.2 The Components of the System and the Construction Process

2.2.1 Image Processing Technique

First step of this technique consists in applying here with the use of image-video Processing software. Each pixel in the captured frame analyze for detecting the object. The second step concerns designing patterns to simply extract humans from the scene and ignore other moving objects. In this step, a classification technique was used to develop a pattern with different human body shapes in different scales of the same object. The third step is a frame-by-frame adaptation that has been used to overcome background change problems using a frame-by-frame method to extract changes between two image frames by comparing these two pixel-by-pixel frames[2]. This pixel frame had been any changed, then the proposed system decided the motion of the camera amounted servo motor.

2.2.2 Further Motion Detection Technique

The image processing technique of the proposed system control by fixed Web camera which we used in prototype. These processing signals passed to personal computer, then through Universal Serial Bus (USB) to TTL serial cable to Arduino Mega board. According to that signal Arduino Integrated Development Environment (IDE) is controlled the servo motor with camera[4].

2.2.3 Wireless Video Transmission

Figure 2.5: Figure of Wi-Fi module

One of the most important techniques of the project is wireless transmission technique used in Wi-Fi module. Optimal resources with a better wireless network, transmission of real-time media in everyday life is now possible. Many service providers facilitate this type of system to overcome this problem; cameras can be placed such that they have a small area in common so that they can use a common server, reduces maintenance.

3. RESULTS AND DISCUSSION

This proposed system could be able to detect and recognize a human activity through the low cost camera according to the signals process through the above discussion hardware and software platforms with the use of three techniques; Image Processing, Motion Detection and Wireless Video Transmission. The assemble system with 10% cost effective than the commercial available systems. But the short coming of the system are, slow motion detect, 120 degree rotation only one camera use capturing. Mainly image processing part of the system was controlling by personal computer (PC) and object tracking part controlled by Arduino mega board then the wireless video transmission part was an interesting feature includes in the system which it was controlled Wi-Fi module.

3.1 Features of the proposed system

Such system implementation cost is lower and the system does not spend much money. Also the installation of this system was easier. The proposed system has the following features; video playback, having someone else to monitor your home automation technology and most important feature is the proposed low cost object following multimedia camera system.

3.2 Further enhancement of the proposed system

The system can be improved to program for a preschedule in order to use for special occasions. Also with the help of new technologies, more accurate face detection systems could be implemented. Also can be improved this designed system for 360 degree rotation to use capturing of camera head.

3.3 Limitations of the proposed system

That device is not a portable system, because personal computer was need to this system. Such system cannot identify fast movements of objects because of camera has not more sensitivity[5]. This system was used difficult lack of knowledge about the technology within technical and maintenance staff.

Figure 3.1: The proposed and constructed system

4. CONCLUSIONS

The system was tested with a prototype and it was successful. This automated security system is useful for home security purposes as this system is cost effective as well as a reliable system. The most important benefit of the system was the human activity responding camera application for security purposes. Since this system responsible for detecting a human activities and auto focuses the camera whenever such human motion occur. It has more benefits such as saving power consumption, human labour cost reduction and tireless functionality day and night. The cost wise comparison of our proposed multimedia security camera system to such commercially available system gives 10% low cost advantage.

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Authors would like to take this opportunity to express their deepest gratitude and appreciation for the staff of the Department of Electronics, Faculty of Applied Sciences, Wayamba University of Sri Lanka.

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IMU BASED SUN POSITION TRACKING SYSTEM FOR SOLAR THERMAL POWER GENERATION SYSTEMS

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ABSTRACT

This research introduces a reliable and energy efficient Sun position tracking system for thermal solar power generation systems that uses Sterling engines. This system is based on a feedback loop control system which uses gyroscope, accelerometer and magnetometer inputs with the geographic location and time based calculation for the estimation of the position of the Sun. Calculated Sun position values are used as the target location of the sun and it drives a Alti-azimuth motor gear system to keep a parabolic reflector focused towards the Sun all the times. Introduced system ensures a reliable and simple mechanical design while maintaining accuracy and precision independent of location or date-time. It also has very fast response compared to the dead reckoning navigation strategy based controllers.

Keywords: Global Positioning System, Inertial Measurement Unit, Solar Position Algorithm

1. INTRODUCTION

Solar energy is considered as a reliable source of energy in the field of sustainable and renewable energy research. Therefore now there is a trend in the current society towards the solar energy based solutions. Among the solar energy based power solutions, photoelectrical solar cell based systems are very much popular among solar power users. But it has a major drawback of the higher initial cost.

For the most of countries near the equator has Sun fall on almost all the year because of the geographic position. But the most of the developing countries (third world) are also in this region[1]. Therefore, to use the solar energy based solutions in this third world countries, it should be definitely a low cost solution which is affordable for those people.

Therefore the next best possible solution is the thermal electrical power generation with solar heat radiation. This is one of the most successful solutions and already used in large scale power plant called Gemasolar which has 19.9 MW of power generation in Spain[2]. Also a similar power plant established in Clark Mountain, California the Ivanpah Solar energy facility which generates 377 MW of power[3]. The main advantage in here is its scalability and the lower cost because of the energy conversion can be done with heat engines such as Sterling engines and a dynamos[4].

To do such a power generation using a heat engine mechanism, it is necessary to build a fully automatic and accurate tracking mechanism to drive this system. Scope of this research is to build a reliable and cost efficient low power solar tracking system to drive a parabolic dish reflector to use in the domestic scale.

2. EXPERIMENTAL/METHODS/METHODOLOGY

2.1 Proposed Sun Tracking System.

The solar tracking system was implemented as shown in the Figure 1. The design was capable of identify the geo location of the system installation and then track the position of the sun continuously if the sun is above the horizon. It keeps the parabolic reflector aimed directly towards the sun at all the times. The Drive gear system has equipped with an alti-azimuth motorized mounting system which is easier to control because of it has only two axes.

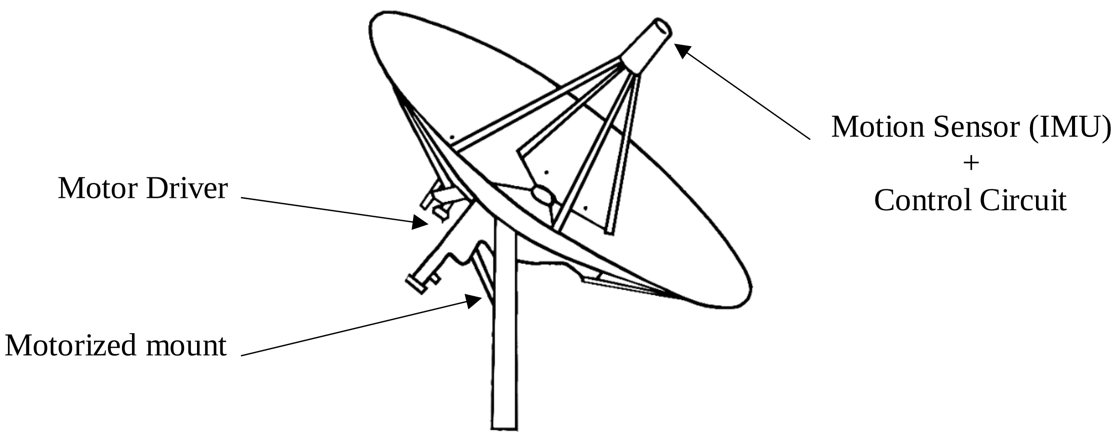

Figure 1: Proposed tracking system

2.2 Tracking Algorithm

The control circuit was designed to get the location and time information from GPS satellites and then calculate the position of the sun in altitude and azimuth coordinate vectors with the help of Solar Position Algorithm (NREL SPA) [5]. With this algorithm, the circuit can estimate the solar position with ±0.0003 of uncertainty[5].

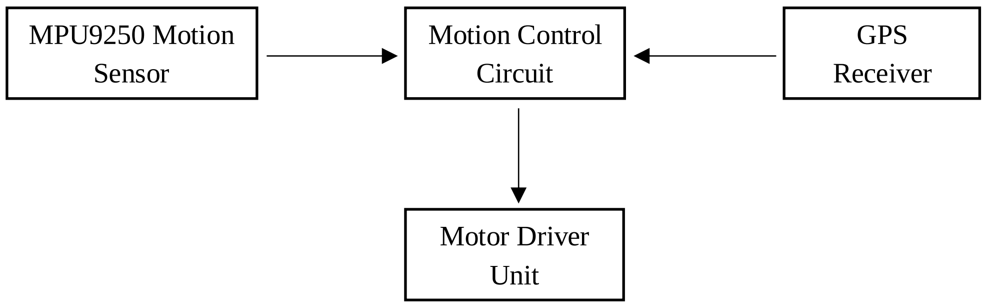

Figure 2: Basic system block diagram

The hardware level block diagram is as shown in Figure 2. It consists motion sensor and the GPS sensor and a motion control unit which processes the motion tracking of the system based on above sensor readings. The functional representation of the system is as shown in the Figure 3. It shows the algorithmic implementations and the flow of the tracking system. The operation of the system is as follows.

When the coordinates of the sun in Altitude and azimuth were obtained, the circuit takes the current heading direction of the parabolic reflector with the help of Inertial Measure unit (IMU) MPU9250, a nine axis (Accelerometer, Compass, Gyroscope devices of 3 axis each) Digital motion processor interface[6]. After obtaining the raw values of all nine axes, it uses a sensor fusion algorithm for combine the multiple sensor values to minimize the drift errors[7]. To do this calculation, a sensor fusion algorithm widely used in signal filtering, well known as the Karlmann filter has used[8]. After digital signal filtering, to determine the heading direction of the reflector, Madgwick's Altitude and Heading Reference System (AHRS) algorithm was used[9].

Then the control system manipulates a closed loop feedback control loop with the calculated values and the IMU feedback of the current position and drives the two axes of the motor system to move the reflector directly towards the Sun. When the calculated solar position is not above the horizon level, the motion will not occurs.

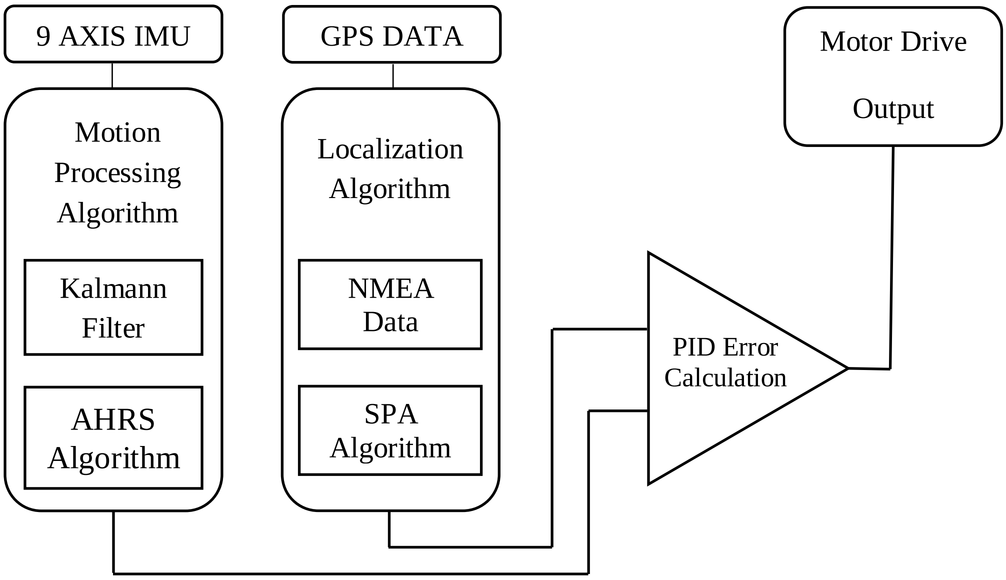

Figure 3: Functional diagram of the system

3. RESULTS AND DISCUSSION

When using the MPU 9250 nine axis IMU, the raw values were not stable with the time because of the drift errors. After applying the AHRS algorithm, the yaw, pitch and roll values and the magnetic compass readings together given a very reliable angular position measurement which was capable of directly measure the current altitude and azimuth of the parabolic reflector. Those current coordinates and the calculated target coordinates made the motion of the motors to exactly point the parabolic reflector towards the Sun.

The tracking system was accurately pointed to the position independent of the location because of the GPS location coordinates were used in this calculations. Since this is an outdoor device, the GPS signal strength wasn't a big issue. Since the GPS NMEA string contains the time signatures, which are highly accurate, the algorithm performed very much better[10].

But when considering the mechanical construction of the system, the performance of the device was not smooth even if it is accurate. But the operation was properly happened with smaller mechanical issues like flick and vibrations. Because of the high powerful motor driver H-Bridges the motors used in this system were not a critical issue to the device[11]. This mounting mechanism is good enough to apply for a medium large scale parabolic reflector. But for that, it has to be much smoother and precise in control because of the larger reflector can be easily damages in flicks and vibrations because they are less stable than smaller designs.

4. CONCLUSION

IMU bases angular rotation measurements and Euler coordinate vector systems are very much accurate and mechanically simple because of Micro Electro Mechanical System (MEMS) based design and also they have a very precise outputs which are reliable compared to the rotary encoder based systems and other dead reckoning based systems. They also ensures the simplicity of the design and lower power demand on the overall circuit while increasing performance with reduced mechanical error.

GPS based time and location service access gives the capability to the system to make it portable or zero configuration usage on almost any geographic location in any given time. With this functionalities, this system can be improved to a satellite and planet motion tracking system by using a high precision and smooth alti-azimuth mounting system with a minimum of modifications into the controller algorithm. Only further requirement is the Kepler equation solver for the planetary and satellite motion path data[12].

This tracking system ensures the solar thermal concentration reflector always tracking the sun and therefore the energy concentration on the prime focus of the dish maintains its maximum value all the times.

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LOW COST COOLING SYSTEM TO IMPROVE THE PERFORMANCE OF A SOLAR PANEL

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ABSTRACT

Overheating of solar panels drastically reduces their efficiency and lifespan. This overheating is mainly associated with temperature fluctuations that occur under severe weather conditions. Overheating also has the potential to form electric arcs that can start to melt metal fixtures and burn away the module's insulating materials. The efficiency of electric solar panels is strongly dependent on temperature regime (especially in hot climates). In this study, a low cost DC brushless fan-cooling system inside the solar panel was introduced as a solution. Temperature sensor was installed on the Photovoltaic module to detect temperature. PIC microcontroller was used to switch ON or OFF the DC brushless fan depending on the temperature of PV module automatically. The performances with and without cooling system were measured. With the implementation of the cooling system, output voltage and output power of the PV module increased. Average temperature drop of 3.85 ˚C was obtained for the PV module with cooling system. The efficiency of PV module with cooling system was higher compared to PV module without cooling system. This is because the temperature of the PV module with the cooling system. By maintain the temperature of PV module at ambient value, a higher efficiency can be obtained, the payback period of the system can be shortened and the lifespan of PV module can also be longer.

Keywords: Photovoltaic cell, Solar panel cooling system, PIC microcontroller

1. INTRODUCTION

One of the most important form of renewable energy is the solar photovoltaic energy. It has undergone a huge research and development in the recent past and is still developing. A solar cell is a device that directly converts the energy in sunlight to electrical energy through the process of photovoltaics. The first solar cell was built around 1883 by Charles Fritts, who used junctions formed by coating selenium (a semiconductor) with an extremely thin layer of gold[1]. In 2009, a thin film cell sandwiched between two layers of glass was made[1].

Countries that have high solar irradiation reception, this source proves a highly efficient, economic and environment friendly form of energy source. There are various factors that affect the efficiency of a solar cell. Cell temperature and energy conversion efficiency are some of them. The reason for the low efficiency of solar cells is their low energy conversion efficiency[2]. A solar cell converts a part of incident solar light into electrical energy the rest being wasted as heat. The infrared light portion of the solar spectrum attributes to this heat loss thus increasing the cell temperature[2]. Cell temperature also has a remarkable effect on its efficiency[2]. As the operating temperature increases the electrical cell efficiency decreases. Earlier the solar cells had an efficiency of less than 1%. Many researches have been carried out and are still in process to enhance the efficiency of a solar cell keeping the cost constraint in mind. From improving the cell material to finding out the optimum operating conditions, the researchers have left no stone unturned in developing technologies to enhance the solar cell efficiency. The maximum efficiency of research photovoltaics is over 40%[3]. Polymer solar cells, dye sensitized solar cells are some of the developments from the material aspect. Cooling also provides a good solution for the low efficiency problem[4].

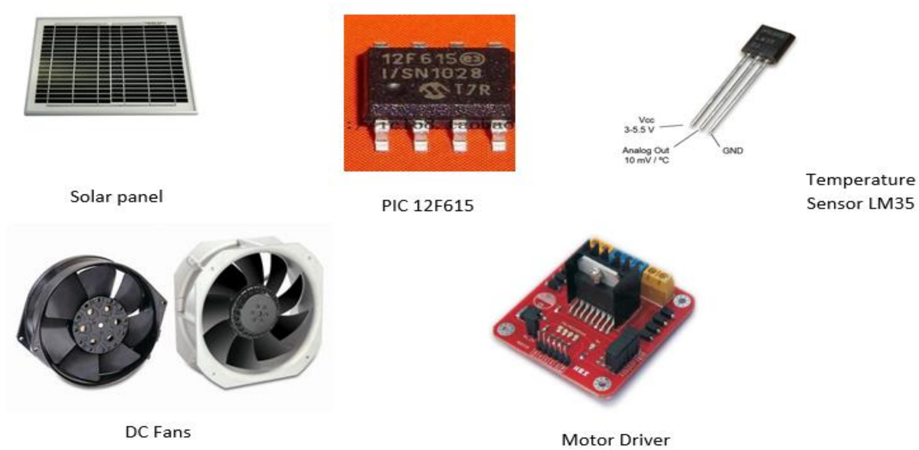

Figure 1: Components of the designed system

A solar panel, A temperature sensor LM35, PIC 12F615, DC Fans and a motor driver are the important components which were used to design the system[5].

2. EXPERIMENTAL

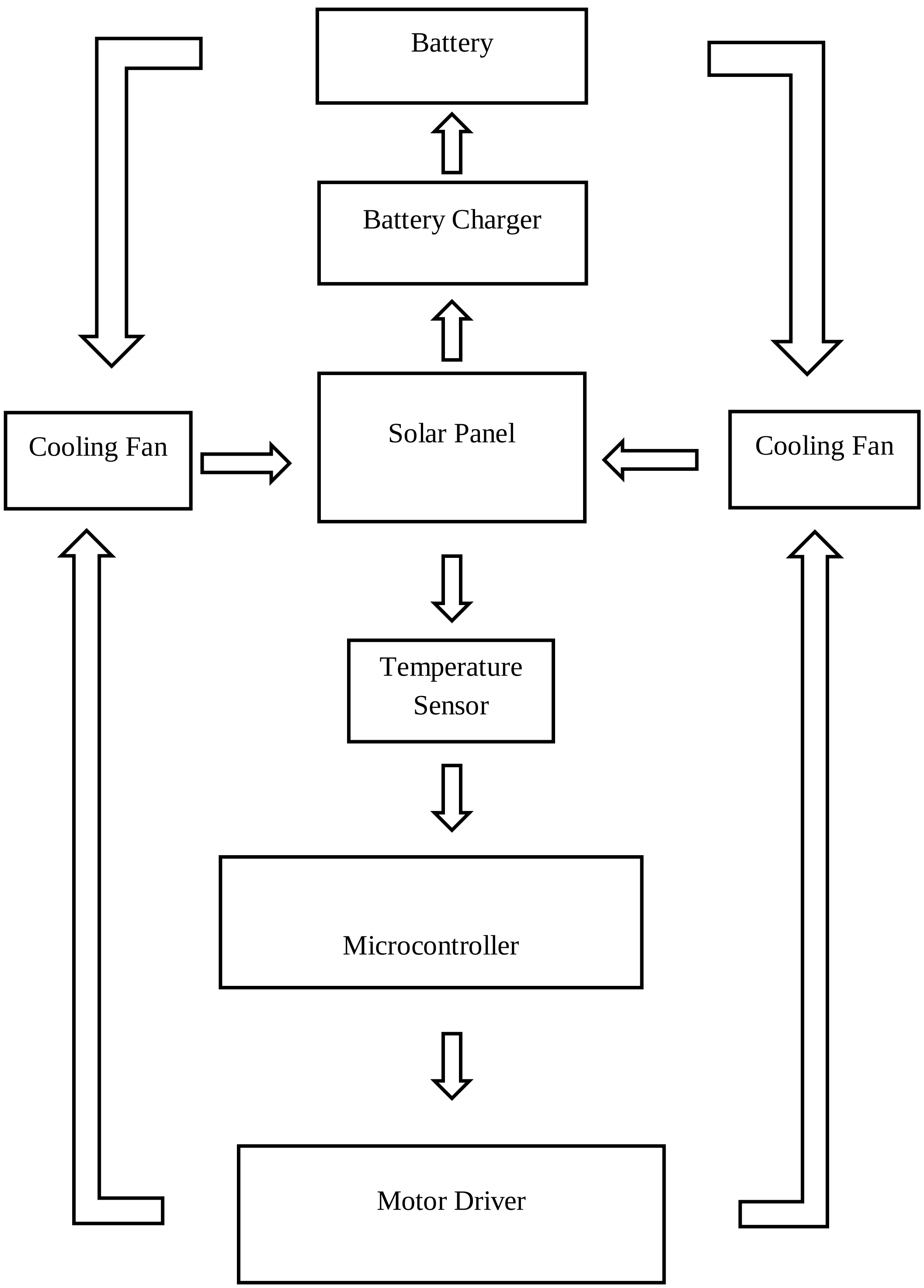

Figure 2: Block diagram of the designed system

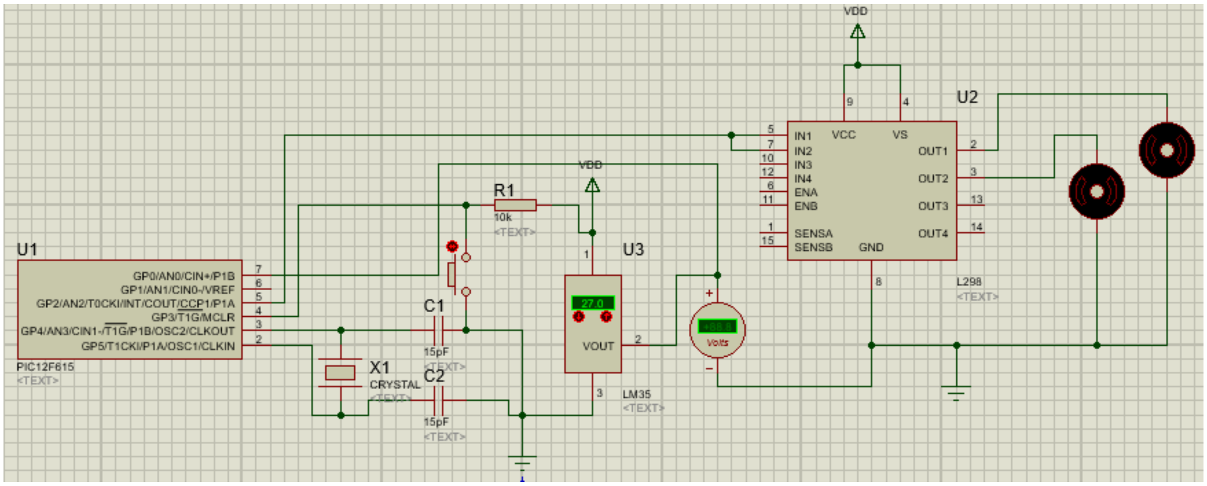

Figure 3: Circuit diagram of the System

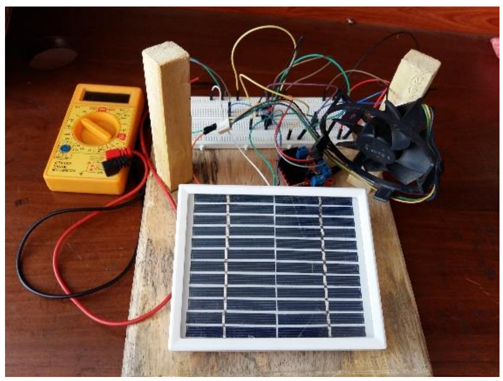

Figure 4: Prototype of the system

Figure 02 displays the block diagram and Figure 03 displays the circuit diagram and Figure 04 displays the prototype of the system. As a way to satisfy the requirement of investigation, the solar energy is chosen as a main supply of this design. The PV module produces electrical energy and provides DC supply to battery charger. The output power of PV module is used to charge the 12 V batteries by using battery chargers. The utilization of battery is used to store electrical energy that generate by PV module. Battery provides power to cooling system that is places at front side of PV module. DC cooling system was used to reduce temperature of the solar panel which will help to improve efficiency of system.

The DC cooling system is controlled by a system which includes a microcontroller circuit and a temperature sensor. LM 35 was used as the temperature sensor which was placed on the back side of the PV module. PV module and temperature sensor output voltages were measured and recorded by using a Digital Multimeter for two days (9.00 a.m to 3.00 p.m) at every ten minutes with and without the PV cooling system. Output power of the PV module was calculated using the data obtained for two days. PIC 12F615 microcontroller was used to switch ON / OFF the DC cooling system automatically.

Two temperature trigger limits (lower and upper) were decided by analyzing the observed data. When the temperature of PV module reach at or more than the upper temperature limit, that will be detected by LM 35 and the PIC 12F615 will switched ON the DC cooling system. After the cooling system is switched on, the blowing of the brushless fans at the front side of PV module starts to cool down the PV module. The cooling system will be switched off when the temperature drops to lower limit.

3. RESULTS AND DISCUSSION

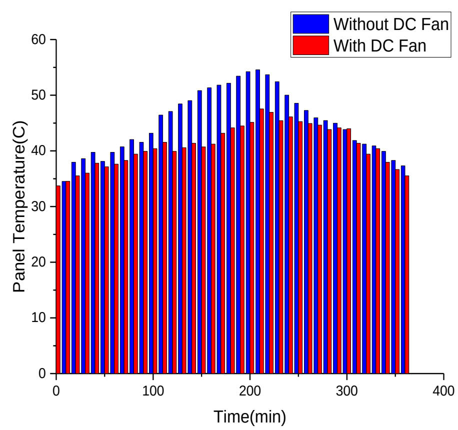

Figure 5: Panel temperature versus time for PV module with and without DC brushless fan.

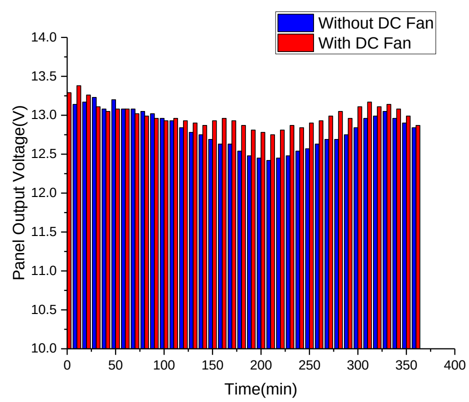

Figure 6: Panel Output Voltage versus time for PV module with and without DC brushless fan.

Figure 5 shows the variation of panel temperature with time for PV module with and without cooling system. The average temperature of PV module with the cooling system was 40.99˚C while the average temperature without cooling system was 44.84 ˚C. The temperature variation of PV module without cooling system seemed to be 3.85 ˚C higher than that with cooling system. It seems that, efficiency of PV module can certainly be affected by panel temperature.

Figure 6 shows panel output voltage variation with time for PV module with and without cooling system. According to that, maximum output voltage of PV module with cooling system was 13.38

V while minimum output voltage was 12.75 V. The average output voltage of PV module with cooling system was 12.99 V. In the same time, the maximum output voltage of PV module without cooling system was 13.23 V while minimum output voltage was 12.42 V. The average of output voltage which produced by PV module without cooling system was 12.82 V. The results showed that output voltage is increased with the use of cooling system.

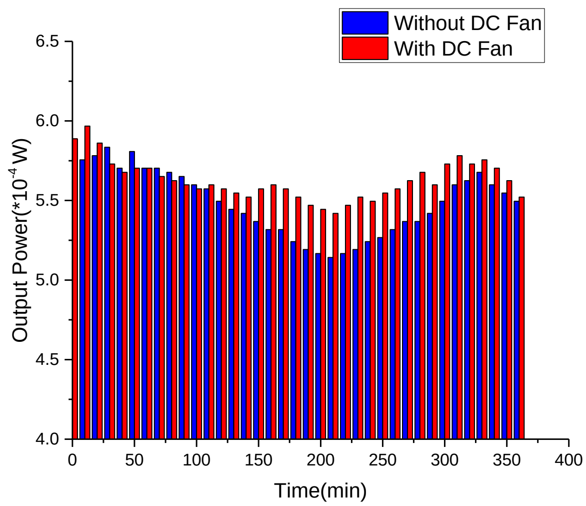

Figure 7: Output Power versus time for PV module with and without DC brushless fan.

Figure 7 shows output power for PV module with and without cooling system. The maximum output power of PV module with cooling system was measured and calculated as 5.97×10^{-4} W while the minimum output power was 5.5×10^{-4} W. The average output power of PV module with cooling system was 5.63×10^{-4} W.

The maximum output power of PV module without cooling system was measured and calculated as 5.83×10^{-4} W while the minimum output power was 5.17×10^{-4} W. The average output power of PV module without cooling system was 5.48×10^{-4} W. It seems that the output power of the PV module slightly improved when DC brushless fan cooling system was used.

Two temperature trigger limits for cooling fan were set by analyzing the observed data. Lower temperature limit was set to 38°C, at which the cooling fans stop and upper limit was set to 40°C, at which the fans start to operate. To reduce the power consumption of cooling fans and to obtain better performance, different speed limits were used at different temperature limits for the cooling fans.

4. CONCLUSION

This study was on using a DC cooling system to reduce the temperature of PV module. The results showed of that with the implementation of the cooling system, the output voltage and power of the solar panel increased with a noticeable value. With that it can be concluded that introduction of a cooling system will improve the performance of the PV system.

5. ACKNOWLEDGEMENTS

Authors wish to extend their gratitude for the assistance given by the Department of Electronics at Wayamba University of Sri Lanka and thank all who have supported to make this project a success.

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REALTIME MONITORING OF BASIC PARAMETERS OF A TURBINE IN A THERMAL POWER PLANT

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ABSTRACT

Turbines that are used in the thermal power plants are working for 24 hours throughout the year. Therefore, there is a necessity to check their conditions at every second in the 365 days, so, they can be operated correctly before a breakdown occurs. Due to the critical environmental conditions of the thermal power plants, a human operator cannot check the conditions of turbine at every second. A system is designed as a solution to avoid this issue. In this system, basic parameters of the turbine such as temperature, vibration, steam pressure and the generated voltage are measured and monitored. Collected data is plotted at a remote display. If there is any critical condition in the above parameters, the whole system is shut down.

Keywords: Turbine Parameters, Thermal power plant, Turbine.

1. INTRODUCTION

At a thermal power plant, there is a critical environment and a human cannot work near the turbines when the turbine is working, because there is high temperature. If a damage occurs in the turbine system, it can’t be recovered quickly. So, it may affect the other systems such as boiler, generator etc. It will consume a lot of time and a huge cost to recover. The time of recovering highly affects the power supply system of the country.

Using a sensor based real time monitoring and automated system, failures of the system can be identified from a distant place and the system can be shut down before the failure affects the other sections of the system.

Since all the parameters of a turbine are monitored at every second, operators can identify if there is a critical condition. If a failure occurs, the system is shut down automatically by the designed system.

A thermal power plant is used to generate the electrical power using the heat energy. The heat energy is generated by firing coal or fuel oil in Sri Lanka. Norocholai Lakwijaya power station is the only currently operating coal fired thermal power plant in Sri Lanka. There are more than 10 power stations that use fuel oil to generate the heat, such as Kelanithissa, Sapugaskanda, Lakdhanvi etc[1].

In the coal fired thermal power plants, heat generates high pressure and high temperature steam in the boiler. The generated steam in the boiler impinges to the blades of the turbine. This rotation is caused to generate the electrical power based on the Faraday's law of electromagnetic induction. After rotating the turbine the steam goes to the boiler again through the condenser[2]. After flowing through the condenser, the pressure and the temperature is decreased. There are three stages of the turbines at the thermal power plants: high pressure, intermediate pressure and low pressure[3].

Steam turbines are the devices that produce the mechanical energy using the thermal energy of the steam[4]. Part of the energy of steam converts into the mechanical energy by turning the blades of rotor. Using that mechanical power, electrical power can be generated[5]. Highly pressurized steam is engaged to the blades of the rotor that is connected to the turbine, through the nozzle. There is a high velocity in the steam since it is engaged through the nozzle. The high velocity cause rotation of the rotor and then electrical energy is generated using the generator[5, 6].

2. METHODOLOGY

The proposed system was designed to measure and monitor the values of some parameters of the turbine that are used in the thermal power plants. If the observed values are greater than the recommended values, turbine system will be switched off. The observed values are remotely displayed. The values are sent to the remote display through the serial port. The received data are plotted at every second at the remote display and they are saved to a file.

There are mainly five parts at a thermal power plant. They are turbine, fuel, boiler, generator and condenser. But this system was designed to measure and monitor the parameters of the turbine. Temperature, steam pressure, vibration and output voltage of a turbine were measured in this system.

Here, DS18b20 temperature sensor module, MD-PS002 pressure sensor module, minisense100 vibration sensor module and ZMPT101b voltage transfer module were used to sense the temperature, steam pressure, vibration and the output voltage of the turbine respectively. All the sensed values of temperature, vibration, output voltage were sent to the ATMEGA328 microcontroller and sensed value of pressure was sent through the HX711 load cell to the microcontroller. The received values were sent to the remotely connected monitor to display values through the serial port. The values were plotted at the remote monitor. At the microcontroller, the received values from the sensors were compared with the maximum values that one parameter can achieve. If one or more sensed values were higher than the maximum values of them, the turbine system was shut down. The turbine was connected through the relay module. The boiler, generator fuel were also turned off using the relay module.

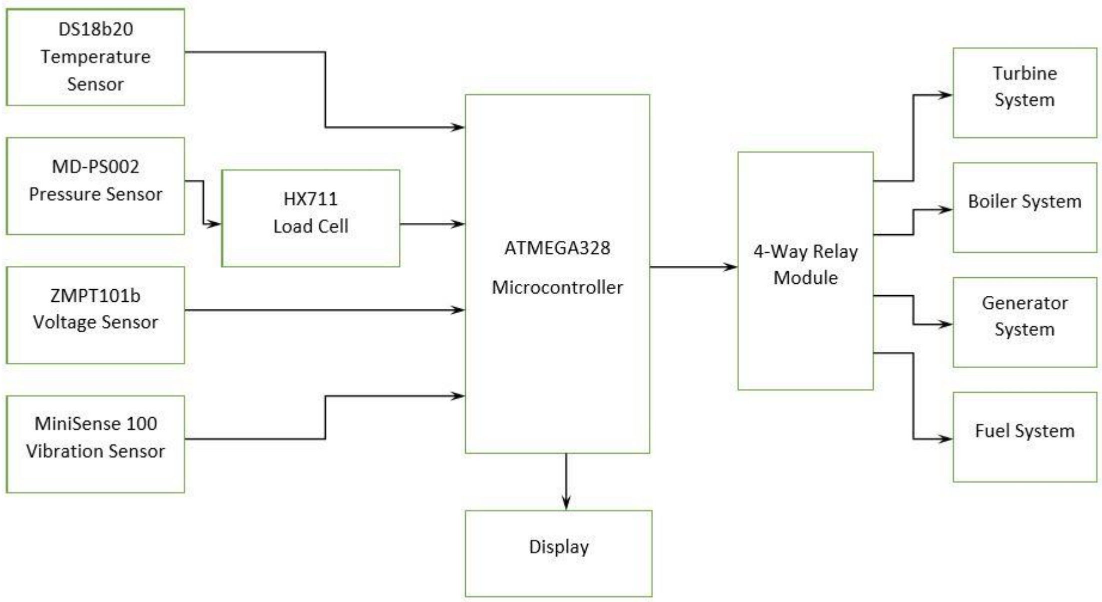

Figure 1. Block diagram of the proposed system.

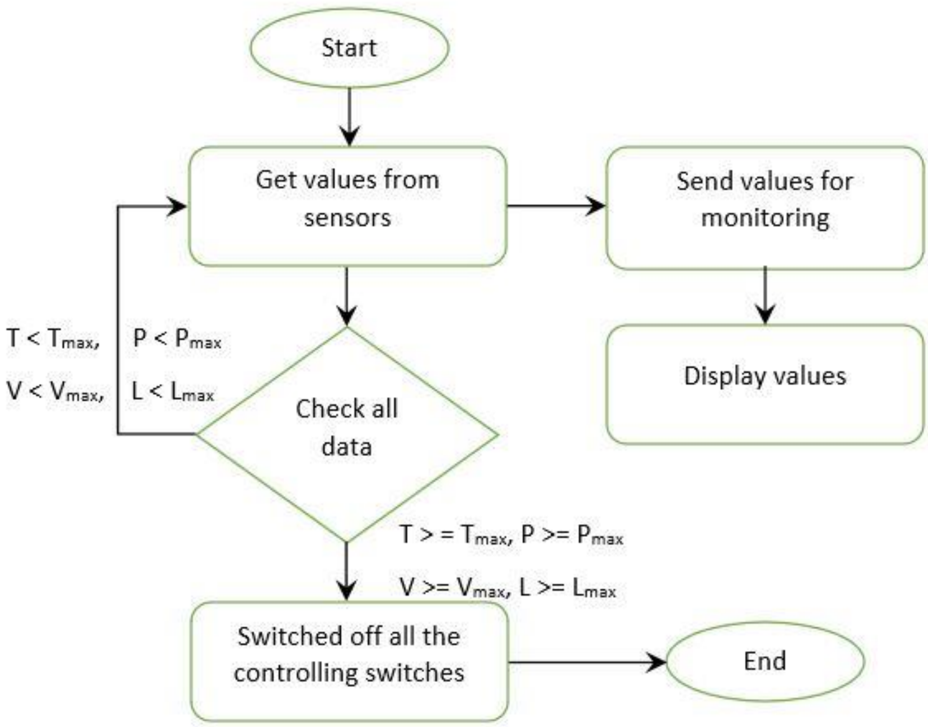

Figure 2. Flowchart of the proposed system.

3. RESULTS AND DISCUSSION

Observed values are sent to the remote computer to display them. Values are plotted in four different graphs at every second.

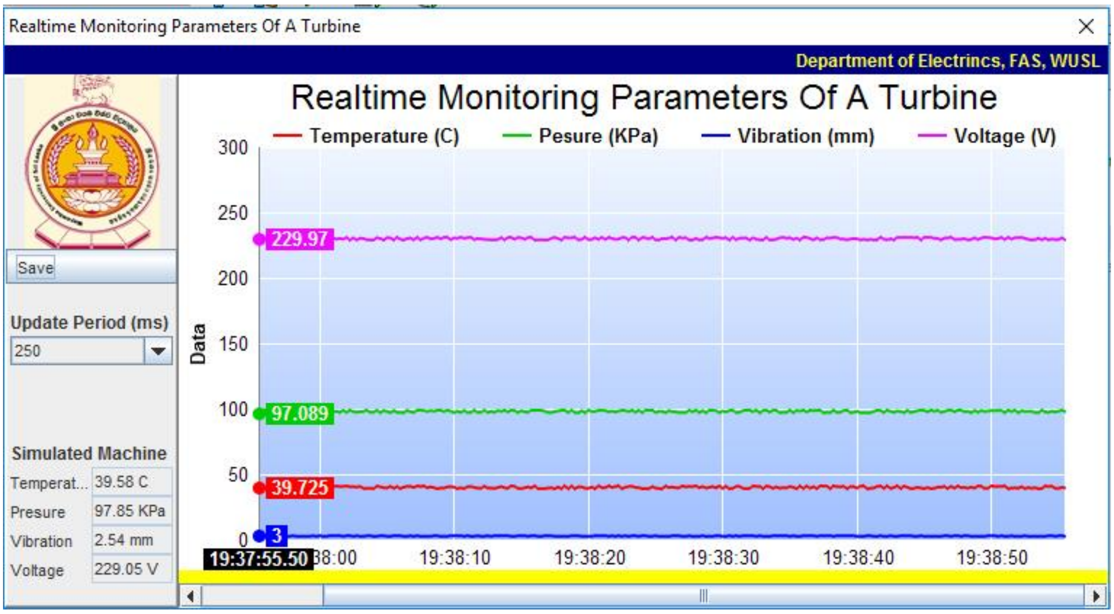

Figure 3. Remotely monitored data of the proposed system for monitoring parameters and controlling the turbine in a thermal power plant.

There are maximum values for each parameter and if the currently sensed value is higher than the maximum value turbine and other systems are turned off using a relay module.

The pressure sensor should be able to operate at high temperature since it is used to sense the steam with high temperature. The accuracy of the sensed values should be in the accepted level at the high temperature. Other sensors are also able to operate in the high temperature because in the thermal power plants, normally there is a higher temperature than the normal environment.

3. CONCLUSIONS

This system is designed to monitor the parameters of a turbine in a thermal power plant. Using this system, any critical condition at the turbine can be identified from a distant place. While the values are being displayed, if there is any critical value of the sensed values, turbine is turned off automatically. Boiler, generator and the fuel are also turned off. Damages to the power generating system since the turbine is already turned off, can be avoided by turning off the other devices.

If a damage occurs on the turbine before it is identified and before the system is turned off, the cost for the repair may be high and it may consume a lot of time. Although the risk is identified before the damage occurs, a man cannot go to this area for operation and maintenance since there is a critical environment at the thermal power plant.

By implementing this system, the critical conditions can be identified before a damage occurs. As soon as the critical condition is reached the power generation system is automatically turned off. The safety of the system is then secured.

In a thermal power plants, there are many sections to help the electrical power generation except the above mentioned five main sections. There is a need of monitoring the parameters of other sections too. It will be helpful to the effective power generation[7].

Although this system demonstrates four main parameters, other parameters also should be monitored such as rpm value, temperature of the blades, input and output pressure of steam at the turbine etc[8].

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COST EFFECTIVE AUTO BRAKING SYSTEM WITH A WIDE ANGLE SENSING FACILITY

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ABSTRACT

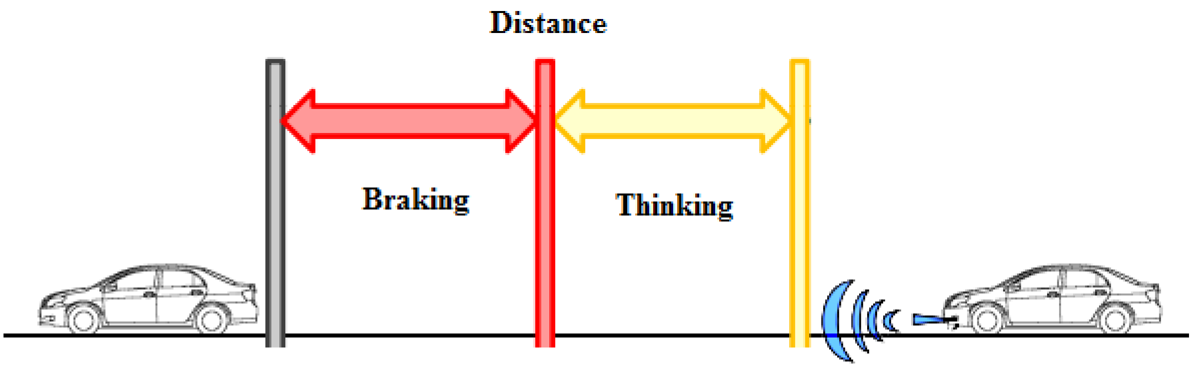
An ultrasonic Automatic Braking System (ABS) is a new system that can assist drivers to control speed of the vehicle. It includes ultrasonic sensors (Sonar) with transmitter and receiver that can produce and receive the ultrasonic waves to determine the distance between a vehicle and an obstacle. By measuring the time taken for detecting a reflected wave (detection pulse) the distance between the vehicle and the obstacle is found. Also, speed of the vehicle and the torque of the steering wheel are measured by the system to clearly distinguish different situations of the vehicle. PIC microcontroller is used to control servo motor based on detection pulse information to push pedal brake to stop or control speed of the vehicle according to all inputs from sensors. A liquid crystal display (LCD) is used to display the speed and a LED is used to give an alert to the driver.

Keywords – Automatic braking system, Torque, Ultrasonic sensors.

1. INTRODUCTION

With the current fast development in information technology, there has been a giant increase in the number of four wheel vehicles. Driving is a compulsory activity for most people because in developing countries public transport services are not satisfactory. People use their vehicle to move from one place to other place even only for a single person. Therefore, the traffic has been increased. Nowadays, accidents are increasing and are uncertain. Accidents can occur anytime and anywhere and cause serious damages, injuries and even death. Automatic braking technologies combine sensors and brake controls to help prevent collisions since accidents are mostly caused by delay of the driver to apply the brake. Therefore automatic braking system (ABS) can save lives and reduce the amount of property damage that occurs during an accident[1, 2]. Nowadays, ABSs are only available in newest generation of luxury vehicles. In the present market, ABSs are very expensive. In developing countries most of the vehicles are non-luxury vehicles. And also, ABS cannot be used for them due to high price. This project is designed to develop a low cost ABS to apply for non-luxury vehicles which are currently in use. This project is about a system that can control braking system for safety using ultrasonic as a ranging sensor. Its function is based on ultrasonic wave. After transmitting, the wave can reflect when obstacle is detected and then received by receiver[3]. The braking circuit's function is to slow down or stop the car automatically after receiving signal from the sensor. The existing systems detect obstacles which are located aline with the sensor. But, the proposed one senses an area nearly an 180^0 coverage.

Figure 1.1: Block diagram of actual distance for braking.



This system can turn on or off. If ABS is in turn on state, then it will alert to driver to brake manually when getting closer to an obstacle in thinking distance which is shown in figure 1.1. And if driver cannot react within that area, this system will brake automatically to prevent collisions when enter to the braking distance area which is marked in figure 1.1.

2. EXPERIMENTAL

This system has ON/OFF switch. Therefore driver can use this switch to deactivate the system temporary or permanently. By an LED, it shows whether the system is ON or OFF state. All three sonars transmit ultrasonic waves continuously and always checking for detection pulses. Using timer counter in PIC microcontroller, it calculates the time taken to detect a detection pulse since it is transmitted. Then the distance between the vehicle and the obstacle is measured by using the time. Speed of the vehicle is detected using a potentiometer. The torque of the steering wheel is detected using a potentiometer and therefore can detect if vehicle is about to turn left or right. After calculating the distance, speed, torque, the current state of the vehicle is distinguished by the system.

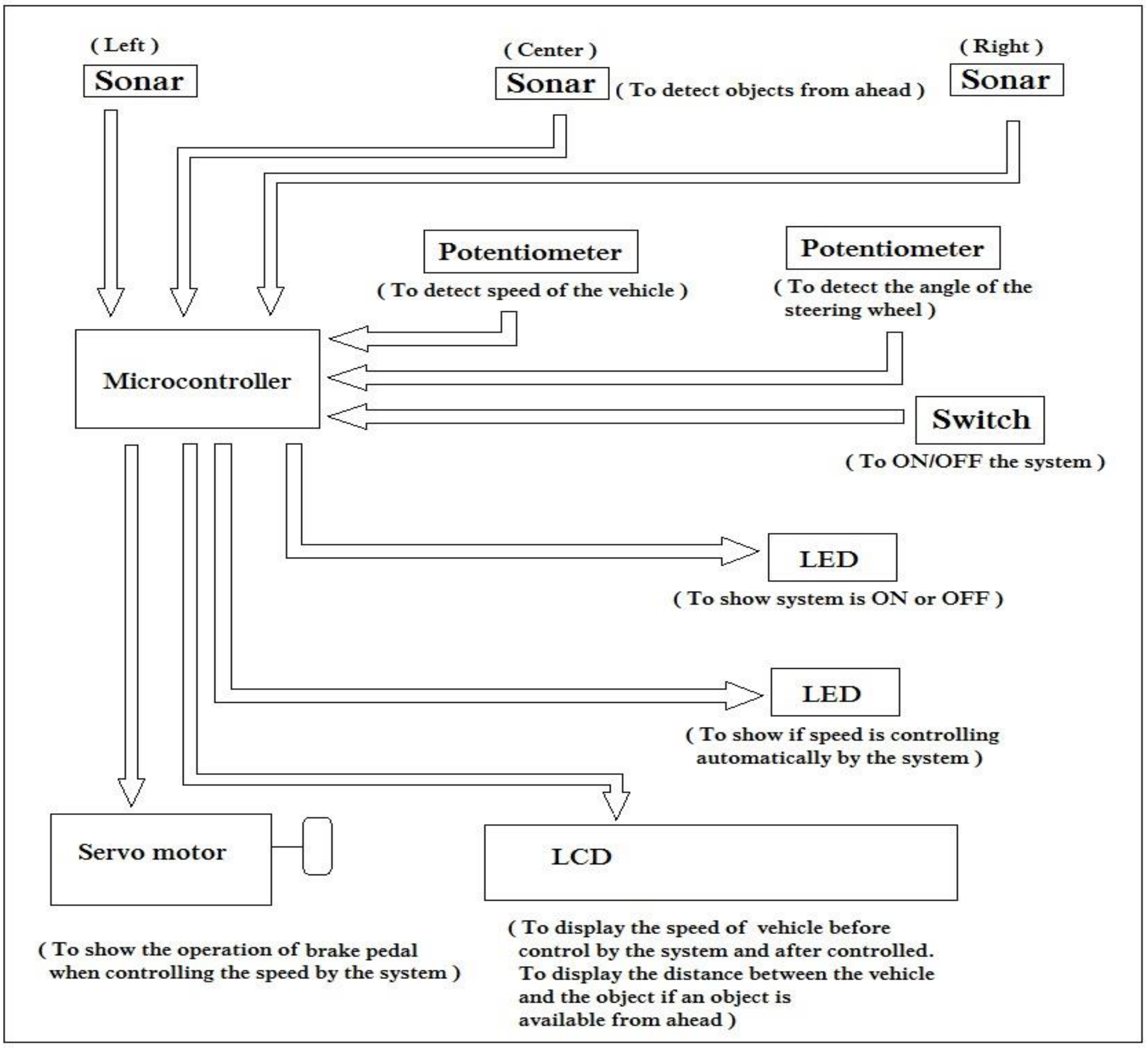


Figure 2.1: Block diagram of the system.

Different states are determined by using below conditions,

1) Speed should be less than or equal 50 kmph.
2) Torque of the steering wheel should be 0 Nm.
3) Distance between the vehicle and the obstacle should be less than the standard braking distances for relevant speeds as shown in Table 3.2.

If and only if above all three conditions are true, then it determines as “speed controlling state”.

If above all three conditions are true and the distance in third condition is less than two meters, then it determines as “stopping state”.

If above first, third conditions are true and the distance in third condition is less than one meter and the obstacle is not moving, then it determines as “stopping state”. Otherwise, it determines as “take no action state”.

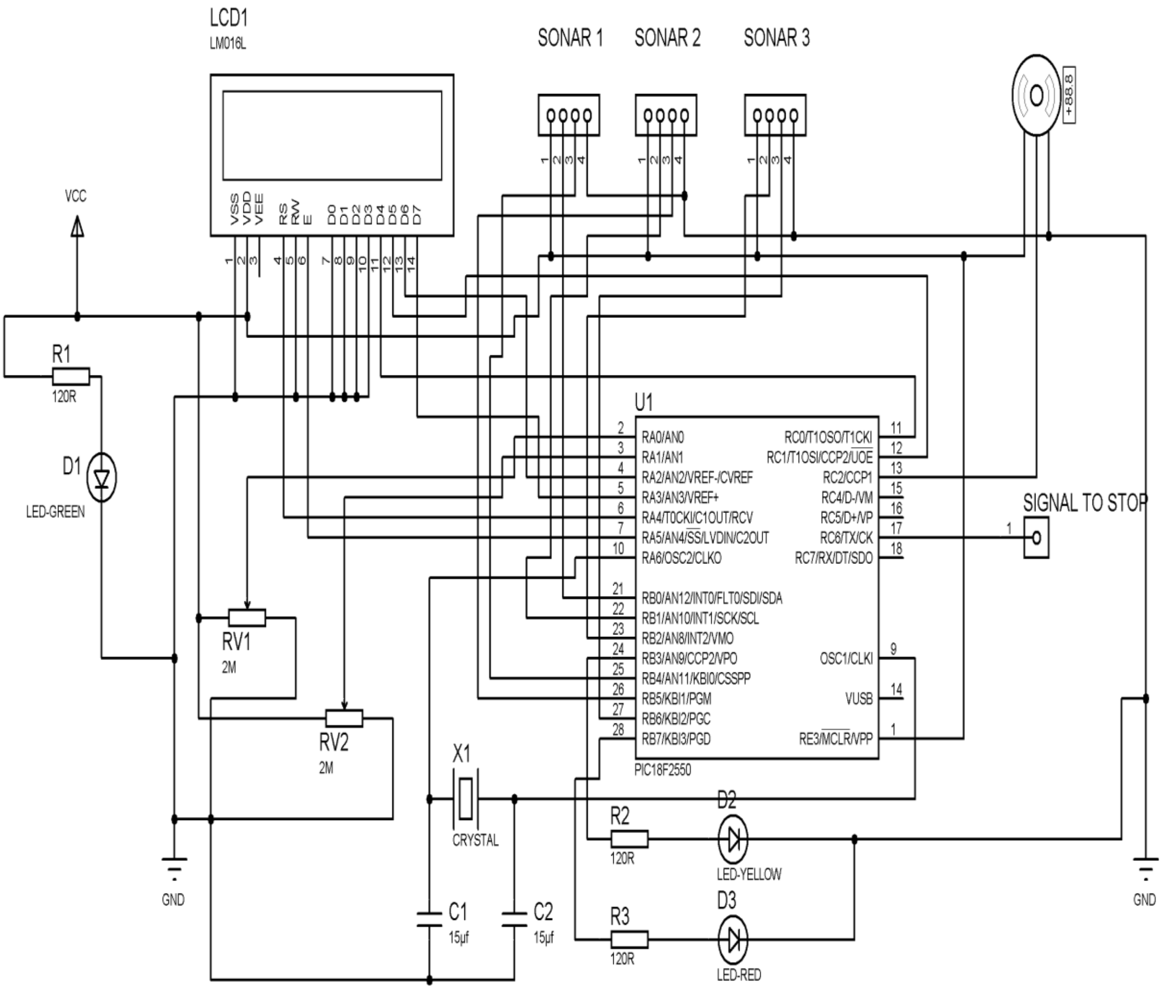


Figure 2.2: Circuit diagram.

3. REUSLTS AND DISCUSSION

3.1 RESULTS

All the separate circuits have been tested individually before simulation and then integrated as a whole circuit. Results were observed for different situations with different distances, speeds and steering wheel torques. The observed results are shown in table 3.1 when a stationary obstacle, a moving obstacle, and a bend were detected by the system.

Table 3.1: Observed results for different states of the vehicle.

Speed		Torque		Distance		Action
Value (kmph)	Satisfaction	Value (Nm)	Satisfaction	Value (m)	Satisfaction	
40	Satisfied	0	Satisfied	12	Satisfied	Slowdown
20	Satisfied	0	Satisfied	1.5	Satisfied and Distance < 2 m	Stopped
20	Satisfied	0	Satisfied	7	Not satisfied	Took no action
20	Satisfied	5	Not satisfied	6	Satisfied	Took no action
10	Satisfied	5	Not satisfied	0.5	Satisfied and Distance < 1 m	Stopped
30	Satisfied	5	Not satisfied	8	Not satisfied	Took no action
55	Not satisfied	0	Satisfied	20	Satisfied	Took no action
60	Not satisfied	0	Satisfied	35	Not satisfied	Took no action
55	Not satisfied	5	Not satisfied	20	Satisfied	Took no action
60	Not satisfied	5	Not satisfied	35	Not satisfied	Took no action

3.2 DISCUSSION

The system uses ultrasonic sensors to detect obstacles and measure distance between the vehicle and obstacles. Ultrasonic sensors normally transmit waves within 30^0 of total angle. Therefore to prevent the detection of unnecessary obstacles, disturbances have been used for help sonars to send waves directly with a reduced range of 15^0 angle. When measuring the distances it was assumed that four centimeters equal to one meter. It is more dangerous to apply sudden braking for a moving vehicle at high speed over 50 kmph. Therefore this system handles speeds below 50 kmph.

4. CONCLUSIONS

This ABS is a user friendly system and assists drivers for a less stressful driving specially in traffics. This implementation may increase the prevention of fatal collisions. The system can handle a maximum speed of 50 kmph. Therefore this system can be used to get maximum success at traffic near cities. In this prototype, sonar sensors have been used to detect obstacles and it is cheaper than radars. For real world applications, radars can be used to detect obstacles because radars can detect a higher distance than sonars. And also18F2550 PIC micro controller has been used to control the system[4]. For real world applications, Field Programmable Gate Array (FPGA) can be used to control the system because of FPGAs are programmable semiconductor devices that are based around a matrix of configurable logic blocks connected through programmable interconnect with up to 300 MHz frequencies[5]. The existing vehicles can use this ABS easily since this is a low cost and a reliable system.

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Authors would like to acknowledge and extend heartfelt gratitude to all staff at Department of Electronics, Wayamba University of Sri Lanka.

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A MICROCONTROLLER BASED FAULT LINE DETECTOR FOR POWER TRANSMISSION SYSTEMS

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ABSTRACT

Power transmission and distribution systems are essential links that realize essential continuity of service generator plant to end user. Identifying fault line in power transmission is one of the Ceylon Electricity Board's (CEB's) major problems. The designed system includes a fault line detector for a power transmission line and a remote communicator coupled to the fault detector circuit for sending status data, including load current data to a remote location. The proposed system relates to a method of monitoring and responding to current fault and load fluctuations an electric transmission network.

Keywords: Transmission line, Fault line indicator, Load monitoring, GSM controlling.

1. INTRODUCTION

Sri Lanka has approximately a fully coverage of electrical transmission lines [1.] CEB controls all major functions of electricity generation, transmission and distribution. Considering the large transmission network, a fault line cannot be identified easily. Supervisory Control and Data Acquisition (SCADA) system is used for controlling transmission lines. The pole mounted line indicators were used by the CEB to indicate the faults in transmission lines. Basically a pole mounted line indicators use current sensors to detect the current and the sensors are based on Hall Effect theory. But the system has failed due to transmission problems, because the pole mounted fault indicators cannot be used in combined line feeders. That is when high voltage current transmission and low voltage current transmission use the same transmission path. Due to this fact, two different magnetic fields occurred. Therefor Hall Effect current sensor cannot sense the current properly. And also battery was used as the power supply in pole mounted indicators. These are the big failures in pole mounted system. The new system has the ability to operate and detect a fault in any current line of a distribution system. Compared with the old system current sensing method is different. In this work a current transformer (CT) was used as current sensor.

Atmel 328p microcontroller was used in the proposed system to control the system. Microcontroller based systems refine, extend or supplement human facilities and ability to observe, communicate, remember, calculate or reason and take certain decisions when necessary. The proposed system which was developed to act and respond like human. attempts to make life more interesting by reducing unnecessary waste of man-power by employing microcontrollers. Microcontrollers are used to control devices thereby reducing the human effort. Microcontroller based fault line detector is an alternative to manually searching for fault lines which is laborious, frustrating, costly and time consuming. The proposed system comprises of several components, the first is the current sensors which detect amount of current flow in transmission line. Each current sensor sends a signal into the microcontroller for processing. If a fault occurs in transmission line, then a message is sent to indicate which line is having a fault to SCADA system in remote station. The designed system has many advantages. CEB can identify the line which has a fault quickly and respond [2]. And also this system is operated with solar power.

2. EXPERIMENTAL

2.1 Block diagram of the designed system.

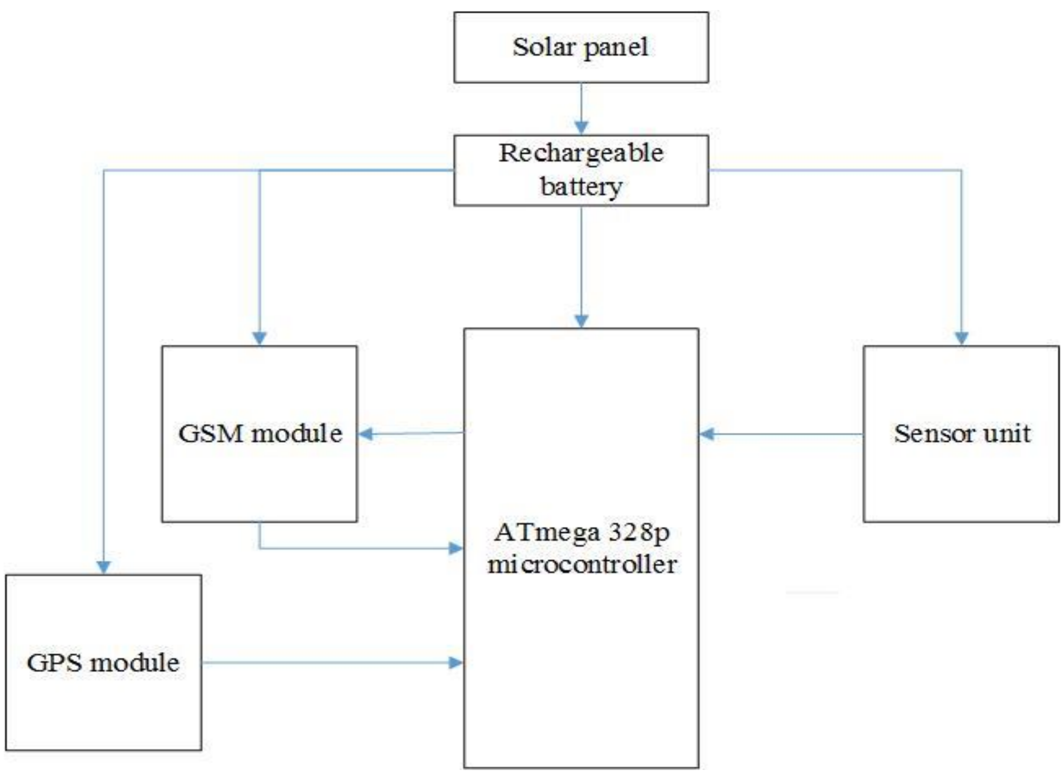

Figure1. Block diagram of the designed system.

The block diagram shows Microcontroller ATmega328P based power transmission line fault location indictor system. There is a solar panel and solar panel output is connected to rechargeable battery. The system uses battery power. The proposed system uses current sensors to sense current flow in transmission line. Whenever flow of current rises or decreases and current transformer sense the flowing current in transmission line. When the electric transmission line breaks down, sensor detects the fault. Then GSM module and GPS module will be active. After that GPS module take their location and give it to the microcontroller. Then the microcontroller creates a specific message with that location. This message is sent using GSM module to the SCADA system at remote station. SCADA system will display where the fault occurs as it has networked all the devices to a map to identify the location accurately.

2.2 Current sensor unit

Sensor unit is one of the main parts in this system. Current transformer was used as a sensor of this system. In the current measuring circuit, the current transformer will step down the current signal to the ratio 2000:1. But with a microcontroller current signals cannot be directly read, thus a voltage signal is needed to be given to the analog read pin. Therefore the secondary of current transformer needs to be connected to a burden resistor as shown in the Figure 2 Value of the burden resistor will be changed depending on the maximum current willing to be measured by the device.[3]

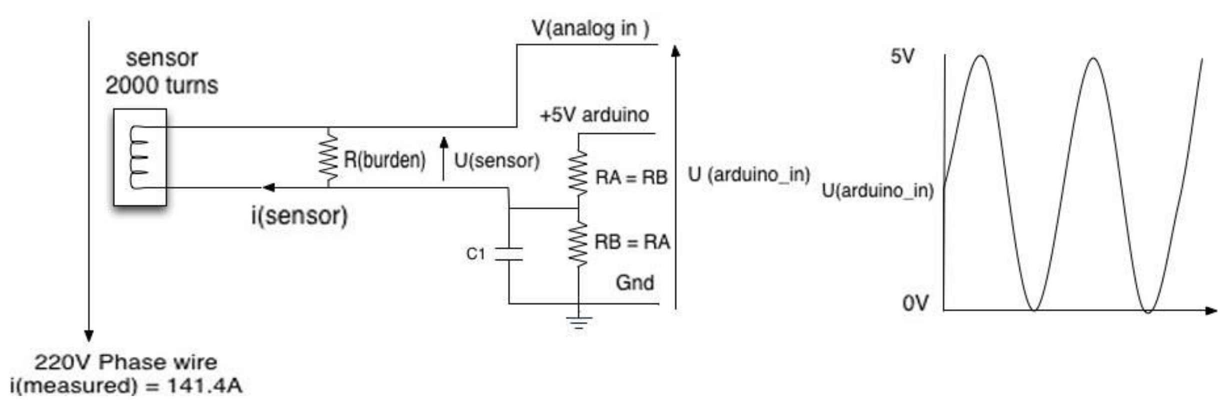

Figure 2. Conversion of current signal to voltage signal

First we need to know the measurable maximum peak-current

$$i(\text{measured}) = \sqrt{2} * i(\text{rms current}) = 1.414 * 100\text{A} = 141.4 \text{ A}$$

The current at the output of the sensor is defined by its number of turns (here is 2000)

$$i(sensor) = i(measured) / nb\_turns = 141.1A / 2000 = 0.0707A$$

Microcontroller can only handle voltage (between 0V and 5V) so we need to convert this current into an acceptable voltage. Therefore a burden resistor is needed in the circuit.

As the current is alternative around 0 and to maximize measurement resolution, the max voltage at burden resistance should be Max_accepted_voltage / 2 = 2.5V. Then a better burden resistor value can be calculated as follows

$$R(burden) = U(sensor) / I(sensor) = 2.5V / 0.0707A = 35.4\ \Omega$$

The ideal burden resistor is 35.4Ω, It is not an available resistor, therefore a 33Ω resistor was used.

Here Emon library was used for calculating Irms value. The input voltage to the microcontroller has a constant bias added to it, but this is immediately removed by a software filter, so we can ignore it when calculating the calibration constant. Likewise, we can work in RMS values for currents, voltages and counts. Thus the number seen by the processor is,

$$\text{Counts} = (\text{input pin voltage} / 5) * 1024$$

Where, Input pin voltage = secondary current * burden resistance

And Secondary current = primary current / transformer ratio

In software, in order to convert the count back to a meaningful current, it has to be multiplied by a calibration constant.

$$I_{supply} = \text{count} * \text{a constant}$$

Where, Constant = current constant * (5 / 1024)

And, for the emon library

$$\text{Current constant} = (100 / 0.05) / 33 = 60.606$$

2.3 The Controlling Unit

The system is mainly controlled by Atmel 328p microcontroller. CT which identifies the current passes analog output into microcontroller. As the signal is 50Hz signal, sampling speed of this had to be increased. The reason for using Atmel 328p microcontroller is to speed up data processing microcontroller. When the current flows through the transmission line a signal is generated from CT, proportional to the current flow and at the same time a proportional current is passed to the microcontroller as an input. The Irms value by calculating the input current is given by microcontroller. If Irms value is zero or Irms get rapidly increased then the GSM module will start and get GPS location from the GPS module. Finally a message is sent to SCADA system at a remote location.

3. RESULTS AND DISCUSSION

Figure 3 shows CT output when CT is connected to a transmission line. The received signal is given to the microcontroller and signal will be analyzed by microcontroller.

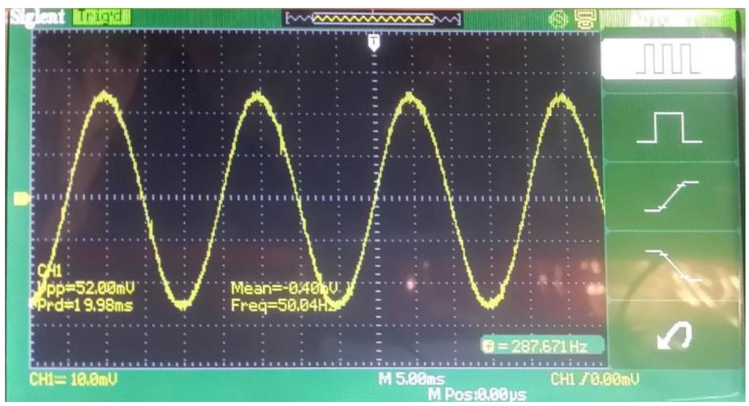

Fig.3: Current transformer output

Here a GSM module has been used to gather data. 3G/4G module can be used to upload real time data to the web server, other than the GSM module. Then this data can be analyzed and calculate apparent power using this data. The main advantage of this system is to detect the variation of power supply through a period of time. By connecting to a web server, real time variations can be detected and graphically interpreted using SCADA system [6]. And also the power consumption of regions can be calculated approximately as real time voltage is considered as a constant in this system. That leads to get a rough idea about the power consumption within the regions. It is easy to identify the regions where further improvements are needed. CT has been used as a current sensor this CT signal can be used to identify characteristics of current flow in transmission line but have to develop this signal and use digital signal processing [5]. Usage of Solar panel brings a

lot of advantages. The maintenance cost for power supply batteries are high as they should be renewed frequently. Usage of solar power will reduce the maintenance cost and defects.
This can be further improved to complex systems comprising with high voltage by using specific equipment which are applicable to each specific instance.

4. CONCLUSIONS

This system was designed to detect fault location in electrical transmission lines. Using this system, details of current flow in transmission line can be obtained of at anytime. And also when some fault occurs, message is sent to SCADA system. The system proposes a good platform for using alternative to the power sources as solar energy is frequently available in Sri Lanka. Usage of this power source helps to reduce the defects within the system and it leads to increase the efficiency within the system. And also it reduces the cost. This system helps to identify the fault location quickly and that will lead to take quick remedies for the fault.

ACKNOWLEDGEMENTS

The authors wish to express their gratitude to the staff of the Department of Electronics, Faculty of Applied Sciences, Wayamba University of Sri Lanka for the assistance.

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HUMAN DETECTING ROBOT FAN WITH BLUETOOTH BASED CONTROLING TECHNOLOGY

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ABSTRACT

Nowadays there are so many types of fans are used in the society. With the development of electronic-mechatronic controlling technology the automatic controlled fans are more favorable today. It is useful to control their speed and rotation more easily giving comfort to humans. In general, people often used to employ ceiling fans, table fans, stand fans and wall fans. Such fans have 4 or 5 buttons to manually operate the speed and the oscillation of the fan. Our research study is based on designing a table fan which can control these functions automatically and remotely. This proposed fan is a development of an ordinary fan that consists of several features that lead to comfortable and easier life. This proposed fan can regulate speed regarding to the environment temperature and it will only operate whenever there is presence of human. Furthermore, the fan is designed to automatically oscillate with respect to the location of human. In today's world, there are some table fans which can operate using IR remote control. Sometimes finding the remote may be difficult. But in present, the smart phone is a frequently used device which always closely kept by the people. Therefore, this proposed fan can control by a smart phone using Bluetooth technology. Our proposed fan can be produce with low cost, about 40% cheaper than commercially available such fans.

Keywords: Bluetooth technology, Mechatronic controlled , Human detection.

1. INTRODUCTION

More living rooms are often not well arranged with air conditioning. So the fan is the cost effective easily used way of cooling down houses and is used in most of the houses. But when it is desired to change the direction of air flow, the fan doesn't have any automatic or efficient feature. Conventional fans have usually two options for directing air flow. Firstly, fan is static and we physically redirect it to direct air flow in the desired direction. This option is not user friendly because when one wants to change the location in the room, he has to redirect the fan's air flow. The physical effort which is required to redirect the airflow may be difficult if the fan is heavy or the user is of elderly age and not well people. It may also require multiple attempts to redirect the fan in the desired direction. Secondly fan can rotate back and forth with a set angle less than 180 degree. And it is unnecessary to direct the fan at empty space which may cover its large portion of the rotation cycle which we need to avoid. Moreover, rather than controlling the fan by pressing a button or by finding the controlling device and aiming its IR path towards the fan may not be comfortable. Therefore, we propose the fan control with the use of smart phone with using Bluetooth technology and creating user friendly Android applications. Moreover this will be a great benefit for people who are paralyzed.

2. EXPERIMENTAL

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

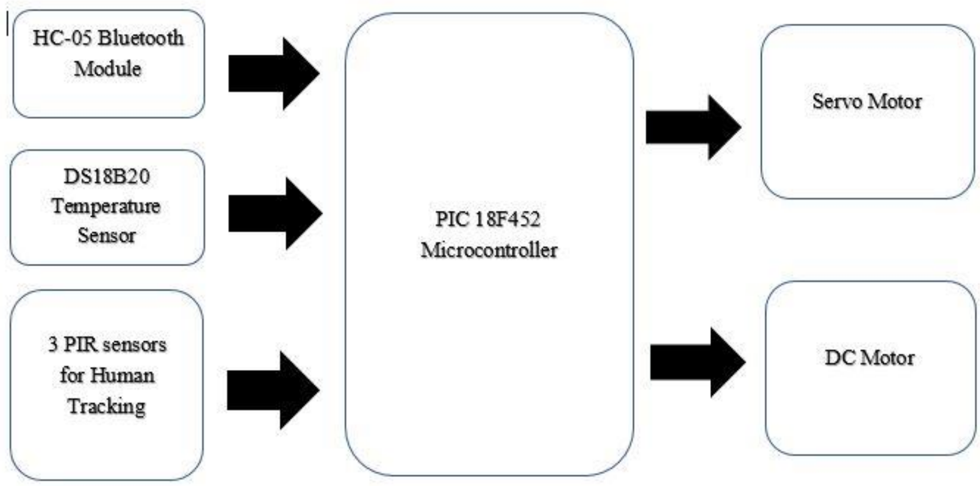

Figure 01: Block Diagram of the System

In the proposed system, the temperature of the environment was measured by DS18b20 temperature sensor. The DS18B20 digital temperature sensor provides 9-bit to 12-bit Celsius temperature measurements. It communicates over a 1-Wire bus that by definition requires only one data line (and ground) for communication with a central microprocessor. And it is more accurate and faster than other temperature sensors.[1]

And 3 PIR (Pyroelectric Infrared) sensors was used for human tracking. PIR sensors allow you to sense motion, almost always used to detect whether a human has moved in or out of the sensors range. They are small, inexpensive, low-power, easy to use and don't wear out. To detect the side where the human stay, 3 PIR sensors were used towards the different angles.[2]

HC–05 Bluetooth module was used to develop Bluetooth controlling unit. HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband.

Servo Motor was used to oscillate the Fan and the DC motor was used to rotate the Fan. This is the circuit diagram of the proposed system. Here, 3 push buttons were used for PIR sensors.

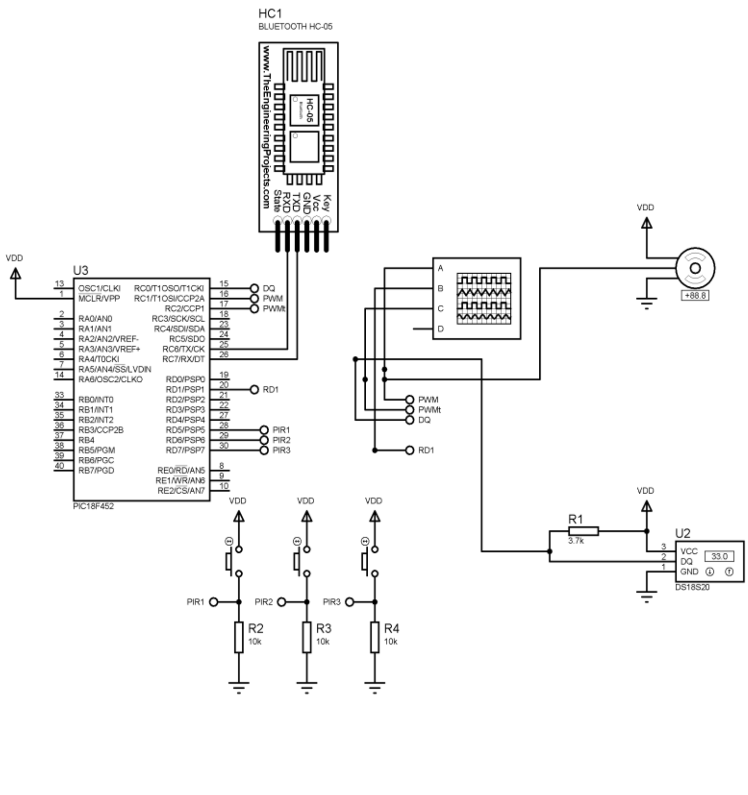

Figure 02: The simulated circuit diagram of the System

3. RESULTS AND DISCUSSION

Based on the performance of our fan controlling system, the rotation speed changing part directly functioned according to environment temperature change. The controlling part via Bluetooth technology was done successfully. But based on the result obtained from the PIR sensor, the response is somewhat fast in which the fan will turn on whenever there is detection of motion. However, the limitation of the system is found where the fan will turn off if the person that the PIR detected earlier is not moving. If there is motion made by the user the fan will turn on again even for small movement such as waving the hand. In automatic mode, this limitation makes the fan lack of reliability where the users have to make a movement to make the fan to keep turn on. So As further developments we hope to use a camera and image processing technology to identify people correctly. But in our research study, the user can control the fan from anywhere in the room using his/her smart phone via Bluetooth controlling technology.

4. CONCLUSION

A control system for a fan comprising a temperature sensing module for determining the surrounding temperature when the fan is operating. An human locating module for constantly detecting the location of human within an angle of oscillation of the fan. Also, there is a Bluetooth controlling unit to control the fan using a smart phone. This controlling unit using Bluetooth technology is a novel concept in our research study. A microcontroller for processing signals from the modules and provide output accordingly for on/off operation of the fan, varying the fan speed, and oscillation angle of the fan. So this is a law cost(about 40%) and more user friendly fan than the other commercial fans available today.

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DESIGNING AND IMPLEMENTATION OF LOW COST MACHINE AUTOMATION SYSTEM FOR HARISCHANDRA MILLS PLC

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ABSTRACT

Today, main focuses in food production field is to maintain high quality, to have low cost production and to maintain the production line at international standard. As a result, lots of companies tend to use machine automation and production quality analyzing systems. The aim of this project was to design and implement low cost machine automation for Harischandra Mills PLC. The objective of this project is to develop a device that can automatically regulate power surge for machineries in the factory and allow its users to remotely control and monitor each machine separately by using a mobile phone. The system measures the temperature and humidity of the production process and it will be displayed on the LCD display. For developing this device, SIM900A GSM/GPRS Shield, AM2301 compound Temperature/Relative Humidity sensor, 12V 5A switching mode power supply unit, LM2596 adjustable voltage regulator and an arduino circuit were used. AM2301 compound Temperature/Relative Humidity sensor was used to measure the temperature and humidity of the production. A sim card installed GSM shield provides the connectivity between operator and the unit. The arduino circuit was used to control the whole system. The designed system has a Liquid Crystal Display (LCD) to display the temperature, humidity and status of the machine.

Keywords: GSM (Global System for Mobile communication), GPRS (General Packet Radio Service), Arduino, Adjustable voltage regulator

1. INTRODUCTION

Harischandra Mills PLC currently possesses forty-seven machines relevant to its productions. Most of them are used throughout the day. Switching on and off each machine is done by its operator. In this situation, some machines will be forgotten to switch on or off as predetermined. So improper machinery and electricity usage will occur and due to that huge maintenance costs had to be incurred by the company[1]. As a solution for this major problem of the company, machine automation system was developed. Controlled production processes are essential for the production of high quality and healthy food. The quality parameters humidity and temperature are indispensable in various kinds of food[2]. At the moment, the company measure humidity and temperature of the raw materials and the final product of the production process. This proposed system, can measure humidity and temperature at the intermediate level of the production.

The developed system can be divided into two basic sections. First section to measure temperature and humidity of the production to switch the machine (on/off) according to the sensor readings.

In the proposed system, machine can be on/off by sending the text massage through the operator's mobile phone. The system will measure temperature and humidity of the production process and display on the LCD display. If the temperature or humidity exceeds the upper threshold limit, then the machine will be automatically stop by the system indicating the status of the machine. A text massage will be sent to operator's mobile phone. Furthermore temperature, humidity and status of the machine will be displayed on the LCD display of the system.

2. EXPERIMENTAL

The block diagram given in figure 01 describes the system.

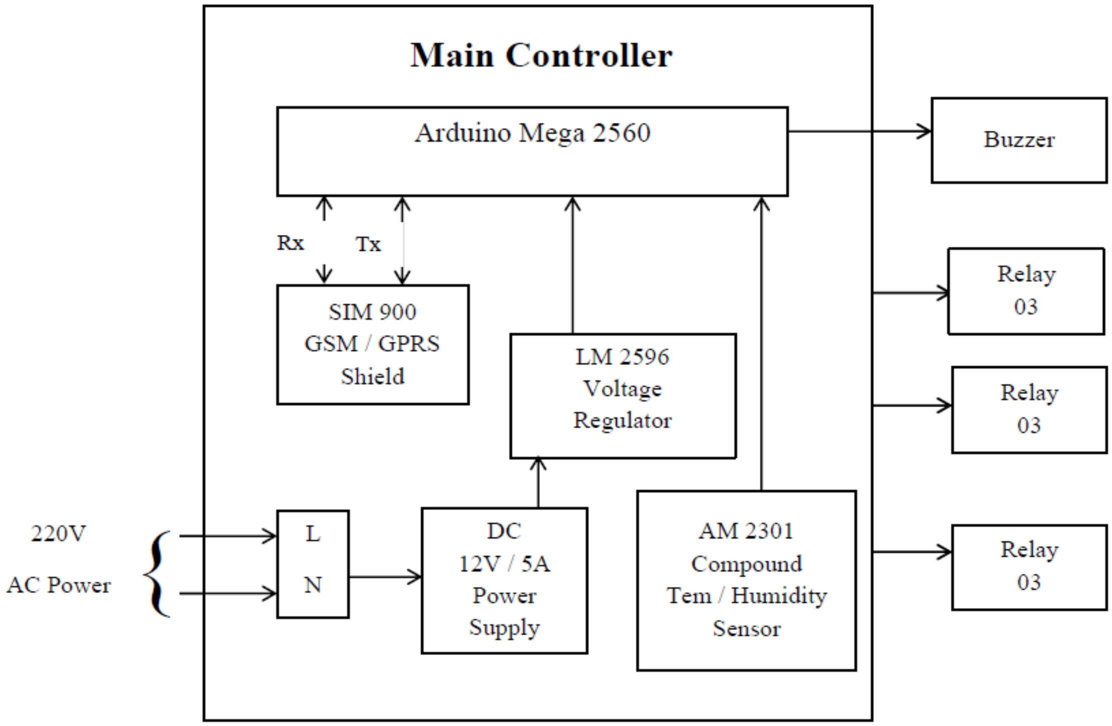

Figure 01: Block diagram of proposed system

To establish a connection between operator and the machine, a sim card was installed in a GSM shield. This method was used, because it enables the operator to identify any machine by a unique number[3].

The task assigned to GSM shield was to receive a SMS (Short Message Service) from the operator and to hand over it to Arduino Mega 2560. Arduino will check whether the messages arrived are in given format or not. If a message is in correct format, it will start to read the message[3]. At the reading stage of the message it will try to identify content of the message. i.e. the message is to control the current status of the machine. To achieve efficient control from the mobile phone, three relay contacts were attached to the system to control three machines separately.

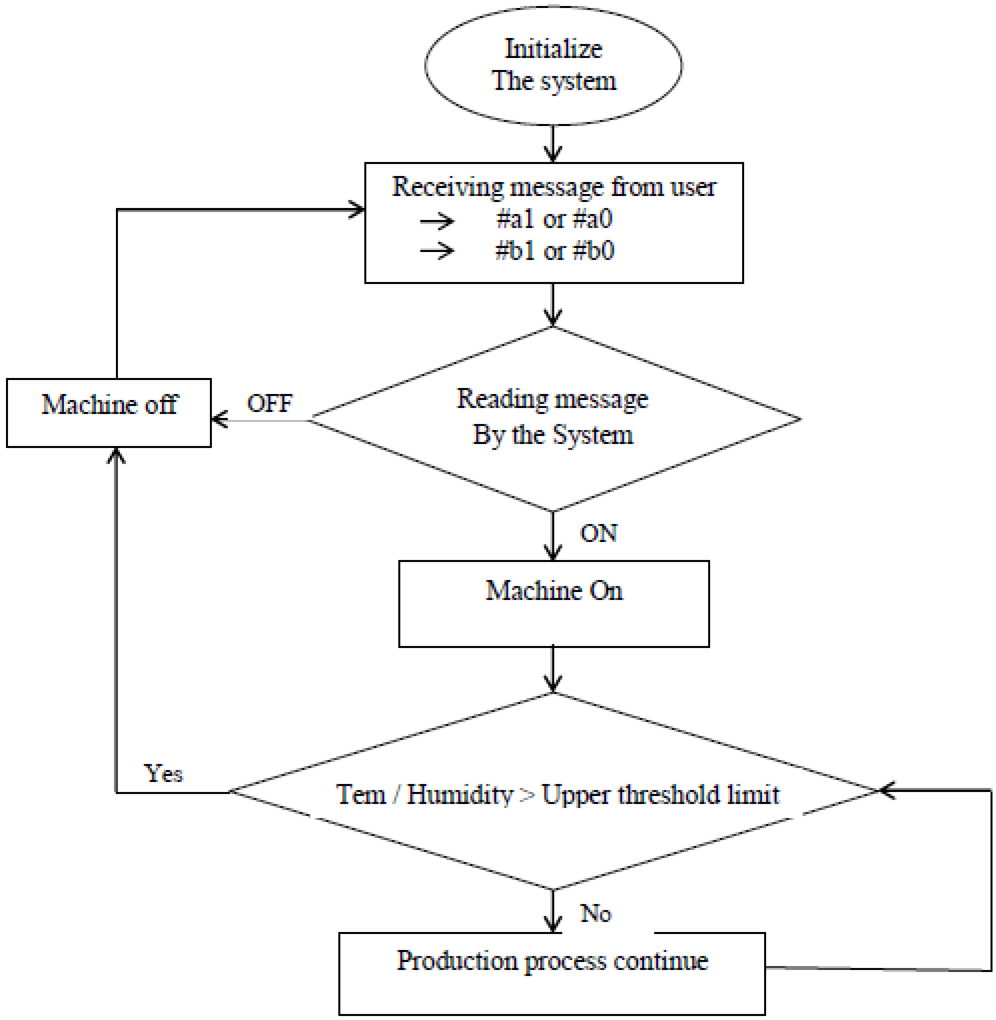

Figure 02: Flow Chart of the System

The flow chart given in figure 02 describes the functionality of the system. When the power supply is on, system will get initialized. System will require the instruction message from the user to continue the process. At the reading stage of the message, it will try to identify content of the message. If the machine is on, the system will measure temperature and humidity of the production process. If the temperature or humidity exceeds the upper threshold limit, then the machine will be automatically stopped by the system and the status of the machine will be sent to operator's mobile phone via a text massage.

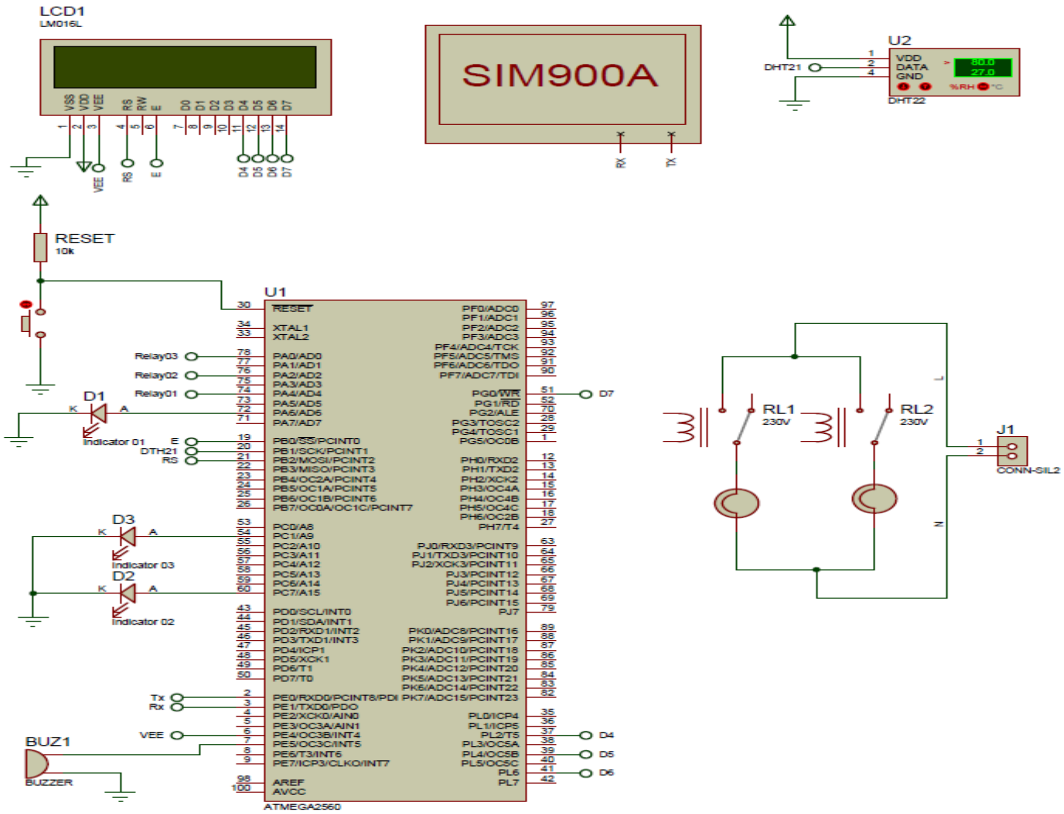

Figure 03: The circuit diagram of the machine automation system

3. RESULTS AND DISCUSSION

3.1 Results and Discussion

After compiling and launching the system, main controlling unit was functioned properly as expected. The status of the particular machine, temperature and humidity were displayed on the LCD. Furthermore, communication between the system and the operator was functioned properly.

This system is a cost effective solution for the company. This type of a factory automation system is very expensive. However, this system can be developed at the half the price, of the market price.

3.2 Strengths of the project

- No need to visit each machine to check the working status of the machines.
- Status of the machine and status of the production were sent to the operator's mobile phone via a text message.
- Cost effective
- Time saving
- Improve productivity
- Ease of use

4. CONCLUSION

This machine automation system is a cost effective solution for the problem of improper machinery/ electricity usage and to maintain the quality of the production. Working states of the machines can be seen clearly using the developed system. With this solution, the company will be benefited financially by cutting down undesired expenses while improving the productivity.

ACKNOWLEDGEMENTS

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DESIGNING OF SELF LEVELING TRIPOD HEAD

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ABSTRACT

Today automation plays a vital role all around the world. Each and every aspect of the human's life is impacted by the automation in numerous ways. Most of the industries are tend to automate their manual works to reduce the labor cost and the time consumption. This study was carried out with the intention of developing automatically leveled tripod head useful in Construction, Photography and Surveying industry. The purpose of the self leveling tripod is to maintain the tripod head at leveled position although the tripod was placed in uneven ground. This paper presents a method to design and control a self-leveling tripod head and it focused on hardware description, signal processing, filtering and Proportional Integral Derivative (PID) control loop algorithm.BasicallyATMEGA328P microcontroller and MPU6050 chip was used to design the circuit. MPU6050 chip has MEMS based inbuilt accelerometer and gyroscope sensors which used to gather motion data for self balancing. In this system data was manipulated by filtering using complementary filter and motion of the tripodhead was obtained by two servo motors.ATMEGA328P microcontroller produce control instructions to the respective servo motors to rotate by certain angle given from the complementary filter.The PID algorithm smoothes the motion of the motors by adjusting the process control inputs and help to reach the desired set point. This design can be used in several industries to enhance the efficiency, accuracy and flexibility of the existing system.

Keywords: Accelerometer, Gyroscope, Leveling

1. INTRODUCTION

Some industrial applications need steady surface to mount devices used in that industry. The Nature of the terrain where device has to be mounted depends on the application or the industry. Most of terrains consist of slopes or uneven planes which make it difficult to mount or temporally placed the devices necessary for various applications. Tripod is the device used in these situations to provide stable platform to mount devices.It is a device with three-legged frame and a mounting head which is commonly used as a portable device. The importance of having this three leg frame was the ability of providing stability inany uneven ground or any unstable surface. The mounting head has particular applicability in providing an extremely stable platform for various objects such as cameras, telescopes, total stations, theodolites, and levels or transits. Tripods are most commonly used in Construction industry, Photographic industry, surveying industry and in laboratory works.

Photographic industry needs only smooth motion with the camera mounted to the tripod. But in Construction and Surveying industry the accuracy of measurements is much more important factor to be considered than in Photographic industry. However in all these cases the tripod head has to be leveled properly to obtain better results. Leveling is the process of measuring vertical distances between two or more ground points either directly or indirectly for the purpose of determining their elevations.[1]Existing surveying tripods cannot be leveled individually and the required leveled platform was obtained by the instrument mounted to the tripod. But in photographic tripods there is an inbuilt mechanical system to level the tripod individually. The leveling procedure in both these tripods was carried out manually using a bubble level. The user has to adjust the leveling screws of the instrument mounted to the tripod continuously until the water bubble gets centered. Although it provide precise leveled position from this leveling process it consume much time and the accuracy depend on the user's optical view. Another huge issue in the existing system was when the position of the tripod changed this leveling process has to be carried out again and again with much effort. Therefore there was a need of designing automatically leveled tripod to overcome these limitations.

This research work was mainly focused on developing a self-leveling tripod head which could move to the desired position efficiently and effectively by a simple manipulation of the operator. This study can support number of persons from beginners to experts in many occasions with high flexibility

2. EXPERIMENTAL

Prototype for the tripod head was developed for achieving efficient leveling capability with minimum hardware support as shown in Figure 01. One of the main aspects of designing this model was to implement it in low cost with high efficiency, accuracy and durability. The motion of the platform can be controlled efficiently as there are two separate motors to control both X and Y axes individually. This servo arrangements a more efficient use of space and it limits the amount of slop[9].The develop model consists of several units. They were Position detection unit, Main Controlling Unit, Motion controlling unit and Power supply unit. The block diagram of the proposed system was shown in Figure 02.

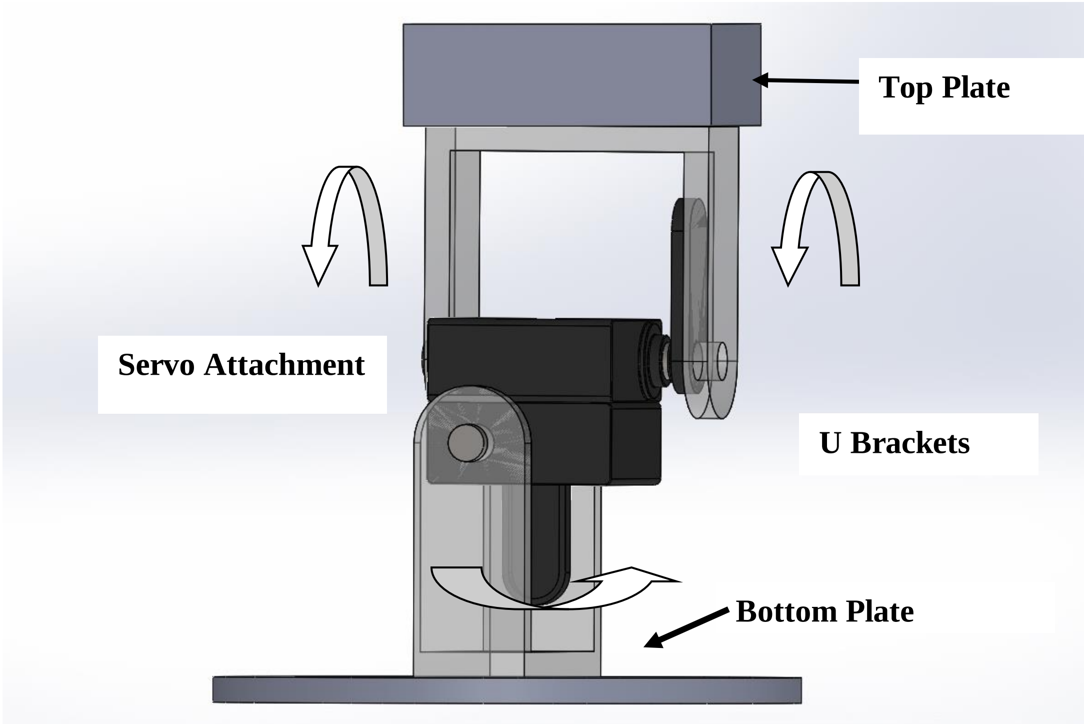

Figure 01: Prototype of the system

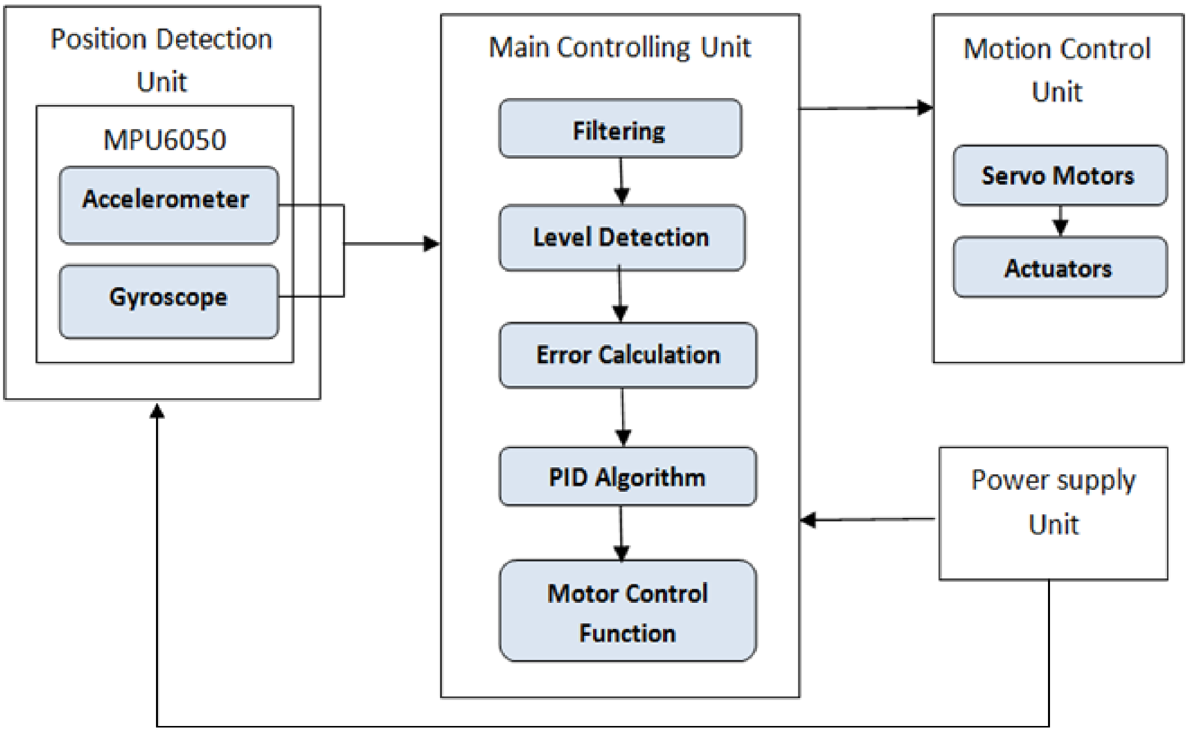

Figure 02: Block diagram of the proposed system

- Position detection unit

The Position detection unit consists of MPU6050 module (Accelerometer sensor+ Gyroscope sensor). This MEMS(Micro-Electro-Mechanical System) based MPU-6050 sensor contains a MEMS accelerometer and a MEMS gyroscope in a single chip.[10]The component of acceleration (g) along X and Y axes on the tripod head was detected using the accelerometer sensor and the component of angular velocity along X (Roll) and Y (Pitch) axes was detected using the gyroscope sensor.[2] The digital outputs of the sensors were then fed in to the microcontroller unit.

- Main Controlling Unit

Main Controlling Unit consists of ATMEGA328P microcontroller. Inside this unit the data gathered from MPU6050 was filtered using complementary filter to obtain higher accuracy and precision.[10, 2] Filtered data was send to the microcontroller which measures how far the current position of the tripod head was located from the desired set point (leveling point).Then instructions were given by the microcontroller to control the motion of the two servos attached to two legs. The smooth motion of the servo motors were controlled by using PID control loop algorithm.

- Motion controlling unit and Power supply unit

As shown in Figure 01 C shape mounting brackets were attached to the motor and the two servo motors are attached together horizontally. This horizontal servo arrangement provides more stability within the system than vertical servo arrangement. According to the instructions from the microcontroller the motors rotate either clockwise or anti clockwise to reached the desired set point. The microcontroller unit, servo motors and sensors were powered by the power supply unit.

3. RESULTS AND DISCUSSION

The outputs of the accelerometer and gyroscope sensors were analyzed before using them for self leveling process. After the analysis it was found that the data from the accelerometer sensor generate lot of noise while the gyroscope sensor data drift over time. As a solution for this limitation complementary filter was used. The results of the complementary filter eliminate that noise from the accelerometer sensor and the drifts from the gyroscope sensor[2, 5] as shown in Figure 03.

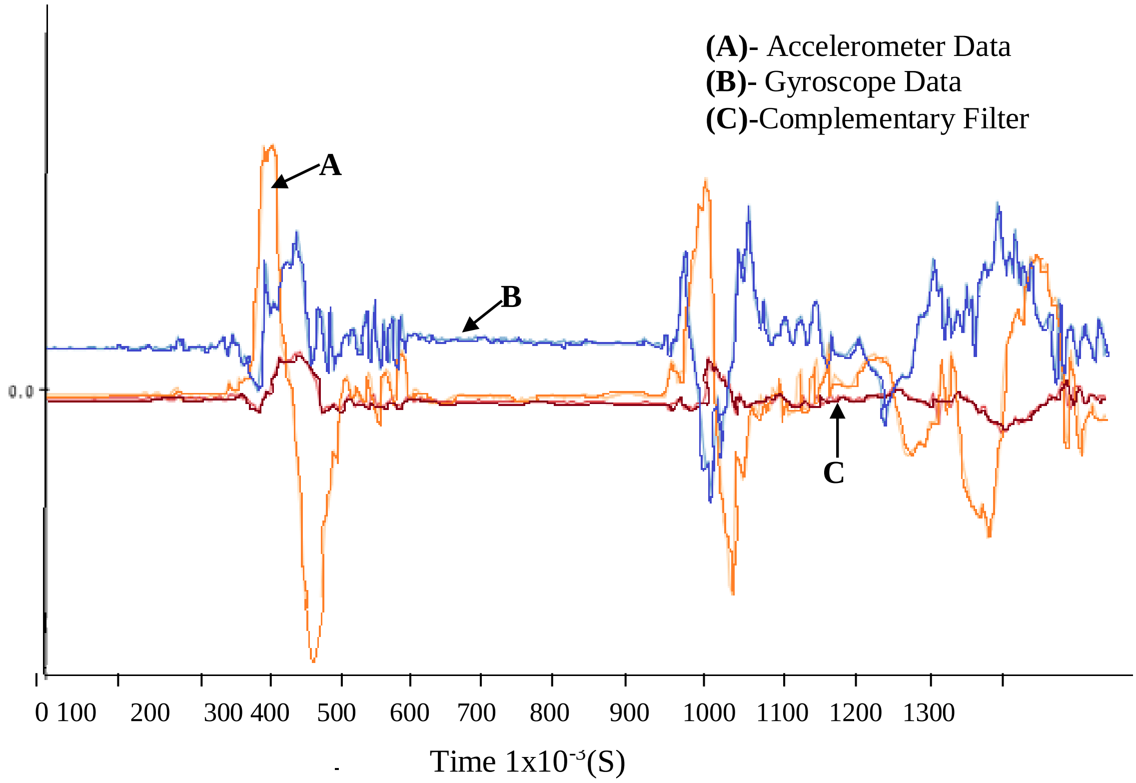

Figure 03: Filtered and unfiltered data from the MPU6050 sensor

When the filtered data was directly given to the motor control unit the tripod head tends to drift when it reached to the balancing point. This issue was solved by using PID controlling algorithm. It provides smooth motion with the motors which help to obtain desired balance point easily.[2, 5, 7]

The accuracy and the precision of the tripod was checked by measuring time taken to reach to the leveling point by placing different weights on the tripod head. The results represents that when the amount of weight places on the tripod head increases, time taken to reached the balancing point will increases. The final output of the prototype was checked by placing bubble level on the tripod head. The bubble level results showed that the accuracy of the tripod head was approximately 93% at lower weights. This accuracy value was determined by observing how much of the bubble remained within the “level” limits marked on the bubble tube.[9]when a heavier object was placed on the level, the accuracy improved to about 96%.

Sensitivity of the system was measured by placing the tripod in different angles with different surfaces. Time taken to reach the leveling point was measured as shown in Figure 05. It represents that the tripod head has the ability to align 15 degrees with in a second.

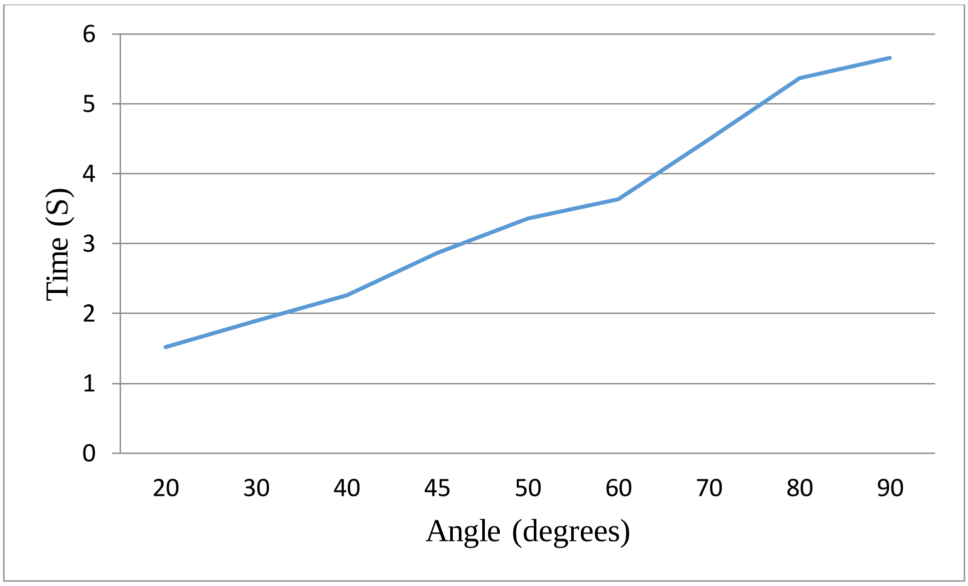

Figure 05: Variation of the position with the time

4. CONCLUSION

The proposed system and the prototype can be used in numerous industrial works. It is an accurate, effective, efficient and flexible designed which can be used by any user. As the servo motors used in the prototype was not so speed, leveling process cannot be done with a very high speed. This limitation can be overcome by using high speed servo motors. Mechanical drawbacks of the design may influence on the final output. This concept of self-leveling tripod head can also be used to design self-balancing platforms which will be applicable in self balancing robots, vehicles and in self balancing Landing Platforms.[2, 3, 4, 8]

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PROGAMMABLE MULTIPURPOSE WATER DISTRIBUTION CONTROLLER

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ABSTRACT

In agriculture the use of the bulk of available freshwater resources and the use of freshwater resources will continue to increase as population growth and food demand increase. An automated irrigation system designed primarily to optimize the use of water on the agricultural industry. This study developed an embedded system for the automation of the programmable water distribution controller for plant irrigation in order to reduce water wastage and provide an appropriate water supply using the programmed programming method. In the conventional irrigation system, the farmer must monitor the irrigation schedule, which is different for different crops. As far as the use of this device is concerned, it can supply water to the plants for a given time and this system allows the right amount of water to be applied at the right time irrespective of the availability of the valves or the engine ON & OFF. The water supply system is automated using the PIC18F452 microcontroller, the RTC DS1307, POW110D3B and DC standard servomotors. A prototype of the water distribution controller proposed by the microcontroller has been designed and tested.

Keywords: Automated irrigation system, Programmable Integrated Circuit (PIC), Real Time Clock (RTC)

1. INTRODUCTION

The ever-increasing demand for food requires a rapid improvement in food production technology. In a country like Sri Lanka, where the economy is mainly based on agriculture. However, it cannot fully utilize agricultural resources due to lack of rainfall and water shortage in the reservoirs. Continuous extraction of the earth's water is the reduction of the water level by which the land batch slowly comes into the areas of non-irrigated land. Another very important reason for this is due to the unplanned use of water because of which a significant amount of water is wasted. This problem can be corrected if we use an automated irrigation system based on a microcontroller in which irrigation will take place only when there will be an acute requirement of water[1].

1.1 Need of an Automatic Irrigation System

In everyday life, there are some physical elements that need to be controlled so that it can perform their expected behaviors. A control system can therefore be defined as a device or set of devices that manages, controls, directs or regulates the behavior of other devices or systems. Therefore, automatic control involves designing a control system to operate with minimal or no human interference. Automatic irrigation systems are convenient, especially for those traveling. Watering with a pipe or an oscillator wastes water. Neither method targets the roots of plants with a significant degree of precision. Automatic irrigation systems can be programmed to discharge more accurate amounts of water into a targeted area, which promotes water conservation[1, 2].

1.2 Existing Automated Irrigation Systems

Extremely high-tech solutions are using Geographic Information System (GIS) and satellites to automatically measure the water requirements of each crop plot and optimize the irrigation system. There are six high-tech automation systems,

1. Time based system
2. Volume based system
3. Open loop systems
4. Closed loop systems
5. Real time feedback system
6. Computer-based irrigation control systems

In real time feedback irrigation system is based on actual dynamic demands of the plant itself. The plant root zone is effectively reflecting all environmental factors acting on the plant. The time based and volume based systems are using irrigation time clock controllers and volume controlled metering valves respectively. Open loop control systems use either the irrigation duration or a specified applied volume for control purposes. Open loop controllers normally come with a clock that is used to start irrigation. Termination of the irrigation can be based on a pre-set time or may be based on a specified volume of water passing through a flow meter.

The purposed automated water controller is a combination of above one to four existing systems, that operator makes the decision on the amount of water to be applied and the timing of the irrigation event[3, 4]. The controller is programmed correspondingly and the water is applied according to the desired schedule.

2. EXPERIMENTAL

2.1 Components of Automated Water Controller System

Effective water management involves providing water according to the actual requirement, and therefore measuring water is a very essential step in water management systems. There are many techniques for measuring water flow as well as different types of water flow meters used to measure the volume of water flow in pipelines, but these are all too costly. Implementing this system there are mainly three components exists[5]. Following Figure 2.1 shows the block diagram of the proposed system.

1. Controllers (RTC, Servo motor A/B)
2. Sensors (Flow sensor A/B)
3. Monitoring software/decision support system (LCD)

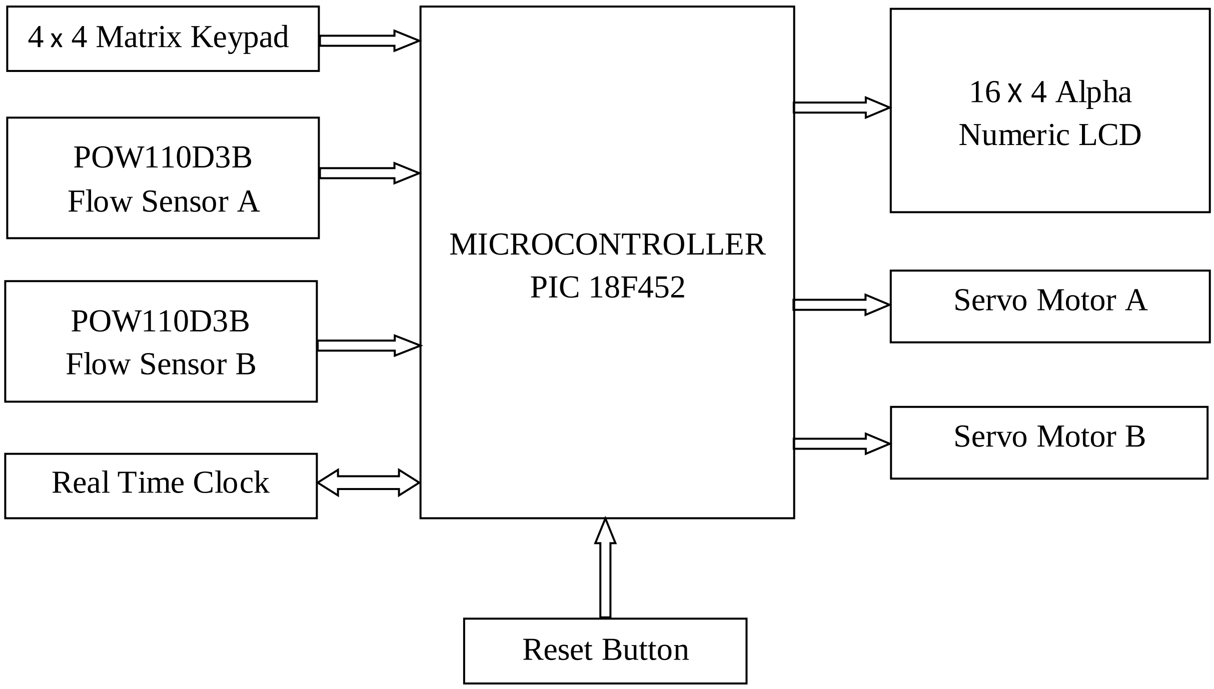

Figure 2.1: Block diagram of the proposed system

2.2 System Operation

All the input data are entered to the system using the 4 x 4 matrix keypad and they are saved in the EEPROM, which is a non-volatile memory located in the microcontroller. Flow sensors, valves and servo motors were mounted on a stand according to the design. Then, mikroC program codes were implemented to test flow sensors and servo motors. Flow sensor readings were taken using the implemented test codes and flow count, flow rate and calibrations were found. Test programs were implemented to control the servo motors according to the user given flow rates and flow sensor readings.

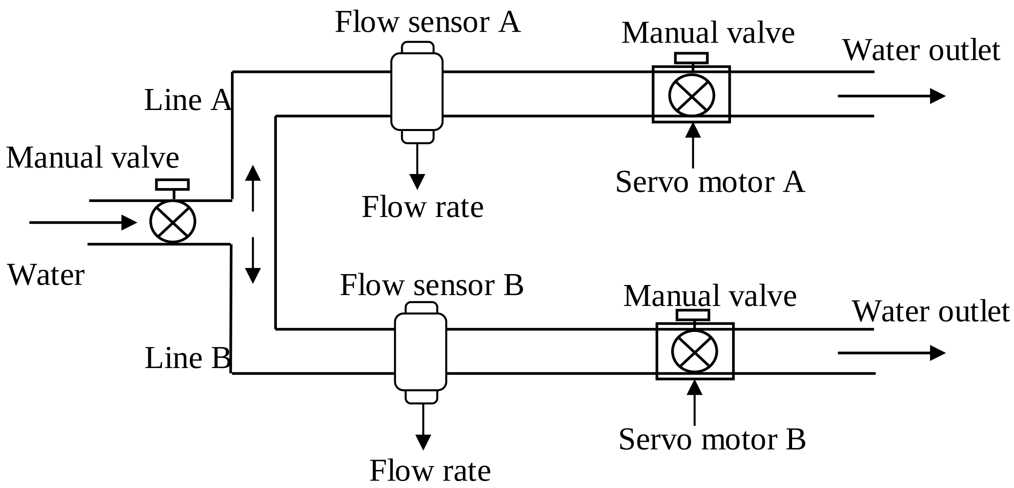

Figure 2.2: The layout of the proposed

After that, mikroC program codes were implemented for all the interfaces and menu items. RTC IC was interfaced with the microcontroller and codes were written to set date/time and read date/time with the help of the RTC's data sheet. Also 4x4 matrix keypad was interfaced with the microcontroller and codes were written to take user inputs. Algorithms were implemented to handle the user input data more accurately. MikroC PRO for PIC version 6.0.0 was used to develop and compile the mikroC codes. Proteus 8 Professional software was used to do simulate and check the program codes. PIC Kit 2 programmer with PICKit 2 V2.61 was used to upload hex files to the microcontroller.

A PCB was designed for the system and all the components were soldered to it. For better durability and protection PCB, LCD and the keypad were mounted on a project box. All the connections were made with the circuit and external components (flow sensor, servo motors, LCD and keypad). Finally, further testing's conducted with the designed system[6]. Figure 2.2 shows the layout of the proposed system and Figure 2.3 shows the flow chart of the proposed system.

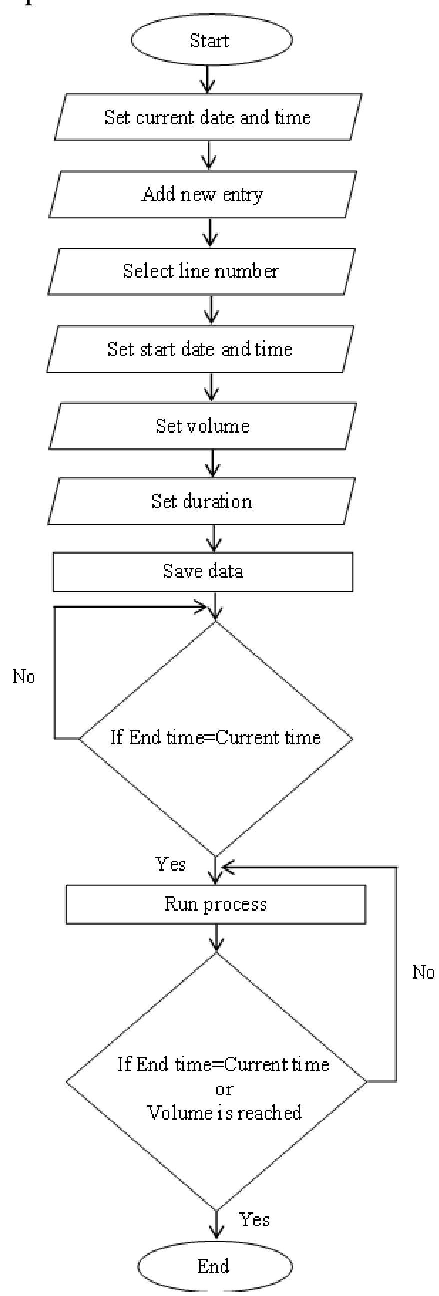

Figure 2.3: Flow chart of the proposed system

3. RESULTS AND DISCUSSION

In the proposed system, a schedule is called an entry and number of entries depending on the capacity of the microcontroller's ROM. An entry consists of starting date and time, duration, volume and the flow rate at which water should supply. Hence, at the beginning when a specific schedule is entered into the system, flow rate is calculated using the input data (duration and volume). Then at the start of a scheduled process, current flow rate is measured by means of the time duration between two pulses given by the flow sensor and the amount of water is calculated by counting the number of pulses. In this research study there are mathematical functions to control the sensor and controllers. The flow rate of the flow sensor was calculated using following Equation [3.1].

$$\text{Flow rate} = \text{Volume}/\text{Time} \qquad [3.1]$$

Water pressure and the flow rate may vary with the normal household water. Therefore, first of all it was tested the flow sensor reading in order to obtain accurate outputs. The Figure 3.1 shows the results of flow sensor measurements that how the flow rate is changing with the time for fixed volume of water. When the flow rate is high it takes less time to distribute the water supply.

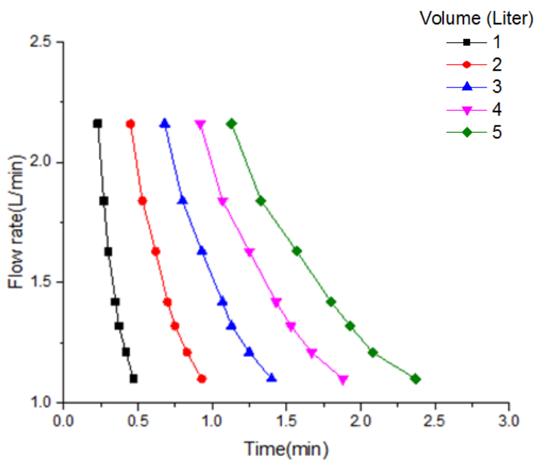

Figure 3.1: Flow rate vs. time for fixed amount of water

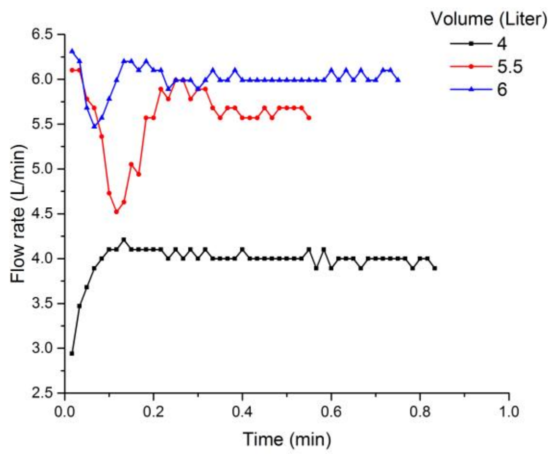

Figure 3.2: Output flow rate variation for given time schedule

Pulse frequency is directly proportional to the flow rate of the flow sensor. It can be obtained from the following Equation [3.2].

$$\text{Pulse Frequency (Hz)} = 7.5 \times Q \qquad [3.2]$$

Where, Q- flow rate in L/min.

This system maintains the flow rate by matching the calculated flow rate and the measured flow rate using the servo motor controlled values. It's varying each and every time the water pressure varies. The designed system outputs are showing in the Figure 3.2. Horizontal line defines the equality of the two flow rates and fluctuations represent the variations of supply water pressure. Since the water supply is not always a steady flow, servo motors are always working trying to match the two flow rates throughout the given time period, so then it consumes more power. If it can supply a bubble free steady water flow with constant water pressure, can obtain more accurate results and power consumption will be less. Flow sensor errors can be minimized by using more sensitive equipment and the correct alignments reduce the servo motor rotation errors.

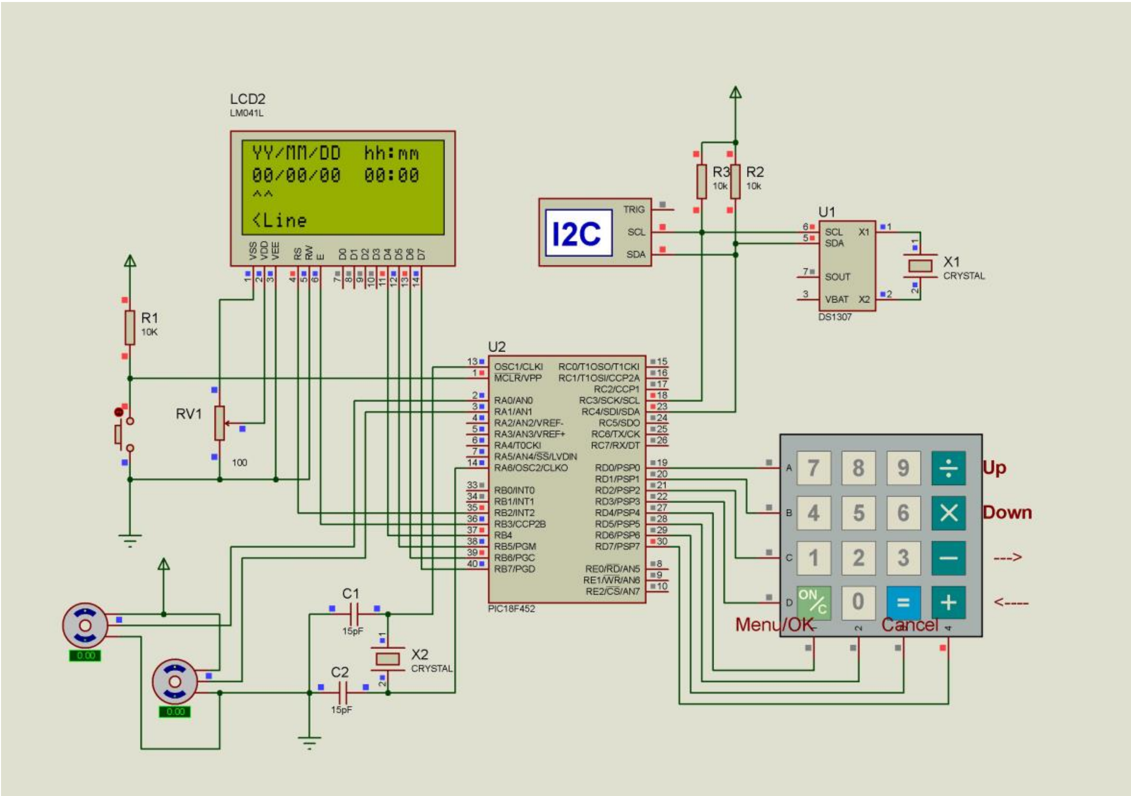

Figure 3.3: The simulation circuit layout of the proposed system

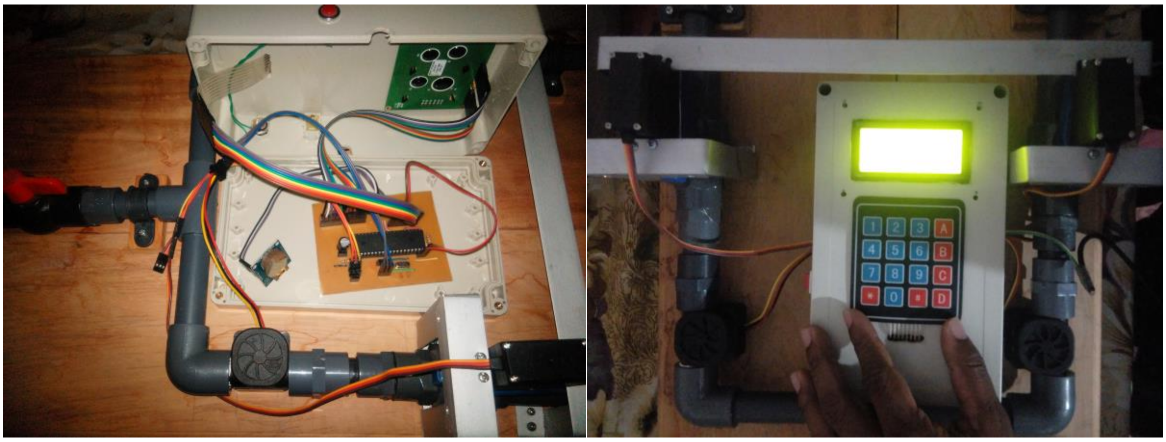

Figure 3.4: Final design of the proposed system

4. CONCLUSION

The “Programmable Multipurpose Water Distribution Controller” has been designed and tested successfully. It has been developed by integrated features of all the hardware components used. Presence of every module has been reasoned out and placed carefully, thus contributing to the best working of the unit. The system has been tested to functions automatically[6, 7]. The flow sensors measure the flow rate (Hall Effect) of the different water pressures flowing through the line A and B. Until the manually inputted flow rate is matched with the flow rate of supplied water pressure valves are automatically controlled with the servo motors. When the desired flow rate was reached, the system supplies accurate amount of water in given schedule. Future forces studies of this water controller system can be used not only for water controller but also in industrial manufacturing systems as fluid controlling systems. Also this device can be implemented as fully automated real time feedback system. Finally, it can be say this research study is a basement of all these huge area of future forces inventions.

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DRIVING INFORMATION RECORDER

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ABSTRACT

This project is to develop a low cost and reliable system for recording driving information. The purpose of the system is to facilitate police officers to get reliable information about a vehicle and the driver after an accident. Arduino UNO board was used in the project to collect and record driving information at low cost. A real time clock module, alcohol sensor module, photoelectric speed sensor module and a sonar sensor module were used in the system to collect the data of the vehicle in reliable way, and a SD card module is used to store the data.

Keywords: Alcohol sensor, Driving information, Photoelectric speed sensor.

1. INTRODUCTION

In Sri Lanka, after an accident, police officers measure the speed of the damaged vehicle or vehicles by the size of the damage or by their work experience. Those methods are not reliable. Modern vehicles have black box itself. But in Sri Lanka, most of the vehicles do not have black boxes. Therefore, driving information recorder is a really important thing. There are various types of black boxes in the market. But they do not record the speed or the alcohol level inside the vehicle. They only record a video footage. And also, they are too costly. In this driving information recorder project, Arduino UNO is the controller. Real time clock module gives the exact time. Alcohol sensor module gives the alcohol level inside the vehicle. Photoelectric speed sensor gives the rpm of the wheel to the controller. Sonar sensor is used to identify the accident. SD card module with a SD card is used to record the data given to the controller as a .txt file. There is a signal light to indicate the alcohol level to outsiders.

2. EXPERIMENTAL

The block diagram of the driving information recorder system is shown in figure 1.

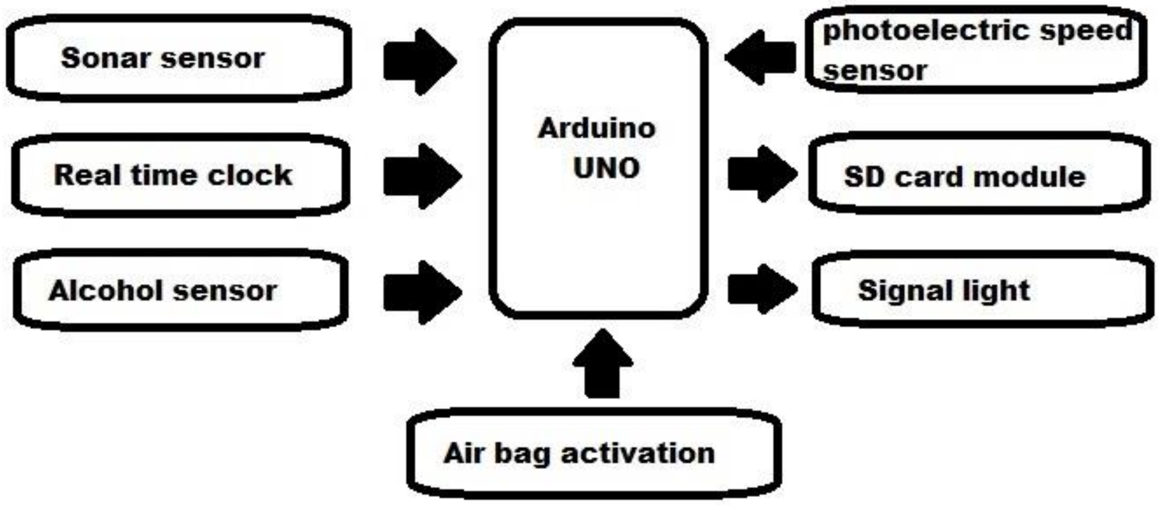

Figure 1: Block Diagram of the Designed System

When the vehicle is started, the system starts and the controller starts to collect the data. Speed sensor gives the rpm . Following equation is used to calculate the speed of the vehicle.

$$\text{speed} = \text{rpm x circumference of the wheel}(ms^{-1})$$

Alcohol sensor gives analog values between 0 and 1023. In normal situations it gives a value around 250. Therefore the value was set to 600 as the reference level. When the sensor gives a value above 600, controller take it as a high alcohol level in the vehicle. When the alcohol level is above 600, there is a bulb to indicate it to outsiders. Then they will know that the driver is drunk.

Real time clock module gives the exact time to the controller.

Controller determines the time duration between transmitting signal and receiving signal of the sonar sensor. Since the speed of sound in air is around 340 m/s, following equation is used to calculate the distance.

$$\text{distance} = \text{duration}/58 \text{ (cm)}$$

If the distance is 0 cm, the controller assumes it as the vehicle hits with an obstacle.

The controller takes an input when the air bag is activated. If the distance given by the sonar is 0 cm or input given by the air bag is high, the controller determines the situation as an accident.

Till an accident happens, the controller records the speed and the alcohol level with the exact time for every 3 seconds in the SD card. If the alcohol level is above 600, it writes in the SD card as “Alcohol - Yes” and if the alcohol level is lower than 600, it writes in the SD card as “Alcohol - No ”. After an accident occurs, the controller stops the data collection and stops writing data to the SD card.

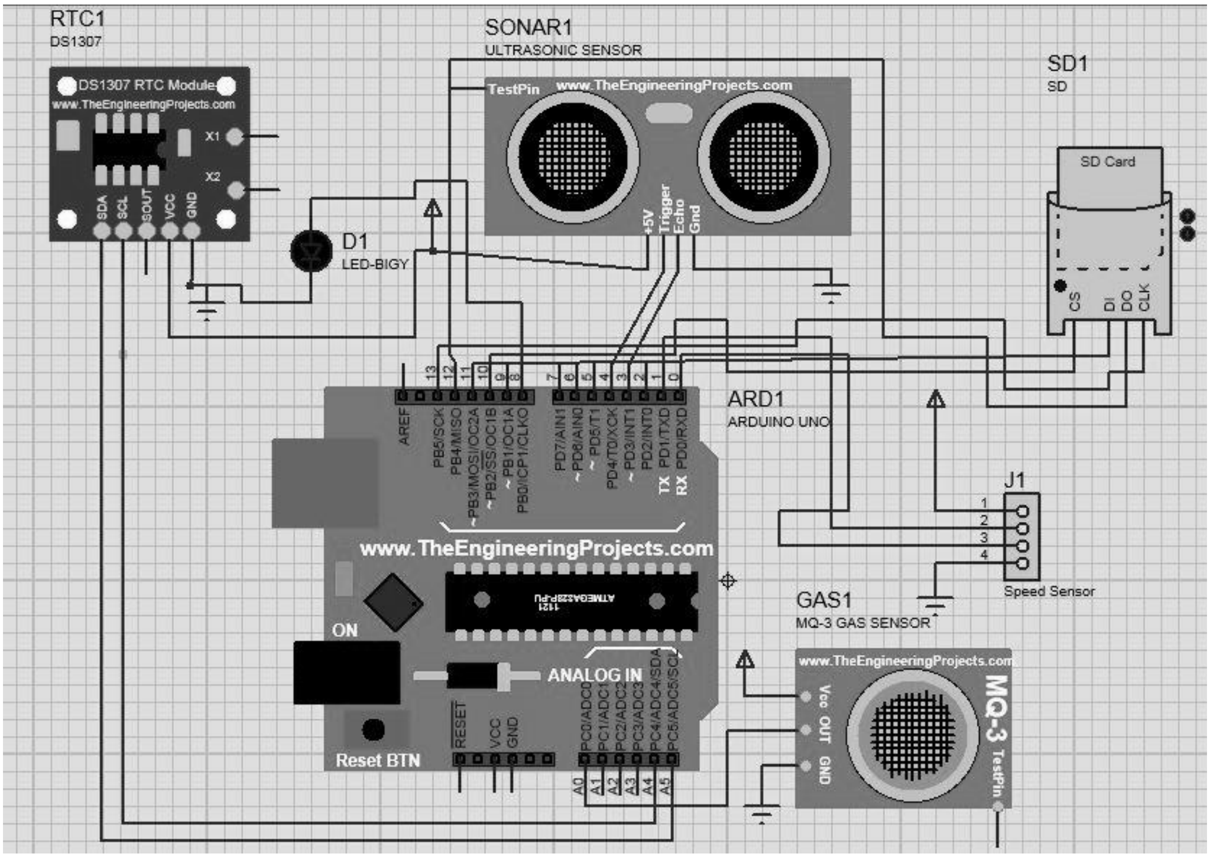

Figure 2: The Circuit Diagram of the System

3. RESULTS AND DISCUSSION

This project is to develop a low cost and reliable system for recording driving information. The purpose is to determine the speed of a vehicle before an accident happens and determine whether the driver is drunk or not when the accident happens. As a result of this project, the speed of the vehicle and alcohol level inside the vehicle could be recorded with the time for every 3 seconds and store that data in the SD card as a .txt file.

Additionally there is a signal light added to the device to indicate whether the alcohol level inside the vehicle is high or low to other drivers. Therefore the device has an ability to not only record the data but also gives a warning to other drivers to reduce accidents.

There is also LEDs to indicate the SD card module and SD card is ready to write the data or not. The sonar sensor which was used gives more accurate distance values between 10 and 300 cm. Therefore it is better to get the distance value of 10cm as 0 for more accuracy. Therefore the sonar sensor should be placed 10 cm inside the vehicle.

4. CONCLUSIONS

This driving information recorder device is cheaper than other black box cameras in the market. Users can easily install the device to their vehicles. In this device, Arduino UNO is the controller. Real time clock module was used to get the exact time. Alcohol level inside the vehicle is given by the MQ-3 alcohol sensor module. Speed of the vehicle is calculated by using rpm value given by the photoelectric speed sensor. Accident is identified by using a Ultrasonic sensor. Collected data are recorded by using a SD card module with a SD card. Outsiders are informed whether the driver is drunk or not by using a LED.

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WATER PURIFICATION USING ACTIVATED CARBON OF WOOD-APPLE FRUIT SHELLS.

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ABSTRACT

Low-cost by-products from agricultural wastage sectors have been recognized as a sustainable solution for wastewater treatment. Wood-apple shell is lingo cellulosic material. Activated carbon prepared from balli shell with phosphoric acid as an activation agent under nitrogen flow was investigated. The effect of activation temperature and time on the adsorption capacities of the activated carbon was studied. The optimum Ac preparation condition was identified by comparing the Acid dye adsorption capacities of the activation carbons. The obtain results show that the pyrolysis temperature and time had strong effect of the on the adsorption capacities. Proximate and ultimate analysis, SEM and FTIR results were used to characterize the properties of activated carbons. According to the literature reviewed and experiment results, novel low-costs adsorbents represent a promising green technology. Potentially, Beli shell activated carbon can be applied at full-scale wastewater treatment.

1. INTRODUTION

Dyes are widely used in textiles to color yarn and fabric and cloth. These dyes are left in the effluent. This effluent effect the natural water bodies.

In recently, activated carbons can be commonly produced from coal, lingo cellulosic materials, activated by physical or chemical process. Because of their pore structure, they have excellent adsorption capacity and are generally used in variety industrial and domestic purposes. Commercial available activated carbon are expensive .commercial available low cost adsorbent were inefficient considering activated carbon. Acid yellow dye was use to textile, paper, soap sector for dying.it is a mono azo dye and toxicity.

The objective of this work is to prepare activated carbon from using phosphoric acid activation under N_2 atmosphere. The prepared activated carbon which characterized their properties from typical technique was use for removal of acid yellow 36 dye in aqueous solutions by batch method. The parameters such as effect of initial pH of dye solution, contact time, dosage of activated carbon, and initial concentration of dye were studied.

2. MATERIAL AND METHODS

Acid yellow 36, an odorless yellow solid at room temperature with a chemical formula of ($C_{18}H_{16}N_3NaO_3S$) and supplied from Analytical grade. Deionized water supplied by Nano Technology research laboratory water treatment system was used to prepare all reagent solutions. Wood-apple shells bought from kuliyapitya fair; the wood-apple shell removed. The proximate and element analysis result for the raw materials are shown in table 1

Table 1: Characteristic of Activated Carbon

	Proximate Analysis				Ulitymate Analysis		
	Moisture (%)	Ash (%)	Volatile (%)	Fixed carbon (%)	O (%)	C (%)	P (%)
Actived Carbon	2%	3.2%	1.05%	98%	72.2	0.21	1.05

2.1 ADSORBENT

The shells was washed several times with distilled water with soap flex to remove adhered impurities from its surface. The wood-apple fruit shell was dried at 120^0C for 2 hours. The dried wood-apple fruit shell (800mg) was milled and sieved to micro level. The dried wood-apple fruit shell was added in small portion to 1.5M H_3PO_4 during 15mins and then the mixture was filtered.

The resulting material was heated in an oven at 120^0C for overnight followed by washing with 3L distilled water. The obtained carbon was washed with distilled water until pH of activated carbon reached six and dried in oven at 150^0C for 24h.The resulting activated carbon (BAC) was preserved and used as an adsorbent. BAC was characterized by using FTIR, SEM AND EDS techniques.

Characterization of the produced activated carbon

FT-IR spectrometer (IR 1400 affinity-15, Shimatzu) was employed to determine the presence of surface functional groups in samples and samples were analyzed as KBr pellets. The microstructure of activated carbon was investigated with Scanning electron microscope (EVO, Model LS15).The par6ticle size of activated carbon was investigated with particle analyser(Fritch –nanotech plus)

2.3 EXPERIMENTAL PROTOCOL

The batch adsorption experiments were conducted in a set of 250ml of Erlenmeyer flask containing adsorbent and 50ml of Acid yellow 36 solution in an isothermal water-bath magnatic stirrer at 120rpm and 30+_ 1^0C until the equilibrium concentrations of dye in the solution were measured at 665nm using UV-visible spectrophotometer. The pH of solution was adjusted with HCl and NaOH solutions.

The amount of dye adsorbed and percentage removal of Acid yellow 36 were calculated.

$$\text{Removal Effiency } = \frac{\text{Ci} - \text{Ce}}{\text{Ci}} \times 100$$

C_i and C_e are respectively initial concentration and equilibrium Concentration of Acid yellow 36.

3. RESULTS AND DISCUSSION

3.1 FTIR ANALYSIS

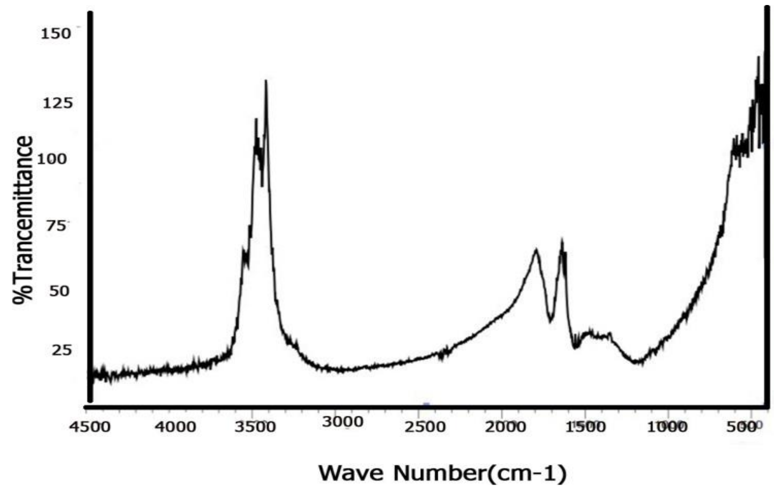

Figure 1: FTIR Analysis of Beli Activated Carbon

FTIR analysis was used to determine to the surface functional group of activated carbon .Functional group enhanced adsorption capacity of dye on activated carbon. The adsorption peak at 3433cm-1 corresponds to the O-H stretching vibration of lignocellulose material. Thus showing consists of free hydroxyl group on the surface. The other peak range between at 190-200 due to –CH2, C-C,C=O and C-N stretching

3.2 SEM PICTURES

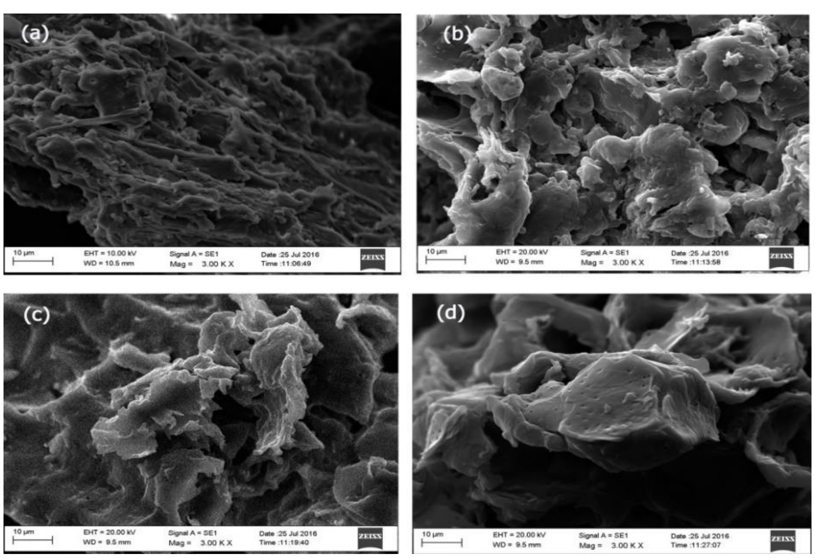

Figure 2:(a) Raw power (b) Treated with phosphoric (C) Unwashed (d) washed

SEM was used to study the morphological structure on the activated carbons (Figure 2).Figure 2(a) shows the surface structure of the wood-apple shell fruit. It shows inorganic matters-covered and unclear pores. Figure 2(b) shows the surface structure of the phosphoric treated wood-apple shells powder. It shows surface of sponge like structure. Clean and burn pore with no tunnel or honeycomb-like structures. The figure 2(c), shows the surface structure of the unwashed activated carbons tunnel and honeycomb-like structures.it also not shows clear, deep and long tunnels.figure2 (d) shows remarkable change. The pore has a burn and look with tunnels.it also had a honeycomb –like appearance. This was due to washing. But some impurities covered from pore surface .it can be seen in EDX results of washed activated carbon.

3.3 Removal efficacy of Acid Yellow 36 Dye

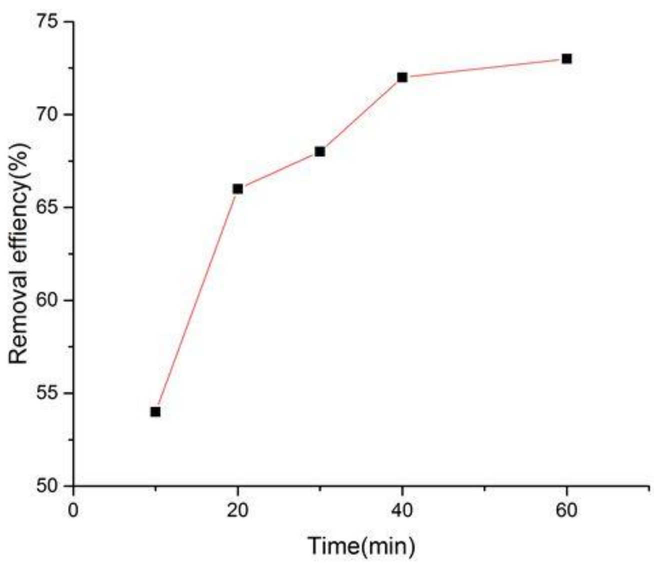

Figure 3: Removal efficacy of Acid Yellow 36 Dye

Figure shows Removal efficiency of acid yellow 36 on wood-apple activated carbon activated at different periods of contact time ranging from 0 to 60 min.Fig.5.it can be seen that the adsorption of dye particles was rapid in the initial stage and gradually decreased with the progress of adsorption until the equilibrium was reched.it shod mention that activated carbon has consist of different pore sizes and pore volume. The equilibrium time for wood-apple fruit shell activated carbon were found to be 75% at 60 min.

4. CONCLUSION

In this work results show that activated carbon production from natural cello sic low cost material such as wood-apple fruit shell. Following conclusions were drawn based on the above study:

1) The waste biomass from wood apple shell is converted into activated carbon using concentrated H_3po_4 acid;

2) The sorption was found to be dependent on initial MB dye concentration and the contact time;

3) Increase in pH of the initial concentration of dye solution and carbon dose increases the rate of the reaction.

Adsorption capacity with regard to the removal efficiency (75%) acid yellow from aqueous solution. Adsorption is mostly depending on contact time and pH level. These conditions are more favorable to water purification of effluents.

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GRAPHENE BASED SUPERCAPACITORS

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ABSTRACT

Due to their high energy-storage capability and high power-delivery capability, Supercapacitors exhibit great potential as high performance energy sources for future advanced technologies. Recently, Graphene have been widely investigated as effective electrodes in Supercapacitors due to their high thermal/electrical conductivity, mechanical strength, chemical stability, large surface area and relative low cost. The recent progresses on the development of high performance Supercapacitors allow for the greatly enhanced Specific Capacitance in the synthesis of such Graphene electrode materials with the different aqueous electrolytes such as KOH, H_2SO_4 etc. This research project summarizes a brief description of an attempt to find the best electrolyte among KOH & H_2SO_4 and best performance value of Specific Capacitance for appropriate aqueous electrolyte, its relevant Scan Rate using the preparation of Graphene Oxide (GO) from Graphite by Hummer's Method of graphene based supercapacitor. In this study, Cyclic Voltammetry (CV) Tests, Electrochemical Impedance Spectroscopy and Continuous Galvanostatic Charge-Discharge Tests are used to test the performance of different electrolytes and to test their cycling ability of the prepared Electrical Double Layer Capacitor (EDLC). Also, Material characterization of GO is analyzed using Fourier transform infrared (FTIR) spectroscopy, for characterizing and identifying organic molecules at Nano Research Laboratory, Wayamba University of Sri Lanka.

Keywords: GO, Specific Capacitance, Supercapacitor

1. INTRODUCTION

In 1950s, General Electric Engineers were started experimenting components using porous carbon electrodes for fuel cells and rechargeable batteries. In 1957, H. Becker was developed a "Low voltage electrolytic capacitor with porous carbon electrode"[1,2]. That capacitor was come to known as Supercapacitor as it stored very high amount of energy. In recent applications, many researchers are trying to develop Supercapacitors with high energy storage. So, it is important to introduce new, eco-friendly and low cost energy storage devices for modern society[1].

Supercapacitors are energy storage devices with very high capacity and a low internal resistance which can be able to store a large amount of charge and it can be delivered at much higher power ratings as compared to rechargeable batteries due to the mechanism of energy storage. It involves a simple charge separation at the interface between the electrode and the electrolyte. A supercapacitor consists of two electrodes, an electrolyte, and a separator which isolates the two electrodes electrically. Some benefits of Supercapacitors when compared with other energy storage devices are high power capability, long life, Wide working temperature (-40° to 70°C), low weight, flexible packaging, and low maintenance[1,3].

Electrode material is the most important component of a supercapacitor. In this review, GO is used as the electrode material. Graphene, a 2D flat single-layer of sp^2 hybridized carbon bonded in a honeycomb-shaped hexagonal lattice, is the parent of all the graphitic carbons[4,5,6]. Due to this unique structure, graphene is provided some chemical and physical features; such as strong mechanical strength, extra-ordinarily high electrical and thermal conductivity and large surface area[7].

Also, electrolyte is directly affected to the cell's operational voltage window and its resistance. In this case, aqueous type is used as the electrolyte because of its low cost and abundance. KOH & H_2SO_4 are the common aqueous electrolytes that we used, because of its ability to handling easily in an open environment and its low ionic resistivity.

2. EXPERIMENTAL

2.1 Preparation of Electrode Layer

Graphene Oxide (GO) was prepared from natural Graphite by Hummer's Method. Using Fourier Transform Infrared (FTIR) Spectroscopy, organic and inorganic molecules in Graphene and Graphite were identified. Then, stainless steel current collector was cleaned by Acetone and GO was pasted on it. After that, GO with current collector was dried using oven at 70°C for 10 minutes. Then, the mass of GO layer was measured.

2.2 Preparation of Supercapacitor cell

Sandwich type supercapacitor cell was prepared by a pair of electrodes and separated by filter paper in the Teflon sample holder. The electrochemical measurements were carried out at ambient temperature using $KOH_{(aq)}$ and $H_2SO_{4(aq)}$ with the concentration of 1M as electrolytes.

2.3 Electrochemical Measurements

Cyclic voltammetry (CV) was carried out in the different voltage window using a computer controlled Potentiostat/Galvanostat (Metrohm AUTOLAB) to evaluate the capacitive characteristic at scanning rates of 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 30, 40, 50, 60, 70 and 80 mV/s with different start/stop potential related to each voltage window and step potential of 1mV. Then area of the curves was calculated. In cyclic Voltammetry, Capacitance can be calculated as, $C = \frac{\int idV}{2\mathrm{VS}\,\Delta \mathrm{V}}$ (1) ; where, $\int idV$ is the integrated area under the CV curve, V_S the potential scan rate and ΔV the potential range. Then, Specific Capacitance can be calculated as, $C_S = \frac{4*C}{\mathrm{m}}$ (2) ; where, C is the calculated capacitance from equation (1) and m the mass of a single electrode.

Galvanostatic charge-discharge (GCD) cycle was examined for each electrolyte within a applicable charge/discharge current density.

The Electrochemical Impedance Spectroscopy (EIS) was exploited in the frequency range of 0.01 Hz to 1MHz with AC amplitude of ±10mV which is used to determine the frequency response as well as the ESR of the Supercapacitor.

3. RESULTS AND DISCUSSION

The best specific capacitance of the 1M KOH shows at 1V voltage window and 2.5mV/s scan rate which is 0.15727 mF/g and the best specific capacitance of the 1M H_2SO_4 shows at 1.2V voltage window and 2.5mV/s scan rate which is 0.142033 mF/g. Generally, a rectangular CV resembles an ideal capacitor. However, EDLC do not behave ideally, resulting in a deformed rectangular shape. At low scan rates, CV behaves like an EDLC because it shows a deformed rectangular shape and high specific capacitance.

In below Figure 2, EIS curve shows normally a deviated straight line in the low-frequency region and a small arc in the high frequency range approximately. This high frequency loop should relate to the electronic resistance of GO. The deviated vertical shape at lower frequency range should indicate a pure capacitive behavior, representative of the ion diffusion in the electrode structure[6].

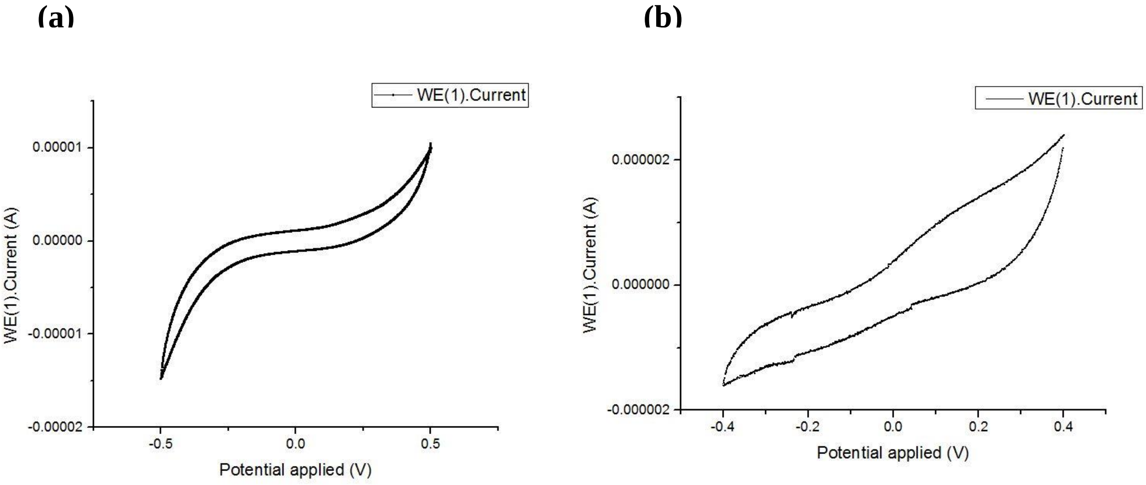

Figure 1: Cyclic Voltammetry of (a) the 1M KOH at 1V voltage window, 2.5mV/s scan rate and (b) the 1M H_2SO_4 at 1.2V voltage window, 2.5mV/s scan rate

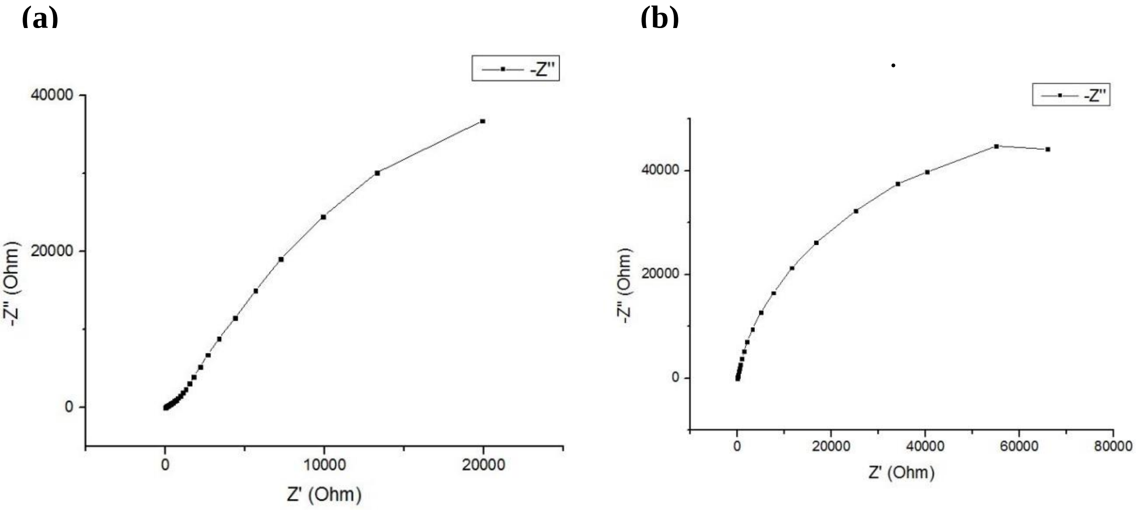

Figure 2: Electrochemical Impedance Spectroscopy of (a) the 1M KOH and (b) the 1M H_2SO_4

In this study, GCD of supercapacitor is linear when it uses GO as electrode material with above two electrolytes. Therefore, it shows a quick charging time and quick self-discharge.

(a) (b)

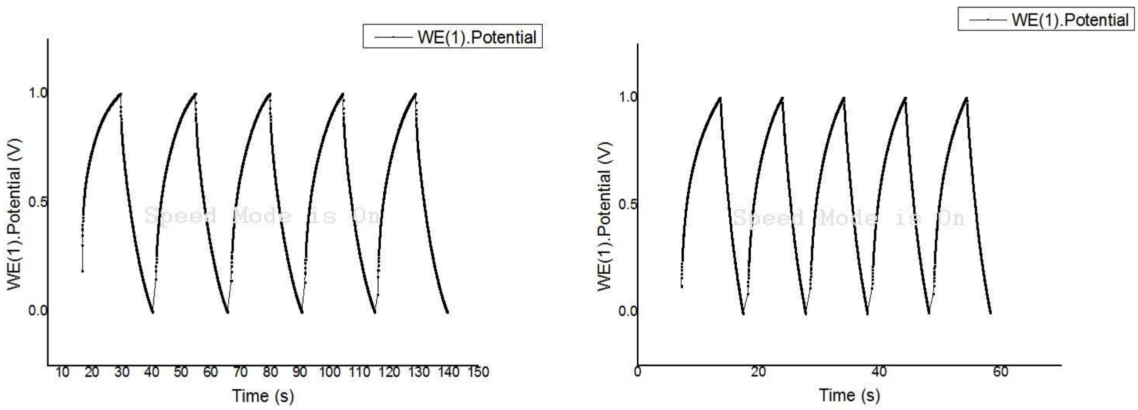

Figure 3: Continuous Galvanostatic Charge-Discharge curves of (a) the 1M KOH and (b) the 1M H_2SO_4

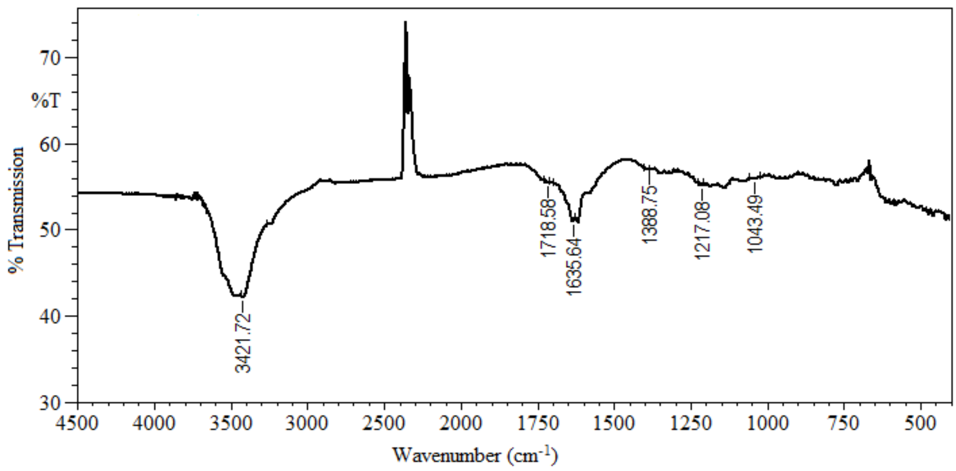

Figure 4: FTIR Spectrum of GO

Figure 4 shows that synthesized GO has a peak in the range of 1100 cm^{-1} -1200 cm^{-1} (1043.49 cm^{-1}) which is attributed to the C-O bond, confirming the presence of oxide functional groups after the oxidation process. The peaks in the range of 1600 cm^{-1} to 1700 cm^{-1} (1635.64 cm^{-1}) show that the C=C bond still remained before and after the oxidation process. The absorbed water in GO is shown by a broad peak at 3400 cm^{-1} to 3500 cm^{-1} (3421.72 cm^{-1}), contributed by the O-H stretch of H_2O molecules. This supports the fact that GO is a highly absorptive material.

4. CONCLUSION

In conclusion, GO acts as good electrode materials for application in supercapacitor. Due to above results, best specific capacitance shows at 1V voltage window and 2.5mV/s scan rate which is 0.15727 mF/g of 1M KOH aqueous electrolyte. So, this supercapacitor shows high performance when using the KOH as electrolyte.

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DESIGN OF AN AUTOMATED WATER LEVEL CONTROLLING SYSTEM

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ABSTRACT

Now-a-days water scarcity has become a serious problem due to many factors such as improper supply of water from the dam, improper water saving systems, etc. One major factor is the improper opening and closing of the dam gate according to the level of water in the reservoir. Most probably the controling mechanism of the dam gates are manual or PLC operated. The manual method is not much accurate. On the other hand the PLC based systems are huge and hence suitable only for major dams due to its cost. Medium and small dams like irrigation dams do not require such huge PLC systems. Therefore, to reduce these problems, a microcontroller based control system is proposed in this paper. This paper describes a PIC16F877 microcontroller based dam gate control system which continuously control the efficient operation of dam gate according to the level of water. Using this design, the level of water in the tank can be monitored by using the GSM mechanism. The proposed dam gate control mechanism reduces the water wastage and ensures efficient usage of available water. A prototype was developed to demonstrate the implementation of this mechanism.

Keywords: dam gate, level monitoring, gate mechanism, microcontroller

1. INTRODUCTION

Microcontroller based systems refine, extend or supplement human facilities and ability to observe, communicate, remember, calculate or reason and take certain decision when necessary. In a search for making Electronics Applications think, act and respond like Human, the proposed system was developed. The proposed system attempts to make an easy working environment by reducing unnecessary waste of man-power by employing microcontrollers. In addition to this development, human being is not resting in an effort to find a solution to all of there problems and this project is in no exception. Microcontroller based automatic gate is an alternative to a manually controlled gate which is laborious, frustrating, expensive and energy consuming. The proposed system comprises of several components. The sensors detect water level and send a signal to another set of components. It is interesting to note that this device can perform some operations like automatically opening and closing. This design can be employed in the irrigation department for the dam gates, water tanks and anywhere that require the use of gates. It has many advantages over a manned gate in the sense that it eliminate stress and wages of a gateman, Further the project engineer can monitor the water level, without going to the site. Due to the GSM module is send the water level description to the engineer's mobile phone automatically when the water level increasing or decreasing

.

2. EXPERIMENTAL

2.1 BLOCK DIAGRAM

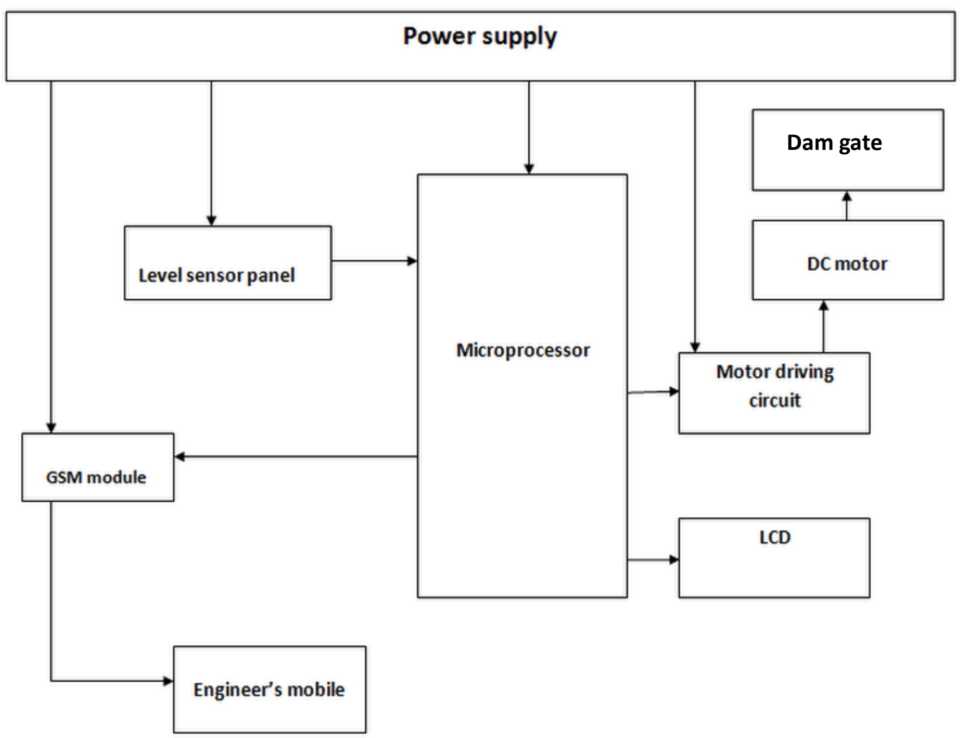

Figure1:Block Diagram

The block diagram of Microcontroller PIC16F877 based Dam Gate Control System is shown in figure 1. The proposed system uses four sensors to sense four water levels. Whenever the water level rises or decreases and comes in contact of any sensor then the circuit is complete and sensors transmit the output signal as a binary digit and microcontroller act as a receiver.

Whenever the water level rises above the highest level or decreases below the lowest threshold level then the sensor panel triggers the microcontroller. According to the code written and fed in the microcontroller, it will drive the DC (Direct Current) motor through the motor controlling integrated circuit. Then the dam gate connected to the DC motor will also move and it will get opened or closed according to the water level. When the water level is increasing or decreasing dam gate is automatically opened and closed according to the water level. The GSM module is used to send the water level information to the Engineer's mobile phone according to the water level. To operate the gates of the dam at the water levels which are not supported by the system an operator can be placed at the control room to control all the operation of the dam.

2.2 SENSOR PANEL

Four floating sensors were used to this project for detecting the different water levels in the reservoir. First sensor was mounted at the ¼ height of the dam wall. That mounted position is named as the low position. Second sensor was mounted at the half of the dam wall height and it was named as the half position. Third sensor was mounted at the ¾ height of the dam wall and it was named as the ¾ position. Last one was mounted at the maximum position in the dam wall and named as the maximum water level position. When the water level is touched the each and every float switches which are activated and transmit the signal to the microcontroller.[2]

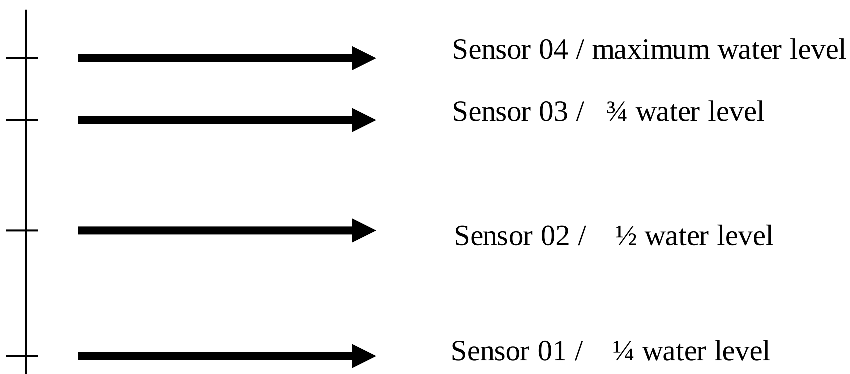

Figure2:Sensor panel

2.3 DISPLAY UNIT

A LCD is interfaced to the microcontroller kit. The LCD is used for indicating the operator about the frequent level changes in the dam. LCD will be placed in the control panel. The LCD used is a 16x2 LCD with the green backlight is used. In this LCD the water level will be continuously displayed according to the changes in the water level in the reservoir. Therefore dam gate operator can identify water level situation according to the water level variations the in the tank. If we want to regulate the LCD brightness, a regulator is available to change the brightness.

2.4 THE MICROCONTROLLER KIT

PIC16F877 is the microcontroller used in this system with 8MHz crystal frequency. The microcontroller is programmed to control the operation of gates, indicate the operator the exact level of water in the reservoir using LCD and also inform the exact water level by using the GSM. Port 0 is interfaced with the LCD module and Port 2 is interfaced with the motor control circuit. Port 1 is interfaced with the sensor circuit. +5V power supply is given to the system.[1]

2.5 MOTOR DRIVING IC(INTEGRATED CIRCUIT)

From microcontroller we can not operate a motor directly because microcontroller can not give sufficient current to drive the DC motors. Motor driver is a current enhancing device, which can act as a Switching Device. A motor driver was insert in between motor and microcontroller. Motor driver take the input signals from microcontroller and generate corresponding output for the motor.[4]

2.6 DAM GATE

It works in 3 different situations which are fully closed, partially opened and fully opened. The small trait bar was connected to DC motor shaft. Two bolts were fitted to the trait bar and these, bolts were pasted to the gate wall. when the motor shaft is rotating, dam gate is moving up and down through the aluminum beam.

2.7 SIM 900 GSM MODULE

Using this design the, project Engineer can identify the water level exactly without going to the site by using the GSM module.GSM module is sent the water level information to the Engineer's mobile phone. The operation of a GSM modem requires a SIM(SUBSCRIBER IDENTITY MODULE) for connecting to the Engineer's mobile.[3]

3. RESULTS AND DISCUSSION

3.1 RESULTS

A prototype of the proposed system has been successfully implemented and results have been observed. I found that the time taken for the dam gate to open and close is accurately synchronized with the increment or decrement in the water level because of the use of Low Speed High Torque DC Reduction Gear Motor. Due to the use of 16F877 microcontroller control kit the dam gate can be opened or closed automatically and LCD display and GSM module increases the system reliability and flexibility. This system is user-friendly and remotely operational.

3.2CIRCUITDIAGRAM

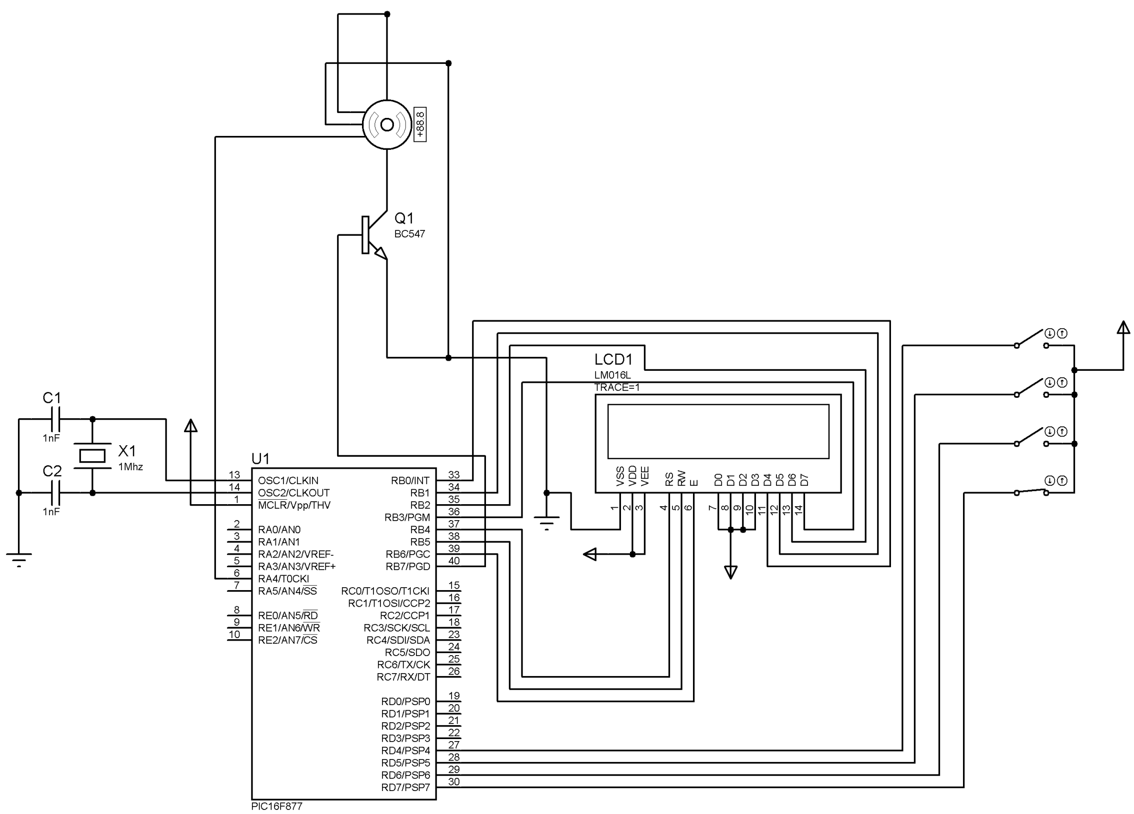

Figure 3: Circuit Diagram

3.3 FLOW CHART

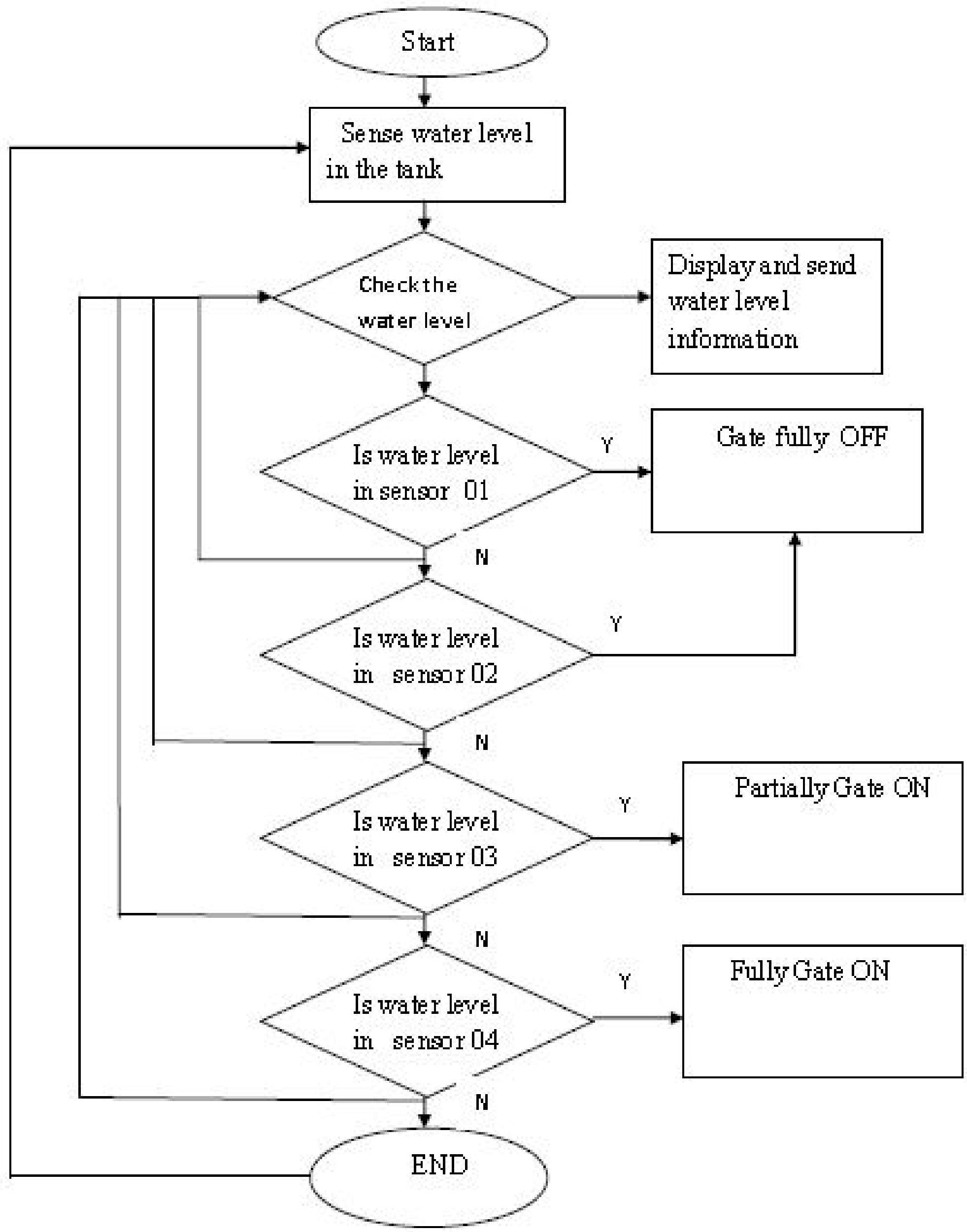

Figure 4:Flow chart

When the water level is touched first sensor, dam gate normally closed and display and send the water level information. When the water level touches the second sensor, dam gate normally closed like the first sensor and send and display the water level information. If the water level is touched the 3rd sensor, dam gate is partially opened and send and display the information. If the touched the 4th sensor, dam gate is fully opened and send and display the water level information about the water level.

4. CONCLUSION

The proposed mechanism of dam gate control reduces the water wastage, ensures efficient use of available water resources and generates more precise and accurate results. There is no requirement of human labour for monitoring the level and just one technically skilled person can take the responsibility of opening and closing the gate according to sensor output, because GSM module send the water level information to the Project Engineer’s mobile phone. Number of more sensors , LCD, GSM and DC gear motor were used to design the prototype.

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The authors wish to express their indebt gratitude to the staff of Department of Electronics, Faculty of Applied Sciences, Wayamba University of Sri Lanka.

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DESIGN OF AN INTELLIGENT RAILWAY CROSSING SYSTEM

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ABSTRACT

Accidents at railway gate crossings have been increased day by day in Sri Lanka due to various reasons. This paper presents an intelligent railway crossing system which helps to identify and indicate the train arrival, which helps to reduce the number of train accidents. This particular system has been developed for the unprotected railway crossings. In the proposed design, the arrival of the train is detected by using Modulated Infrared sensors and informs it to the motorist at the level crossing by using wireless RF communication. This is an early awareness system. Hence, the person or vehicle that crosses the road is given a signal of train arrival and also the train driver can identify whether there is any vehicle or person at the level crossing through a video stream. Therefore, the proposed project is more economical rather than the traditional railway crossing systems and it gives certainly a considerable benefit to people.

Keywords: Intelligent railway crossing, Modulated IR, Wireless RF communication

1. INTRODUCTION

When go through daily newspapers, it is a common news that railway accidents are occurred at unprotected railway crossings in Sri Lanka. There are nearly 612 unsecured railway crossings throughout the country, according to the department of railways; the highest number of 225 unprotected level crossings are along the coastal line which is from Colombo Fort to Galle.

However, a large number of rail crossings remain without any safety mechanisms to warn the drivers of arriving trains. Carelessness in manual systems and lack of workers can be identified as the main reason in railway accidents. As well as, Railway department is unable to introduce railway gates for each and every location in Sri Lanka, because at each level crossing train has to reduce its speed. Therefore , this project has came up with a solution for that problem and this can be introduced as a solution for the informal level crossing in Sri Lanka. So this project is about the intelligent railway crossing system. This system helps to reduce accidents occurred at the level crossing. Further it can reduce the expenses on railways due to reduction of manpower.

2. EXPERIMENTAL/METHODS/METHODOLOGY

This particular system has been developed with an automated signal light indication system and an early awareness system, which send a video stream of the level crossing to the train driver.

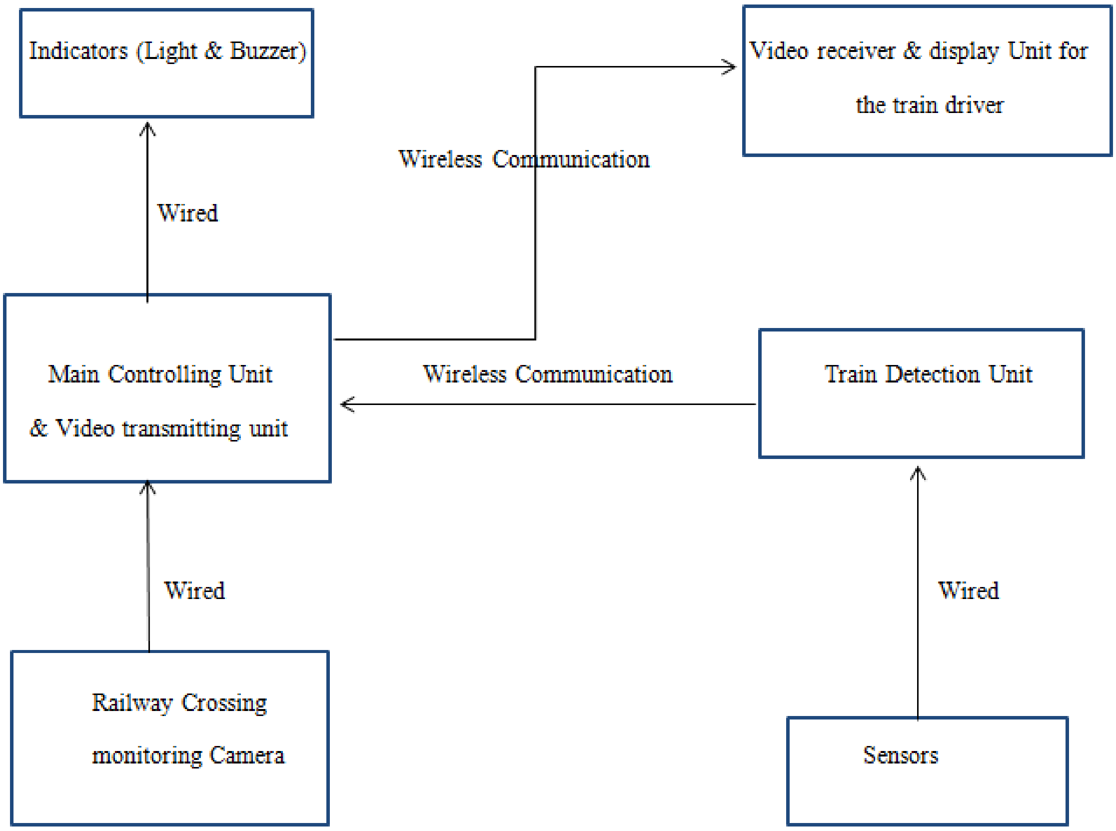

Figure 1: The Block Diagram of the system

This project consists of following three major controlling units.

1. Detection Unit
2. Main Controlling Unit
3. Video Transmitting/Receiving Unit.

Communication among these units are wireless.

The train detection unit is responsible for detecting the train, coming from the correct direction (using sensor unit) and informing it to the main controlling unit through wireless communication. The train is detected using modulated IR transmitter/ receiver unit. For detecting the train, TSOP1738 is selected because it has a special feature of high sensitivity against ambient light. TSOP1738 receives the modulated Infrared waves and changes its output. TSOP1738 reacts when it receives the IR radiation modulated at 38KHz.TSOP operates on particular frequency so that the other IRs in the environment can't interfere, except the modulated IR of particular frequency.

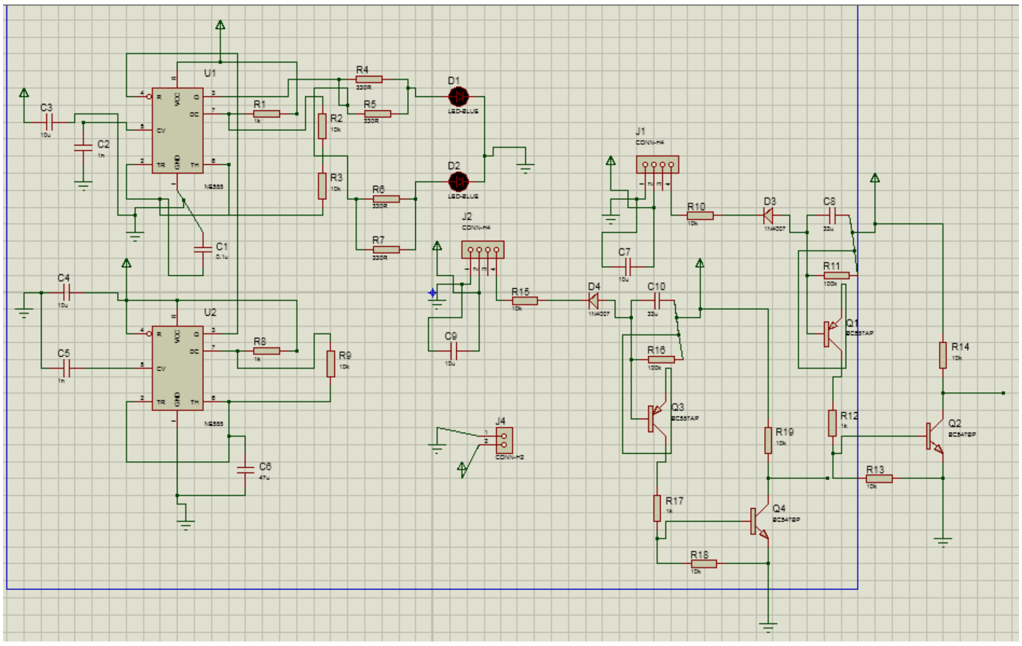

Figure 2: The Circuit Diagram of the Train Detection Unit

Wireless communication is used to keep the communication link between the Main Control Unit and the Train detection Unit. In this system, long range RF transmitter Receiver has been used for the circuit. Here 315 MHz RF band has been selected to communicate between the main unit and the train detection unit. The signal which has been taken from the sensor unit is encoded and transmitted to the main controlling unit. The main controller unit is responsible for getting correct signal from train detection unit and controlling the activities at the level crossing. The main controller unit consists of a microprocessor & light indicator unit.

The video transmitting unit captures the scene from the camera and transmits that video stream to the receiving unit via 5.8 GHz microwave link. The video receiving unit receives that signal and converts it into the visible video stream and displays on a train display.

In this System, the arrival of the train is detected by the sensors at the level crossing. According to the test results figure (3-5) modulated IR sensors are better than normal IR sensors at 30C.

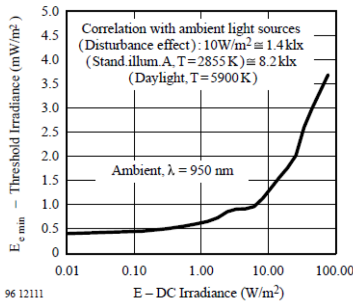

Figure 3. Sensitivity in Bright Ambient [3]

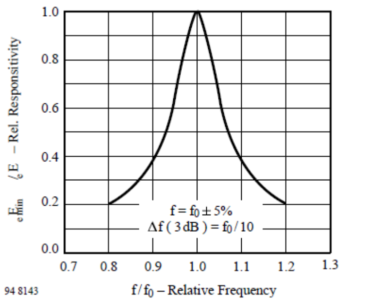

Figure 4. Frequency Dependence of Responsivity [3]

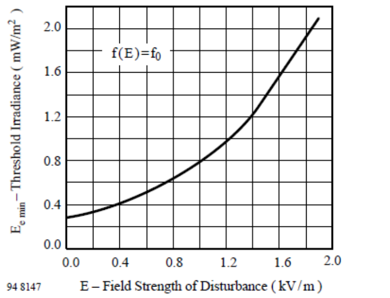

Figure 5. Sensitivity vs. Electric Field Disturbances [3]

3. RESULTS AND DISCUSSION

3.1 Working process of the system

When arrival of the train is sensed by this system, it is informed to motorists at the level crossing by switching on the red signal light and buzzer. When the train passes the crossing, the indicator switches to Green signal light. A microcontroller is used to manage all the functions of the railway crossing system.

A camera has been fixed on the signal indicator bar at the railway crossing. When a train reaches to the video transmitted range of 1Km from the level crossing, the video receiver at the train will receive the video signal and will display to the train driver through the display at the train.

3.2 Discussion

In the existing railway system, a lot of vehicle accidents have been occurred due to careless manual gate operations. So in this project, by using intelligent railway system the risk of accidents at manual level crossings is solved by controlling the complete system automatically. Through this project, human errors can be eliminated and the expenses on railways are reduced due to the reduction of man power. In the existing system, only Green signal light is indicated to the train driver when the railway gate is closed. But through this system, train driver can see the live video stream of the crossing condition on a screen fixed in the train. Therefore, implementation of this system will reduce accidents occurring at the level crossing.

4. CONCLUSION

The main objective of this project is to build an automated light indication system for train arrival and giving early awareness to train drivers and vehicles, at the railway crossing. In this system, the arrival of the train is detected by the sensors and it is informed to motorists at the level crossing by using signal light indicator and a buzzer. When a train reaches to the video transmitted range, the video receiver at the train will receive the video signal and will display to the train driver through a screen fixed in the train. A prototype has been built and it works properly as expected.

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LOW COST, LIGHT WEIGHT WALKING STICK FOR BLIND PEOPLE

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ABSTRACT

Blindness is a state of lacking the visual perception due to physiological or neurological reasons. The partial blindness represents the lack of integration in the growth of the optic nerve or visual center of the eye, and the total blindness is the full absence of the visual light perception. The blindness is always a great problem. Just like a sighted, blind also needs to travel around or inside a closed premise like a house, a factory, an office, a school etc. They may also like to go for shopping, visiting friends and other places of their interest. Visually impaired persons find themselves challenging to go out independently. There are millions of visually impaired or blind people in this world who are always in need of helping hands. In this work, a simple, cheap, user friendly, smart blind guidance system is designed. The proposed work includes an equipment consists of a mini hand stick to help the blind person to navigate alone safely and to avoid any obstacles that may be encountered, whether fixed or mobile, to prevent any possible accident. The implemented system is also, fast, an innovative affordable solution to blind and visually impaired people.

Keywords: Bluetooth module, Micro controller, Ultrasonic

1. INTRODUCTION

Many people suffer from serious visual impairments. Therefore, various techniques have been introduced for assisting them. Also mobility specialists who help the visually impaired and blind people, trains them to move on their own independent and safe way, usingtheir other remaining senses.

Another method is the guide dogs which are trained specially to help the blind people on their movement by navigating around the obstacles to alert the person to change his/her way. However, this method has some limitations such as difficulty to understand the complex direction by these dogs and they are only suitable for few years. The cost of these trained dogs is very expensive and also it is difficult for many of blind and visually impaired persons to provide the necessary care for another living being.

There is an international symbol tool of blind and visually impaired people just like the white cane with a red tip which is used to enhance the blind movement. For many years the white cane became a well-known attribute to blind person's navigation. Blind people have a big problem when they walk on the street or stairs using white cane, but they have sharp haptic sensitivity.With the advances of modern technologies many different types of devices are available to support the mobility of blind. These mobility aids are generally known as Electronic Travel Aids (ETAs) [1]. The most important function of ETA for the blind persons is to get information on the shape of the road and the position of obstacles when they are in unknown places. With this information, they need to arrive at their destinations, avoiding unexpected obstacles. The electronic walking stick will help the blind person by providing more convenient means of life. The main aim of this paper is to contribute the knowledge and services to the people of blind and disable society.[2]

2. EXPERIMENTAL

Blind stick is an innovative stick designed for visually disabled people for improved navigation. A blind stick is proposed for visually challenged people to navigate with ease using advanced technology. The blind stick is integrated with ultrasonic sensor along with light and water sensing. The proposed project first uses ultrasonic sensors to detect obstacles ahead using ultrasonic waves. On sensing obstacles the sensor passes this data to the microcontroller. The microcontroller then processes this data and calculates if the obstacle is close enough. If the obstacle is not that close the circuit does nothing. If the obstacle is nearby, the microcontroller sends a signal to sound a buzzer[2]. It also activates a different buzzerand alerts the blind person if it detects water. Another feature of this implementation is that it allows the blind person to detect if there is light or darkness in the room. The system has one more advanced feature integrated to help the blind people to find their stick if they forget where they kept it. A wireless Bluetooth modulebased remote is used for this purpose. Pressing the remote button sounds a buzzer on the stick which helps the blindperson to find their stick[3]. Also, it alerts the person if the battery level goes low. Thus this system has many attractive features that are immensely useful for visually disabled people.

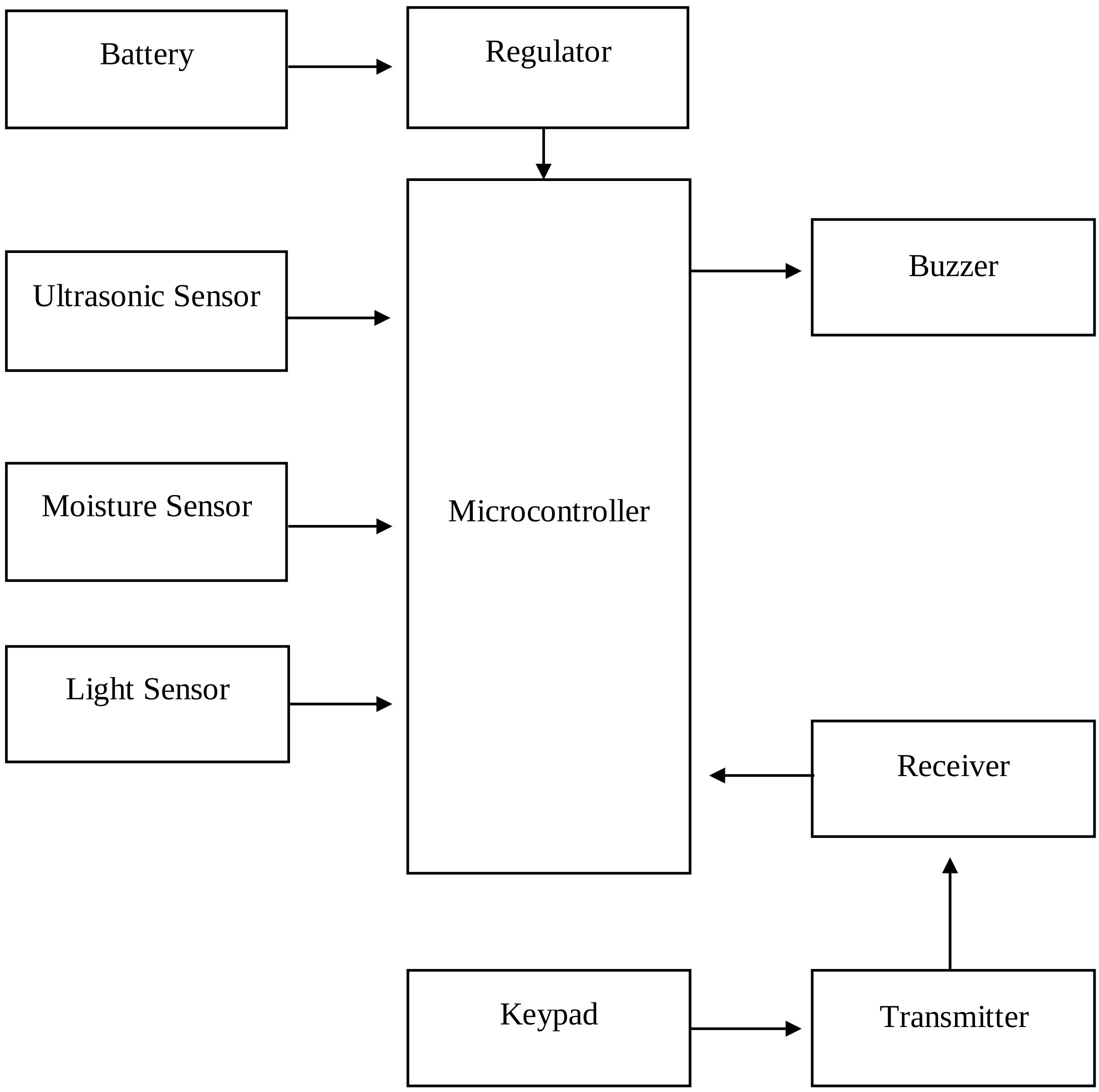

Figure 1: Block diagram of the system

2.1 The system has six major units

- Microcontroller
- Ultrasonic sensor
- Light Sensor
- Bluetooth Module
- Moisture
- Buzzer

2.2 Flowcharts of the system

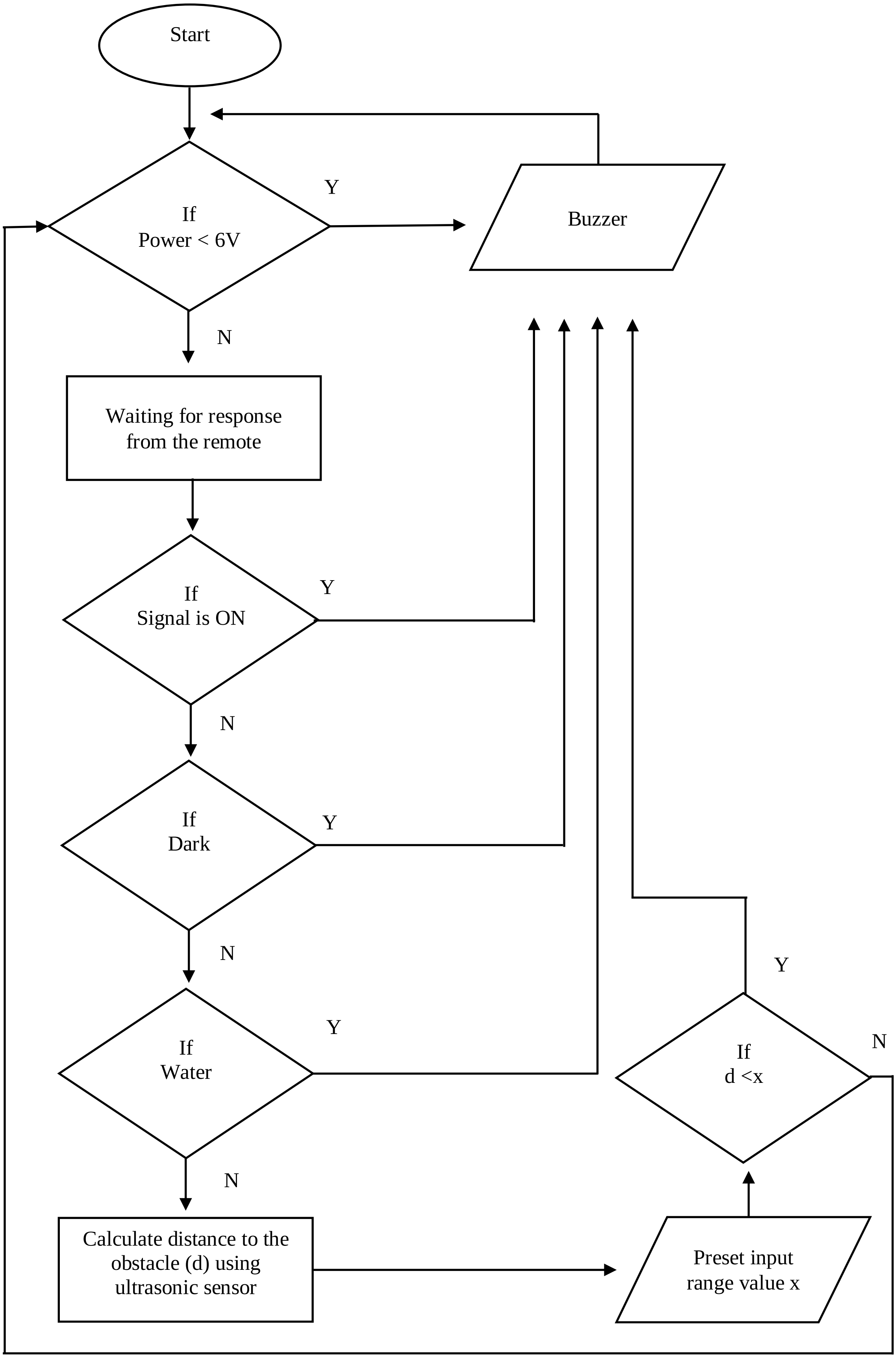

Figure 2: Flowchart of the walking stick

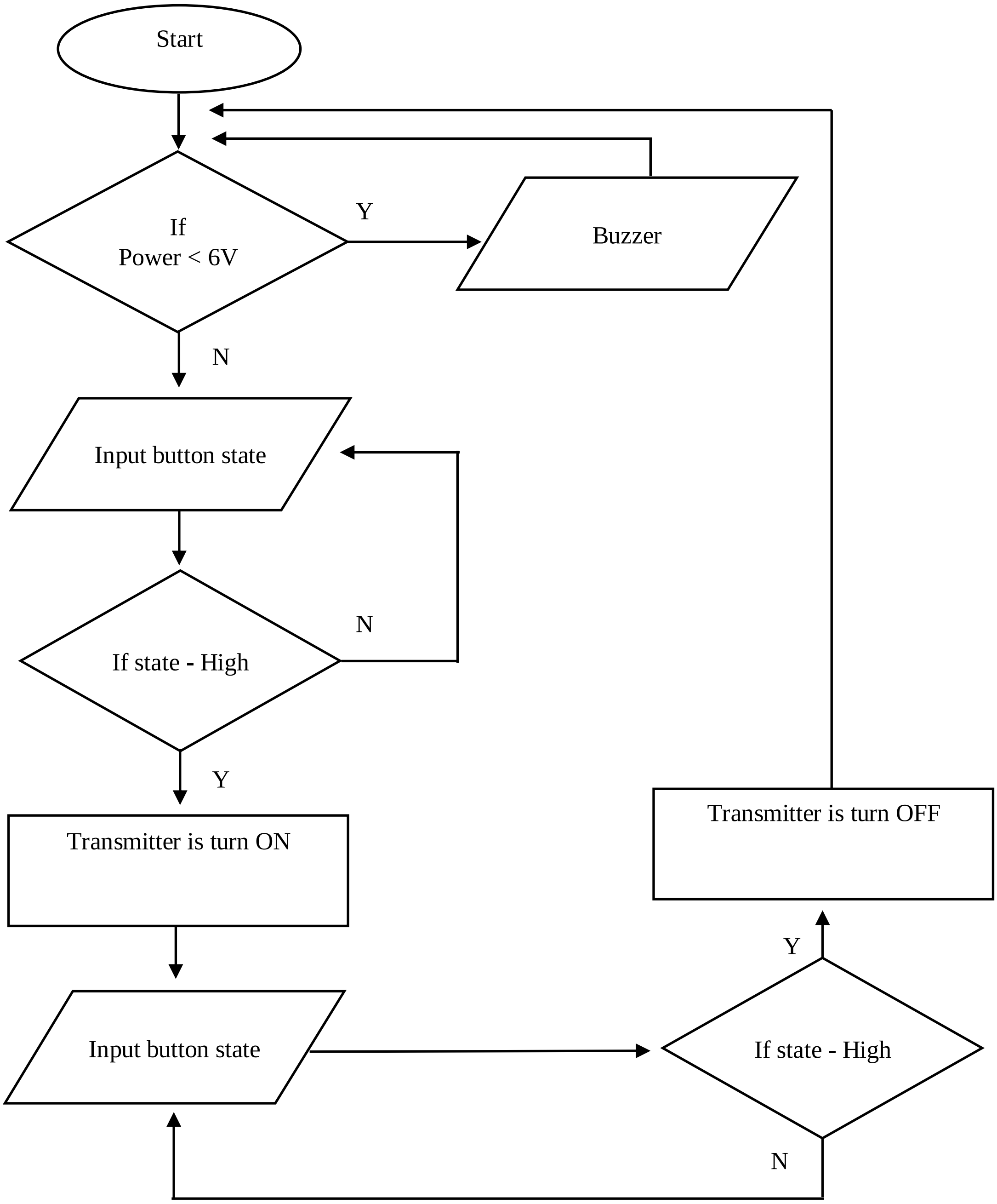

Figure 3: Flowchart of the remote

2.3 Circuit diagrams of the system

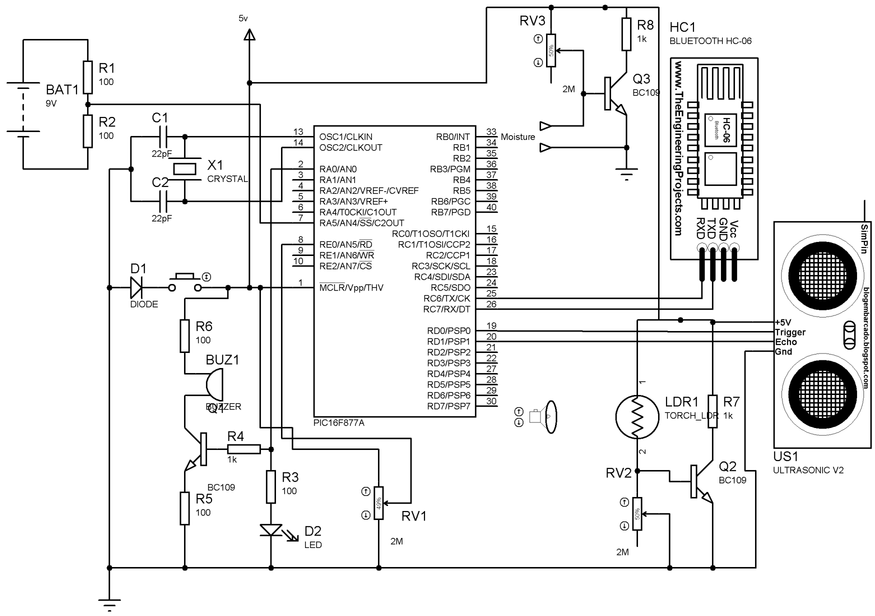

Figure 4: Circuit diagram of the walking stick

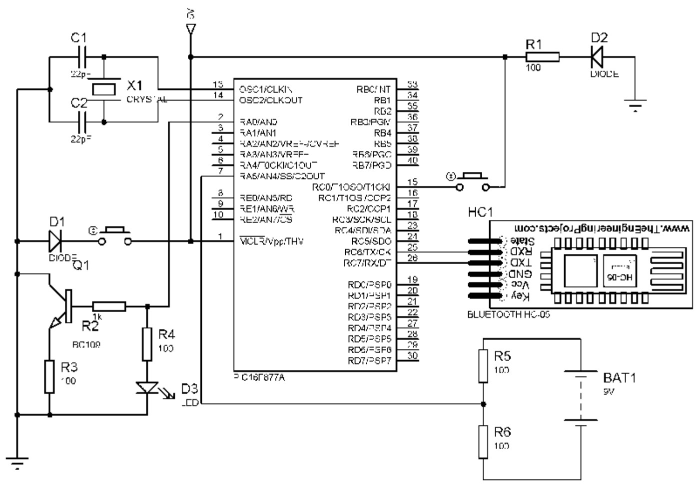

Figure 5: Circuit diagram of the remote

3. RESULTS AND DISCUSSION

Working range of the ultrasonic sensor ranges from 1 cm to a maximum of 200 cm for convenience. It is adjustable in between minimum and maximum range using the preset. And working range of the Bluetooth module ranges from 0 cm to a maximum of 1000 cm.

The walking stick is designed and developed for the blind person to identify path appropriately. Final outcome of this project is successful identification of the path safely by this system.

The device created for both indoor and outdoor navigation. In the project first a nrf24l01 module was used for wireless part but that module did not support PIC microcontroller. Therefore a Bluetooth module was used. It includes a remote, which helpsto find the stick easily. The cost of producing this device is around Rs.3350.00, weight of the stick is 250 g and weight of the remote is 100 g.

4. CONCLUSION

The main purpose of this study was to design a prototype blind stick that can detect battery status, obstacles, water and identify lightness or darkness in front of users, in the form of signal to users and also helpsblind people to find their stick if they forget where they kept it. Aim of this project is to facilitate blind people with safe movements. The advantage of the system lies in the fact that it is very low cost.

Future development of the system can be carried out in following way.

- Number of ultrasonic sensors can be increased to cover wide range around blind person.

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PROPERTIES OF THE NANO COMPOSITES MADE FROM TiO_2 AND Fe_2O_3

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ABSTRACT

This study describes about synthesis of TiO_2-Fe_2O_3 composites using a simple chemical method. Introducing Fe_2O_3 particles into TiO_2, it enhances the absorption of visible light and can create more electron-hole pairs. The prepared TiO_2-Fe_2O_3 powder were characterized by UV-spectrophotometer, particle size analyzer, Fourier transform infrared (FTIR), field emission scanning electron microscopy (FE-SEM) and energy dispersive X-ray (EDX).

Keywords: Composite, TiO_2, Fe_2O_3

1. INTRODUCTION

The most frequently studied material for photoelectrode is TiO_2. Despite its high band gap energy of ~ 3 eV, TiO_2 is the most preferred photo-electrode owing to its high photo-corrosion resistance in aqueous media, chemical stability, low cost and non-toxicity. Given its indirect band gap transition, the anatase in comparison to rutile and brookite phases of TiO_2 is the most preferred phase for photoelectrode applications[1].

In general, TiO_2 is intrinsically an n-type wide bandgap semiconductor, which renders a poor capability of absorbing only the UV region of the solar spectrum[2]. It also limits the photocatalytic activity due to its fast recombination of photo generated electron-hole pairs, leading to lower reaction efficiencies, which must be overcome in order to meet the requirement of practical applications. Therefore, several attempts have been made to tune band gap by varying the composition of TiO_2 particles[3]. As a solution, depositing small quantities of stable co-catalysts onto TiO_2 to form a composite, enhances the light absorption and reduces the recombination of photo generated electron-hole pairs[4-6]. Also forming heterounions between n-type TiO_2 and p-type doped metal oxides cause to change in the nature of semiconducting behavior of TiO_2 [7-9].

Among the various p-type semi-conducting materials, the Fe_2O_3 has been identified as a promising one as it possesses a considerably low band gap energy (Ebg = 2.2 eV) and the ionic radius of Fe^{3+} (0.64 Å) is quite comparable to that of Ti^{4+} (0.68 Å). However, Fe_2O_3 was found to be more prone to photo corrosion [1]. Iron oxide (Fe_2O_3) materials have received increasing attention due to their extensive applications as magnetic materials, catalysts, pigments, gas sensors, optical and electromagnetic devices, drug delivery, tissue repairing engineering and electromagnetic devices[10] . According to such advantages, this study concern about preparing TiO_2-Fe_2O_3 composites.

2. METHODOLOGY

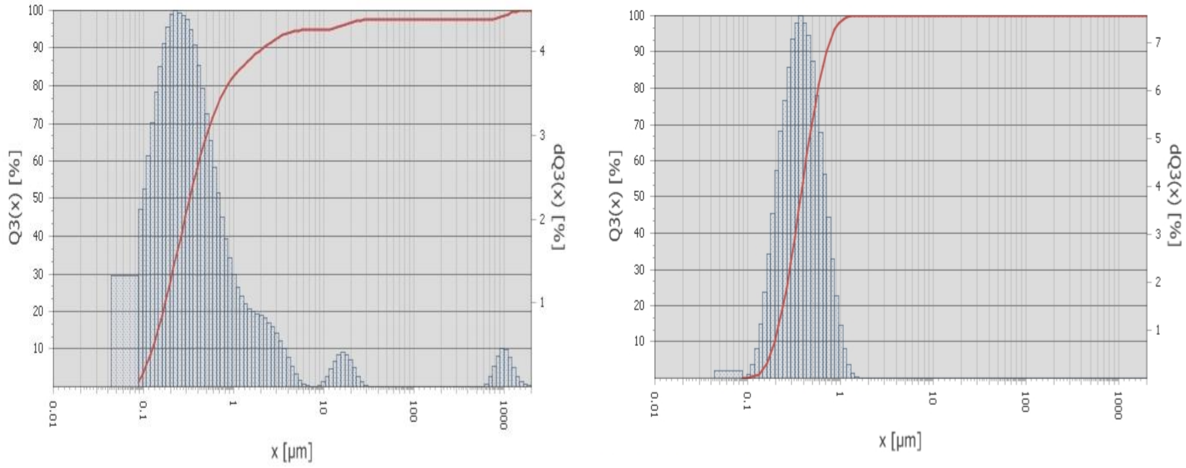
2.1. Preparation of the composite and the powder

Commercially available TiO_2 was pulverized with an agate mortar and pestle. 1 g of fine TiO_2 powder was stirred and boiled (100 ^{0}C) in a solution containing $FeSO_4$ with various concentrations (0.001 M, 0.005 M, 0.01 M, 0.05 M, 0.1 M) for 1 h. Distilled water was added to the solution continuously to maintain the same experimental conditions. The obtained composition was filtered and dried at 70 ^{0}C for 30 min.

2.2. Characterization techniques

Absorption spectra were recorded using SHIMADZU 1800 UV spectrophotometer. The particle size of the composites was obtained from FRITCH Analysette 22 particle size analyzer. SHIMADZU IRAffinity-1S FTIR spectrophotometer was used to measure the IR spectra. Field emission scanning electron microscopy (FE-SEM) images were obtain by a Carl Zeiss supra-55 field emission microscope using an acceleration voltage of 20 kV and energy dispersive X-ray analysis (EDX) was used in conjunction with scanning electron microscopy to study the surface morphology and to detect the elements in the prepared samples.

3. RESULTS AND DISCUSSION



(a) (b)

Figure No 01, Particle size distribution of : (a) TiO_2, (b) TiO_2-Fe_2O_3 composites

Particle size distribution of pure TiO_2 and TiO_2-Fe_2O_3 composites are shown in figure 1. The mode particle size of TiO_2 is 230nm and the TiO_2-Fe_2O_3 composites is 380nm . According to the observed values, When TiO_2 made composite with Fe_2O_3, the particle size is increased.

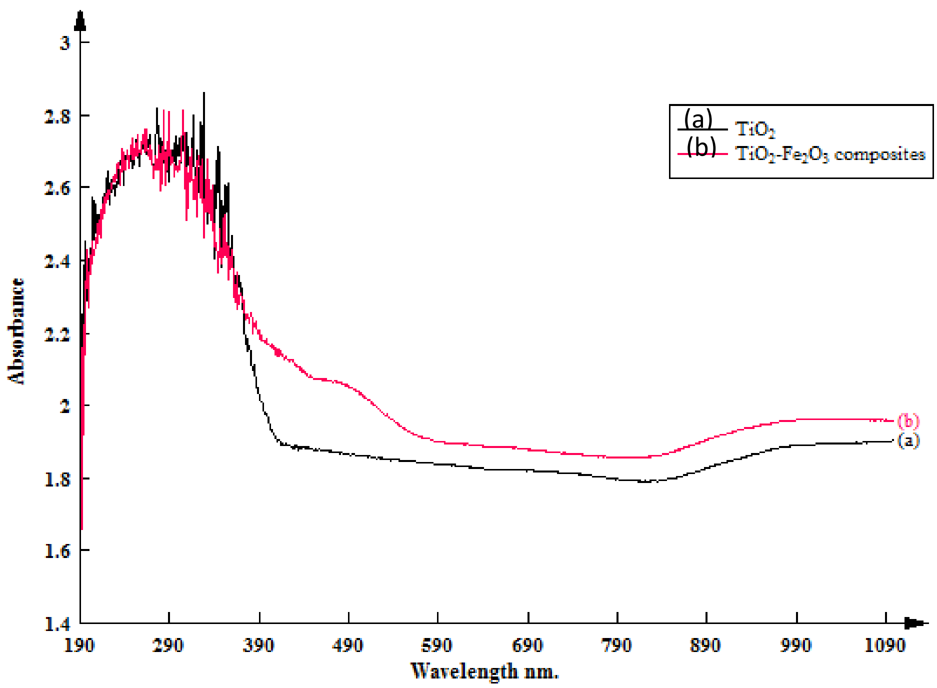
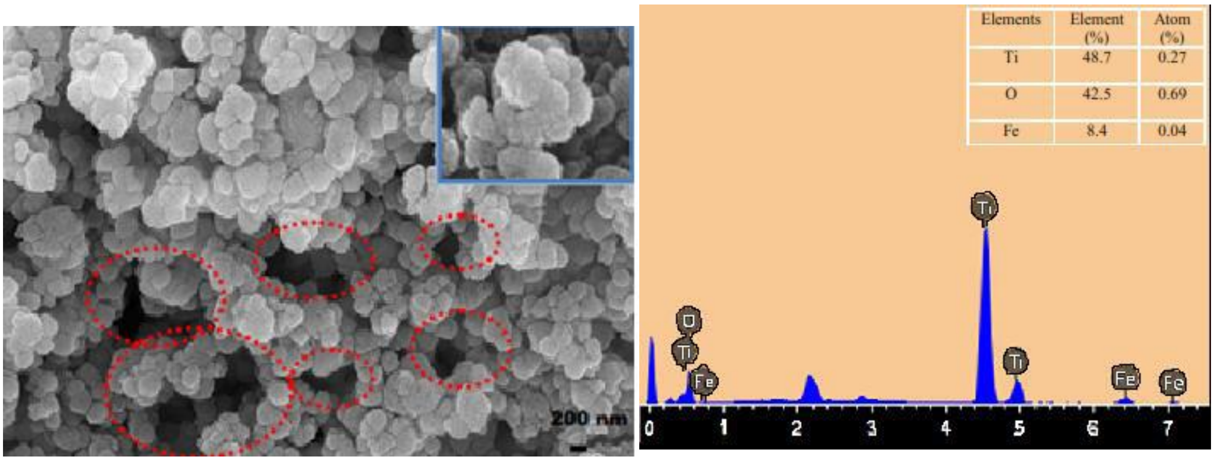


Figure No 02 , Diffuse reflectance spectra for (a) bare TiO_2 and (b) TiO_2-Fe_2O_3 composites

Diffuse reflectance spectroscopy was used to measure the UV visible absorbance of bare TiO_2, Fe_2O_3 and TiO_2-Fe_2O_3 composites. The absorbance spectrum for bare TiO_2 is shown in figure 2(a). According to the figure, TiO_2 powder has shown an absorption edge at ~ 400 nm, corresponding to a band gap of ~ 3.08 eV. As in figure 2(b), Fe_2O_3 showed an absorption edge at ~ 576 nm, corresponding to a band gap of ~ 2.16 eV. Also the TiO_2-Fe_2O_3 composite material displays the absorption edges seen for both TiO_2 and Fe_2O_3 alone according to the figure. It can clearly say that the making Fe_2O_3 composites with TiO_2 could increase its optical absorption from UV into visible light range.



(a) (b)

Figure 3 (a) FE-SEM image of synthesized TiO_2-Fe_2O_3 composites (b) EDX spectra of TiO_2-Fe_2O_3 composites

Figure 3(a) depict the morphology of synthesized TiO_2-Fe_2O_3 composites and figure 3(b) shows the elemental composition of sample analyzed by EDX. As mark in circles in figure 3(a), the porous network of spheroids facilitates better water absorption, penetration and photoreaction. Therefore, it clearly says the synthesized TiO_2-Fe_2O_3 composites provide easy access of more water molecules to the photo catalysts, enhancing hydrogen production. From EDX it shows peaks for Ti, O and Fe elements and indicates the absence of other impurities.

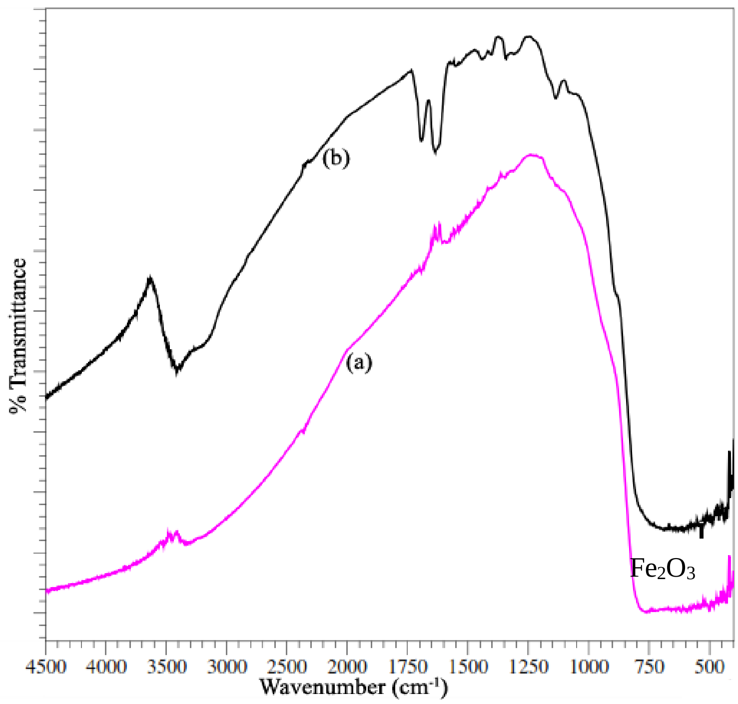


Figure 4 FTIR spectra of (a) bare TiO_2 powder (b-f) TiO_2-Fe_2O_3 composites

The FTIR spectra of bare TiO_2 powder and TiO_2-Fe_2O_3 composites are presented in figure 6. The broad intense band seen below 1200 cm^{-1} is due to Ti-O vibration[11]. It is reported that the FTIR peak of bare Fe_2O_3 appears in ~ 560 cm^{-1} due to vibrations of Fe-O group[12]. But the peak position of Fe_2O_3 in the FTIR spectra of TiO_2-Fe_2O_3 composites appear in ~ 530 cm^{-1} which is quite different from bare Fe_2O_3.

4. CONCLUSION

The present study reports the synthesis of TiO_2-Fe_2O_3 composites using simple chemical method. It implies that boiling TiO_2 powder in $FeSO_4$ solution make TiO_2-Fe_2O_3 composites than making Fe doped TiO_2 particles. It is further proved, because the particle size of the TiO_2-Fe_2O_3 composites is larger than pure TiO2 and it also shows a remarkably high absorption after introducing the Fe_2O_3 particles. Furthermore, synthetization of TiO_2-Fe_2O_3 composites have also been identified by FTIR, FE-SEM and EDX studies.

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THE LOW COST DEVICE TO MEASURE ENVIRONMENTAL FACTOR USING THE MICROPROCESSER

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ABSTRACT

There are so many devices to measure environmental factors in the industry that are thermometric, lux meter, air humidity meter , moisture meter and etc. These devices are very expensive and one device can measure only one factor. So user has to buy one device to achieve one goal. People who work in various fields need to measure those factors for their duties. The low cost device was implemented to measure environmental factors such as temperature, light intensity, humidity and soil moisture as the solution of above problem. The device has a sensor panel that contains LDR (Light Dependent Resistor), AM2302 and soil moisture sensor. The reading of sensor panel was taken the microprocessor and data was transmitted to the LCD (Liquid Cristal Display) using the NRF module. Light intensity value was the calibrated value. Then the NRF receiver model was received the data and display it on the LCD display that is in the remote location. Also this device has capability to analyze the sensor's data as the low, good and high. Low means that value of environmental conditions are lower than the expected value of user. Good means that current environmental conditions are behavior as the user requirement. High means that current environmental conditions are not suitable for user because those values are higher that the user requirement. So this device will be the user friendly device.

Keywords: AM2302, LDR, Soil moisture sensor

1. INTRODUCTION

Environment composed of various factors like light, temperature, humidity and soil moisture which are directly or indirectly plays important role in successive growth of plants. In some cases, poor or weak environment can damage plants by providing diseases. Hence better understanding of climatic factors is necessary that may affect the development of the plants and appropriate actions can be drawn to prevent these problems. To overcome these problems, environmental parameter effects that are temperature effects, humidity effects, light effects and soil moisture effects are needed to be taken in to consideration. Also cricket umpire wants to get the information about the current environmental condition because one responsibility of umpire is checking the environmental condition such as light. Following environmental factors are useful to the various fields to get the best output. They are,

- Temperature
- Light intensity
- Humidity
- Soil moisture

In physically, intensity is the power transferred per unit area, where the area is measured on the plane perpendicular to the direction of propagation of the energy [3]. Cricket umpire uses the light meter to indicate lighting levels on the cricket field. Light meter was helped to the farmer to determine how much sun light receives for the plant**.**

Relative humidity is very important for many agricultural environments, such as fruit and vegetable storage facilities, greenhouses, and tobacco curing and handling facilities. Several scientific instruments measure temperature and relative humidity [1]. The temperature is an objective comparative measurement of hot or cold.

Soil moisture is the amount of water in the soil. It plays a crucial role for efficient photosynthesis, respiration, transpiration and transportation of minerals and other nutrients through the plant. Proper irrigation schedule is very critical to plant growth [4].

The more accurate those instruments are costly. Devices that are economical for agricultural use in a barn, greenhouse, or a semi-protected environment often do not hold their accuracy over very long periods if they are used carelessly. There is no device with identify all above characteristics using the one device. So in this project, the low cost device is proposed that can be used to measure temperature, humidity, light intensity and soil moisture more accurately.

2. METHODOLOGY

In this propose prototype, the device can be measuring environmental factors (light intensity, humidity, soil moisture and temperature) with low cost and high accuracy as the requirement of the various field using the microcontroller.

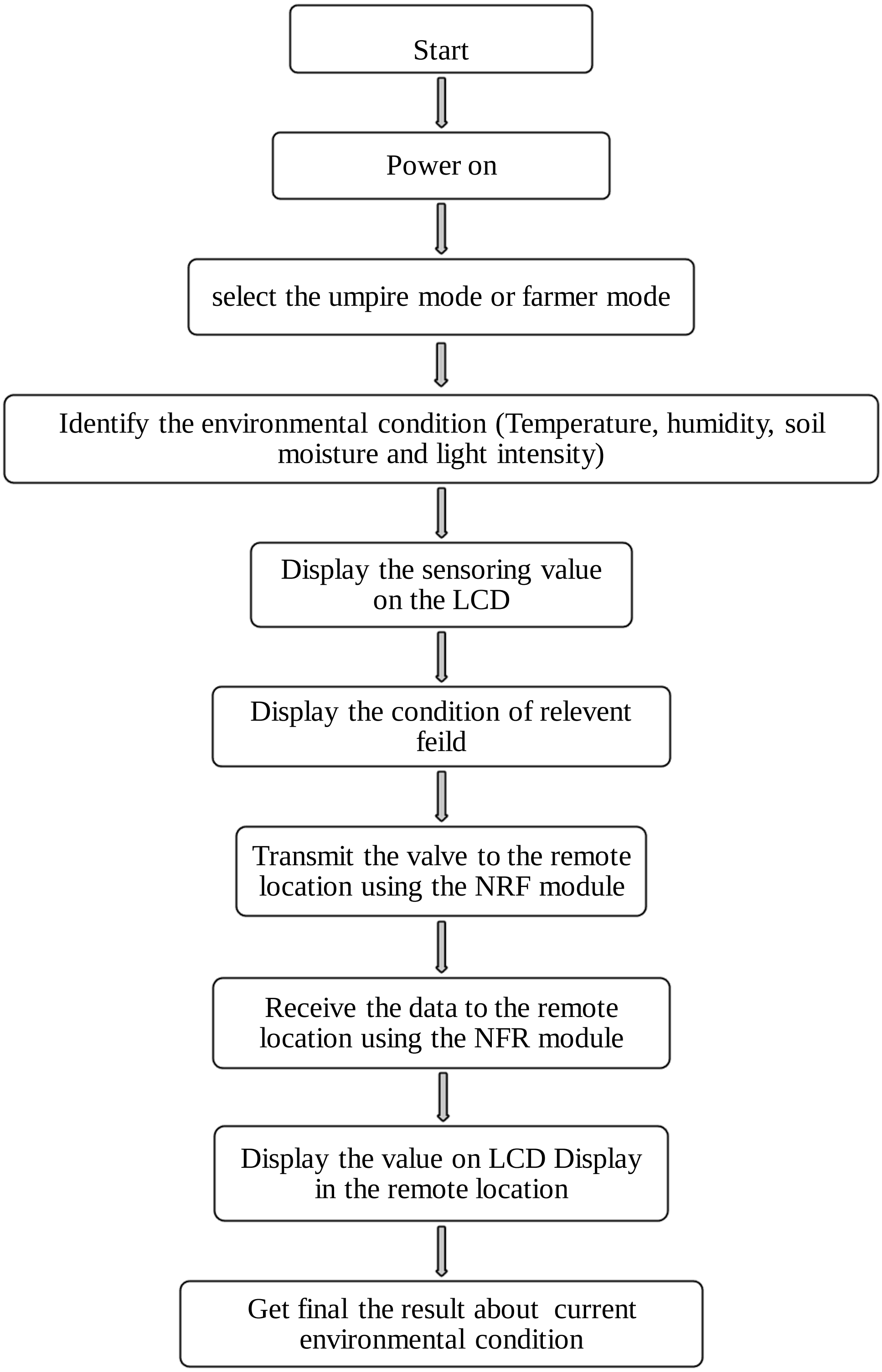

Figure1: The flow chat to explain the device

This device has 2 circuits. They are,

1. Transmitting circuit
2. Receive circuit

2.1 Transmitting circuit

The transmitting circuit has sensor circuit, microprocessor and transmit device. LDR, AM2302 and soil moisture sensor used to create the sensor circuit. The AM2302 is the Digital relative humidity & temperature sensor that used to measure the humidity and temperature of the air accurately.AM2302 has a huge operating range and low supply power. Soil moisture sensors measure the volumetric water content in soil. LDR is a resistive light sensor that sensor can change its electrical resistance from several thousand ohms in the dark to only a few hundred ohms when light falls upon it. There were 3 LDR in the sensor panel in order to measure light intensity by 3 directions. The output of LDR was a calibrated value.

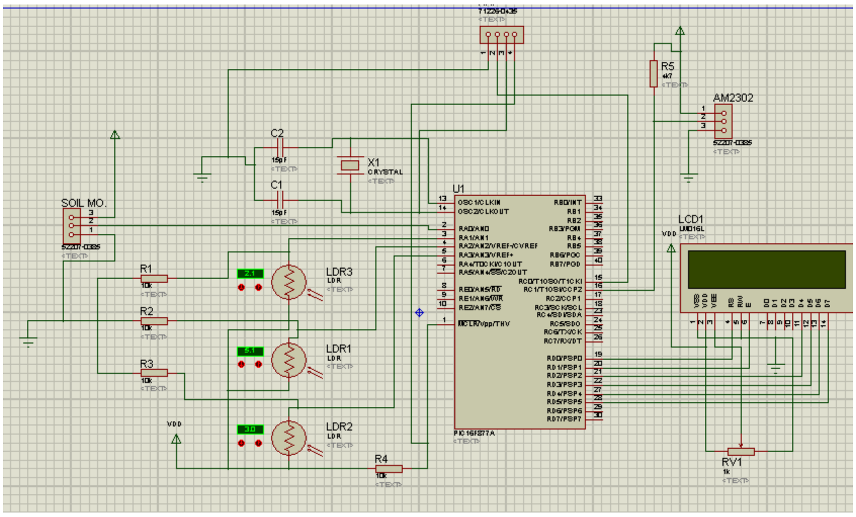

Figure 2: Circuit diagram of Transmitting circuit

2.2 Receive circuit

This circuit used to receive the data to the remote location and display the data.

3. RESULTS AND DISCUSSION

This is low cost accuracy device can be specially introduced to the farmer and cricket umpire. This device helps them to take decision that can’t take in naked eye. This device is kept the ground and soil moisture sensor was connected to the soil. Then user brings only the receiving device. Then user get the final result of the current environmental condition as the “LOW”, “GOOD”, and “HIGH” as shown as the table 1 and table 2.

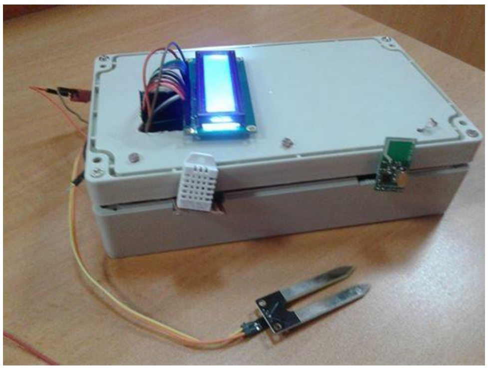

Figure3: The prototype of the device

TABLE 1: FARMER REQUIREMENT

Farmer Requirement	Temperature (^{o}c)	Humidity (%)	Light Intensity (V)	Soil Moisture
LOW	Less 20	Less 60	Less 0.15	Less 40
GOOD	20- 30	60-80	0.15-3.0	40-50
HIGH	More 30	More 80	More 3.0	More 50

TABLE 2: UMPIRE REQUIREMENT

Umpire Requirement	Temperature (^{o}c)	Humidity (%)	Light Intensity (V)	Soil Moisture
LOW	Less 15	Less 60	Less 0.15	Less 40
GOOD	15-38	60-80	0.15-3.0	40-50
HIGH	More 38	More 80	More 3.0	More 50

The device measures environmental factors (light intensity, humidity, soil moisture and temperature) with low cost and high accuracy and send the detail to the user's location.

Three sensors are used in three directions. It also can affect more correct reading because the final output result of LDR is the mean value of the above 3 sensor. The device was used the NRF module to the transfer the data because this is low cost than other transfer device like Bluetooth, GSM module and etc. Also NRF module has a capability with long distance data transfer. The AM2302 digital temperature and humidity sensor is a digital device providing a calibrated temperature and humidity output.

4. CONCLUSION

This device is solution for the high cost environmental factor measurement devices. The device can measure the light intensity, humidity, soil moisture and temperature more easily and accurately. User can get the current environmental condition at the remote location so this device is recommended to the farmer and cricket umpire so can take correct decision at the real time using this device. Total cost of this device is approximately four thousand rupees. Future development of this device can be carried out by adding more environmental factors and give solutions for bad environmental conditions. In addition this can be improved to measure all environmental factors for all plant.

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GSM GPS BASED MOTORBIKE TRACKING SYSTEM

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ABSTRACT

This system deals with the design development of a vehicle tracking system for a mobile phone, which is being used for identifying the location of a motorbike. The system makes use of an embedded system based on Global System for Mobile communication (GSM) technology. The designed system is mounted in the bike. Once the location of the vehicle identified, the message is sent by the vehicle owner. The microcontroller unit reads the SMS and sends it to the Global Positioning System (GPS) module. By using the triangulation method, GPS module will give the exact location in the form of latitude and longitude to the user's cell phone. The designed system is very simple and cost effective.

Keywords: GPS module, GSM module, Microcontroller.

1. INTRODUCTION

In this urban life transportation is very common. A motorbike has become the most commonly used vehicle among everyone. Today, most of the young generation is travelling by motorbike. Their family members do not know that their children have reached their destination safely or not. Therefore parents have to be worry about their children until they come back home.

Motorbike theft is one of the headaches which bike owners face. Most stolen motorbikes are never seen again. It is not the easy task to find the bike even though police authority is informed in time. Motorcycle parts can be removed and sold due to this delaying.

Therefore the need of security and monitoring is essential. Various security systems are available in the market with variety of functions, operating modes and features. Most of the devices are expensive although they have so many features. Due to this high cost, general community has no capability of buying such tracking device for their general purposes.

In this paper a cost effective portable motorbike tracking device is proposed for general community who can't spend extra cost for buying such tracking systems.

A motorbike tracking system is an electronic device, installed in a motorbike to enable the owner or a third party to track the vehicle's place. This system built based on embedded system used for tracking and positioning of the vehicle by using GPS and GSM.[1]

2. METHODOLOGY

The tracking system consists of a GPS module, a pic 18F2550 microcontroller and a GSM module. This system can be used in a Vehicle (bike), with the battery. A pic microcontroller is interfaced to GSM module and GPS Receiver. Microcontroller will keep listening to the new SMS arrival. If a SMS arrived, it will check for authentication and after authentication is verified it will read the GPS location. Location data is transferred to microcontroller through serial communication. After processing of the data provided by GPS receiver, microcontroller transmits this information to the user's cell phone in the form of SMS and as the latitudes and longitudes. Microcontroller controls the operation of GSM modem through serial interface using AT commands[2].

Microcontroller is acting as Central Processing Unit and it needs instructions to operate the whole system. These instructions are provided to microcontroller by writing the Mikro C program into microcontroller's flash memory. The time between the SMS can be programed in advanced.

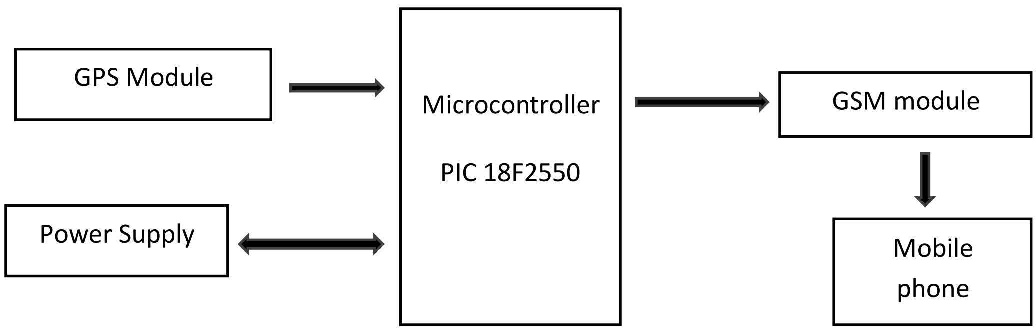

Figure 1: Block diagram of the system

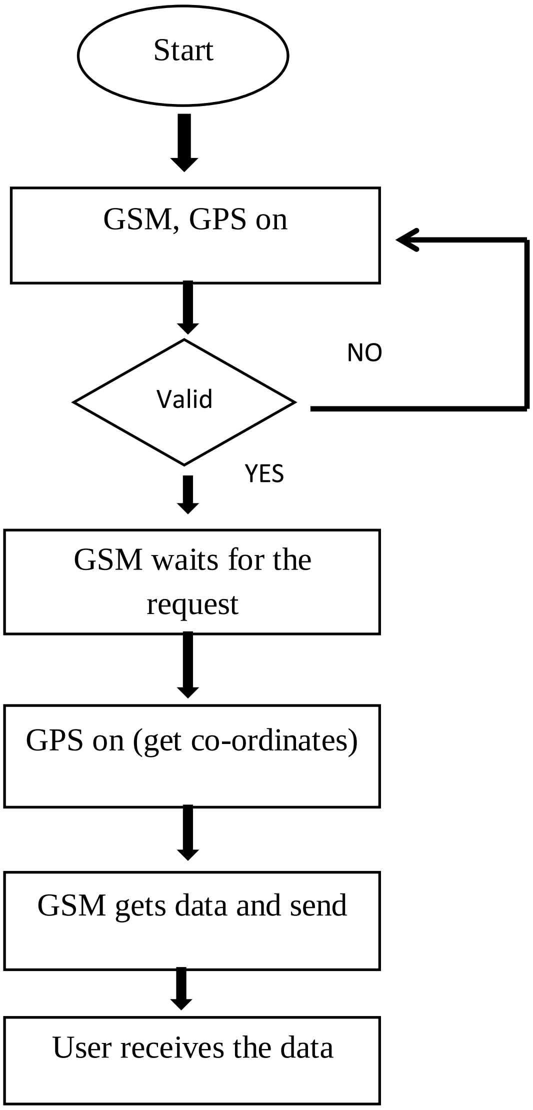

Figure 2: Flow chart of the tracking system

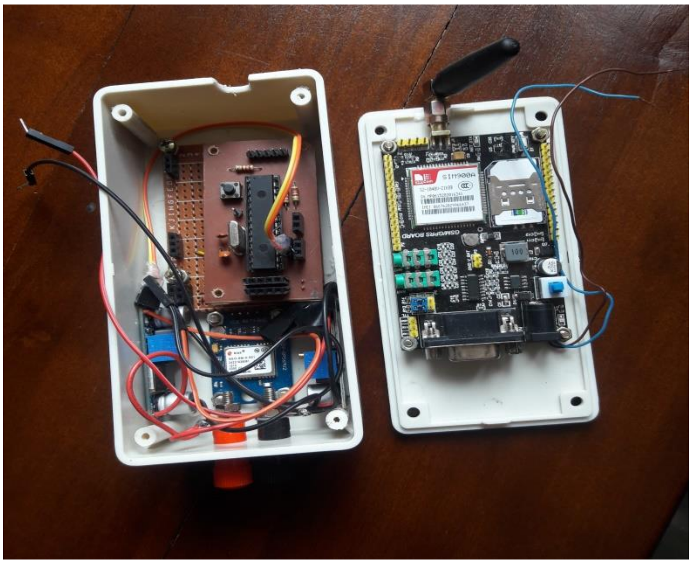

Figure 3: The implemented tracking device

3. RESULTS AND DISCUSSION

Overall result of this project is successful identification of the location of the vehicle by the device. Whenever message is sent to the relevant SIM card number in GSM module, then the device sends message to given mobile device.

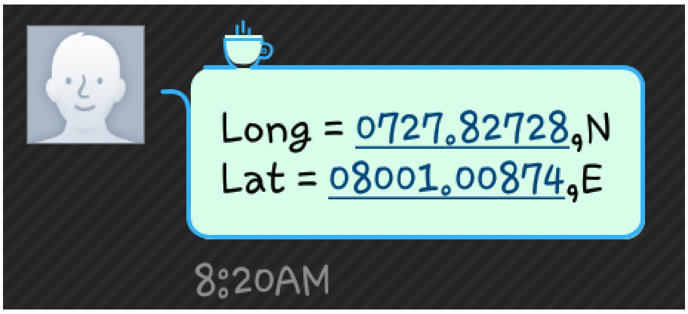

Figure 4: Final output of the system

To get the maximum value of this system, parents should take fixed coordinates in the particular locations where their children go regularly and save it. If not by using this coordinates and Google map, they can find the location easily.

This tracking system is low cost implementation. The total budget is around five thousand two hundred rupees.

Table 1: Cost of producing device

Item	Cost (Rs.)
PIC 18F2550	650.00
GSM module	2200.00
GPS module	2100.00
Capacitors, Resistors, Wires and other expenses	250.00
Total	5200.00

It is a portable device, so it is relatively effortless to install this device to the motorbike in quick time. The quality of hardware ensures there would be minimum maintenance required and provides the maximum service to the user.

The accuracy of the device depends on receiving proper signal to GPS receiver from satellite. Therefore the GPS antenna should be placed where it can capture huge range of signal.

4. CONCLUSION

This paper has described the design and implementation of the motorbike tracking system. The final outcome of this project was a reliable, cost effective real time tracking system which can be used by any people. This will be a better solution for motorbike theft detection.

This system can be further enhanced by the use of camera and by developing a mobile based application to get the real time view of the motorbike instead to check the location using co-ordinates, which would be more convenient for the user to track the target.[3]

ACKNOWLEDGEMENTS

Authors wish to extend their gratitude for the assistance given by the Electronic department of Wayamba University of Sri Lanka and thank all who have supported to make this project a success.

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A MULTI-PURPOSE DIGITAL DATA DISPLAY MODULE FOR NUCLEAR INSTRUMENTS AND RELATED SOFTWARE

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ABSTRACT

Nuclear technology is the applications, processes and methods involving ionizing radiation. Nuclear technology is widely used in many fields. Presently, it is especially focused on instrumentation techniques which demands proper operation, calibration and maintenance. Sri Lanka Atomic Energy Board (SLAEB) uses nuclear instruments to share radiation related knowledge for local community through training programs, workshops, conferences, symposia and seminars. The institute also develops nuclear instruments, related technologies and supporting software to fulfill the requirements of the country. There, a specific data communication protocol is used within the system and software. The protocol is based on the RS232 serial communication. This study presents an electronic display device that can operate upon the above mentioned protocol. It can be used to display data values of the protocol to a mass audience. This display module is developed to be used with the software, and detection system at the SLAEB.

Keywords: RS232 communication, Digital data display, Nuclear awareness, Nuclear instrumentation

1. INTRODUCTION

SLAEB is the authorized state organization which has the responsibility of facilitating the utilization of Nuclear Technology in the medical, agricultural, industrial, energy and environmental sectors and providing services with special regard to safety and security[1,3]. In the Nuclear Instrumentation laboratory, novel nuclear instruments and related technologies are designed and developed[2].

SLAEB conducts training programs, workshops, conferences, symposia and seminars to enhance the public awareness on nuclear technology. For that, several nuclear instruments, demonstration kits and software have been developed. But, due to their smaller size, these cannot be used in mass audiences. Small display units in these systems cannot be viewed from distance. Therefore, this study proposes a multi-purpose digital data display unit that can be used with those instruments and software.

These systems use a specific data communication protocol based on RS232 communication standards. Therefore, the display unit is also proposed to be compatible with the communication protocol defined by the SLAEB.

The SLAEB serial communication protocol consists of 4-data values, 2-command values and 4-auxiliary data values in byte form[4]. Each data value is followed by an auxiliary data byte which contains the decimal point and the unit of each data value. The proposed display unit can display each data value (one at a time) on the user's preference. A 5-bit local standard has been defined by the SLAEB to represent the units of commonly used quantities.

2. METHODOLOGY

The communication protocol is operated at a 19200 bps baud rate. All the data in the protocol are positive numerical integers. Therefore, LED 7-segment system can be efficiently used to display all the data in the protocol. Each data values are in word form which is consisted of 16-bits. Therefore, 6-digit display system is sufficient for the display.

Each auxiliary data byte is consisted of two information: a 3-bit decimal point data and 5-bit unit data. The decimal point data is used to mention the number of decimal points in each data value. The 5-bit unit data represent the unit of each value. The units are displayed as characters. Therefore, a quad-8*8 LED matrix module has been proposed.

A serial to USB Communication Bridge is used to receive the data from PC software modules, such as LabVIEW and Visual Studio applications. A direct RS232 link has been implemented to obtain data from instruments and demonstration kits.

The system can be operated with 5V regulated DC power from the instrument or the PC. For smaller instruments, an external power supply has to be used. For that, a step-down switching voltage regulator has used. To select the data value for display, a 4-way switch has used in priority mode.

The completed hardware architecture of the display unit has been designed and implemented according to the block diagram shown in Figure 1.

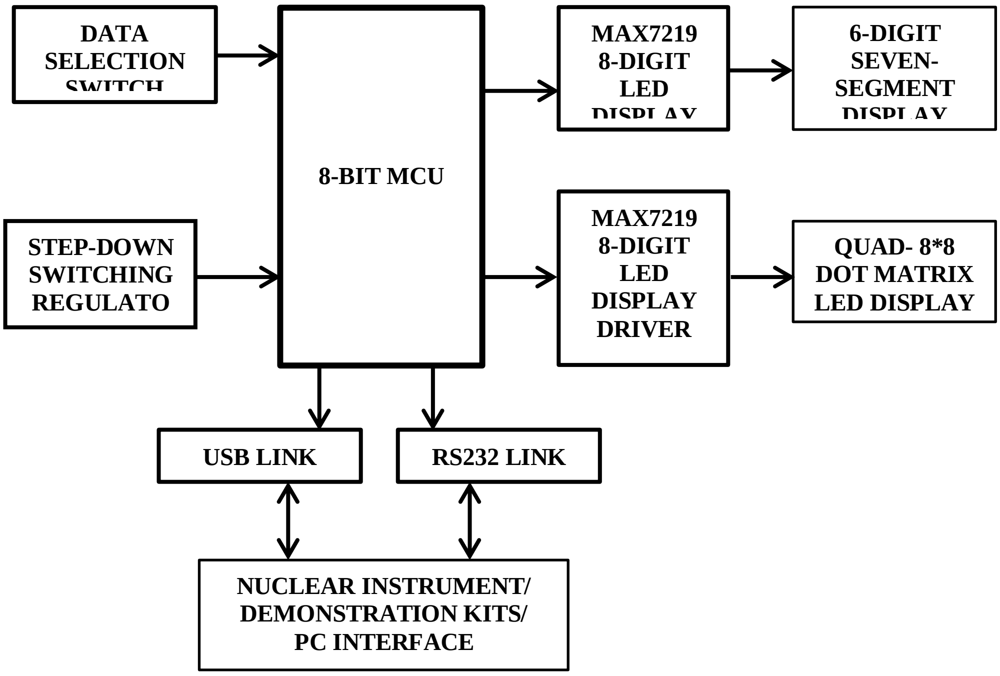

Figure 1: Block diagram of the proposed system

The control unit is the main part of the system. An 8-bit general purpose microcontroller operates as the main controlling component of the system. It controls and coordinates the display module to fulfill its operation. It has a step-down switching regulator to keep the constant output voltage at the desired value in-spite of variations in the supply voltage. The MCU receives data from the RS232 link, analyses it and controls the MAX7219 digital display drivers of the 7-segment and matrix modules to display the data value. As a special function, a potentiometer is used to control intensity of the display modules. The MAX7219 display driver has been used due to the higher number of advance features. It offers relative to the traditional display driving systems. To enhance the efficiency, cost-effectiveness and reliability, several design standards have been followed. And suitable components have been selected.

3. RESULTS AND DISCUSSION

A complete prototype of the proposed system has been fabricated and tested for its performance using the RADI-count radiation counter kit.

Also, LABVIEW interface software has been designed to test the performance of the system in the computer based environment.

The display unit can only display the pre-programmed units only. This is a limitation in extended applications. Also, the display unit is comparatively slow for the instruments with very high data update rates. In the units, only the symbols can be displayed. The standard name of each unit cannot be displayed.

4. CONCLUSION

The proposed system is portable, low-cost and well-suited for medium sized audiences in displaying instrumental data. Therefore, it can be used as a powerful tool in the process of introducing nuclear technology to the local community.

The system is specially assigned for the SLAEB. But, by changing the firmware, it can be used for any other serial communication protocol standard.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the Department of Electronics, Faculty of Applied Sciences, Wayamba University of Sri Lanka, Kuliyapitiya, Sri Lanka to carry out this research task while learning many novel concepts and approaches. Also I would like to acknowledge the Nuclear Instrumentation Laboratory, Radiation Protection & Technical Services Division, Sri Lanka Atomic Energy Board, Orugodawatte, Sri Lanka for the material support and facilitation. Also, I thankfully remind Sri Lanka Atomic Energy Regulatory Council, Kelaniya and International Atomic Energy Agency, Vienna, Austria who authored the resources mentioned under the references section

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DESIGNING AND IMPLEMENTING A LOW COST AUTOMATIC DOSAGE SYSTEM FOR IMA C21 TEA BAG PACKING MACHINE

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ABSTRACT

Today, main focuses in tea packing field are to maintain high quality of the production, to have low cost production and to maintain the production process at international standard. As a result, lots of companies tend to use fully automatic systems for their production process.

In industry, weighers and weighing mechanisms are to be very accurate. Without the accuracy, extraction figures are meaningless. Weigher is the necessity either to weigh or to weigh the final products to calculate extraction rate. Low cost automatic dosage system will be designed considering the advantages of electronic weighing and linear motion guide ways moving accuracies.

The objective of this project is to develop a device that automatically changes the dosage of the machine, according to the load cell feedback. Load cell was used to measure the mean weight of the twenty five tea packets. Mean weight is in the range of 70 g to 80 g. If weight exceeds the upper threshold limit (packet weight>80 g) then the relay 2 is switching on and decreases the weight of the packets. If otherwise (packet weight<70 g) the relay 1 is switching on and increases the weight of the packets. For developing this device, a load cell (Capacity-300 g),
12 V, 5 A switching mode power supply unit, LM2596 adjustable voltage regulator and an arduino circuit were used. The arduino circuit was used to control the whole system. The designed system has a Liquid Crystal Display (LCD) to display the weight of the packets.

Keywords: Arduino, Adjustable voltage regulator, Liquid Crystal Display

1. INTRODUCTION

Mechanical scales are not reliably precise and their applications in automatic lines are complicated. Mechanically operated weighers are obsolete and maintenance oriented. Electronic weighers are sophisticated and calibrate themselves by using built in calibration procedures and save the data themselves[1]. Load cells are widely used in a variety of industrial weighing applications such as wending machines and weighing systems[4].

Statistical analysis indicates that there was no significant difference in mean value of measurements from set weights and measured weights at the 95% probability level. Automatic weighing equipment can be successfully used for weighing and dosing of products into bags, containers in automated production processes[2].

In this system, it will measure the average weight of the 25 tea bags by using the load cell output. The system will measure the weight of the tea packets for several times within four seconds and it will be displayed on the LCD display. If the average weight exceeds upper threshold limit, then the relay 2 will switch on and reduces the dosage of the machine. If otherwise, relay 1 will switch on and increases the dosage of the machine.

2. EXPERIMENTAL

The block diagram given in figure 01 describes the system.

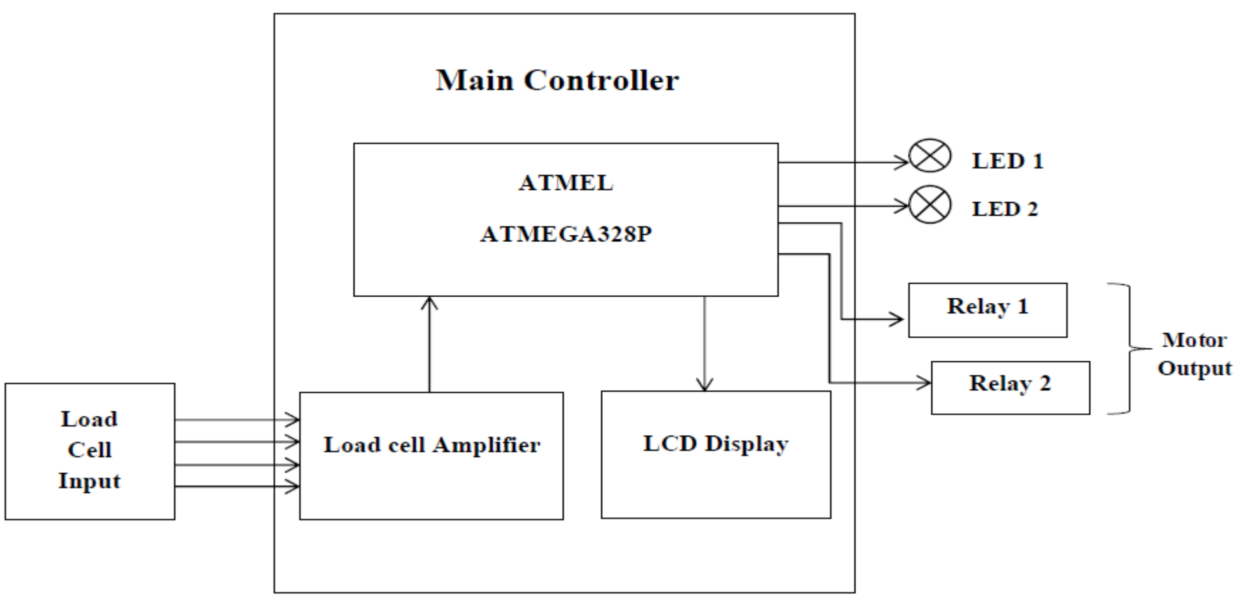

Figure 01: Block diagram of the proposed system

The task assigned to load cell amplifier was to receive an analog input from the load cell and to hand over it to Arduino ATMEGA 328P. Arduino will check the mean weight of the packets with the programme and it will be display on LCD display. If weight exceeds the upper threshold limit (packet weight >80 g) then the relay 2 is switching on and otherwise (packet weight<70 g) the relay 1 is switching on. To achieve efficient control of the motor, two relay contacts were attached to the system to control the direction of the motor.

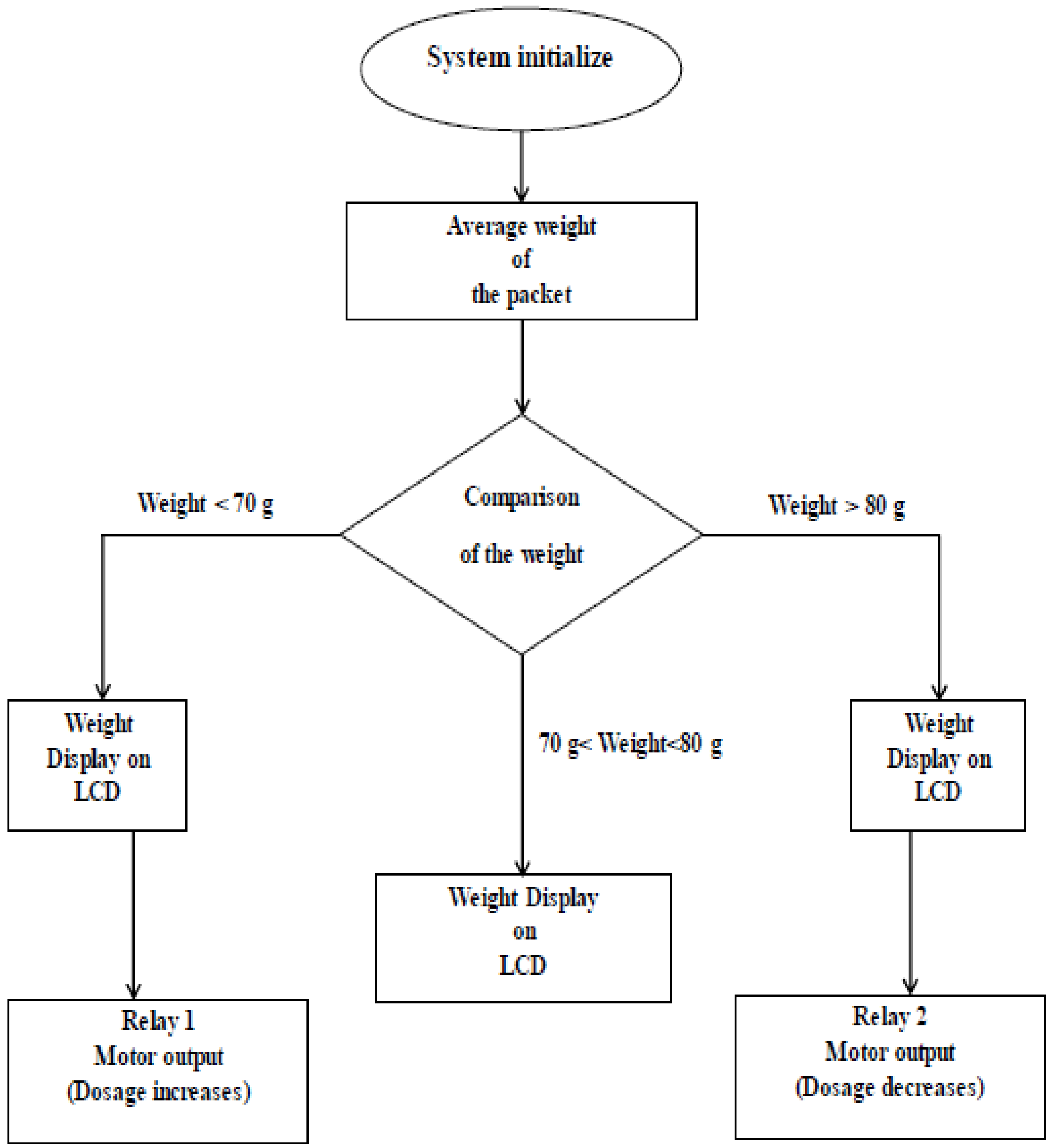

Figure 02: Flow chart of the system

The flow chart given in figure 02 describes the functionality of the system. When the power supply is on, system will be initialized. Average weight of the packet will be measured by using the load cell output and displayed the weight on LCD display. If the weight of the packets exceeds upper/lower threshold limit, then the relay 1/relay 2 was switched.

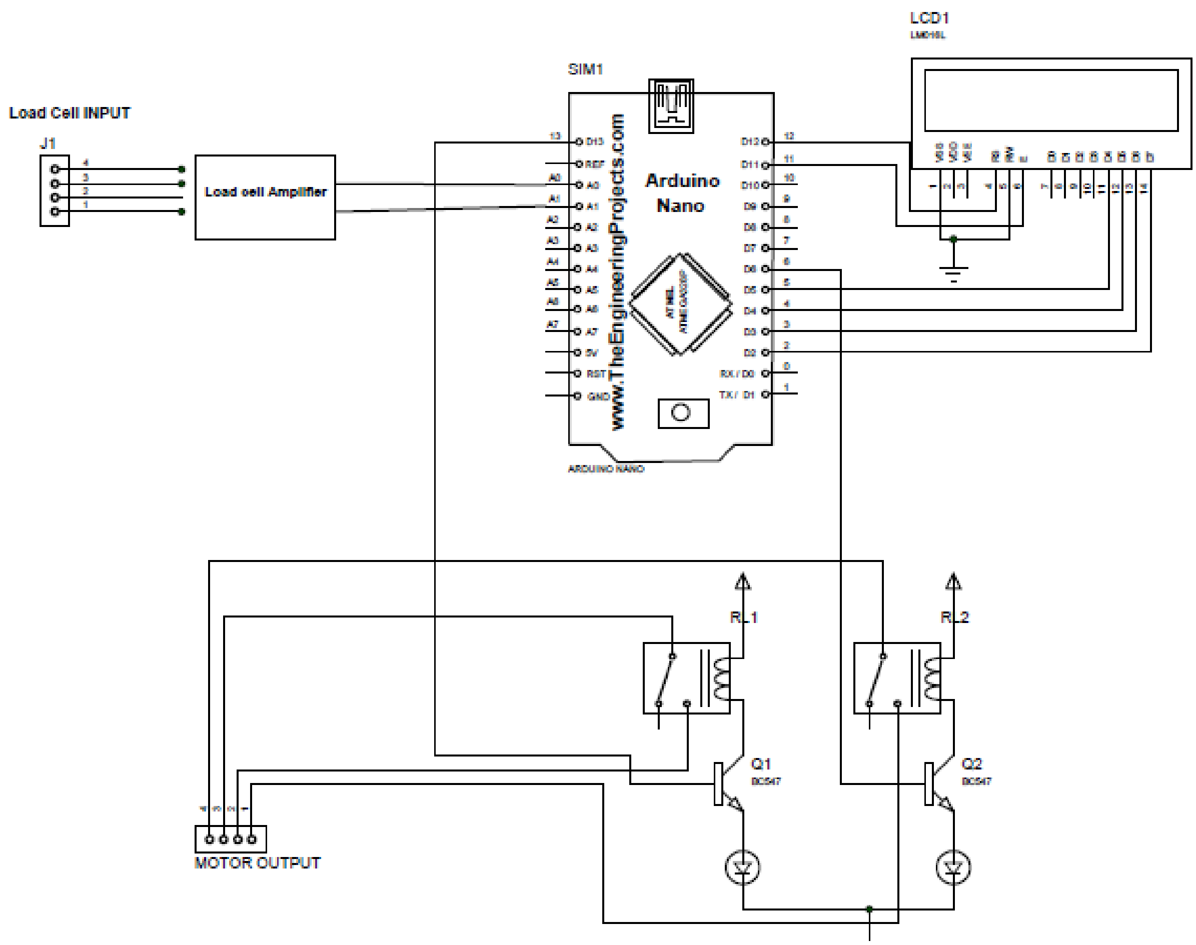

Figure 03: The circuit diagram of machine automation and production quality analyzing system

Motor was controlled by the main output of the system from relay 1(RL1) and relay 2 (RL2). Load cell output was amplified by using the amplifier and it was directly sent to the arduino circuit.

3. RESULTS AND DISCUSSION

3.1 Results and Discussion

After compiling and launching the system, main controlling unit functioned properly as expected. The average weight of the tea packets were displayed on the LCD. Furthermore, communication between the system and the machine functioned properly. Motor rotates according to the relay output.

The proposed system is a cost effective solution for the company. This type of automatic dosage system is more expensive when it was in built with the machine. This system can be purchased at very low cost and high quality.

3.2 Strengths of the project

- No need to visit each machine to check the weight of the packets
- No need to get an employer to check the weight of the packets.
- Cost effective.
- Time saving
- Improve productivity
- Ease of use

4. CONCLUSION

This automatic dosage system is a cost effective solution for the problem of weight varying of the tea bags. Working states of the system can be seen clearly using the LCD display. With this solution, the company will be benefited financially by cutting down undesired expenses while improving the productivity.

ACKNOWLEDGEMENTS

The authors would like to thank many individuals who helped and guided to complete industrial training project. Gratitude is also conveyed to the staff of Department of Electronics, Faculty of Applied Sciences, Wayamba University of Sri Lanka.

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DESIGN AND PLANNING OF A FIBER TO THE HOME ACCESS NETWORK BASED ON GIGABIT PASSIVE OPTICAL NETWORK TECHNOLOGY

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ABSTRACT

This study aims to explain the design and planning of a passive optical network (PON). The main idea of this project is to construct a virtual environment that will allow us to study the fiber to the x (FTTx) and decide which is the most optimal option for this environment. To achieve this, the main element of these networks, fiber optics, was first studied in order to know in detail its operating principles and the most important characteristics. The theoretical part will be followed by the definition of the FTTx networks and the point-to-point and point-to-multipoint configurations, going on to elaborate on PON and concluding which technologies will be the most optimal today. Finally, in the practical part, the OptiSystem 13.0 simulation software that meets the design requirements will be chosen, the design of the passive optical network will be made and in the simulation results that justify the network being viable and can be implemented in a real case be obtained.

Keywords: Optical fiber, Passive Optical Network (PON), Fiber to the x (FTTx)

1. INTRODUCTION

Optical fibers use light signals to transmit data. As this data moves through a fiber, there must be a way to separate it so that it gets to the appropriate destination. A passive optical network shares optical fiber strands for portions of the network. Powered equipment is only needed at the source and at the receiving end of the signal. The gigabit passive optical network (GPON) consists of three major units, namely the optical line terminal (OLT), the optical network unit (ONU) and the optical dividers. The data is transmitted from the central office (CO) to a single optical fiber that extends from the CO to the optical dividers. This divisor then divides the power into N distinct paths that go to different subscribers[1, 2].

The number of splitting paths can vary from 2 to 64. The optical line terminal has two main functions: performing a conversion between the electrical signals used by the service provider equipment and the fiber optic signals used by the passive optical network. The optical network unit is used in combination with an optical line terminal. GPON offers many advantages: It supports triple play service. It is a term for supplying two broadband high-speed internet access services and television and a less demanding service bandwidth, the phone on a single broadband connection[3]. It has a high bandwidth transmission and long distance service coverage of 20 km. Because PON uses the same fiber for upstream and downstream transmission, it uses wave division multiplexing (WDM) for bidirectional transmission. Wavelengths of 1490 nm are used for downstream traffic and the wavelength used for upstream traffic is 1310 nm[1, 2].

2. EXPERIMENTAL

2.1 Access Network Design

To perform an optical infrastructure deployment in the best possible way, it is essential to know the scenario of deployment, its particularities, highlighting the most important features, and so on. The area under deployment is a fictitious environment as an expansion of a city but it could easily belong to a real environment[4]. For the case study two scenarios ware selected: Business edge and the Residential areas.

- Scenario 1: Business offices area
- Scenario 2: Residential area

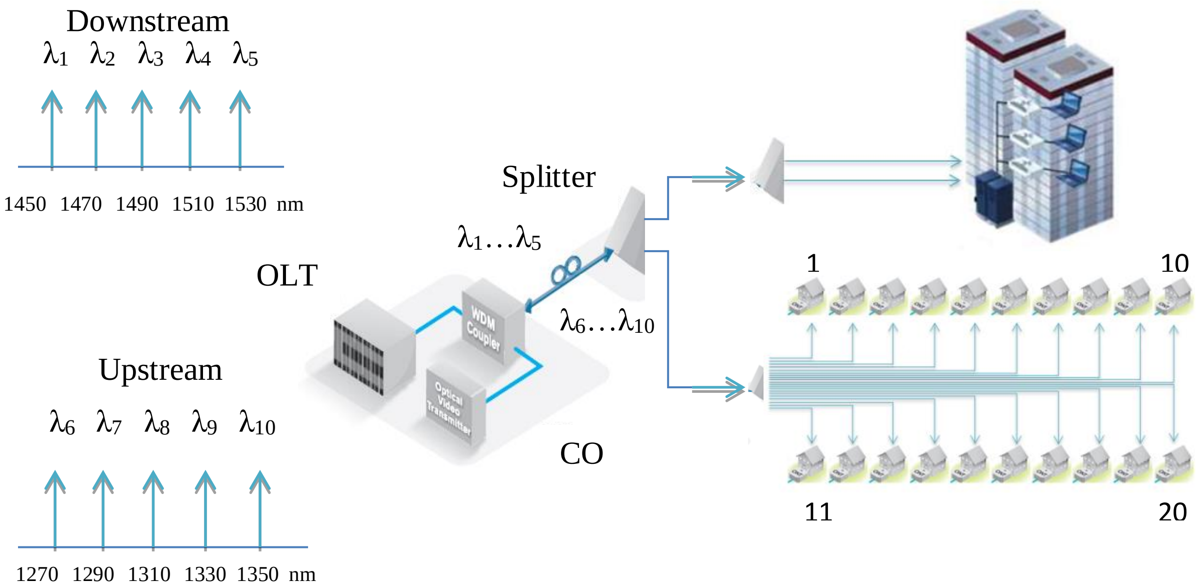

Figure 2.1: Deployment scenario of optical fiber access network

2.2 Scenario 1: Business Offices Area

In this, business office area has two office buildings, in which each one will have 15 offices, making a total of 30 offices. Each of these offices will require services such as broadband internet, HD Videoconference, FTP, VoIP, cloud computing, etc[5]. With that today and for future forecasts, 75 Mbps would be enough. Therefore, he bandwidth required for these 30 offices would be,

$$\frac{75\ \text{Mbps}}{\text{Office}}.30\ \text{Offices}\ = 2550\ \text{Mbps} \qquad [2.1]$$

So the design with a 2,488Mbps, symmetrical GPON link would be sufficient to cover all needs.

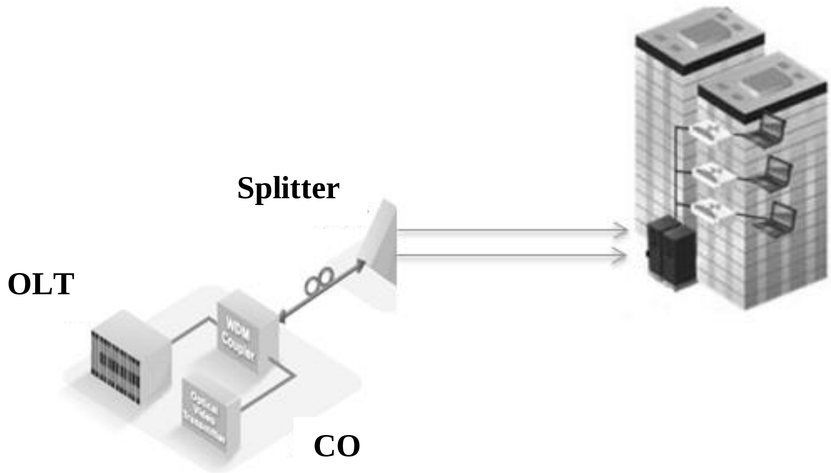

Figure 2.2: Business area design

2.3 Scenario 2: Residential Area

The residential area will have 20 single-family houses, located 1 km from the optical SPLITTER and 6 km from the OLT, which will demand last generation triple play service. These services may include:

- Broadcast:

  2 HDTV channels: 2 * 15 Mbps = 30 Mbps

  1 3D channel: 50 Mbps

- Real-time applications:

  HD videoconference: 7 Mbps

  Online games: 1 Mbps

  Home automation, VoIP, audio: 2 Mbps

- Broadband internet:

  Web, mail, P2P: 10 Mbps

This will make a total of 100 Mbps per household and therefore it will need a bandwidth of,

$$\frac{100\ \text{Mbps}}{\text{User}}.20\ \text{Users} = 2000\ \text{Mbps} \qquad [2.2]$$

So it just needs a GPON link with 2,488Mbps downstream and 1,244Mbps upstream.

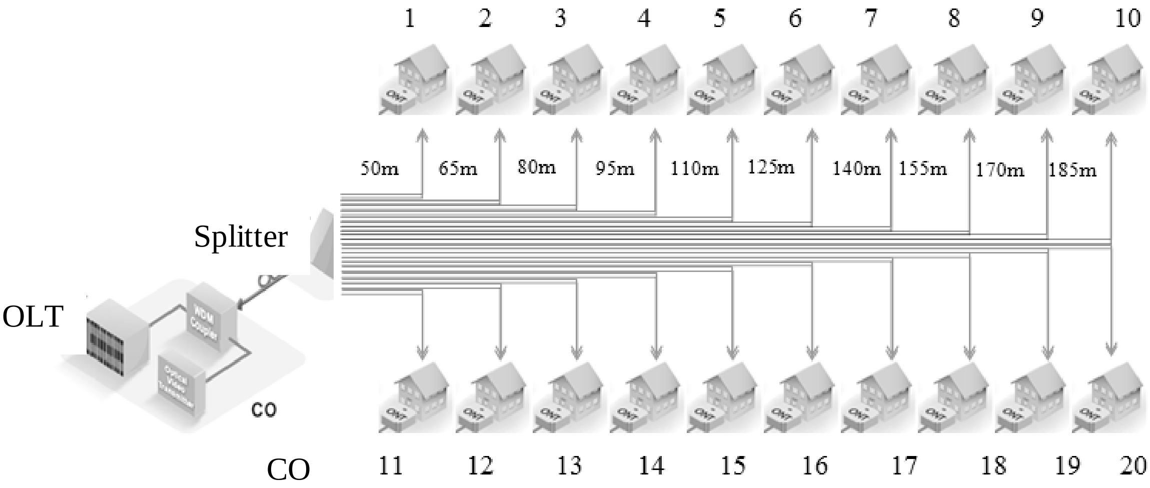

Figure 2.3: Residential area design

Simulation allows to detect network problems before they are implemented, test new networking solutions, testing new communications technologies even including theoretical models that in reality could be difficult to construct. Therefor the simulation program OptiSystem 13.0 was chosen for the design of two scenarios.

3. RESULTS AND DISCUSSION

3.1 Complete System Design

On the left side of the design is the OLT which will transmit information to different users and it will receive information from the ONT's. All this information will be transmitted multiplexed at different wavelengths through a single optical fiber, and then de-multiplexed to spread to different areas in downstream, and multiplexed from different areas in upstream.

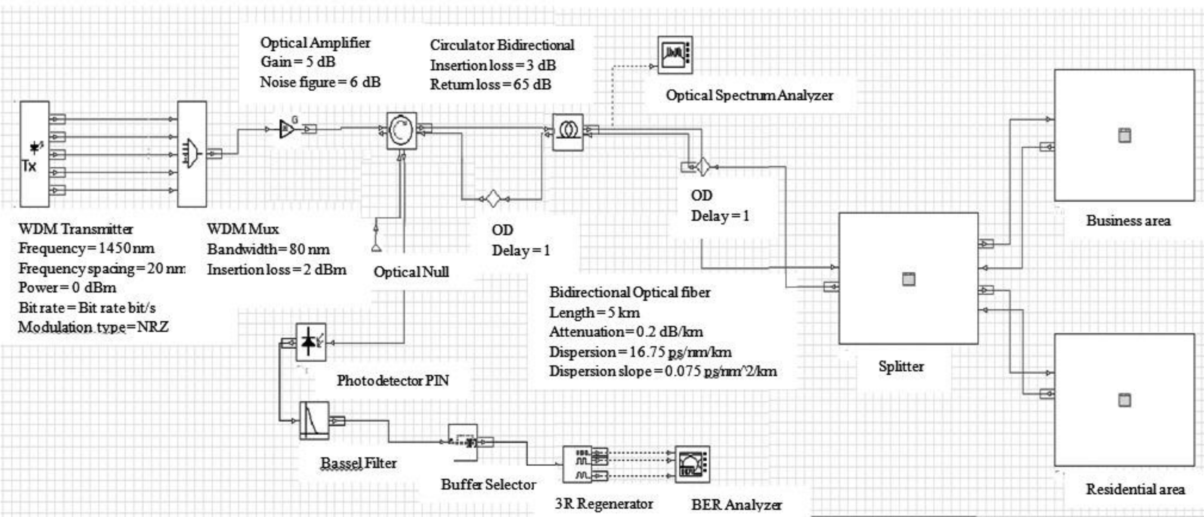

Figure 3.1: Complete system design

3.2 Downstream Results

In downstream, the optical signal will be directed from the OLT to the end users (ONT's). The first network element is the optical transmitter located at the OLT. This laser broadcast five different wavelengths from 1450 nm to 1530 nm with a frequency spacing of 20 nm. The transmission power will be 0 dBm and it will use non return to zero (NRZ) modulation.

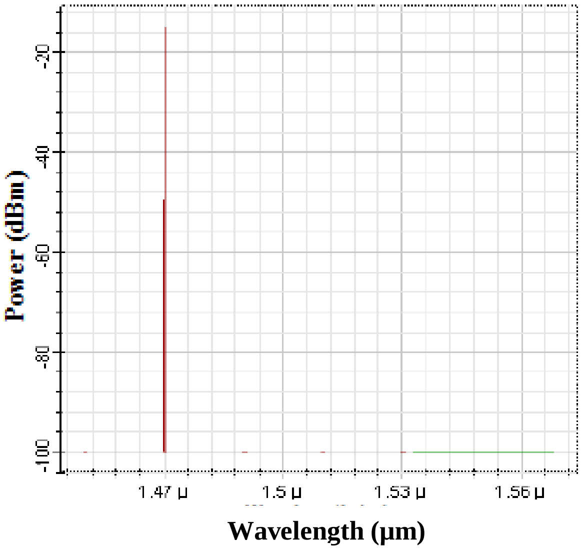

Figure 3.2: Downstream spectrum into business block

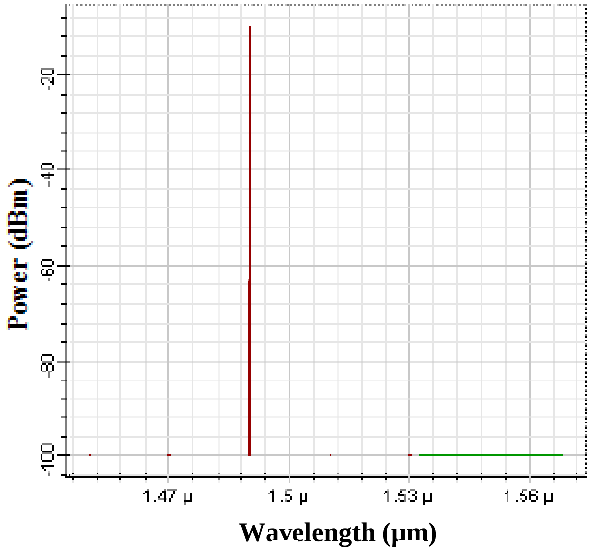

Figure 3.3: Downstream spectrum into residential block

3.3 Upstream Results

In upstream direction, the optical signal will travel from each of the end user (ONT's) to the OLT. Therefore, it will review the various blocks that define the two areas and end up explaining the OLT as the receiver. The signal in upstream will pass through the same elements and therefore they will have the same characteristics and parameters.

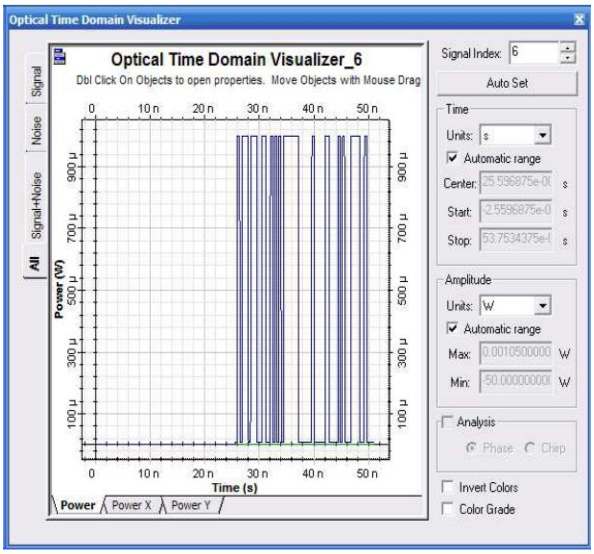

Figure 3.4: Optical time domain visualizer in business block

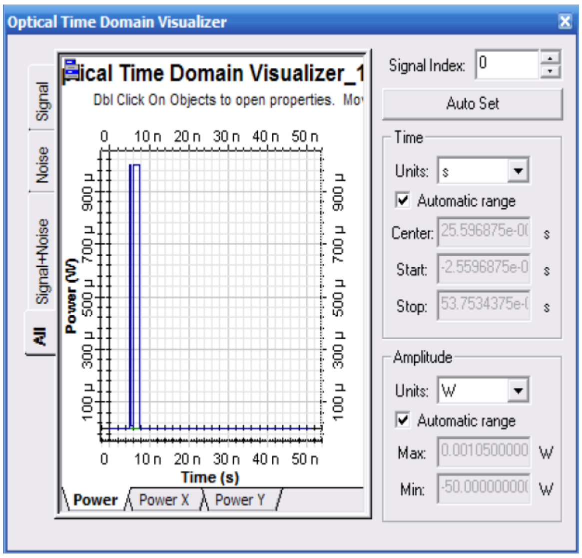

Figure 3.5: Optical time domain visualizer in residential block

In the business block, the path that the signal covers to two ONU's is exactly the same since the last fiber has the same dimensions. So the results are identical: Following figures shows the performance parameters of eye diagram. Figure 3.6 represents the Q factor which is high and its sharp graph indicates low loss. Figure 3.7 indicates the BER which is less. In figure 3.8 an open eye pattern is obtained which indicates less jitter and signal distortion.

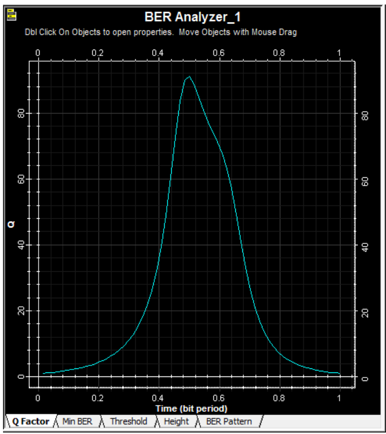

Figure 3.6: Q factor

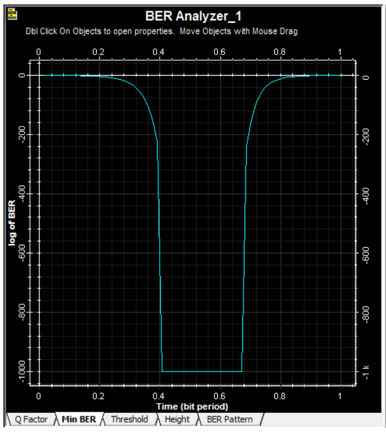

Figure 3.7: Minimum BER

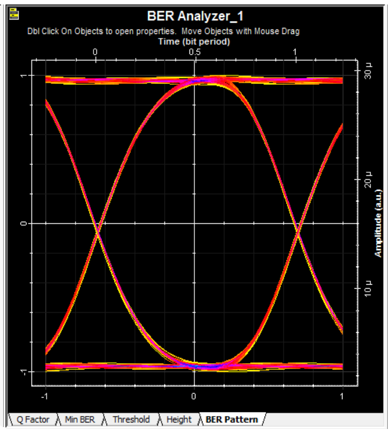

Figure 3.8: Eye diagram

In the residential block there were 20 ONU’s that situated in the different distances. Figure 3.9 represents the Q factor and Figure 3.10 indicates the BER which is low. Figure 3.11 has more number of amplitude variations at the one level than the zero level. Hence there was more number of one’s in the signal than zero’s. So in the resident block the houses which are in the far away from the splitter have more signal distortion than the nearest houses.

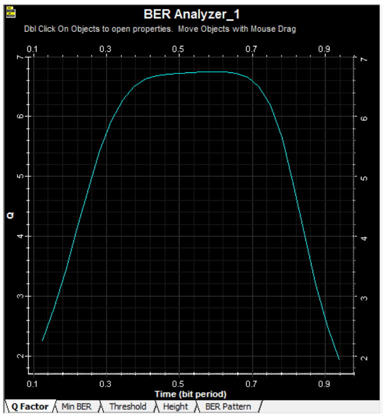

Figure 3.9: Q factor

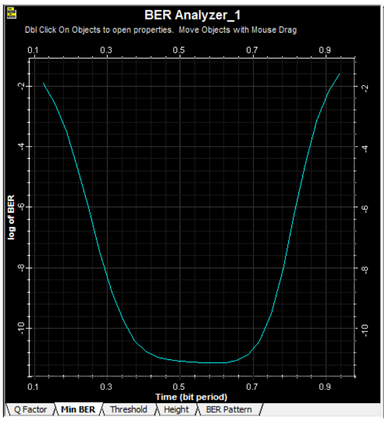

Figure 3.10: Minimum BER

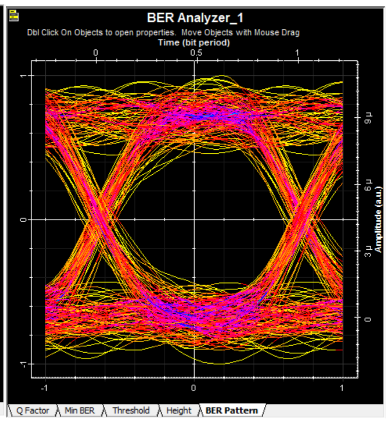

Figure 3.11: Eye diagram

4. CONCLUSION

The results showed a BER of about 10-12 for the worst case that will be of the farthest house in the residential area. This shows the high reliability that will have in each of its points when implement this network. In the business block the paths that the signal covers two ONU's are exactly the same since the last fiber has the same dimensions. The residential block will have

20 ONU's. As the results of the 20 ONU's will require a lot of space, results of the closest ONU (located at 50 meters from the splitter) and the farthest ONU (situated at 185 meters from the splitter) have been shown. The logical and physical design of the same establishes optimal conditions for the current implementation of the system but also offer the possibility of future expansion. These works has taken this into account and have raised a fiber network that brings the fiber to the maximum number of users. So in medium to long term the current infrastructure is reusable for future use[6]. The deployment of next generation networks over FTTH networks is becoming more common and the emergence of companies such as neutral carrier model are an important solution for the evolution of them.

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VEHICLE MOVEMENT BASED STREET LIGHTING SYSTEM

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ABSTRACT

This vehicle movement based street lighting system was developed as an energy saving, efficient and low cost method for one way streets. Main aim of the project is to reduce the high electricity usage in street lighting at night. PIC 16f877a was used as the controller of the system. Infrared receivers and transmitters were used for vehicle detection in the system. Light emitting diodes (LED) were used as street lights in the prototype. This system will detects the vehicle is appeared and a light window with three lights will get illuminated. Then the light window will follow the vehicle.

Keywords: Infrared receivers and transmitters, Street light array, Microcontroller.

1. INTRODUCTION

Street lights are used in almost every street in Sri Lanka. They are turned on at night and turned off in the morning. Therefore street lights are illuminated for about 12 hours. There are lot of vehicles on the streets during 7 pm to 11 pm in night time and 5 am to 7 am in the morning. But at midnight and between 11 pm and 4 am, only few vehicles are on streets. However every single street lights are turned on without vehicles. This is a huge waste of energy. If the street lights can be turned on only when a vehicle appear, this electricity waste can be reduced. This “vehicle movement based street lighting system” was designed as a solution. Here when the system detects a vehicle, a light window with three lights will be get illuminated. Then unnecessary street lights will be turned off. Street light will be only get turned on when they are needed. In this system PIC 16f877a was used to control the system. Infrared transmitters and receivers were used to sense a vehicle. A light dependent resistor (LDR) was used to detect the sunlight.

2. EXPERIMENTAL

The block diagram of vehicle movement based street lighting system is shown in the figure

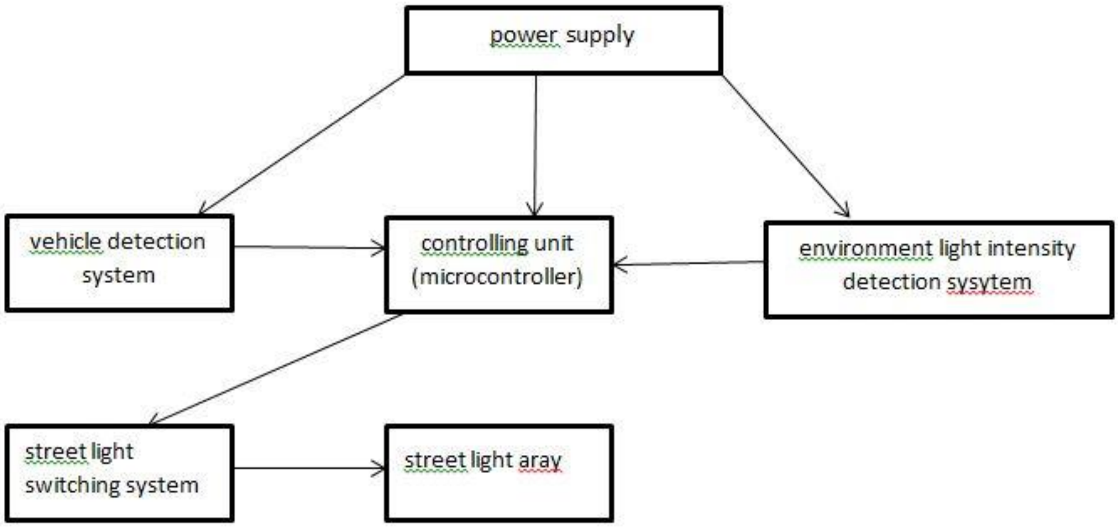

Figure 1: Block Diagram of the System

The system will be turned on automatically, when the surrounding light intensity is below than the reference level. Then the LDR gives high resistance and controller takes that signal. Then the system will be turned on by the PIC 16f877a microcontroller[1].

LDR which was used in the prototype gave 60 kΩ at the complete dark and 6 kΩ with light. Therefore, a preset with 20 kΩ was used in the prototype. The reference level can be changed by using the preset.

A single pair of infrared receiver and transmitter was used to detect the vehicle in the prototype. Infrared transmitter was placed on one side of the street and the receiver was placed on the other side of the street. Both transmitter and receiver should be aligned[2].

When a vehicle cuts the first infrared beam, the controller identified the signal and turn on first three street lights of the street light array near to the sensor. These first, second and third lights will stay turned on until the vehicle cuts the second infrared beam. when vehicle cuts the second beam, first street light will be turned off and fourth street light will be turned on. This will go on until the vehicle leaves the street[2].

LEDs were used as street lights with DC current in the prototype of this project. But in real road lighting systems AC current is used. Then the relays have to be used to control the AC current. When the DC signal is given to the relay, it controls the AC signal with respect to the given DC signal.

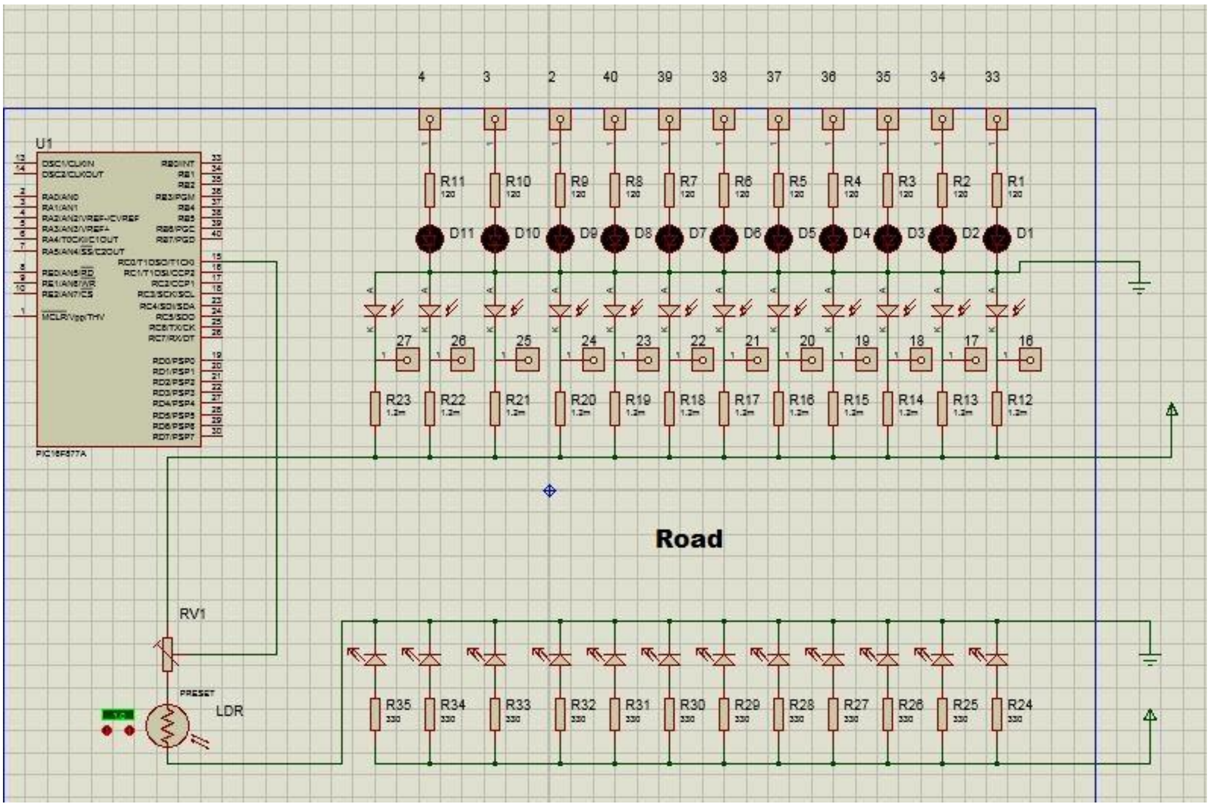

Figure 2: The circuit diagram of the prototype

3. RESULTS AND DISCUSSION

This vehicle movement based street lighting system was developed as energy saving, efficient and low cost method for one way street traffic. Main aim of the project is to reduce the extra electricity usage for street lighting during night times.

With the implementation of this project, street lights can be turned on when a vehicle is present. A light window with three lights will be illuminated with every vehicle on the path. The system will get automatically turned on when the dark arrives.

In the prototype, single infrared beam was used to detect vehicles. But in real application, infrared is not suitable, because the beam is get spread out when the distance increases. Infrared beam cannot be used for more than 4 meters. Therefor laser beam is suitable for the detection. But single laser beam will not enough for detection. If only one beam is used, lights will be turned on when an animal is appear and cut the beam. Therefore at least three horizontally placed laser diodes should be used[2].

In the prototype, only one LDR was used to determine the surrounding light intensity. But practically at least four LDRs should be used. The average resistance of them should be taken and then the system should be programed to that value[3].

When relays are used, mechanical relay are not suitable for the purpose. Because in this method, system will get turned on and off frequently. In this situation mechanical relays will get damaged easily. Solid State Relays (SSR) can be used as an alternative, they have longer life time than mechanical relays. Therefore SSRs are better than mechanical relays[3].

4. CONCLUSIONS

Large amount of electricity is used for street lighting in Sri Lanka. But this can be reduced by introducing the proposed vehicle movement based street lighting system. This is an efficient, energy saving and low cost system. The system is proposed to use in streets with one way traffic. This system can be considered as one of the solution to save energy in the country.

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 have supported to make this project a reality.

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HTTP REQUEST BASED NETWORK RFID SCANNER FOR CENTRALIZED VALIDATION AND MANAGEMENT

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ABSTRACT

This research is based on low frequency Radio Frequency Identification (RFID) tags scanner device which uses Representational state transfer[1] (RESTful) API and HTTP based communication with a web application server to centrally control RFID scanners. This approach is highly useful in industrial environments which has large number of RFID tags and scanner devices to be connected and managed from a single location.

Keywords: Radio Frequency Identification, JavaScript Object Notation, TCP/IP Stack

1. INTRODUCTION

RFID based identification is very popular in current industries because it is a cheaper, power efficient and reusable option compared to other alternative solutions such as printed barcodes. But in most RFID based systems, there is a major drawback that they are not designed to use in a centralized control environment.

Most of the RFID scanners are designed to work as network devices either wired or wireless. But they are not flexible enough to integrate with already existing ERP solutions and Database systems. In the market available network RFID scanners, the network communication is done via TCP/IP based socket communication. Therefore the software has to be changed to interface with this system and it might be extremely hard if the software system is not tolerant enough.

They also has a limitation of number of cards supported by the device such as 40000 and it is not enough for some situations such as bundle tracking. They are also painful to use because each and every card should be manually inserted into the scanner to identify as a valid card before use. This is not practical when the amount of cards and scanners is very large. Therefore a better solution is required.

2. EXPERIMENTAL

2.1 Proof of concept

The proof of concept was the first step of the project which was used to prove that the concept of the design is valid and it has technical feasibility to continue up to a successful product. For this experiment the proof of concept was made with off the shelf hardware and some of the user friendly programming platforms instead of using highly optimized and platform specific high performance tools because of time saving was necessary at that point.

In the proof of concept the following capabilities ware included.

- 125KHz low frequency RFID card identification
- RGB Light Emitter Diodes and a Buzzer as indicators
- Sending HTTP request to the webserver
- Receive validation data from the web server
- Web based settings and configurations page
- HTTP authentication for configuration setting access
- Change settings and device restarts via HTTP requests to the device
- JSON object based API for communication
- Ethernet (IEEE 802.3) based network connectivity

The proof of concept was built with a Linux Single Board Computer (SBC) powered by a version of Debian Linux compiled for ARM cortex A7 platform. To speed up the process of software based developments in this project, a well implemented and widely used nodeJS platform was used with Node-Red module. Node-red module was specially made for hardware level access for Linux and some other operating systems which has capabilities of Serial communication, HTTP methods support (GET, POST, PUT, and DELETE), JavaScript based programing and JSON object parsing ability which are main requirements of this experiment[2].

To interface multi-color LEDs, RDM6300 Low Frequency RFID module and other necessary hardware, an Arduino board was used in the proof of concept. The use of this kind of off the shelf hardware modules and software platforms made a faster development of this proof of concept. The Block diagram of the setup is as shown in the Figure 1.

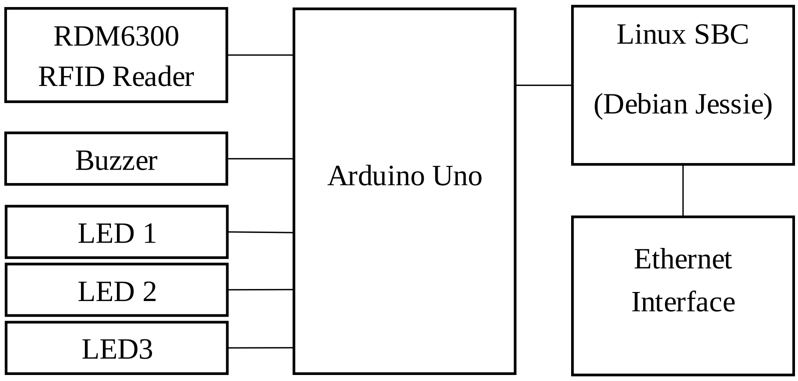

Figure 1: Block Diagram of the proof of concept

2.2 Actual Prototype

After successful implementation of the proof of concept, the next stage of the experiment was designing the actual RFID reader device prototype. The prototype was made using dedicated ICs and microcontrollers to ensure optimum speed and proper smooth operation. The prototype has following features in addition to the previous Proof of concept features.

- Wireless access
- Real time clock for timekeeping
- Small footprint
- Fast booting time
- Low latency communication

The block diagram of the prototype is as shown in the Figure 2. It uses two separate microcontrollers for RFID decoding and web services. The key expectation of such implementations was to ensure the reusability of the hardware and firmware with minimum or zero modifications when a requirement get changed. It separates the RFID card detection and the network communication into two different blocks.

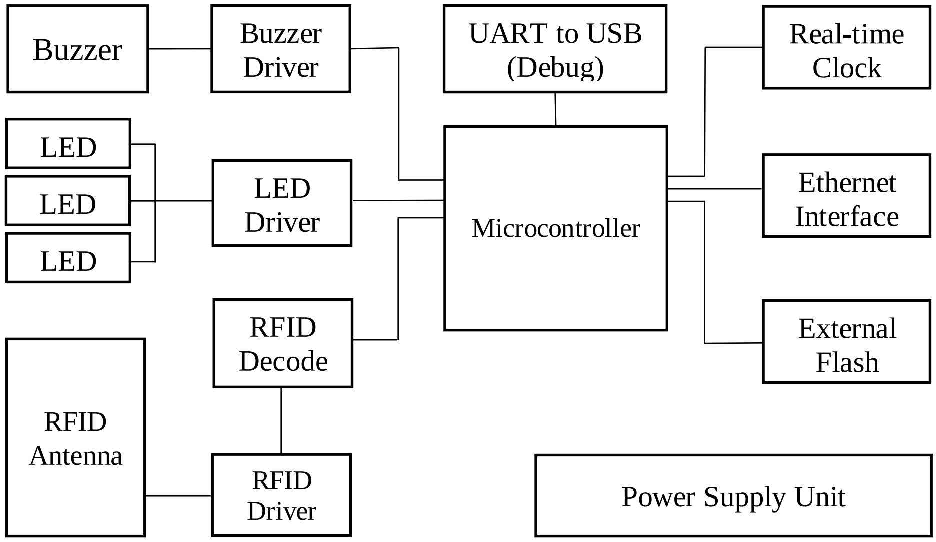

Figure 2: Block diagram of the prototype

The prototype used a dedicated low frequency RFID interfacing chip EM4095 by EM Microelectronic which supports low frequency RFID cards[3]. To decode the received signals from this chip, an atmega8 microcontroller was used. The Ethernet interface was driven by ENC29J60 a 10BASE-T Ethernet controller by Microchip Corporation[4]. An Atmega2560 microcontroller was used as the IP core of the device which provided the HTTP server, client and software implemented TCP/IP stack.

3. RESULTS AND DISCUSSION

The proof of concept and the prototype ware successfully tested with the webserver. A sample http request sent via the system was captured by an http debug proxy is shown in the Figure 3. It shows the JSON object on the HTTP request method body.

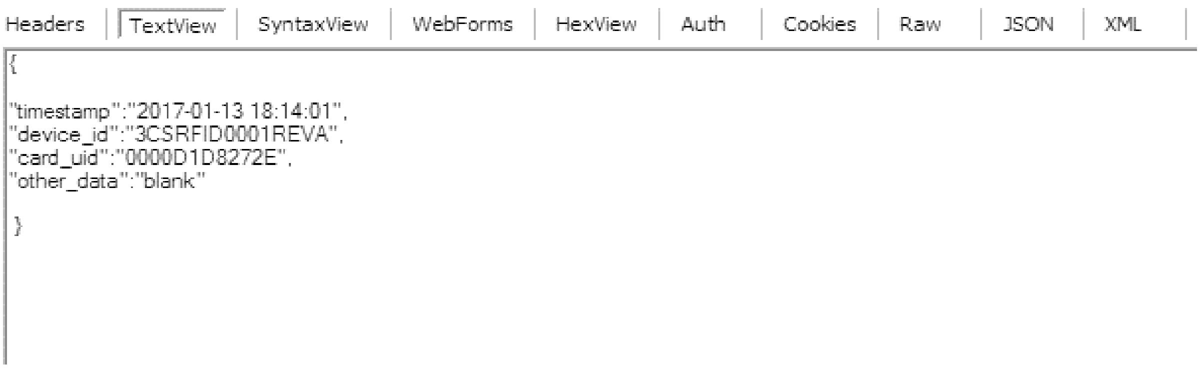

Figure 3: Fiddler Debugger output

In the proof of concept, the most basic functions were tested and verified that they are possible to do. But there were several drawbacks on the proof of concept as follows.

- RFID card detection latency of almost near one second because the poor performance of used RDM6300 module.
- Slow startup time after power ON. This is mainly because of the Linux operating system and NodeJS platform. They are typically used for relatively long running dedicated servers. Therefore they check each and every small things before boot up. Proof of concept took 15-20 seconds to get into ready state.
- Delays of the communication because the Arduino and the Linux SBC communications and JSON object parsing through Node-Red platform

Those drawbacks were not appeared in the prototype because

- Card detection latency was reduced because of the use of separate interfacing RFID interface chip.
- Faster startup time because of bear metal firmware implementation other than a host operating system.
- Faster communications between integrated circuits with SPI communication.

4. CONCLUSION

RFID based authentication and tagging systems are very much reliable and reusable because of its power efficiency and the longer lifespan. Therefore this king of RFID scanner is very much useful in the industry because it has centralized control over all the scanners in a factory floor. It also ensures ease of access to all the resources via any connected device without configuring the particular device for specific cards.

Also this research based on http request based communication of Representational State Transfer (REST) and it ensures ease of integration with existing software and systems with minimum design changes. Therefore this device can be connected to multiple applications such as web based authentications, Attendance systems, Bundle and cargo tagging vehicle tagging and so on.

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PID CONTROLLED IR PREHEATERS FOR WAVE SOLDERING SYSTEM

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ABSTRACT

The Core business of the multinational PCB assembling company is assembling and soldering electronic products needed by the customers' requirements. There are three technologies used to assemble components on PCB. The important type of technology for this study is Through Hole Technology; a technology for assembling electronic circuits boards (PCB) in which the pin-through hole (PTH) components are inserted through holes drilled into printed circuit boards (PCBs). 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 product (PCB). A problem was identified such that some of the PCBs were not dragging lead up from the lead tank as per the customer's requirements. The proposed system and supporting software fulfill the requirements of the bigger PCB products. Using K type thermocouple, the system measures the temperature on the top side of the PCB. It is easy to implement the PID controller and it can be designed based upon the system parameters if they can be estimated precisely[4]. The IR top preheaters act according to the calculation from the PID controller through SSR (solid state relay). PID controller was designed using ATMEGA328p and the implemented controlling had capability to communicate with PCs with the use of MAX232 based serial communication. The user can input values manually and the graphical user interface made using National Instrument LabVIEW program will be used to verify the results.

Keywords: Printed circuit board, Through Hole Technology, PID controller, Solid State relay

1. INTRODUCTION

Wave soldering is a large-scale soldering process by which electronic components are soldered to a printed_circuit_board (PCB). This method of soldering provides compatibility with the continuous electronics assembly production line, and supplies speed and reliability. This soldering method is the accepted norm for through-hole assembly, especially in large scale productions.

In PCB assembling company CCS Lanka (Pvt) Ltd, two wave soldering machines (lead and lead free) are used to assemble THT components. Both machines do not have top heaters in the preheating section but bottom heaters are available. In some bigger PCB items, the top side temperature is not the same as bottom side. The cause is that, it is unable to transfer the heat to the top side from the bottom preheaters. Some customers request and expect a top filleting in their PCB from this company. For boards, the main concern is the distortion that occurs; it is often referred to as 'warpage' or 'warping'. This is mainly caused by the difference in thermal expansion between the underside of the hot board, which is exposed to solder, and the cooler top.

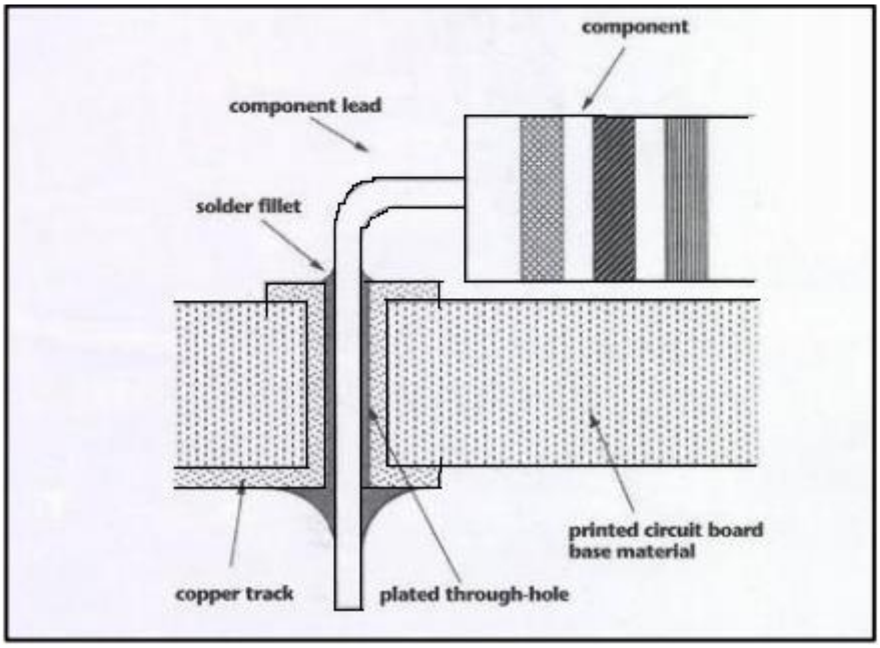

Figure No. 1: Solder fillet

When manufacturing the final output result is that the center depresses and pushes itself further into the wave, whilst the sides curl up and may not come into contact with the molten solder. The warpage is made worse by the random location of holes drilled in the board, internal copper layers, and by the uneven distribution of component weight. When the IR top heater works without any controlling system. It can damage the most sensitive components or SMD components. To accurately control process temperature without extensive operator involvement, a temperature controller can be used, which accepts the temperature sensor such as a thermocouple input. It compares the actual temperature to the desired control temperature for the desired control element. The PID controller designed using ATmega328/p. It has 32Kbytes of In-System Programmable Flash with Read-While-Write capabilities, three flexible Timer/Counters with compare modes and PWM, 1 serial programmable USARTs , 6-channel 10-bit ADC (8 channels in TQFP and QFN/MLF packages) and Timer/Counters, etc[5]. above mentioned functions are used to do the project. Max232 used for serial communication. LM2576 IC (adjustable) used for regulating voltage from upper limit as (7 -40) V to 5V. The program was written by using MikroC for AVR.

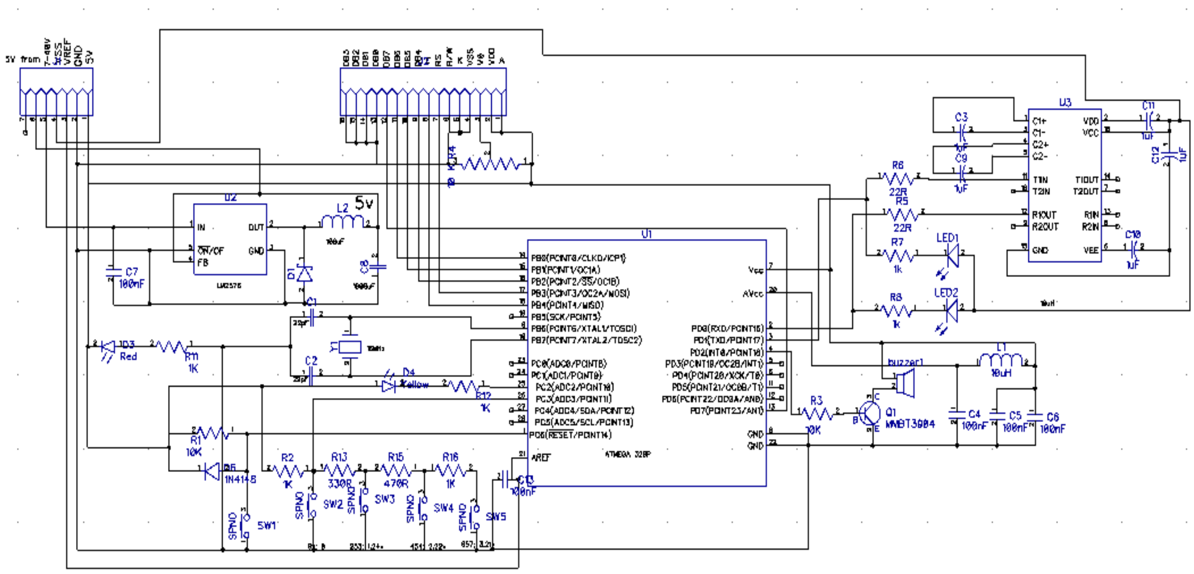

Figure No. 2: The proposed system controlled
Board for THT wave soldering

2. METHODOLOGY

2.1 Flow diagram of the proposed system

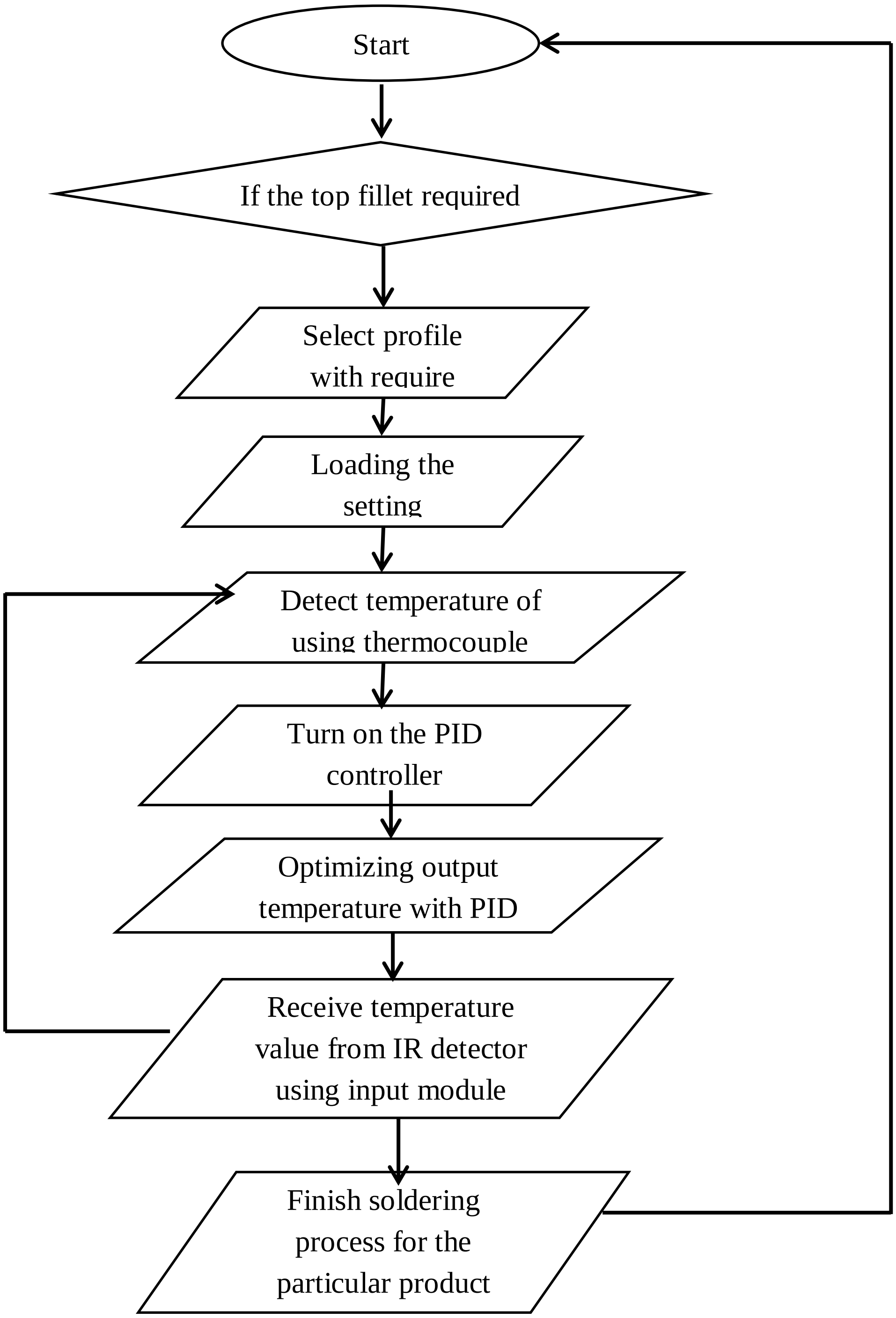

Figure No. 3: Flow of the proposed mechanism for PID controlled IR heaters

2.2 Circuit and PCB design

There are 4 sub-units in the control system. They perform the various tasks of the device such as sub – system coordination, controlling, input, and output.

1. User interface circuit
2. ATMEGA – PID controller circuit
3. Thermocoupler circuit
4. Output to IR heaters through SSR

The user interface is responsible for maintaining the communication between the user and the device. It accepts data (temperature, etc.) from the user and display necessary notifications. ATMEGA based PID-controller unit is the central processing unit of the system, which controls all the processes and functionalities. It also saves the data in the PC through LabVIEW interface for profiles. Thermocoupler unit is used to evaluate the temperature of PCBs on top side. LM2576 IC is used as a step down switching regulator and the output is an adjustable version. This is used to reduce the voltage 24v to 5v. Max232 IC was used to carry out serial communication from LabVIEW interface to the system. Temperature from input unit will be sent to the LabVIEW software from the control unit and the output temperature will be calculated by PID controller and the signal with IR heaters from LabVIEW through serial communication.

3. RESULTS AND DISCUSSION

3.1. Operation

First the IR top heaters were implemented in the machine and were observed how it works without any controlling; It will give many difficulties to the PCBs. After the completion of the controlling unit it was successfully implemented in the industry. A number of settings had to be set before initializing the soldering process. The unit can save settings as profiles for various types of soldering procedures. This is not available in most of the soldering devices currently available. Setting up the system is required to be done only once. Configuration setting steps are as follows,

1. Input temperature
2. Soldering profile

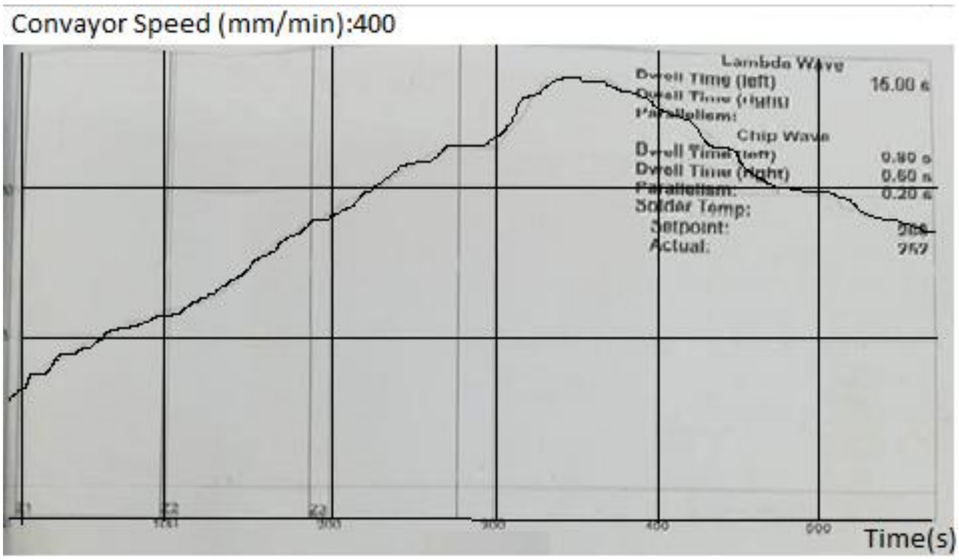

Figure No. 4: CT-203, Trafo soldering profile[3]

Optimized PID values are,

- Kp => Proportional gain is 120.00
- Ki => Integral gain is 0.20
- Kd => Derivative gain is 600.00 , these values were measured by using LabVIEW interface, designed for this system.

4. CONCLUSION

The Wave soldering technique is one of the most important soldering technology implement at the company. Most of the commercial wave soldering machines have top and bottom heaters
which are comparatively expensive. When these systems fail, they are difficult to repair due to the higher cost and secured design. But, if the system is based on simple ATMEGA- PID controllers, as presented by this study, it will facilitate easier maintenance at a low-cost. This device has been fully fabricated using the low cost components and advanced methodologies, which can be extended up to a mass production. The system can increase the user-friendliness of the device, since the device can be upgraded depending on the user requirements. The system is proposed for implement at the multinational company while

obtain the industrial training this technique is proposed to test for its operation in the industrial environment. Already the prototype system was tested successfully.

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A GLUE LEVEL DETECTING AND CONTROLLING SYSTEM

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ABSTRACT

In most of the factories, the glue applying system in the packing machine is a very important device. Normally factory labourers add the liquid glue manually from the glue loading tank to glue tank of the packing machine. There is a system to turn on and turn off a motor for adding the glue. In this work, an automated glue tank filling system will be proposed. The system is designed by applying an ultrasonic sensor, direct current gear motor, a Liquid Crystal Display (LCD), an arduino promini controller, 4x4 keypad and a motor driving Integrated Circuit(IC) in order to automatically fill the glue tank when the glue level is decreasing upto the minimum level. An ultrasonic sensor is mounted on the top of the packing machine and it transmits an ultrasonic pulse down into the tank. This pulse which travels at the speed of sound will be reflected back to the transmitter from the liquid surface. The time delay measurement between transmitted and received signals enables the device to calculate the distance to the surface. The arduino promini controller is programmed to automatically determine the liquid level and automatically turn ON the DC gear motor which is mounted on the top of the glue loading tank. When using this system the tank capacity, minimum glue level and maximum glue level should be given as inputs.

Keywords: Arduino Promini controller, Direct Current Motor, Ultrasonic Sensor

1. INTRODUCTION

This glue level detecting and controlling system was designed for the packing machine. That machine is used for pasting both sides of cardboard plates in the boxes. Therefore glue is the most important part in the packing machine. That packing machine is already having a glue tank. But labourers must refill it manually when the glue is over. Normally when the glue level is decreasing upto the minimum level, glue is added the tank manually by labourers upto the maximum level. Factory must allocate the extra labourers for doing that purpose. If boxes are not pasted properly, packing machine automatically stops. To avoid that problem, an automatic glue level detecting and controlling system is proposed to the plant. One of the present technologies is the automation technology. In some cases, the people sometimes want to carry out their work to be set automatically so that they can save the energy to perform another activity. This proposed system based on the ardiuno promini controller which enables to control the electronic circuits logically, is able to read the input, process the program, and produce many outputs based on the necessity. The system attempts to make life easier by reducing unnecessary waste of man-power. Ardiuno based automatic glue level controlling system is an alternative to a manually controlled system which is laborious, frustrating, costly and energy consuming. The proposed system comprises of several components. The first is the sensors which detect glue level in the tank and send a signal to another set of component. This system is commonly made in order to help the labourers to perform some activities easy. This device can perform activities like opening and closing automatically and also can be used for any other packing machine.

2. MATERIALS AND METHOD

2.1Materials

To perform this research, several items were needed such as an arduino promini controller, an ultrasonic sensor HC-SR04 module, a DC gear motor, a Motor Driving ICL239D, a LCD 16 × 2 display, a 10 kΩ potentiometer, a printed circuit board (PCB), some connector cables including male to male cables and male to female cables, as shown in figure 1. [3]

Figure 01: Materials which were used for the prototype design.

(a)ardiuno promoni controller,(b)4x4 matrix keypad,(c)l239d motor driving IC,(d,k)male to male and male to female cable,(e)16x2 LCD,(f)DC gear motor,(g) 10 kΩ potentiometer,(h)ultrasonic sensor,(i)9v transformer,(J)PCB

2.2Method

2.2.1 Block Diagram

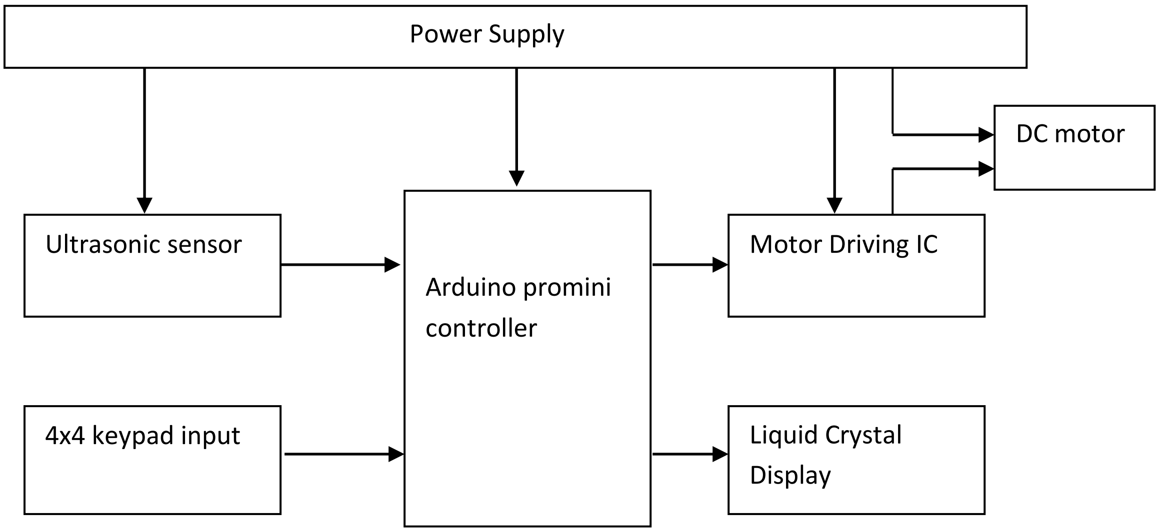

Figure 2:Block diagram of the automatic glue level detecting and controlling system

The block diagram of glue level detecting and controlling system is given in Figure 2. The proposed system uses ultrasonic sensor to sense glue levels such as minimum level and maximum level in the glue tank which is in the packing machine. Minimum glue level, maximum glue level and maximum height of the glue tank should be given as keypad inputs. Whenever the glue level increases or decreases, ultrasonic sensor sends out a high-frequency sound pulse and then calculates how long it takes for the echo of the sound to reflect back. The sensor has two openings on its front. One opening transmits ultrasonic waves while the other receives them. When the glue level increases or decreases at the maximum and minimum level, ultrasonic sensor senses the level and transmits the output signal to the ardiuno controller which acts as a receiver. According to the code written, glue is supplied automatically upto the necessary level from the glue loading tank by driving the Direct Current(DC) gear motor through the motor controlling integrated circuit. The glue loading tank hole is connected to the DC motor shaft which is connected using the trait bar. Hole will be opened or closed according to the glue level. [1]

2.2.2 Flow Chart

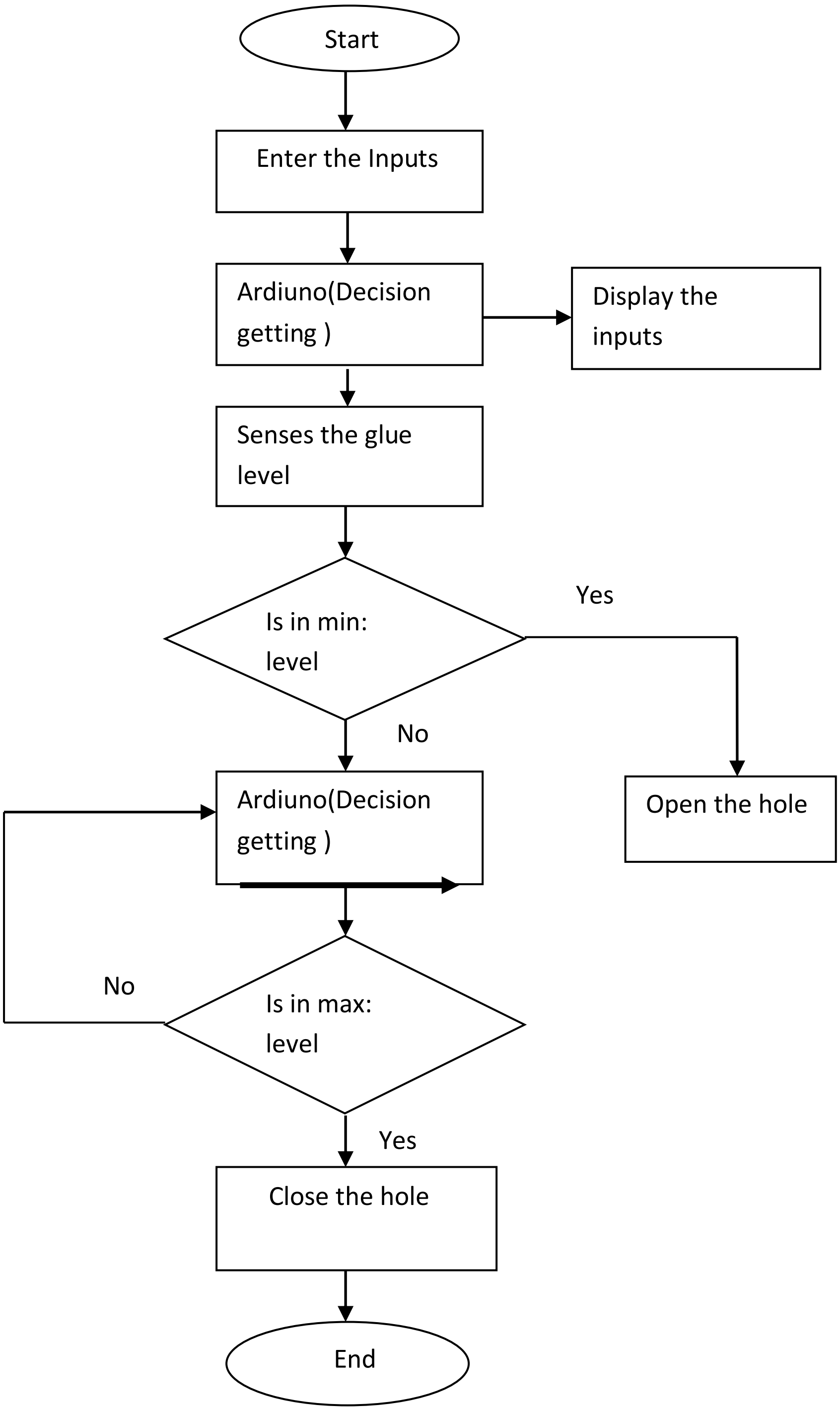

Figure 4: Flow Chart

2.2.3 Hardware Design

The system performs the sensing level and controls activities without the manual observation and attention on the machine. The automatic glue level detecting and controlling system has the following main components.

Sensor Unit

For detecting the glue level at the existing glue tank in the packing machine, ultrasonic sensor HC –SR04 was used. That sensor was mounted on the top of the glue tank of the packing machine which is using a technique called as a ECHO. The sensor transmits the ultrasonic wave to the glue surface and receives the reflected wave. Distance is calculated by using the time duration between transmitting and receiving periods and sound velocity on air. This ultrasonic sensor detects the minimum glue level and the maximum glue level in the reservoir.

Distance = (Time duration)/2 x sound velocity

Control Unit

The basic operation of control unit is controlling a DC motor by using arduino promini controller which is programmed by using arduino software. DC motor was connected with an output pin of arduino via a motor driving IC.

Liquid Crystal Display (LCD)

LCD is the most common message display device used to display ASCII character. LCDs have become a cheap and easy way to get text display for embedded system. LCD is interfaced to the arduino controller. The LCD is used for indicating the operator about the frequent level changes in the glue tank. LCD will be placed in the control panel. And also initially operator must give the tank capacity, minimum glue level and maximum glue level as inputs. Due to that, LCD is interfaced with the controller kit for displaying the order to the operator when adding the inputs. The LCD used is a 16x2 LCD with the green backlight feature. In this LCD the glue level will be continuously displayed according to the changes in the glue level in the tank. And also if it is needed regulate the LCD brightness during the night or day, a regulator is provided to access the brightness.[5]

4x4 Matrix keypad

Initially operator should give some values such as glue tank full height, minimum glue level and maximum glue level by using the keypad as inputs. Due to that, keypad was interfaced to the controller kit. Minimum glue level value may be a higher value than the maximum glue level value due to the ultrasonic sensor is mounted on the top of the glue tank. So height always decreases during filling the glue tank. Therefore minimum glue level value is high value and maximum glue level value is low value.

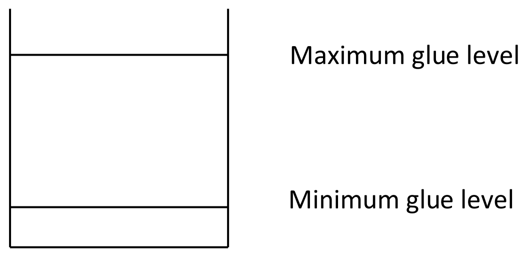

Figure 3: Schematic diagram of the glue tank

Motor driving integrated circuit(IC)

From controller, the motor cannot be connected directly because controller cannot give sufficient current to drive the DC motors. Motor driver is a current enhancing device. It can also act as a switching device. Thus, a motor driver was inserted in between motor and controller. Motor driver takes the input signals from controller and generates corresponding output for motor.[4]

Glue supplying method

Extra glue loading tank was added to the prototype for supplying glue to the existing glue tank in the packing machine when the glue level is decreasing. DC gear motor was mounted on the top of the glue loading tank which has a hole in the bottom of the glue loading tank for getting the glue. Motor shaft was connected to that hole through the trait bar. According to the glue level changes, motor shaft is automatically rotated to both directions. Due to that cause, glue loading tank hole will be opened and closed automatically.[2]

3. RESULTS AND DISCUSSION

A prototype of the proposed system has been successfully implemented and the results were observed. Time taken for the glue controlling system was accurately synchronized with the increase or decrease in the glue level because of the use of low speed high torque DC reduction gear motor. Working range of the ultrasonic sensor ranges was from 1 cm to a maximum of 200 cm for convenience. Due to the use of ardiuno promini control kit, the DC gear motor can be opened and closed the hole automatically according to the glue level. When the glue level decreases upto the minimum level, automatically open the hole and supply extra glue to the glue tank of the packing machine until the glue level raises upto the maximum level. LCD display shows the change in glue level continuously and also glue limitation level can be changed by using the keypad.

4. CONCLUSION

An automatic glue level detecting and controlling system has been constructed successfully. The system is suitable to be used in packing machines contributing for the decrease of the energy consumption. There is no requirement of human labourers for adding the glue in to the glue tank. One operator is sufficient for entering the input initially. The prototype can be proposed to handle the glue level for any packing machine and also this system can avoid operator stress. Packing machines can execute continuously by using this proposed system.

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Department of Electronics - Wayamba University of Sri Lanka

GSM BASED TELECOMMUNICATION SECTOR ANTENNA BRACKET

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ABSTRACT

In a cellular telecommunication, BTS becomes the important component. BTS antenna 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 direction that is wanted. Many of techniques had been developed by many researchers to have tilting control capability. Tilt direction change is somewhat difficult task, because it is done by manually using tilt meter and compos. When changing the tilt and direction of a sector antenna officer should take the permission from regional engineer to visits the site. Accuracy of the manual tilt direction change of a sector antenna is below far.

In this study, here it is proposed that a prototype antenna bracket which can be controlled the tilt and direction by using Global System for Mobile (GSM) massage. This system was designed by using GSM serial communication with Arduino to control bidirectional servo motors of the bracket. The system has 16*2 LCD panel to display the mechanical tilt and the direction of the sector antenna. It has been confirmed that, the device created according to this study has good accuracy, effective and efficient than the present available system.

Keywords: Tilt/Direction, GSM, Arduino

1. INTRODUCTION

Cellular device design is changing dynamically to fulfill the trend of customer needs. The technology is developed rapidly. Because of the shape of cellular devices are various, the ability of the antenna is go down because the size should be decreased. To solve this problem, the ability of BTS antenna must be improved [1]. BTS antenna use array antenna. Array antenna is used because this antenna has narrow beam, high directivity, less side lobe, and beam that easy to steer. Telecommunication industry currently experiences an exponential growth in technological advancements. New Technologies demand new regulations and the regulator is forced to keep abreast with its regulations, especially with the burden of installation at a level field [2].

It is possible for a customer to have coverage issues if he is in the null area because of his location. In order to solve the issue, the site which is serving the customer is visited and its exact location is obtained. Then it is checked from which angle the tilt or direction should be changed in order to provide network coverage for the customer. If there are no major issues by changing tilt or direction and the angle to be changed is small (about 5° to 10°) then the tilt or direction is changed as required.

In a cellular telecommunication, BTS becomes the important component. BTS antenna 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 direction that is wanted. Many of techniques had been developed by many researchers to have tilting control capability. Tilt direction change is somewhat difficult task, because it is done by manually using tilt meter and compos.

In Sri Lanka basically network providers change the tilt/direction by using a rigger. Rigger is a person how climb the site and change the tilt/direction manually. When it is done in manually, the accuracy will go down. Sometimes network providers need to change the tilt/direction according to Very Important Person (VIP)/Corporative customers to give them better coverage. To change the tilt/direction technical officer and the rigger should visit the site every time. When the solution is to change the tilt/direction to obtain the good coverage it’s very difficult to visit the site every time. In this case we have the tilt/direction details about every site in Sri Lanka in Piano files and if we could change the tilt/direction without visiting the site is very useful. Network providers face this problem since at beginning. By using this GSM based antenna bracket we can change the mechanical tilt and direction according to the Short Message Service (SMS). So it will minimize the amount of time for the tilt/direction changes. This bracket can be developed by using servo motors. A step of motor is defined as the angular rotation produced by the output shaft each time the motor receives a step pulse so we can adjust the tilt by rotating horizontally and change the direction by rotating vertically.

2. METHODOLOGY

2.1 Block diagram

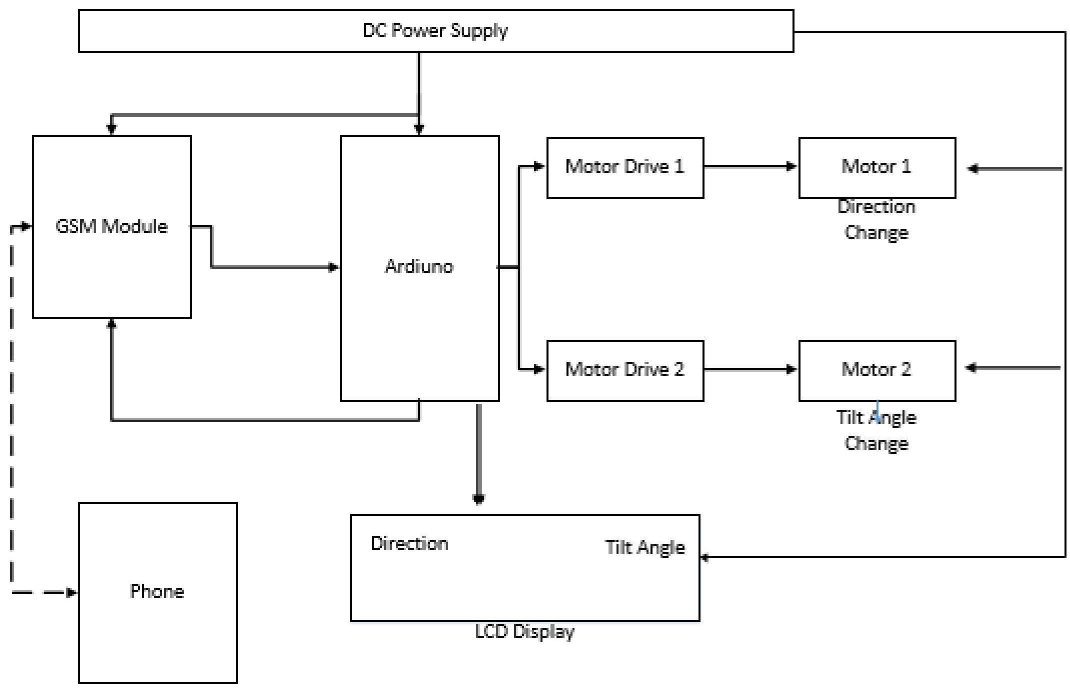

Figure 01: Block diagram

Figure 01 shows the block diagram of the system developed. It shows an Arduino based sector antenna bracket system. The proposed system uses GSM module to connect the phone and the bracket. Whenever the user needs to change the tilt/direction of the sector antenna, SMS should be send to antenna bracket system by using the mobile phone. In the SMS, first user should mention the direction angle and it should not be larger than 180º. Then the tilt angle should mention below 40º. Sent SMS will appear in the GSM module and it will read using GSM serial communication with Arduino. Separate angles for the tilt and direction will identify by the Arduino and servo motors will rotate according to identified angles. Motor 1 rotates as declaration of direction angle and motor 2 as tilt angle. Then it will appear in the LCD display as tilt and direction angles separately.

2.2 System Design

SMS reads by the Ardiuno after received the SMS from mobile phone. There are two limitation for the tilt and direction of the bracket. Direction of a sector antenna bracket should not be more the 180º and tilt angle should not be more than 40º. The process of the system shows in figure 2.

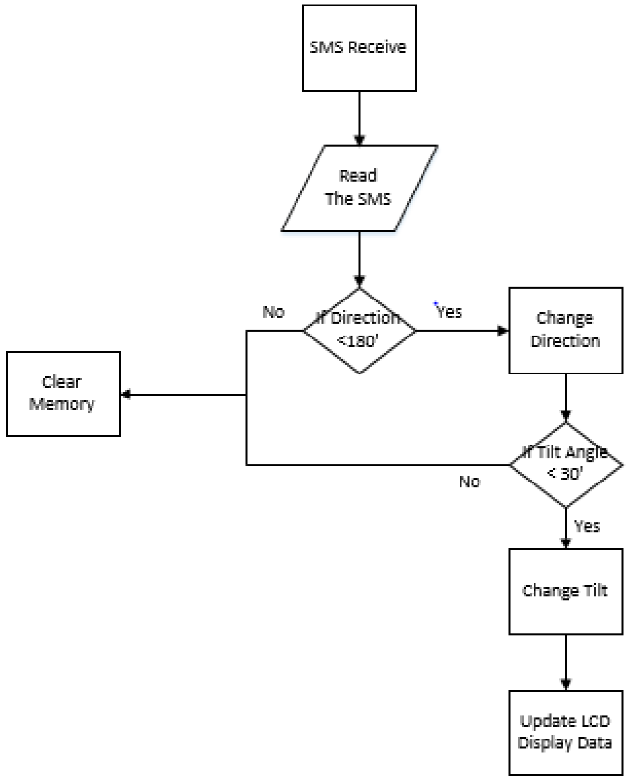

Figure 2: Process of the system

2.3 Hardware Design

The overall hardware design is shown in Figure 3. The GSM module allows an Arduino board to receive SMS messages. Module is possible to communicate with the board using AT commands. Arduino boards use digital pins 0 and 1 for software serial communication with the module [3]. Pin 0 is connected to the module TX pin and pin 1 to its RX pin. The modem's PWRKEY pin is connected to +5V.

The servo motor has three leads. The color of the leads varies between servo motors, but the red lead is always 5V and GND will either be black or brown. The other lead is the control lead and it is usually orange or yellow [3]. This control lead is connected to digital pin 10. For motor 2 lead pin connected to pin 11. LCD is connected as shown in figure 3. The tilt and direction of the bracket displays in the LCD.

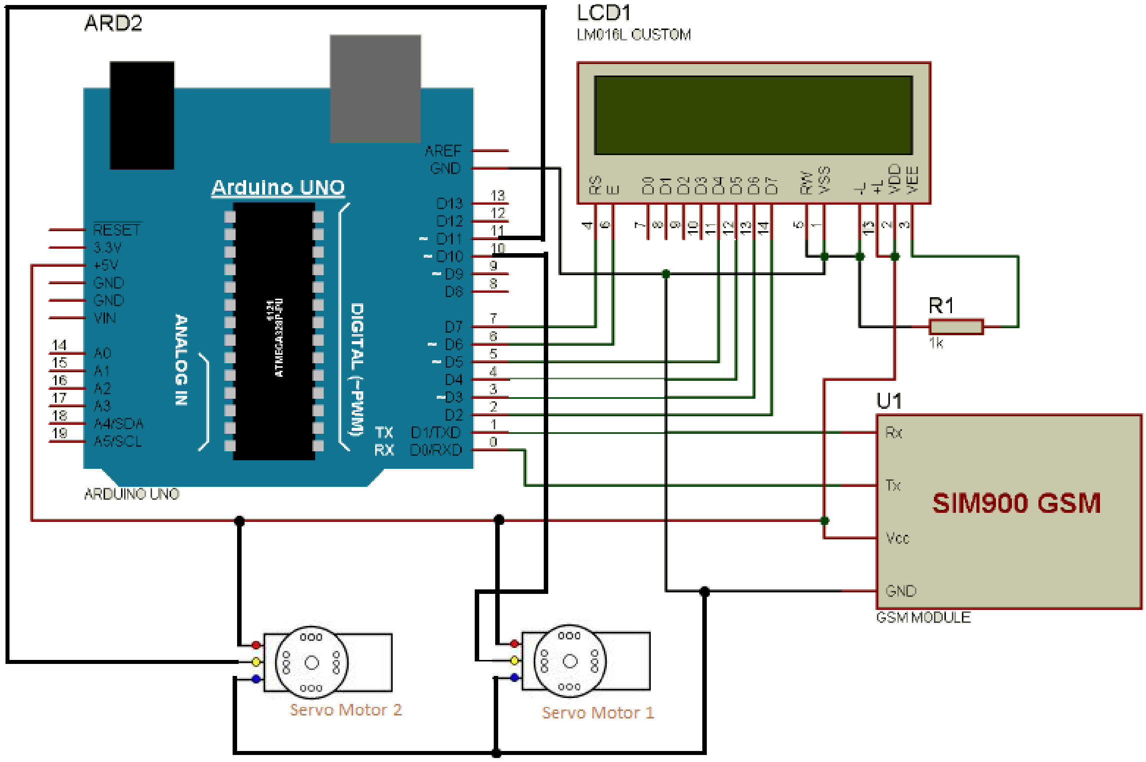

Figure 03: Schematic diagram of design

3. RESULTS AND DISCUSSION

Bracket can change the tilt/direction accurately and efficiently. Then it can change the direction and tilt rather than having a fault. As a result of that, labor cost and time consuming will be reduced in large numbers. This bracket can change the way of optimization in coverage. Below table shows the corresponding angle for the mechanical tilt reading.

Table 01: Corresponding angle for the mechanical tilt

Mechanical Tilt	Angle of the antenna
1	4^o
2	10^o
3	16^o
4	22^o
5	28^o
6	34^o
7	40^o

Present day Sri Lanka does not has this resources to automate the tilt/direction change. Implementation cost of the proto type is less than RS 5000. Therefore with low budget of cost and high accuracy reading of the implemented model will give the country like Sri Lanka a better chance to overcome the problem which can be taken place in the work site.

4. CONCLUSION

Telecommunication industry requires lots of installation costs. In Sri Lanka there are different kinds of telecommunication activities and processes which needed the precise installation. Most of those activities are done as manual process which creates less accuracy situations. As there is no any program or specific automated device to change tilt/direction of sector antenna, this study is based on GSM based sector antenna bracket to change the tilt/direction by giving the coordinates and tilt by a SMS. By using this bracket we can change the tilt and direction without visiting the site. It has been confirmed that, the device created according to this study has good accuracy, effective and efficient than the present manual control.

5. ACKNOWLEDGEMENT

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Department of Electronics - Wayamba University of Sri Lanka

GSM BASED MONITERING SYSTEM AND REMOTE CONTROLLING SYSTEM FOR INDUSTRY APPLIANCES

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ABSTRACT

In this study, we present one of the emerging applications of the GSM technology and the design of a stand-alone embedded system that can be monitor and control industry appliances locally using built-in input and output peripherals. Remotely, the system allows the monitor and control industry appliances via his mobile phone set by sending commands in the form of SMS messages and receiving the appliances status as well. The proposed control system was designed using a prototype board equipped with Atmega 328 microcontroller. For implementation of data communication between the remote modules that compose the proposed system a sim900A GSM module was used. The quality of the proposed design was evaluated through extended performances analysis focused on the delay time, maximum transfer rate, failure tolerance and reliability.

Keywords: Monitoring System, GSM, Remote Controlling

1. INTRODUCTION

Industrial automation is the use of control systems such as computers to control industrial machinery and processes, reducing the need for human intervention. In the scope of industrialization, automation is a step beyond mechanization. Whereas mechanization provided human operators with machinery to assist them with the physical requirements of work, automation greatly reduces the need for human sensory and mental requirements as well. Processes and systems can also be automated. Automation plays an increasingly important role in the global economy and in daily experience. The proposed design is to provide industrial automation is useful for controlling the devices from any distance. A microcontroller is used which control the components according to the given message and the sensed information sent from the sensors. This paper discusses the working of this system. As the automation is microcontroller based it automatically regulates the sensor input and sms command.

The system has two parts, namely; hardware and software. The hardware architecture consists of a embedded system that is based on atmel 328p microcontroller [2], relay module, power unit and a GSM modem **.** The GSM modem provides the communication media between the user and the system by means of SMS messages. The system program is developed using an interactive C programming language platform.

The SMS message consists of a set of commands and appliances status. Two types of SMS messages are used in the system. One is outgoing message from the system to the user's mobile and the other is incoming SMS message from the user's mobile to the system. The incoming SMS message is sent to the GSM modem via the GMS public networks as a text message with a maximum length of 160 characters. The message consists of a set of commands to turn a specific appliances ON/OFF. Once the GSM modem receives the message, it will be downloaded via the RS-232 connection to the system. The system will interpret the commands and turn the appliances accordingly. The outgoing message contains the industry appliances status such as COMPRESS AIR LOW, POWER CUTTOFF, and so on. This outgoing message will be send to Engineer, Engineer Assistant and Electrician. As the system controls industry devices remotely, it is necessary to provide a mechanism to ensure that devices are set up according to the desired command.

The electricity wastage and damaging industry appliances caused by leaving the electrical appliances in the ON state despite not being in use. The simplest yet most overlooked way of electrical energy conservation is by switching off of the electrical appliances when not required. Nowadays, GSM technology based industry automation systems are developed to control industry appliances when the operator away from the control area. This paper report on a system developed to overcome these difficulties. The developed system is a cost effective and used only ardunio NANO, signal converter, GSM module and relay driver to control the system.

2. EXPERIMENTAL

The block diagram of the designed system is shown in the Figure

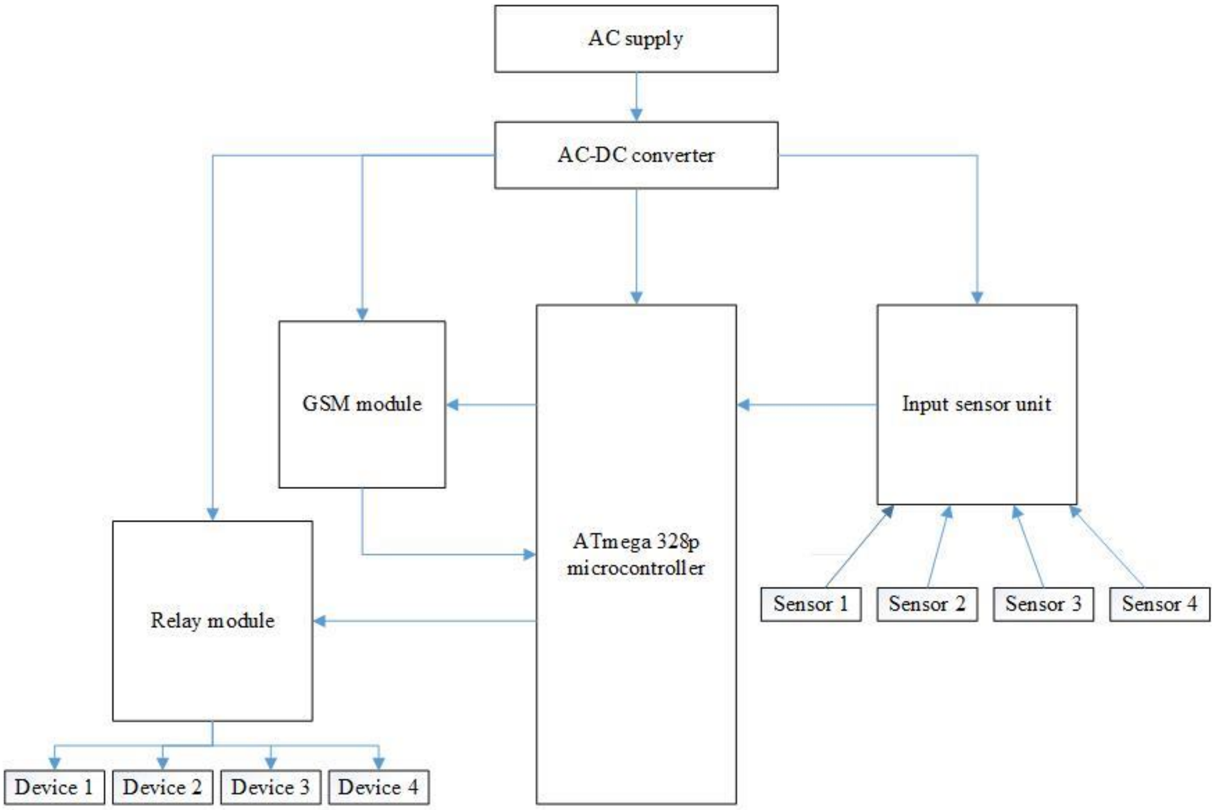

Figure 1. Block diagram of designed system

The design of the remote control system is realized around an Arduino Nano development board. The main element of this board is the Atmega 328 microcontroller. This microcontroller is a high performance device operating on 8 bits and having a set of 131 instructions that are mostly executed in one clock cycle. The relatively reduced instruction set combined with a 20MHz maximum clock frequency lead to an increased operation speed of microcontroller that reflects also into the operation speed of the development board and the system.

On the peripheral side, the module offers 14 digital input/output terminals, six of them been configurable as PWM outputs (Pulse Width Modulation). Also the analog input signals from various sensors. The internal analog-to-digital converter used for implementing the analog inputs of the system operates with a 10 bits resolution.

The initial programming of the Atmega 328 microcontroller is realized through onboard ICSP interface (In-Circuit Serial Programming). This allows the programming of the Atmega 328 microcontroller while it is mounted on the board. The communication interface of the Atmega 328 is represented by a programmable serial Universal synchronous/asynchronous receiver/transmitter (USART). In our approach the communication with the remote module is achieved through GSM network infrastructure. A mobile phone is used for monitor and control the remote module that is directly connected to the process through actuators and sensors [1, 4]. For ensuring the bidirectional communication with the user terminal from which are sent the commands, the Arduino Uno development board is directly connected to a GSM module implemented with sim900A module [5].

The GSM/GPRS radio modem is capable to communicate using all standard frequencies: 850, 900, 1800 and 1900 MHz respectively. Also, the modem allows automatic searching and selection of the desired frequency bands through common AT commands implemented is software routines. The AT commands are sent to the radio module as short text strings and represents a common method of control for modem applications. The transmission power used in our application is imposed by the radio modem which can operate in two modes: Class 4 with 2W in GSM 850 and 900MHz and Class 2 with 2W in DCS 1800 and 1900 MHz bands. Also, the maximum achievable data transfer rates with the GSM module included in the proposed design of the remote control system is limited to 85,6kb/s for both downlink and uplink directions

1.1 Fault detector unit

The sensor signal sends to the system via connected wires. After that input signals were connected into optocoupler that outputs connected to microcontroller inputs. Inputs are read as a digital read by microcontroller. Microcontroller was programmed as if digital read is LOW, device is working as proper and if digital read is HIGH, device isn't working proper. Then fault message was sent using GSM module to the responsible person of this device (Engineer, Assistant Engineer, Electrician, etc.). When some fault occur then they can be quickly response.

1.2 Remote control unit

The device control unit consists of relays. The main object of this unit is to provide access to the relay circuit when the controlled devices needed to be turned on/off. When write the program, specific message was written in program according to output pins. When the message is received microcontroller compare this message with saved message in program. If both messages are equal then output pins will be HIGH.

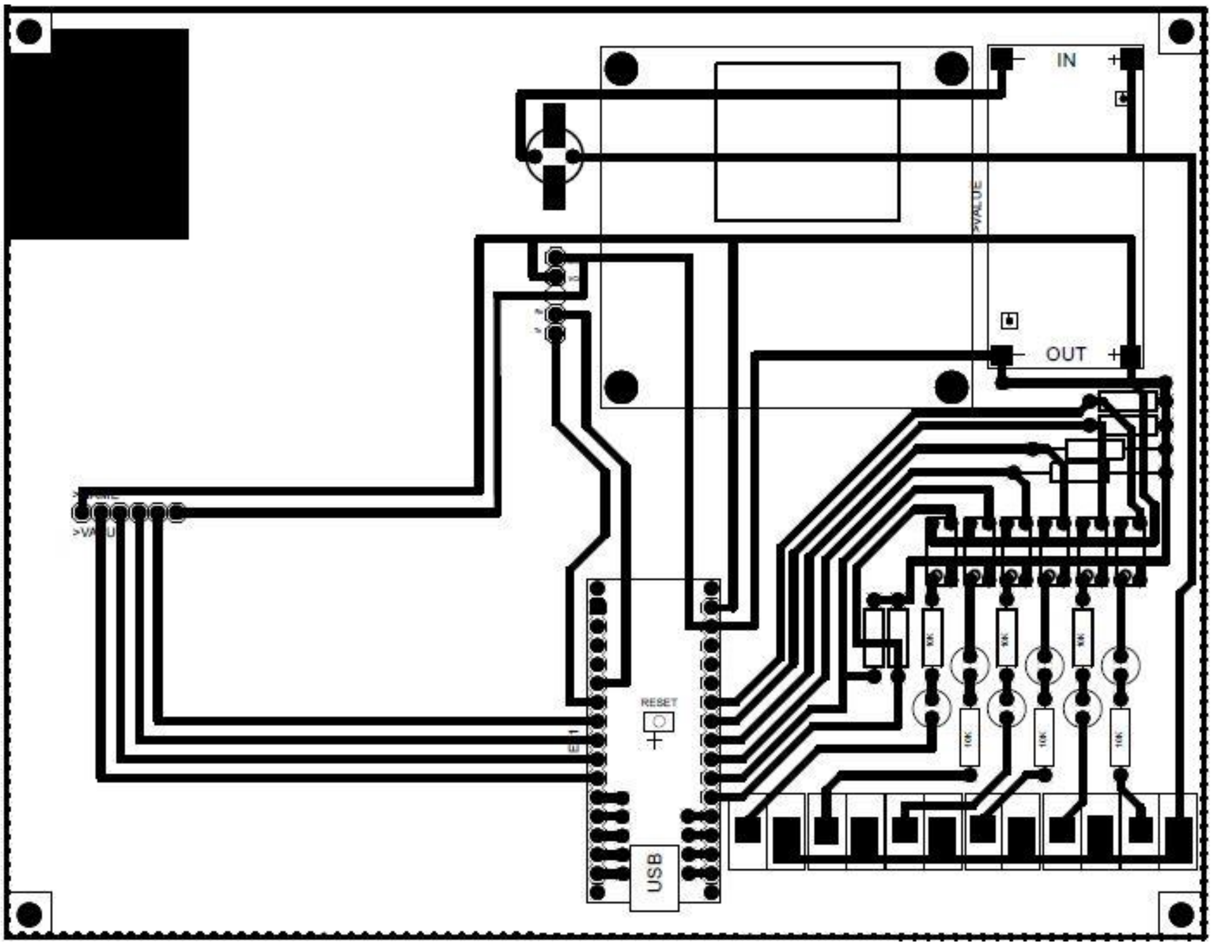

Figure 2. PCB design of the system

3. RESULTS AND DISCUSSION

The sensor signal sends to the system via connected wires. After that input signals were connected into optocoupler .that output was switched by optocoupler and connected to microcontroller input. If it has any changes in input status then message will be send. PCB design was shown in figure 2.

Industry appliances can be controlled from a remote location by using this system. It's a great privilege for users to protect their equipment and save labor cost. If we need to ON some appliance then specific message can be send to control system but this message must be include in a program. In this system, there are several advantages and disadvantages.

Advantages

- It is simple to control the operation of any appliances from anywhere by exploiting the existing mobile network, i.e. it's not necessary to install a specific network.
- Any type of mobiles can be used.
- The control circuit is reliable and simple to build.
- System is secure.
- A low cost system.

- Will provide significant long-term savings in electricity costs.
- Low probability of errors.

Disadvantages

- The limited number of appliances can be controlled by using this system.
- There is an approximately 15 second's delay for received message.
- When increasing the number of users delay for receiving massage is increased.

4. CONCLUSION

The proposed remote control system based on GSM communication represents a versatile platform for developing distributed control systems with very wide spectrum of applications, beginning from complex industrial manufacturing processes that are located in wide areas and extending also in industry automation. Due to the global availability of the GSM network, the proposed implementation solution can be used almost in any location. The system can be extended to operate with a more complex set of commands and with a larger number of mobile terminals or even embedded servers.

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Department of Electronics - Wayamba University of Sri Lanka

REMOTE TILT CONTROLLER FOR BASE STATION ANTENNAS

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ABSTRACT

New approaches to network optimization and management should be taken into account to increase mobile network performance and reduce operational costs. Antenna tilt is a powerful parameter for optimization of a mobile network. It has direct impact on shaping the boundary of the serving cell and hence on the coverage and interference parameters of the network. With the introduction of Remote Tilt antennas, tilt optimization can be used in the context of self-optimization. This work discusses how base station antenna tilt can be used as a self-optimization tool for load-balancing and presents a framework for a self-optimization process that can be integrated into existing and future mobile networks. Tests using real track data proved that the self-optimization process can be used to correctly identify congested cells. Both link level and system level simulations are performed to determine the impact of tilt adjustments on network performance. The results show that antenna tilt can be an elective tool to achieve load-balance between neighboring cells and thus increase the Grade of Service (GoS). Furthermore, deferent tilt adjustment procedures are discussed each with its advantages and disadvantages. It is concluded that antenna tilt can be successfully used for self-optimization purposes and possible limitations and issues are discussed.

Keywords: Antenna tilt, Micro controller, Telecommunication

1. INTRODUCTION

The increased complexity of mobile networks, the need to deliver high data rate services and the variation of mobile track put a high burden on operation and maintenance in terms of extra workload and additional costs.

On the wireless mobile network, the coverage to the area is radiated by the polar antenna, which is on the top of the tower. To cover all parts of the area, certain number of antennas are installed with respect to the number of sectors[1]. Here the antenna will act as a transceiver.

Nowadays the network planning has become more complicated. There is a need to make improvement on quality of service. To make the network efficient, network operator must use the antenna parameters efficiently. There are some antenna parameters, which are used to control the transmission signals through the antenna. They are

- Mechanical Tilt
- Electrical Tilt
- Azimuth

To find out the efficient values of these parameters, operators have to perform some tests around or necessary areas on that cell. Changing the mechanical tilt and azimuth will strongly affect the coverage. So they mostly use calculations to find out those values. In some cases, those calculated values may not be the efficient value, are they may cause poor coverage. So they slightly change the electrical tilt value with respect to the result of the coverage test each time, until they achieve the required completion on coverage[2].

In the proposed tilt adjustment system, there are two main units. They are

- Controller Unit
- Remote Unit

Here both the controller and the remote unit have their own microcontroller. Controller unit will get the user inputs and transmit them to the remote unit. Then the remote unit will receive and control the stepper motor with respect to the received signal.

2. EXPERIMENTAL

The designed system consists of electronic circuits and mechanical parts. In the electronics circuits the microcontroller, LCD display, keypad, Bluetooth module and motor driver were included. As the mechanical parts, the stepper motor shaft was connected with a screw which is similar to the tilt screw on the sector antenna.

In the controller unit, the user inputs were fed into the controller unit by using 4x3 matrix keypad and the microcontroller will perform the process to analyse and transmit the command signal to the remote unit by transmitting through the Bluetooth transmitter module. When user enters the data into the system, the user must choose the correct antenna and enter the respective tilt value. Then user must feed the command to transmit the command signal which was entered to the system. In the remote side, the microcontroller receives the command signal by using the Bluetooth receiver module[3]. The microcontroller will choose the correct antenna, assign the stepper motor and control the stepper motor motion according to the received command signal.

2.1 Block diagrams of the system

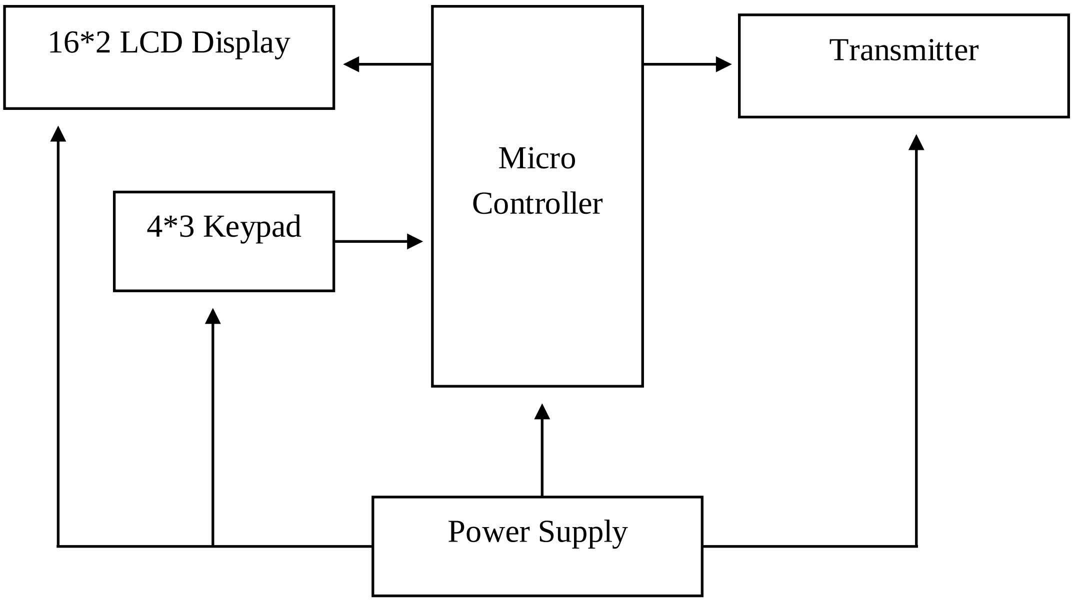


Figure 1: Block diagram of the controller unit

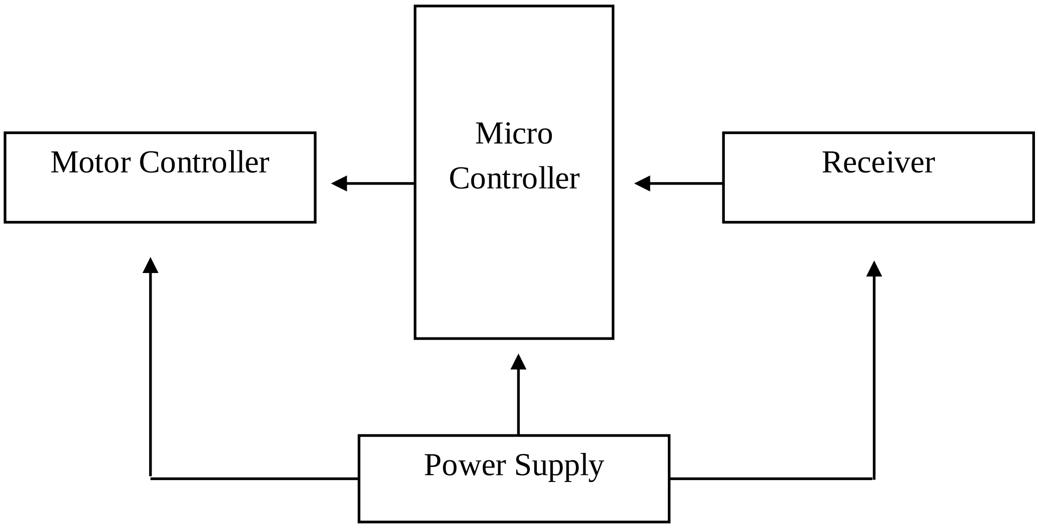
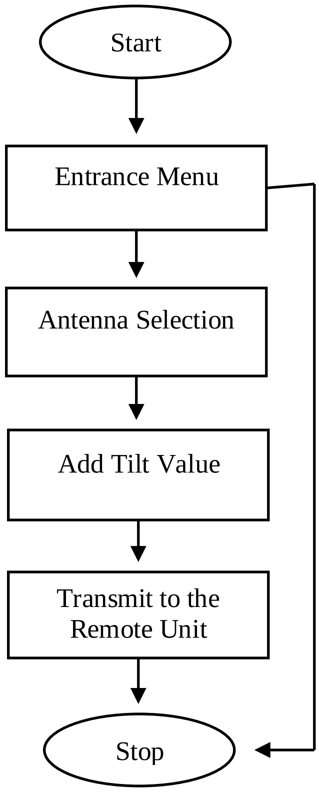


Figure 2: Block diagram of the remote unit

2.2 Flowcharts of the system



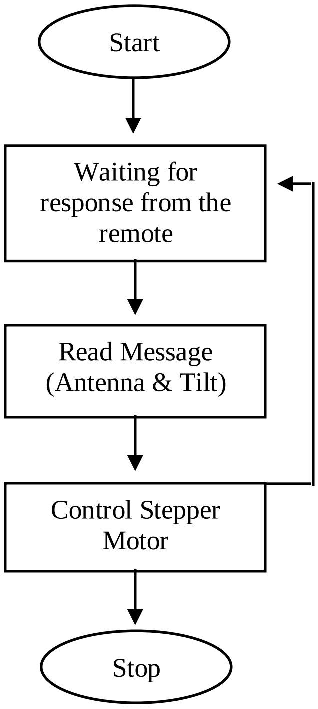


Figure 3: Flowcharts of the controller unit

Figure 4: Flowcharts of the remote unit

2.3 Circuit diagrams of the designed system

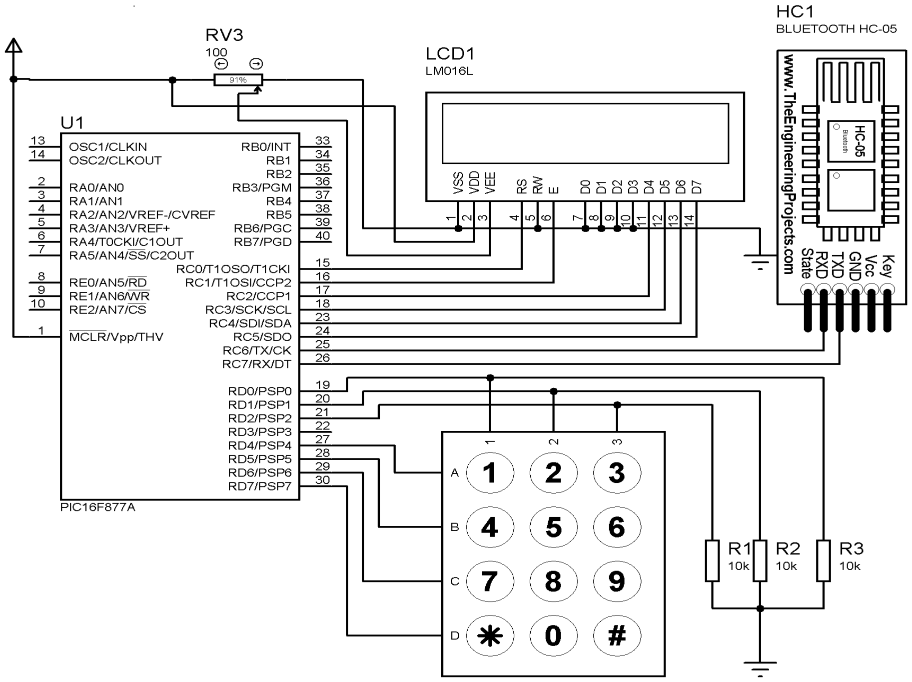


Figure 5: Circuit diagram of the controller unit

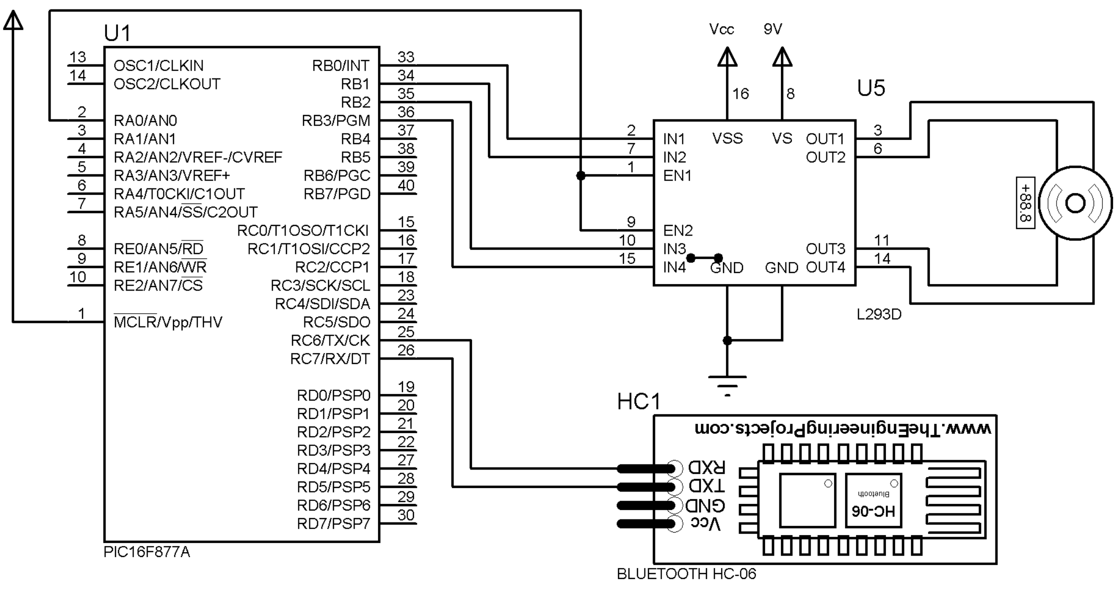


Figure 6: Circuit diagram of the remote unit

3. RESULTS AND DISCUSSION

After choosing the correct antenna and up or down tilt adjustment, the antenna automatically adjusts the tilt according to the tilt value given by the user. The range of the mechanical tilt is 30^0 and the step size is 3^0. The actual minimum tilt is 0^0 and the maximum is 30^0. The range of the electrical tilt is 0 to 9. The communication between the antenna and the controller unit is done by Bluetooth modules. The maximum working range of Bluetooth modules limits to 10 m. The device is intended for outdoor use. In this project, first 433MHz RF module was used. But due to high interference, 433MHz RF module was replaced with HC05 Bluetooth modules.

Areas of achievement

- User inputs were successfully fed to the controller unit by using 4*3 matrix keypad.
- The input values were successfully validated before transmitting.
- UART serial communication between two PIC modules were successfully done.

Future development of the system can be carried out to

- Make it more user friendly on controller unit.
- Modify the communication medium as fiber optics.
- Increased range and accuracy by using GSM module for communication.

4. CONCLUSIONS

The developed tilt controller unit can be used to modify the tilt during the optimization process remotely on the RF mobile network antenna. By using this system, there is no need to climb up the tower and it is easy to modify the tilt value whenever required.

ACKNOWLEDGEMENTS

The authors are indebted to NMI Infra (Pvt) Ltd for their guidance and constant supervision as well as for providing necessary information regarding the project and also for their support in completing the project.

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Department of Electronics - Wayamba University of Sri Lanka

DESIGNING OF A LOW COST CABLE PATH TESTER FOR TELECOMMUNICATION INDUSTRY

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ABSTRACT

Lot of cables such as coaxial cable, twisted pair cable, Ethernet cable and power cable are used in telecommunication industry. When those cables need to be changed, the process is very risky because if unwanted cable is unplugged, the system will collapse. In this study is proposed to remove a cable safety. In this design, a simple voltage detector was used to track a cable by using the Ampere's low. A transistor acts as a switch in this device. When the voltage through the wire is increased, magnetic field around the wire will increase. This theory was used to identify the exact cable. This is a very low cost device because companies always consider the cost of the device and how easy to handle. However this method is not suitable for fiber cables.

Keywords: Ampere's low, Network cable, Voltage detector

1. INTRODUCTION

Telecommunications is the communication of information over distances and includes electronic transmission of impulses by telephone, computer and television. The beginning of telecommunications started with the invention of the telephone in 1874 [2]. Today, advancement in technology evolved from basic voice conversation to combining voice, video and data. In the telecommunication industry, various cables are used to transfer voice traffic, data traffic, power and etc.

Following transmission media are used in the telecommunication industry,

- Twisted pair wire cable
- Coaxial cable
- Fiber-optic Cable
- Power cable
- Ethernet cable

In telecommunication industry, coaxial cable and twisted pair cable are used to transmit data from the base station antenna to switches. Long cables and huge amount of cables were used for transmitting the data. When those cables are needed to be changed, the process is very risk because if unwanted cable is unplugged, the systems will collapse. So the exact cable has to be identified and it is not easy to do this physically. Therefore this system was designed to track a required cable.

2. METHODOLOGY

A magnetic field is produced around a current carrying conductor if current through the conductor is AC (Alternative Current). The direction of the magnetic field due to moving charges will also depend on the right hand rule. For the case of a long straight wire carrying a current *I*, the magnetic field lines wrap around the wire [4].

Using the ampere's low

$$B = \frac{\mu_0 I}{2\pi r}$$

B = Magnetic field

I = Current through the wire

μ_0 = Magnetic permeability

r = Distance from the wire

The magnetic field varied periodically with respect to the current through the cable. A non-contact AC voltage detector detects the changing magnetic field around AC energized objects. This non-contact AC voltage detector uses NPN type transistors in order to detect voltage [3]. A transistor has three terminals that are collector, emitter and base. Collector to emitter current is controlled by the base current. When there is no base current, no collector to emitter current flows. Thus, a transistor acts as a switch. It can be 'ON'; it can be OFF or in-between.

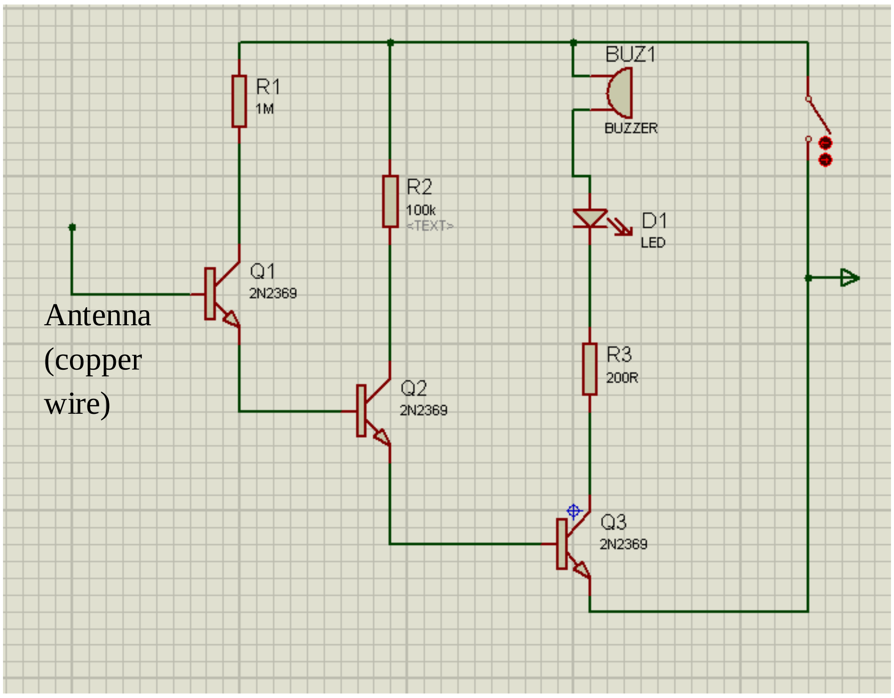

Figure 1: The circuit diagram for voltage detector

In the design, an antenna (copper wire) was connected to the base of first transistor (Q1). When the object was placed near the antenna, AC energized and small current gets induced into the antenna due to electromagnetic induction. This current triggers the first transistor and output of the first transistor triggers the second and third. The third transistor switches ON the LED and buzzer circuit, indicating that AC voltage is present.

Using ampere's low,

$$B \propto I$$

B = Magnetic field

I = Current through the wire

Using ohm's low,

$$V = IR$$

V = voltage across the resistor

I = current through the wire

R = resistance of the wire

$$I \infty V$$

When the voltage through the wire increased, the current through the cable will be increased. As the result of increasing current, the magnetic field around the cable will increase. This change was used to identify the exact cable from bundle of cable.

3. RESULTS AND DISCUSSION

This device was designed mainly to track a cable used in telecommunication industry. This method is successful for coaxial cables, power cables and twisted pair cables. This system cannot use for fiber cable because there is no method to supply voltage to the cable. This system is high responsive to high voltage supply.

This system is a low cost device to track the unwanted cable in the telecommunication industry and the system is easy to use because it is a small device. User can get measurements very quickly. However this system has no method to check the accuracy of the device. This is not suitable for all types of cables.

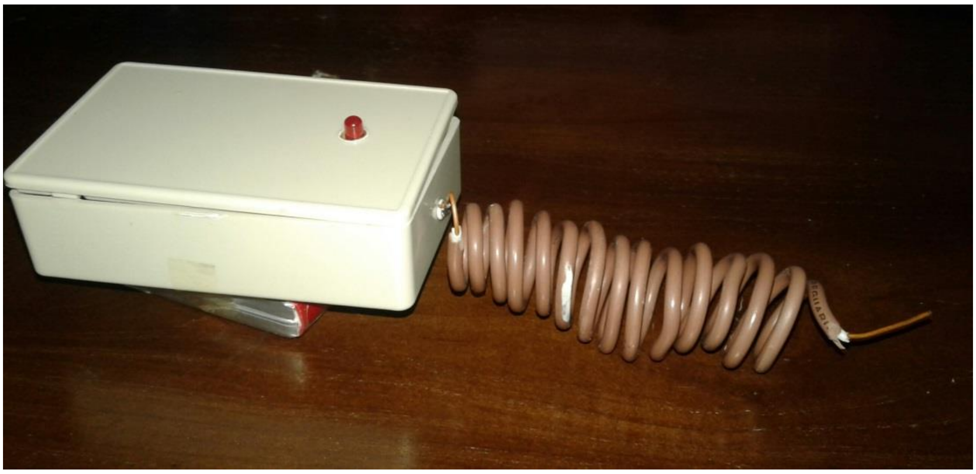

Figure 2: The prototype of the device

4. CONCLUSION

In this study, a low cost method was designed and constructed to detect a cable from a bundle of cable using Ampere's law. However this method can be used with cables having metal wire inside them. This system will be future developed to test all type of cables that are used in telecommunication industry.

ACKNOWLEDGEMENTS

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AN ADJUSTABLE AC POWER SUPPLY FOR PCB TEST EQUIPMENT

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ABSTRACT

PCB (Printed circuit boards) testing is the most important process in assembling and soldering electronic product needed by the customers in PCB manufacturing industry. Adapters are mainly used for this purpose. These adapters required variable voltages for PCB testing. This paper describes the design and development of an adjustable AC power supply that can be used in PCB test adapters. An important feature of our system, in addition to the variable power supply, is that it isolates the power from the main supply, increasing the safety of the PCB being tested. The proposed system consists of a PIC microcontroller and provides variable voltages from the range 0V to 230V, and the range of output current is 0A to 10A.

Keywords: PCB(Printed circuit boards) , Variac (Variable autotransformer), Power supply

1. INTRODUCTION

A printed circuit board (PCB) is used to electrically connect electronic components using conductive pathways, tracks or signal traces etched from copper sheets. It is composed of a variety of complex electronic components, including resistors, capacitors, diodes, transistors etc.

In order for a PCB to function properly, each component must play its part. If one component fails, the PCB may fail. Therefore, it is important to make sure that each component is connected properly within the PCB, and it is one of the main processes in PCB manufacturing. PCB manufacturers follow standards to maintain quality of their products and PCBs are tested in variety of ways.

- In circuit test - In circuit test equipment provides a useful and efficient form of printed circuit board test by measuring each component in turn to check that it is in place and of the correct value.
- Functional test – It is used to verify a PCB's functionality and its behavior.

The PCB testing is done using the special test equipment called test adapters. It is the sophisticated test equipment used to measure thousands of test points on a PCB through the mechanical interconnect. It contains probe based test fixture which acts as an interface between the board and the in circuit tester. It takes the connections for the driver sensor points and routes them directly to the relevant points on the PCB using a probe tips. Then the PCB is held on to the probe tips and it is tested using the written software which instructs the test system what tests to perform, between what points and details of the pass / fail criteria.

The supply voltage for the proper operation of those test adapters are differ from one by one according to the test method used. Variac (Variable autotransformer) is commonly used to supply required voltages to those adapters form 230V main supply.

A variac is a single-coil transformer in which two portions of the same coil are used as the primary and the secondary. As voltages travel through the coil from both the primary and the secondary, the overall voltage is increased or decreased, depending on the placement of the primary and the secondary voltages and the number of taps in between them. Since the variac do not provide the electrical insulation between their windings like regular transformers do, this presents a safety hazard as it possibly allows a high primary's full input voltage to pass directly to the secondary's output. Therefore unwanted voltages can be appeared through test equipment and causes the equipment burn out.

The adjustable isolated ac power supply is highly essential when test adapters are used. In this paper we propose an adjustable AC power supply suitable for PCB test adapters. The system consists of a microcontroller, a Variac, an isolation transformer, relays, and voltage and current sensor modules. The main features of the proposed power supply system are,

- It can provide adjustable voltage in the range 0V – 260V.
- It isolates the powered device from the main power source for safety reason.

- If the pre-defined levels for voltage and current exceed the system should be turned off.

This power supply is useful in industrial environment because it outputs adjustable isolated voltage for test equipment. If the microcontroller gets stuck it can be operated with the help of the toggle switch and it will be helpful to carry out their testing process continuously neglecting the control of the microcontroller

2. STRUCTURE OF THE PROPOSED SYSTEM

Figure 1 shows the overall view of the proposed system.

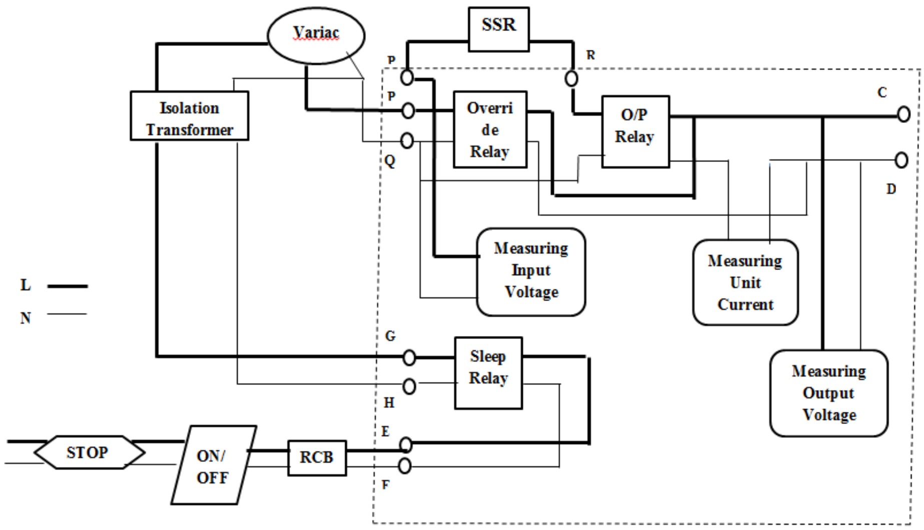

Figure 1: Block diagram of the system

When this system is plugged into the main power supply, the relay coils are powered on and the voltage is supplied to the variac via RCB (Residual Circuit Breaker) and sleep relay. Then the main supply voltage is adjusted as the requirement of the testing method and the adjusted output voltage then connected to the isolation transformer. Since this isolation transformer has 1:1 coil rating, the adjusted output voltage of the variac is connected to the circuit board as the isolated voltage. The live power line (L) is connected to the output relay via SSR (Solid State Relay). The neutral line (N) of the adjusted output voltage is connected to the output relay directly and then the voltage is measured across the output relay while the current is measured through the output relay.

The override relay is not controlled by the PIC microcontroller and it is controlled by the manual switch so that designed power supply can be used at some extend when the microcontroller will burn out.

2.1. FUNCTIONAL FEATURES OF THE MAIN COMPONENTS

PIC 18F4550 microcontroller is acting as the core operation unit of the system and HCPL7520 and ACS712 ICs are used for measuring voltage and current through the circuit.

2.1.1. PIC 18F4550 microcontroller

PIC 18F4550 microcontroller is acting as Central Processing Unit and it is needed instructions to operate the whole system. These instructions are provided to microcontroller by writing the Mikro C program to its 32 kb flash program memory. The operating voltage range is 2V – 5.5V and has 10 bit analog to digital convertor.

2.1.2. HCPL 7520 IC

The HCPL-7520 is an isolated voltage sensing IC with 8-pin DIP package. The supply voltage (VDD) is 4.5 to 5.5 V and the reference input voltage (VREF) is 4V to VDD. The HCPL 7520 outputs linear and accurate voltage at the range of 0V to VREF when increasing the input voltage between -200mV to 200mV.

2.1.3. ACS 712 IC

ACS 712 is a fully integrated, hall effect-based linear current sensing IC which is used to measure current flowing through the circuit. The supply voltage range is 4.5V to 5.5V and optimized accuracy current range is 20A. The output of the device has a positive slope when increasing current flows through the primary copper conduction path which is the path used for current sensing.

3. DESIGN OF THE POWER SUPPLY

The schematic and PCBs of the system were designed using Diptrace software and they were cut using CNC PCB Engraver machine. This designed contained SMT (Surface Mount) components as well as THT (Through Hall) components such as LM7805, capacitors, resistors, transistors and optocupler.

3.1. Control board

Figure 2 shows the schematic diagram of the control board.All the outputs of the sensing modules were connected to the control board and it contained MCU controller unit, the 16 bit LCD for displaying voltage and current measurements, serial communication module and safety circuit for the programmer.

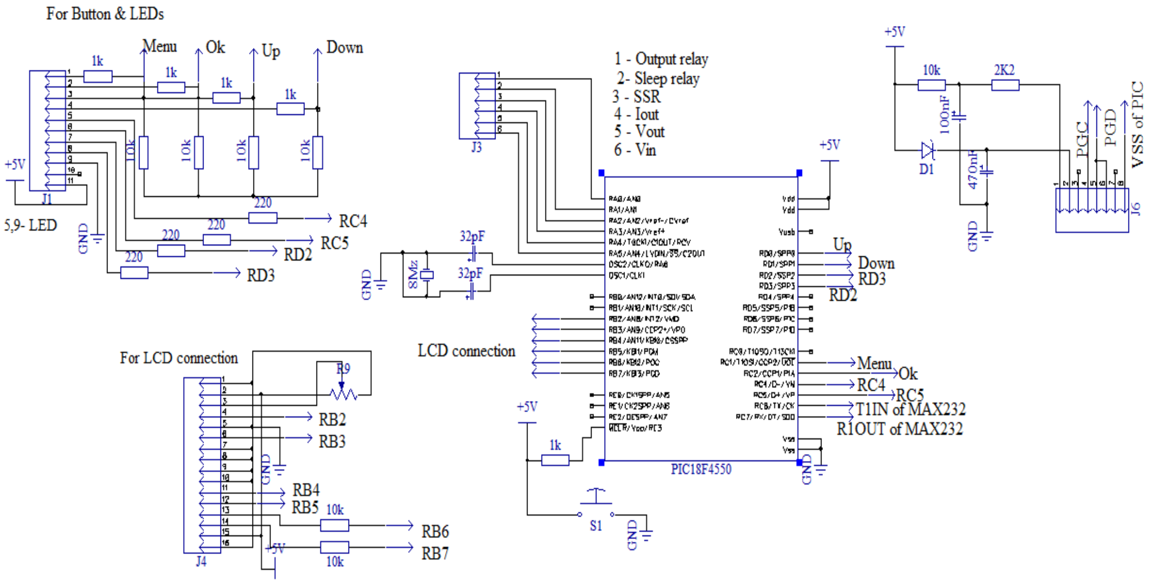

Figure 2: Schematic of the control board

3.1.1. Serial communication module

Figure 3 shows the schematic diagram of the serial communication module. This module is used to make the interface between PC and the system so that verifying the operation of the system.

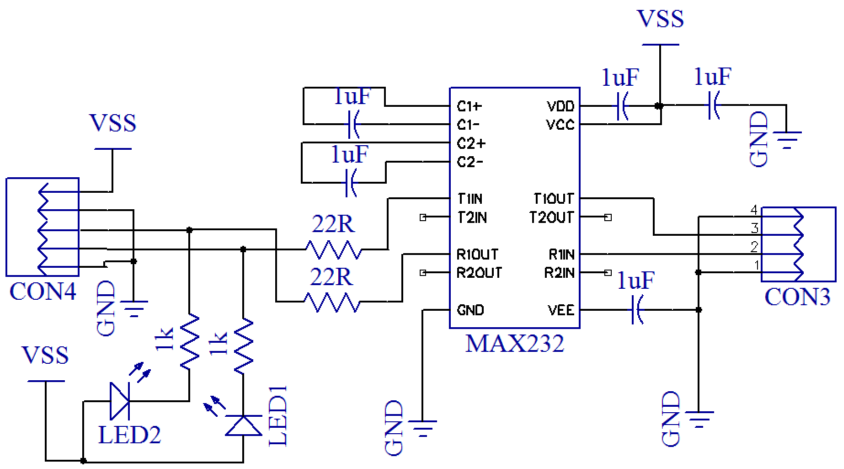

Figure 3: Schematic of the serial communication module

3.2. Relay connection board

Figure 4 shows the schematic diagram of the relay board. The relay connection board was the combination of mainly three relays and circuit connections were made through those relays. They performed the switching operation of the system.

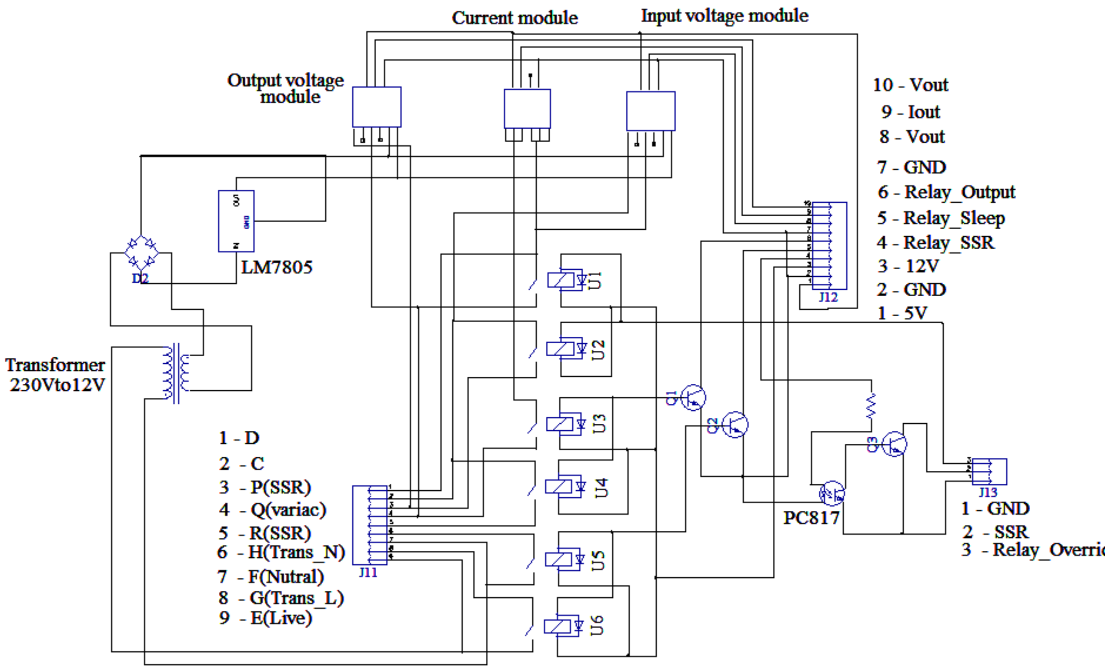

Figure 4: Schematic of the relay board

3.2.1. Voltage sensing module

Figure 5 shows the schematic diagram of the voltage sensing module. Since the HCPL 7520 was an isolated liner sensing IC, the circuit requires two separate power supplies, one on the high voltage side and the other on the low voltage side. Vcc of the high voltage side was supplied by a LM7805 voltage regulator IC and low voltage side Vcc was supplied from the microcontroller. Both grounds were also separated.[1] The voltage divider was connected between the live and neutral wires to supply the recommended input voltage to the pin 2 & 3.

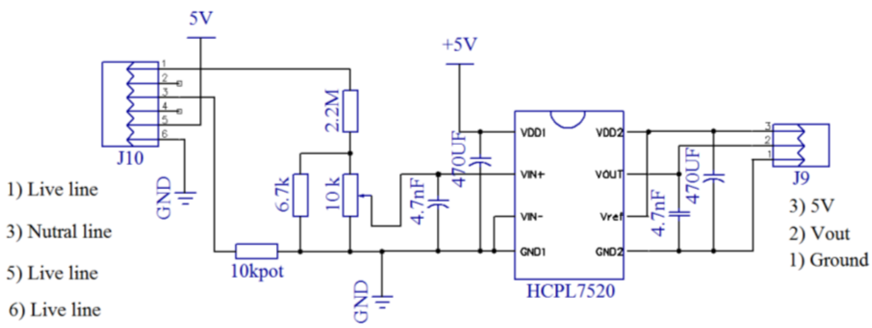

Figure 5: Schematic of the voltage sensing circuit

3.2.2. Current sensing module

Figure 6 shows the schematic diagram of the current sensing module. The ACS712 is used for measuring current with the LM358 IC as the gain circuit and this configuration increases gain to 610 mV/A. The current sensing module was powered by the SMPS (Switch Mode Power Supply) which is also supplying 5V voltage to microcontroller. It is the dual volte Switch Mode Power Supply which outputs the both 5V and 12V also. The relays with coil rating 12V were used for switching function so that it was easy to supply that voltage from the SMPS.

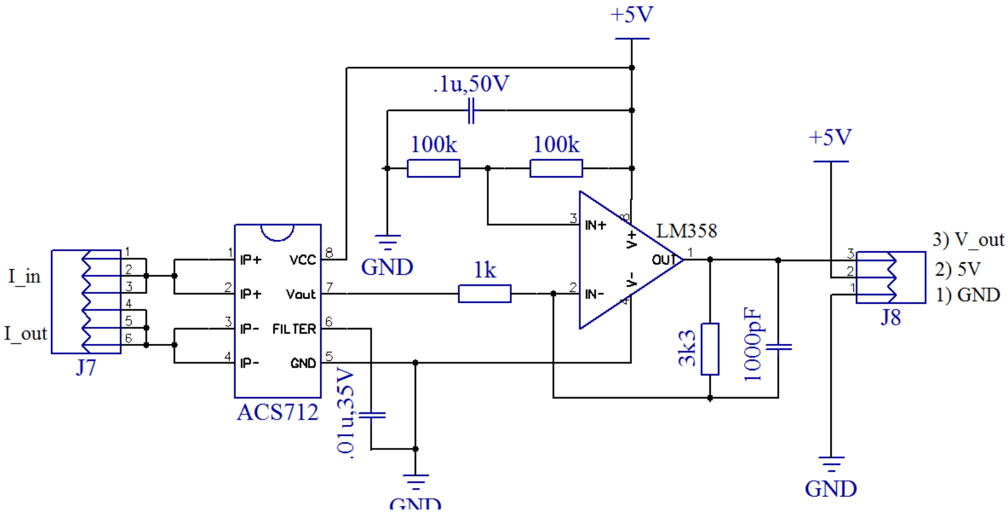

Figure 6: Schematic of the current sensing circuit

4. OPERATION OF THE SYSTEM

The system was tested by observing LCD output values with the variation of input voltages. The observed output voltages were varied linearly at the range 0V – 4V and then it was differed because the maximum linear output voltage range of the HCPL 7520 IC is 0V-4V when the recommended input voltage range is -300mV to 300mV.[3] By considering linearity of the voltages the gradient was calculated and then Micro C program was written for displaying real input voltage values.

The experimental results are shown in Figure 7. According to the graph, the LCD output voltage was varied linearly with input voltage although it showed approximately 1V variation.

The accuracy of the output voltage depends on the input value range. By using more accurate resistor values at the input side of the IC, the more accurate output voltage can be obtained with good resolution.

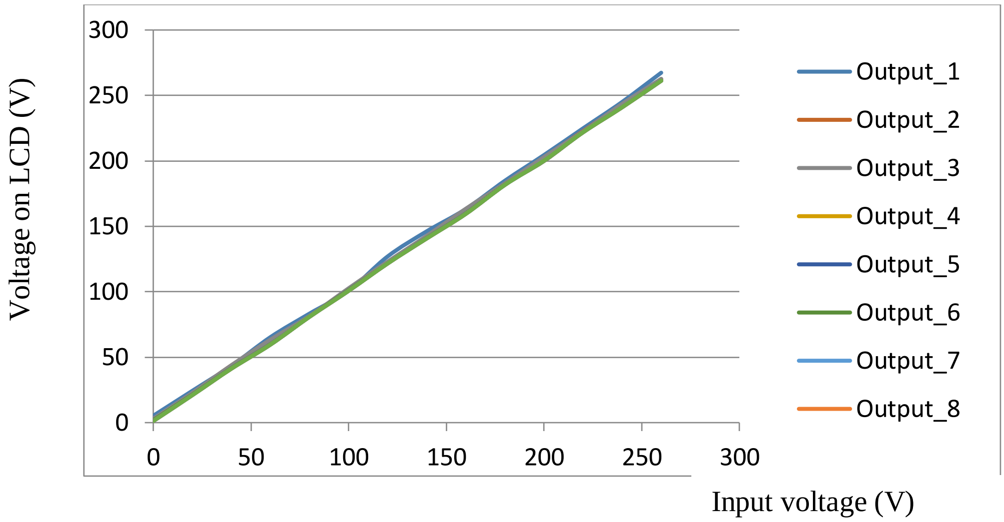

Figure 7: The graph of LCD output voltage vs input voltage

When the voltage value which is set by user was exceeded, the system turned off by switching the relays off.

When the load was connected to the circuit, the output of the system showed a positive slope when an increasing current flows through the circuit.

Since external magnetic field interference was occurred when using ACS712 current sensor IC for measuring high voltages, the output current values were not stable.[3] Therefore the device was covered using surface mount magnetic alloy shield for the protection against external fields. Then the stable output current can be observed according to the load connected to the circuit.

Therefore the overall result of this project was successful measuring the input voltage and current. The measurable voltage range was 0V – 260V and current range was 0A-10A.

5. CONCLUSION

In this paper, we presented the design and implementation of an adjustable AC power supply for PCB test adapters.

This system can be further enhanced by designing the casing with a trolley because the combination of the variac and isolation transformer is not a portable device. It can also be written LAB VIEW software to check the operation of the power supply via PC.

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Department of Electronics - Wayamba University of Sri Lanka

DESIGN OF A MICROWAVE ANTENNA ALIGNING SYSTEM USING ANDROID BASED MOBILE PHONE

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ABSTRACT

In mobile communication industry, microwave (MW) links play a major role in establishing a connection between two or more towers. MW antennas used in communication systems are regularly affected by environmental factors and generally by wear and tear of mounts. These factors cause the precisely directed antennas to be perturbed from respective main lobes. An automated antenna alignment that works without human intervention can decrease the down time and ensure a reliable communication between the near ends and far end terminals of the Base Transceiver Station (BTS). Two smart phones were used at the transmitting and receiving ends. Android applications were implemented to read GPS and compass modules, and also to calculate the bearing angle. HC05 Bluetooth module and smart phone were interfaced with the PIC 16F628A microcontroller on receiver unit. Bearing angle was uploaded to the microcontroller through Bluetooth module. Servo motor position was controlled by the microcontroller which corresponds to the calculated bearing angle. Minimum distance between the transmitter and the receiver was 30 m for better performance.

Keywords: Microwave Link, Global Positioning System, Line of sight

1. INTRODUCTION

Generally a microwave link means a beam of radio wave in microwave frequency range enabling a transmitter and receiver to communicate. Different forms of MW link applications are available in modern communication system. Broadcasters use MW links to send programs from the studio to the transmitter location, which might be miles away. MW link is the backbone in latest telecommunication system. Wireless internet service is another development where service provider can give facility of internet service without any cable. Most of the telecommunication companies communicate between their switching centers through this link although recently it is done by fiber optic cables as well[1].

One of the reasons for the adaptability of MW links is because they are broadband meaning they can transfer large amount of information at high speeds[2]. Another important quality of MW links is that they require no equipment or facilities between the two terminal points. Often a repeater station is installed if the clear Line of sight (LOS) is not available to maintain the signal in required Received Signal Level (RSL). Installing a MW link is often faster and less costly than a wired connection. Finally, they can be used anywhere as long as the distance to be spanned is within the operating range of the equipment and there is clear path between the locations[3].

MW link is configured in the LOS manner due to some errors and faults in LOS manner. There will be a transmission loss due to these losses, the transmission signal may be vary. This paper deals with wireless principles and interference avoidance of MW links as well as automation control. To ensure the LOS in microwave link to reduce the error rate in microwave transmission. Bipolar antenna & MW antenna installation mainly on MW antenna installation due to some miss alignment the transmission signal may be lost. The scope of the study is to reduce the error rate of LOS alignment on MW antenna installation by introducing MW antenna aligning system using Android based mobile phone.

2. EXPERIMENTAL

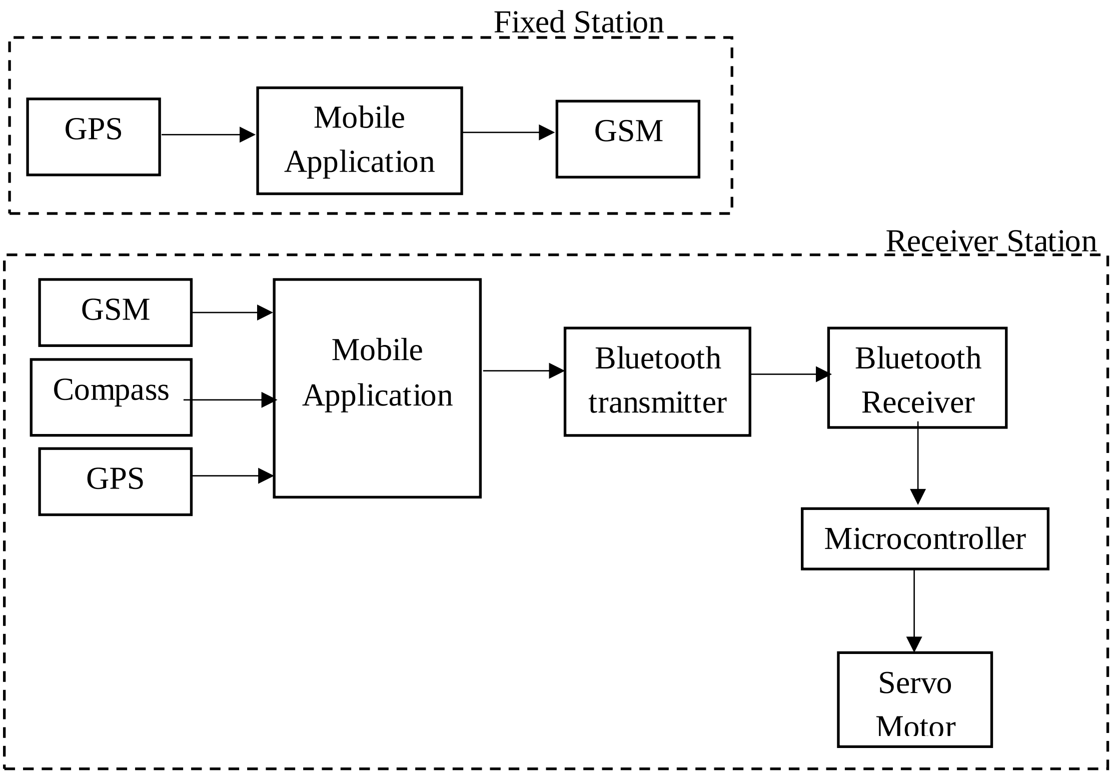

Figure 1: Block diagram of the system

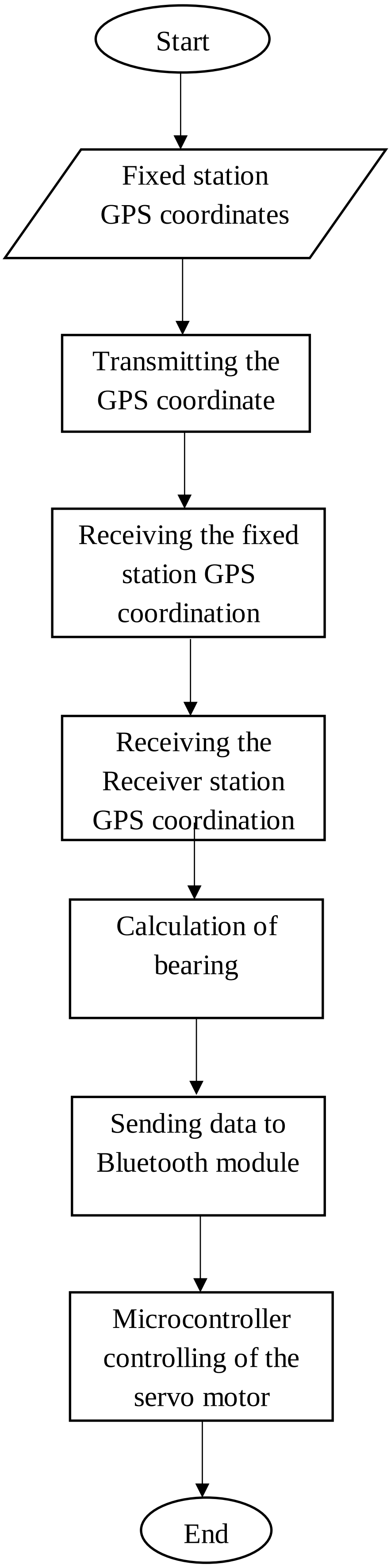
Start
Fixed station GPS coordinates
Transmitting the GPS coordinate
Receiving the fixed station GPS coordination
Receiving the Receiver station GPS coordination
Calculation of bearing
Sending data to Bluetooth module
Microcontroller controlling of the servo motor
End

Figure 2: Flow chart of the system

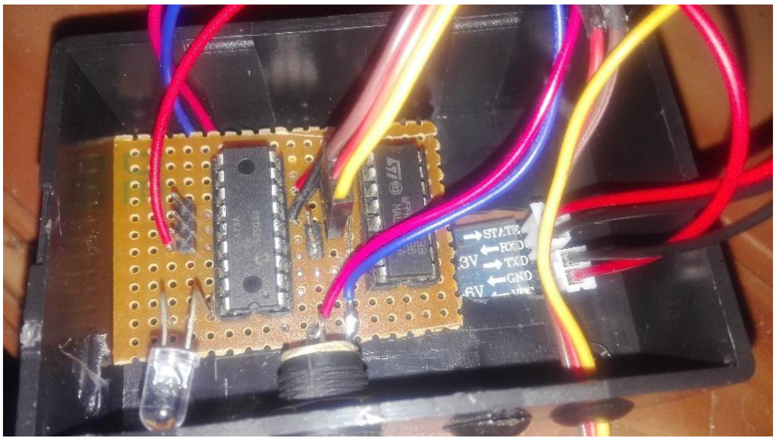

Figure 3: Circuit diagram of the system

Figure 1 displays the block diagram and figure 2 displays the flowchart and figure 3 displays the circuit diagram of the system. The system was designed with two mobile phones, PIC 16F628A Microcontroller, HC05 Bluetooth module and a Servo motor. PIC and Bluetooth module have a great involvement in processing, communication and display information.

The coordinate of fixed microwave antenna was measured by using the smart phone. And it was sent to another smart phone by a message. On the receiver site, the smart phone receives the fixed antenna coordinate and measure the receiver site antenna coordinate. Then the bearing angle will be calculated and sent to the microcontroller by using the Bluetooth feature. The bearing angle was sent to the microcontroller using the Bluetooth feature of Samsung mobile.

HC05 Bluetooth module was interfaced with the PIC 16F628A microcontroller on receiver unit. The HC05 TX (Transmitter) and RX (Receiver) pins were connected to the RX and TX pins of the microcontroller respectively. The signal pin of the servo motor was connected to the PWM (Pulse Width Modulation) pin on microcontroller. All the power pins were connected to one supply bus and it was powered with 5V, 1A power supply. Program functions were written for serial data communication between HC05 module and PIC using Mikcro c compiler. Another function was written for servo motor rotation according to a given angle. Android applications were implemented to obtain GPS (Global Positioning System) coordinates and compass data. Applications were developed to calculate the bearing of the microwave link with obtained data. Then the calculated data were fed to the microcontroller. Microcontroller generates PWM signals corresponds to the bearing and controls the servo motor.

Bearing can be defined as direction or an angle, between the north-south line of earth or meridian and the line connecting the target and the reference point[4].

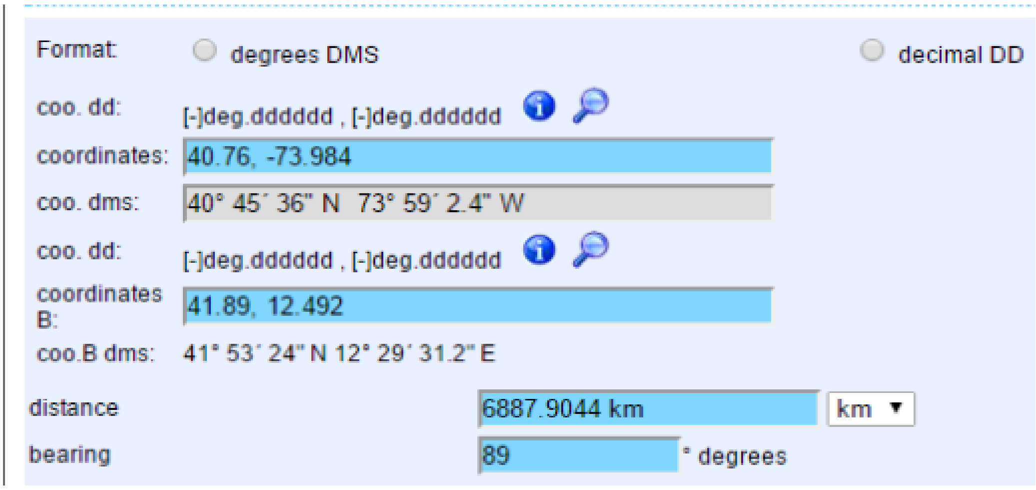

Figure 4: Mobile application of the system[4].

Figure 4 displays the mobile application of the system. When the coordinates of two points are entered, the system calculates the distance between the two points and the bearing.

3. RESULTS AND DISCUSSION

Figure 5: Screenshot of android app developed to calculate the bearing

Android app shown in figure 5 displays the GPS and compass module built in the mobile phone. In the fixed base station side, the app transmit the location data through a message. At the receiving base station, android app generates the bearing with respect to the fixed base station and sends the data to the microcontroller.

Minimum distance between the transmitter and the receiver was 30 m for better performance. Initially digital compass was used to measure the angle of the antenna. Due to low accuracy of the digital compass, it was replaced with android mobile phone.

For the communication between two micro controllers, it was decided to use RF (Radio Frequency) transceiver. But due to its low range of the RF transceiver modules, GSM (Global System for Mobile Communication) module of the mobile phone was used to communicate between the two base stations. Getting the GPS location of the antennas is another advantage of using mobile phones.

4. CONCLUSION

In this study, an automated antenna aligning system has been designed by means of an automation system and modeled loop antennas. This system ensures that the antenna and its corresponding main lobes are set to get maximum RSL. Since the alignment is done automatically, it will make sure that the down time of the link is kept at a minimal level.

ACKNOWLEDGEMENTS

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Department of Electronics - Wayamba University of Sri Lanka

DESIGNING OF ENERGY MONITORING SOCKET

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ABSTRACT

To deal with environmental problems such as global warming and depletion of energy resources, energy conservation measures in the industrial sector and the spread of renewable energy are required strongly. Energy monitoring was most important key factor towards energy conservation. This study was carried out with the intension of designing Energy Monitoring Socket which helpful to analyze energy of machines or electrical appliances. It was an effective method to save energy at commercial industries or at home. This paper was focused on hardware description, signal processing and mobile controlling application of low cost energy monitoring socket. ATMEGA328P microcontroller produces control instructions to display current, voltage and total power consumption of the system. HC-05 Bluetooth module enables the communication between mobile phone and the microcontroller unit. This device can be used as low cost and effective design for monitor energy of different machines and electric appliances which leads to save energy consumption.

Keywords: Energy Monitoring, MIT App Inventor

1. INTRODUCTION

Energy crisis is a most prominent issue in the current world. The continuous depletion of energy resources and its increasing cost impose the reduction of electric energy consumption of common industrial and commercial electrical equipment[1].One way to reduce this unnecessary electricity consumption is to use of an energy management system. Therefore most of the industries show growing interest in the field of analyzing the power consumption. In case of analyzing power consumption, there should be a specific way to monitor energy consumption. The energy monitoring socket will provide good solution for this issue.

Energy monitoring socket can analyze the usage of electricity of each individual appliance or machines separately.[1,2] It also helps to obtain more accurate conclusions about their efficiency and need for replacement. Furthermore this can also determine whether an appliance is drawing unusually high amounts of power when turned it on or turned it off. In this way electricity consumption and cost can be reduced[3]. This design enables the user to acquire energy consumption parameters separately which will be a necessary factor in case of energy saving. Mobile controlling facility and data storing capability of this energy monitoring socket was useful for analyzing energy easily.

When an introducing a new product to the market, specifications of the product should reach the standards. As the energy consumption parameters can be measured individually, this design was useful to obtain sample testing results of newly introducing electrical appliances.

This study can support number of persons from beginners to experts in many industries with high flexibility.

2. EXPERIMENTAL

In this study there are four important steps to be executed. They are design fabrication, installation and implementation of the mobile controlling app. Schematic drawing and the PCB designing has been done using Eagle software. In designing the PCB suitable materials were selected with low cost and effective manner. The fabrication was divided into two sections mainly, hardware and software. Arduino program was used as the connector between hardware and software.

Figure 01 represents the basic block diagram of the proposed system. The system consists of several units. The function of the each unit can be described as follows,

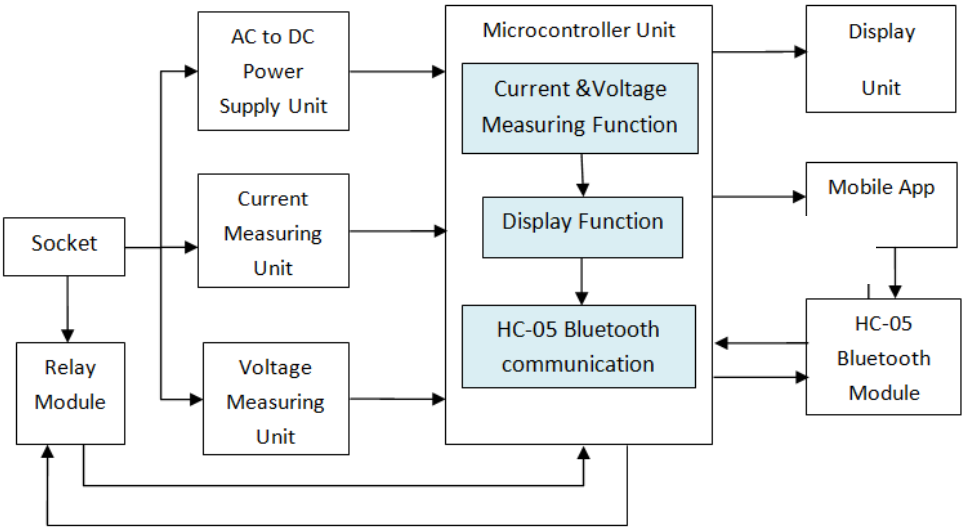

Figure 01: Block Diagram of the device

Socket: This device or the machine which is necessary to monitor energy was connected to this socket.

Relay Module: Relay module was used to on /off the energy monitoring circuit automatically using the mobile app.

AC to DC Power supply unit: Power required (5V DC) to the ATMEGA328P microcontroller was given from this unit. This unit converts the 230v AC power to 7v DC power. This 7v AC power was converted to 5v DC by using 7805 voltage regulator. Required power supply (3.3V DC) to the HC-05 Bluetooth module was obtained by using 1117 3.3v voltage regulator.

Current Measuring Unit: This unit consists of a non invasive AC current sensor. It was used to measure the current across the device connected to the socket and send the current value to ATMEGA328 microcontroller.

Voltage Measuring Unit: This unit measures the voltage of the system using the principal of voltage divider circuit. voltage divider circuit was designed using high resistor values. 230 V 200 mA Transformer was used to isolate the system from main AC power.

Microcontroller Unit: Main Controlling Unit consists of ATMEGA328P microcontroller. The control instructions to display current and voltage on the display unit, sending the current & voltage values consume by the socket to the SD card and Serial communication of HC-05 Bluetooth module was carried out within this unit.

Display Unit: This unit consists of ST7735 TFT display module which used to display voltage and current value. The micro SD card inside this display was used to save voltage and current values on a excel sheet which will be necessary for energy consumption analysis. The voltage and current values were saved in this SD in every 5 minutes. Time was calculated by using 1307 Real Time clock (RTC) IC. Required power supply to 1307 RC was given by CR1220 battery.

HC-05 Bluetooth module: The function of this module was to maintain the connection between Mobile phone and the energy monitoring socket via serial communication by using the Bluetooth facility on the mobile phone.

Mobile App: This app was implemented using MIT App inventor software. Function of this app was to display voltage and current values and also on/off the energy monitoring socket by using the mobile app.

3. RESULTS AND DISCUSSION

The current and voltage values of the Energy monitoring socket was displayed in user friendly manner which can be identified by any user easily. Several devices were plugged in to the energy monitoring socket and current and voltage values were obtained. Actual Current and voltage values were measure by using Power analyzer. The values obtained from the Energy monitoring socket was compared with the actual values obtained by using Power analyzer. Values obtained from low cost energy monitoring socket shows that accuracy of 95% when comparing with the actual values.

4. CONCLUSION

The main purpose of designing this low cost energy monitoring socket was to monitor energy consumption of machines in the factory premises. As the energy measured from the machine was saved in the SD card of the display, it can be used to analyze energy consumption of the machine which leads to energy saving concept. And this socket can be also used to obtained sample testing results for newly introduced electronic equipments within the company. The mobile controlling ability of this socket provides easy access with the user to monitor energy consumption.

Several experimental tests have been carried out to analyze the system performance. The proposed device provides accuracy of 95% when compared with actual values. This can be overcome by replacing high performance current and voltage sensor. This device of low cost energy Monitoring Socket can be used for the concept smart home energy monitoring systems.[3]

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A SMART DOOR LOCK FOR THE SHELTERS USING GSM TECHNOLOGY

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ABSTRACT

This paper describes a development of a smart locking system for Base Transceiver Stations (BTS) sites of mobile communication service providers. A smart lock is a lock that can be controlled using a new technological method without a traditional key. It serves many features more than just locking and unlocking a door. The proposed smart locking system uses GSM technology to communicate with the controlling office. It consists of an Atmega microcontroller as the processing unit. Our system provides higher security and minimizes the time wastage of an operator who is assigned to visit a site for maintenance purpose. Moreover, the proposed smart locking system operates even in electrical power failures.

Keywords: Smart door lock, Atmega, Microcontroller.

1 INTRODUCTION

A smart lock is a lock that can be controlled using a new technological method without a traditional key. It serves many services more than lock and unlock the door. Smart lock can be controlled remotely. Some smart locks identify unauthorized, and record the details of persons who accessed the secured area[1]. Smart locks use various technologies such as Bluetooth, Wi-Fi, Radio Frequency Identification (RFID), finger prints etc.

Smart locks make traditional keys useless to lock and unlock doors. Users can use their mobile phone, finger print, RFID card instead of the key. Smart door locks provide many advantageous than traditional key locks. With smart locks security level can be increased to higher levels. Smart locks not only prevent unauthorized access to secured area, such attempts will be informed to the authorities quickly. When a key of a traditional lock is lost, the entire lock has to be replaced to maintain the security. On the other hand, smart locks have features to reset the credential when a use forgot his or her security passwords.

Many researches have been done on developing smart door locks. Majgaonkar, et.al [2] reports an Automatic Door Locking System, that used the Bluetooth technology to communicate with the smart lock and the Android systems as data input source. When the correct password is sent to the door locking system from the Android device, the lock operates accordingly. Similar smart door locking system is reported in [3] which uses Wi-Fi network to communicate the secured digital key from a smart phone.

A Smart Visitors' Notification System with Automatic Secure Door Lock using Mobile Communication Technology is reported in [4]. The system uses face-recognition to authenticate access to the apartments or workplaces increasing the security to a maximum level.

The smart locking systems can provide a better alternative to traditional locks for accessing Base Transceiver Stations (BTS) of mobile communication service providers. When an operator wants to visit a site for maintenance purpose, he has to go to the regional office to collect the keys and visit the relevant site later. Again the operator has to return the keys to the regional office, once the maintenance operation is done. Sometimes, BTS is situated in far away from the regional office and consequently delays the maintenance operation and involve traveling costs.

Using a smart locking system for BTS shelters, unnecessary time and money wastage can be reduced and as a result mobile service providers can give a better service to their customers. However, there are several drawbacks in existing smart locking system, which can be used for BTS shelters. Bluetooth and Wi-Fi based smart locking system are vulnerable to hackers. Smart locking systems with face-recognition may not be suitable for such applications since such systems need to connect a camera module and additional processing leading to consume more power.

This paper describes the implementation of a prototype smart door lock focusing on shelters at BTS of mobile communication networks. This smart lock uses the GSM technology and it is controlled by Short Message Service (SMS).

2 STRUCTURE OF THE PROPOSED SMART DOOR LOCK SYSTEM

2.1 System Overview

A block diagram of the proposed system is shown in Figure 1. The system mainly consists of a processing unit, a GSM module (SIM900), a Real-time Clock module (DS1307), a 4x3 keypad and the door lock. The processing unit is an Atmega328p microcontroller.

The system works as follows. When the regional office needs to send an operator to visit a site, the system at the regional office generates and sends a Personal Identification Number (PIN) and a reference number to the smart lock through the GSM module. The same PIN is sent to the operator who is assigned to visit the site. When an operator visits the site, he has to enter the relevant PIN through the keypad. The processor compares the entered PIN and the one sent by the regional office. If they match, it grants the access to the site. Using the real-time clock module, all events are recorded and the information is sent to the regional office through the GSM module. Any unauthorized access will also communicated to the regional office to take immediate actions.

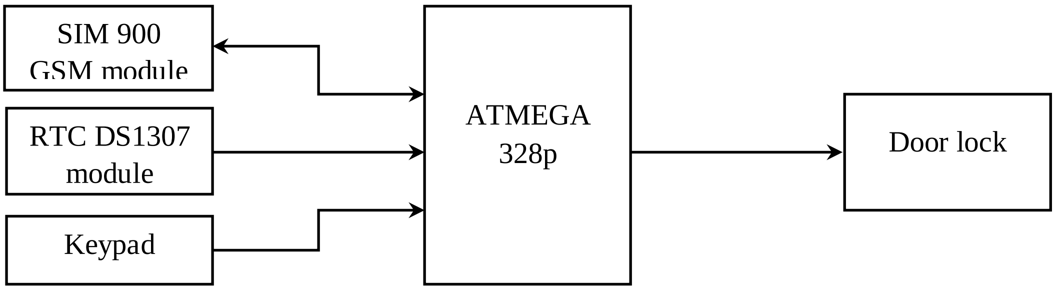

Figure 1: Block diagram of the proposed system.

2.1.A SIM 900 GSM Module

The main purpose of the GSM module is to communicate with a regional office to receive and send information. The GSM module, SIM900 is a complete Quad-band GSM/GPRS system which can be embedded in the customer applications. It comes with industry standard interface for voice, SMS, data, and fax. Since it comes as compact module, it fits to small designs like we proposed in this paper.

Featuring an industry-standard interface, the SIM900 GSM module delivers GSM/GPRS 850/900/1800/1900MHz performance for voice, SMS, Data, and Fax in a small form factor and with low power consumption. With a tiny configuration of 24mm x 24mm x 3mm, SIM900 can fit almost all the space requirements in your M2M application, especially for slim and compact demand of design

2.1.B ATMEGA 328p

The high-performance Atmel 8-bit AVR RISC-based microcontroller combines 32KB ISP flash memory with read-while-write capabilities, 1KB EEPROM, 2KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8 - 5.5 volts.

2.1.C RTC DS1307 Module

The DS1307 Serial Real-Time Clock is a low-power, full binary-coded decimal (BCD) clock/calendar plus 56 bytes of NV SRAM. Address and data are transferred serially via a 2-wire, bi-directional bus. The clock/calendar provides seconds, minutes, hours, day, date, month, and year information. The end of the month date is automatically adjusted for months with fewer than 31 days, including corrections for leap year. The clock operates in either the 24-hour or 12-hour format with AM/PM indicator. The DS1307 has a built-in power sense circuit that detects power failures and automatically switches to the battery supply.

3 OPERATION OF PROPOSED SYSTEM

The diagram shown in the Figure 02, explains the functional operation of the proposed system. After receiving the PIN from the office the system waits until the operator insert his PIN through the keypad. The system compares the PIN entered by the operator with the once received from the regional office. As shown in Figure 2, if they are not equal and the incorrect attempts is equal to three, the warning message will be sent to the office. If the PINs are equal, door will be unlocked and the system will record the time. When the door is locked it checks whether it is temporary or permanent lock. If it is permanent, password is deleted and log will be sent to the office. As shown in Figure 2, if the door is lock temporary, the system waits 1 hour. If the door is not unlock before an hour the door will permanently locked.

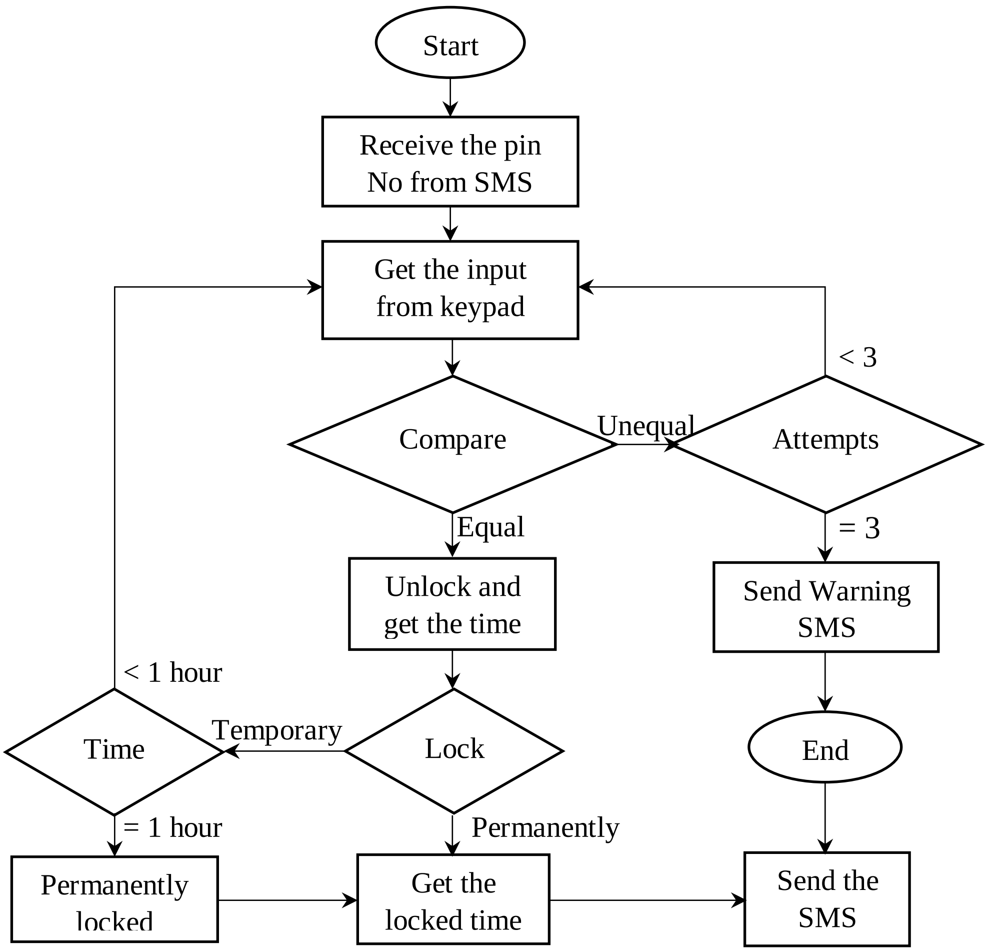

Figure 2: Functional diagram of the proposed system

At the site, visiting operator sends a SMS to the office to check the permission again. The PIN mentioned in the e mail, is sent to the operator as a SMS.

When the operator leaves the site, he has to close the door and he has to enter the PIN with the "#" symbol to lock the door. Then the system locks the door and records the time and sends the regional office and deletes the recorded PIN. The system will not allow to access the site with the PIN that used for previous attempts.

If the operator wants to leave the site temporary, he can lock the site by entering the PIN with the "*" symbol. After locking the device using the temporary lock method, site is locked, but the PIN is not deleted and the log is not sent to the office, however the locking time is recorded. In a situation where the operator does not unlock the site in an hour or nearly an hour, smart lock will be locked automatically and PIN will be deleted and log is sent to the office.

When the site is down, the operator has to enter the master password of the visiting site to access the site. The master password is also set by the Infra system. The master password is changed with the request of the regional office. After changing the master password, it is sent to the regional office.

When the device is broken down, the operator has to visit the regional office to get the key. It confirms the security of the site.

If an operator visits the site while another operator is working at the site, although the door was already opened, the operator has to send the access permission SMS. He will receive the PIN and the operator has to enter the PIN to the lock since lock have to maintain the log. Lock will inform two operators to enter their PIN again if they leave the site first. The log of the operator who leaves the site first, is sent to the office.

The proposed system has a feature to access the site even when there is no mobile signal in the area of the site. In such situation, smart locking system can no longer communicate with the regional office, and hence unable to receive the PIN and the reference number. The master password of the locking system allows the access to the site when there is no mobile signal in the area. The master password can only be reset by the request from the regional office.

4 DESIGN OF THE SMART DOOR LOCK SYSTEM

Figure 03 shows the circuit diagram of the smart locking system. The controller unit is the Atmega microcontroller, which operates with a 5V power source. It operates with a 16 MHz clock signal generated by a crystal oscillator.

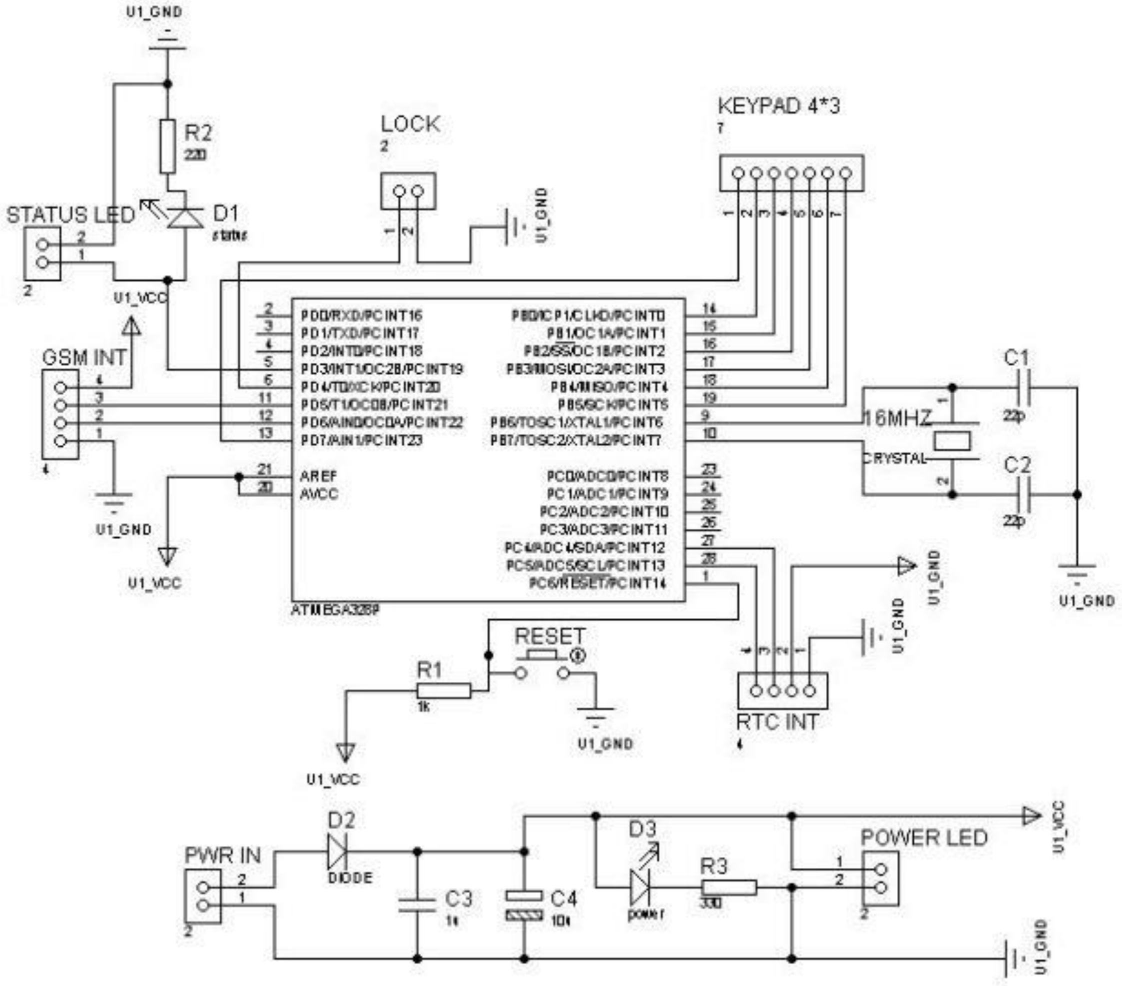

Figure 3: Circuit diagram of the designed system

The smart locking system consumes lower power since it consists of low power microcontroller and few low modules. Therefore, the system can be operated with battery power for a longer period, which is a very good feature because the smart locking system can be operated even with the electricity power failures.

Another feature of the proposed smart locking system is the lower production cost. The total cost of the system is less than Rs. 4000/=.

4.1 Limitations of the System

The proposed smart locking system has few limitations. One limitation is that the system will shut down about six hours of electrical power failures. The system has lower internal memory, and record storage is limited to visits of five operators at once. Using an external memory device can solve this issue.

5 CONCLUSIONS

In this paper, we presented a smart locking system that can be used for the BTS sites of mobile communication service providers. It eliminates the time wastage when an operator visits a site for maintenance purpose. Our smart locking system uses GSM technology and consumes lower power. Therefore, it can be used even in electrical power failures. With the proposed smart locking system, mobile service providers can efficiently maintain the BTS sites with maximum security and provide quality service to their customers.

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LOW COST WIRELESS AUTOMATIC FIRE ALARM SYSTEM

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ABSTRACT

Nowadays, a wireless automatic fire alarm system is a very important system for houses, large warehouses, which can assist people to save their lives and their properties. Most of the existing systems are wired systems. They are expensive and cannot easily mount in anywhere but the proposed system is cost effective and has minimum faults. The system uses an Arduino Nano board as the controller unit. This system includes smoke sensors to filter and detect smokes. Within twenty seconds by sensing smokes it starts to send a signal to the Arduino board to alert a fire is detected. After forty-five seconds taken from finishing detect smokes it stop sending the signal to the Arduino board. Also this system has a temperature sensor to detect high temperatures. Also it gives a signal to the Arduino board if it detect a high temperature situation. This system uses LEDs and buzzers to indicate a fire situation visually and soundly. Radio frequency (NRF) modules use to connect all fire detection points together wirelessly. In some point NRF module works as a signal generator to other points and some other points work as repeaters. Also this system can activate manually using a switch.

Keywords – NRF modules, Smoke sensors, Temperature sensors.

1.0 INTRODUCTION

An automatic fire alarm system is designed to detect the unwanted presence of fire by monitoring environmental changes associated with combustion. In general, a fire alarm system is either classified as automatic, manually activated, or both. Automatic fire alarm systems can be used to notify people to evacuate in the event of a fire or other emergency, to summon emergency services, and to prepare the structure and associated systems to control the spread of fire and smoke[1]. Fire alarm systems have becoming sophisticated and functionally more capable and reliable in recent years. They are designed to fulfil two general requirements,

i. Protection of property and assets.
ii. Protection of life.

As a result of state and local codes, the life-safety aspect of fire protection has become a major factor in the last two decades[2]. There are a number of reasons for the substantial increases in the life-safety form of fire protection during recent years[3], foremost of which are

i. The proliferation of high-rise construction and large warehouses and the concern for life safety within these buildings.
ii. A growing awareness of the life-safety hazard in residential, institutional, and educational occupancies.
iii. Increased hazards caused by new building materials and furnishings that create large amounts of toxic combustion products (i.e., plastics, synthetic fabrics, etc.).
iv. Vast improvements in smoke detection and related technology made possible through quantum advances in electronic technology.

The aim of this project is to design a low cost automatic fire alarm system for buildings that can help to save lives and properties from a fire. Also in this project all fire detection points have been connected together wirelessly. More specific thing is this system is a wireless system. Therefore the reliability is high when it is a fire situation. Also the cost is very low.

2.0 EXPERIMENTAL

This system can be activated manually or automatically. If want to activate manually there is a switch and by pressing it can activate the alarm and pressing again can deactivate the alarm. Using a smoke sensor it detects smokes. It will take twenty seconds to produce a signal after detect smokes. Smoke sensor continuously send signal to the Arduino controller until it finish detecting smokes. After the completion of detecting smokes it will take another forty five seconds to stop sending signals. Also the temperature sensor detects high temperatures and if it detects a high temperature it sends a signal to the Arduino controller immediately[4]. After receiving the signals, Arduino controller sends signal to a LED and a buzzer to indicate fire detection visually and soundly. If one fire detection point detects a fire situation, it sends signal to other points to activate the alarm on all points by using NRF module[5]. This all fire detection point can work as a signal generator point or signal repeater point. The first fire situation detection point work as a generator point and others may work as repeater or receiver. The block diagram of the system is as follows.

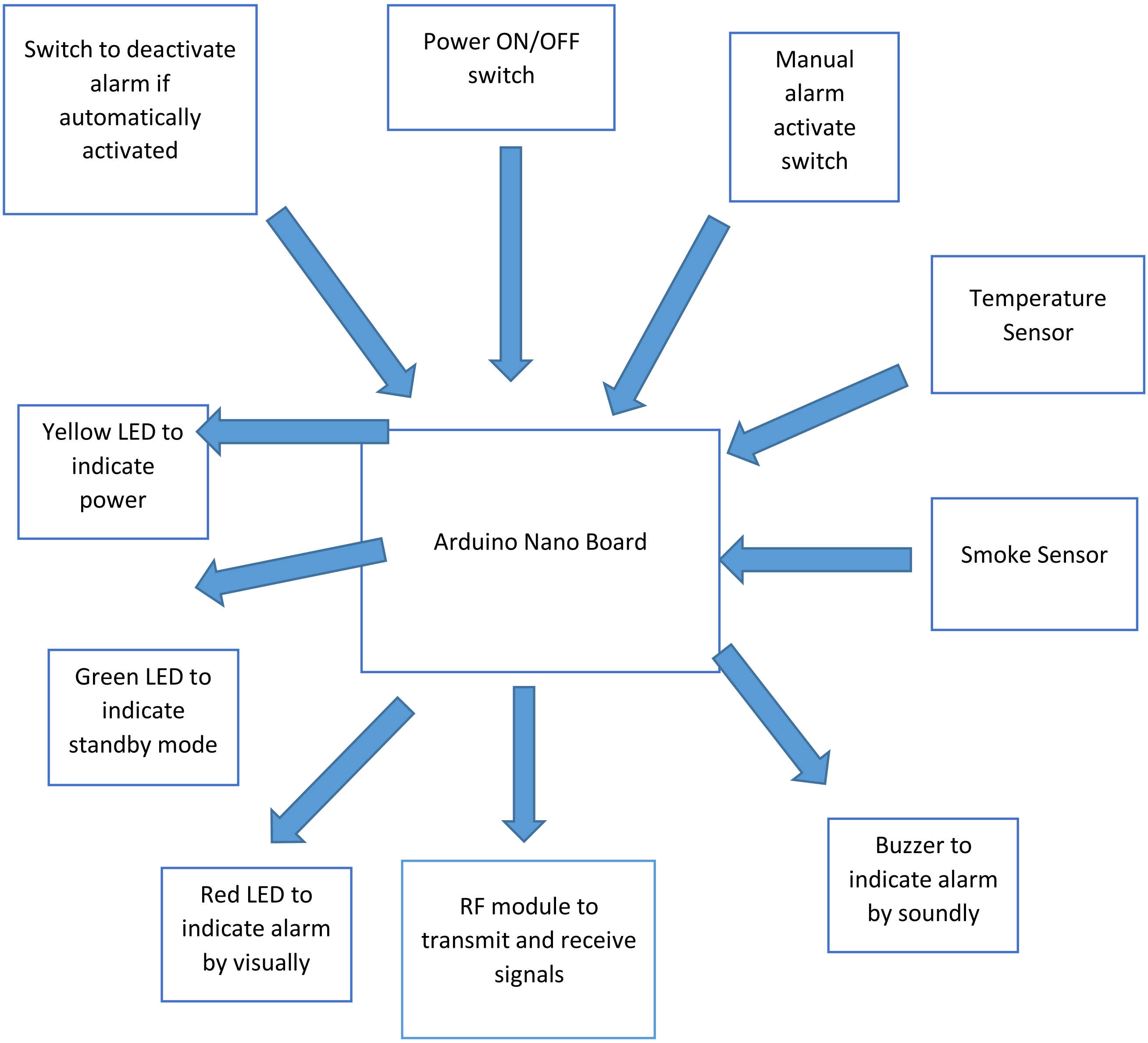

Figure 2.1: Block diagram of the system.

3.0 RESULTS AND DISCUSSION

All the separate circuits have been tested individually before simulation and then integrated as a whole circuit. After it detected smokes immediately LED was blinked and buzzer was sounded. Within thirty seconds all other points were activated automatically. Alarm was activating until smokes were not there. After increasing the temperature near temperature sensor until it reach the cut off limit, the alarm was activated. Alarm was functioning until temperature gone down below the cut off limit. Also the alarm was activated when the manual switch pressed.

Wired system fails to operate due to loose connections and damage caused to wires. High cost for installation and maintenance for wired systems. The proposed system sense both the smokes and temperature. Therefore the alarm activates either smoke is detected and or high temperature is detected. The total cost of the device is Rs.2500.00.

4.0 CONCLUSIONS

The proposed system successfully identifies fire situations by detecting smokes and temperature. Since this system is a wireless system, it eliminates the wired connections making easier to mount on any location. Also one activated device awakes all the other devices automatically within 30 seconds. This system is user friendly, easy to access, less power consumptions. Since all the devices can function as repeaters, each device acts independently. Therefore the functionality of the system can be guaranteed although few devices fails to operate. The proposed system is low cost and more reliable.

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Authors would like to acknowledge and extend heartfelt gratitude to all staff at Department of Electronics, Wayamba University of Sri Lanka. Also like to thank to Metropolitan Engineering (Pvt.) Ltd. for their guidance and constant supervision as well as for providing necessary information regarding the project and also for their support in completing the project.

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AMBIENT TEMPERATURE, RELATIVE HUMIDITY MONITORING AND COOLING SYSTEM FOR AIRTEL INDOOR BASE STATION SITES

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ABSTRACT

Many attempts have been carried out to save energy in the form of energy saving devices or designing a system which helps to reduce the power consumption using the existing device. Telecommunication indoor sites have air conditioner (AC) machines which work continuously day and night. That needs more units of power. In this study, a system was designed for reliable ambient temperature and relative humidity monitoring as well as for cooling telecommunication indoor sites. Accordingly, an intelligent energy saving system and a decision making algorithm are discussed in this study. The proposed system will check the temperature and relative humidity and make appropriate decisions.

Keywords: Ambient Temperature, Relative Humidity Monitoring, Energy Saving System

1. INTRODUCTION

The telecommunications industry is concerning about the energy costs of its operating infrastructure and the various types of methods involved in reducing them. Currently more than half of the total energy is consumed at data centers for the electricity and cooling infrastructure supporting the storage and communications equipment. One method for reducing energy consumption is an approach called free air cooling where the ambient air is used to cool the equipment directly, thereby reducing the energy consumed in cooling and conditioning the air. The ambient temperature and humidity shall be measured at a distance of five feet above the floor level, after the equipment is in operation, at any point along an equipment aisle centerline[1]. For the better performance of telecommunication equipment, room temperature should be maintained in the range 60 ºF-85 ºF and relative humidity range from 30% to 60%. The implementation of free air cooling changes the operating environment, including temperature, humidity and airborne contamination, which may have a significant impact of telecom equipment[2]. Now this process is done by heat exchange unit used in telecommunication base stations, which has two exhaust fans and it works with the base station battery power. When power goes down, air conditioner is turned off automatically and the heat exchange unit turns on. But the problem with heat exchange unit is that it draws high current from the battery, hence a large number of units are consumed by existing system.

2. EXPERIMENTAL

2.1 Methodology

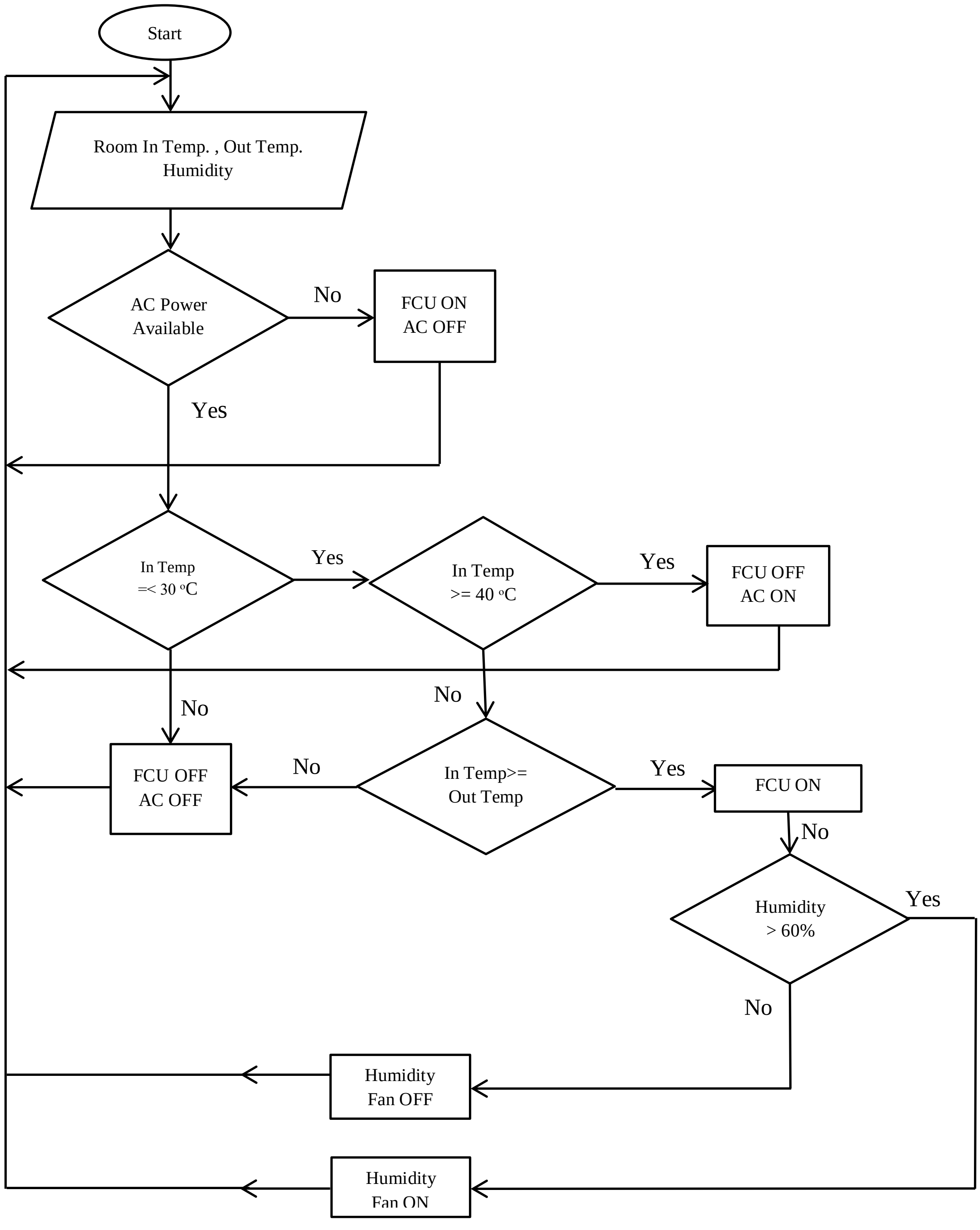

Figure 1: Flow chart of the cooling system

According to above flow chart shown in figure 1, the system operates in a sensor data controlled loop which continuously monitors those exhaust fans and the sensor data. The system checks AC power condition at the beginning of the process. When the AC power is not ok, then FCU (Fan Control Unit) fan will be ON. Also if AC power is ok, then system measures inside and outside room temperatures. If inside relative temperature is high, then air blows to outside through exhaust fan. If inside temperature was low, then air blows to inside through humidity fan[3].

2.2 System overview

A prototype of the device has been designed and implemented according to the block diagram shown in figure 2. The LCD display was used to display messages and information of sensors. Those sensors were used to detect in and out room temperatures and also to detect relative humidity level. The serial communication method in Arduino Nano was used to measure temperature and humidity. According to measured temperature and humidity, those exhaust fans were controlled[4].

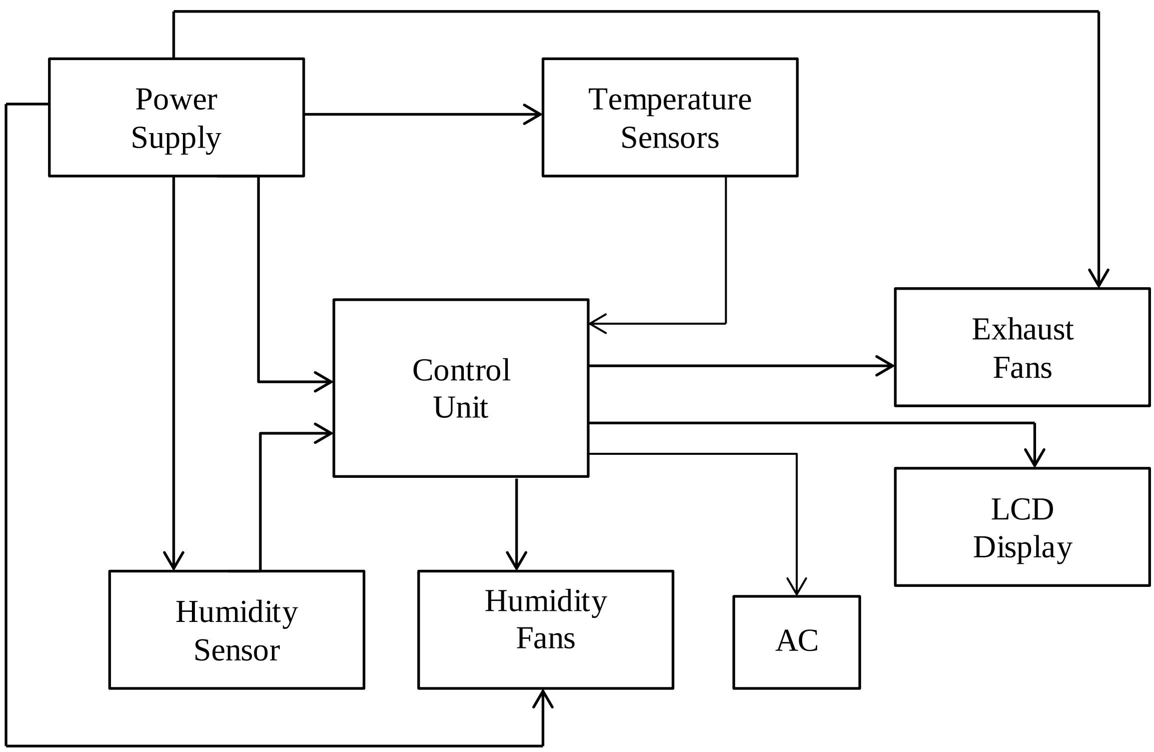

Figure 2: Block diagram of the cooling system

For high accuracy of the system, those sensors are used in the standard values of telecommunication equipment in room or place which are working as a system. External power has to be provided for DC and AC power supply because 5 V controlling unit power line is not sufficient to the systems[5]. The circuit diagram of the cooling system is shown in the figure 3.

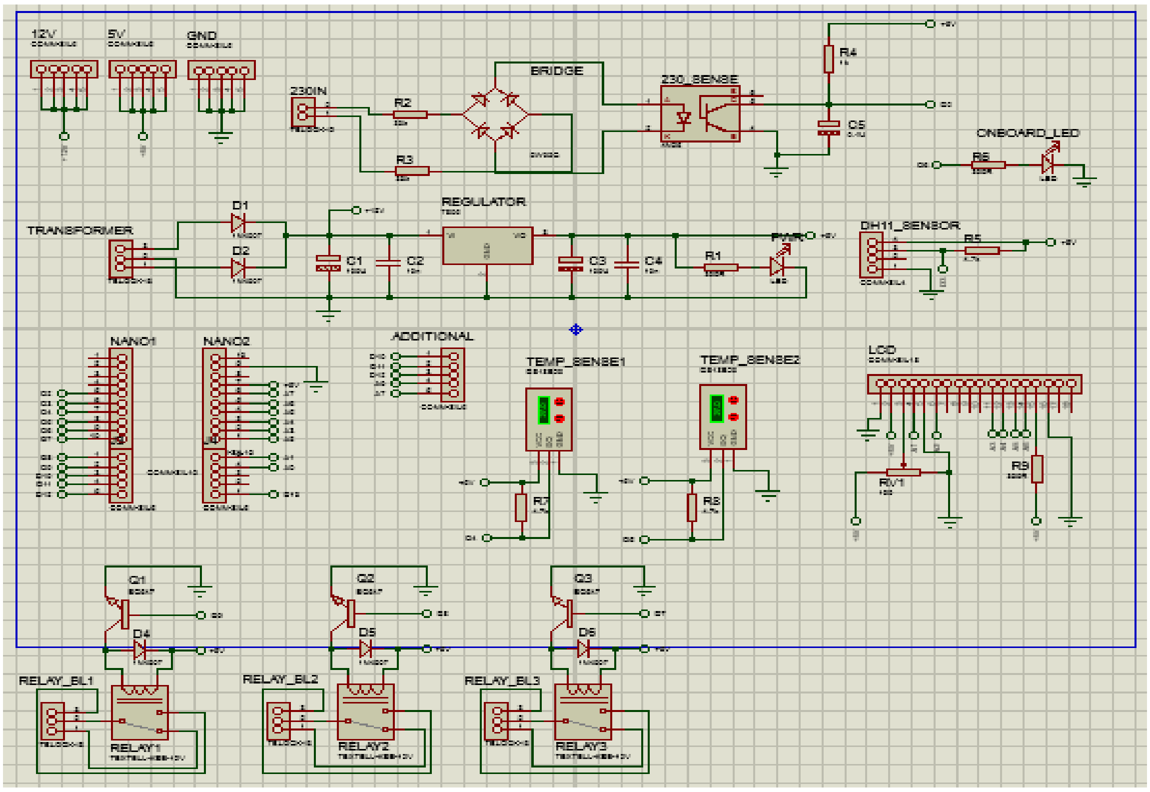

Figure 3: Circuit diagram of the cooling system

3. RESULTS AND DISCUSSION

The following figure shows the implemented final result of the project with the used components.

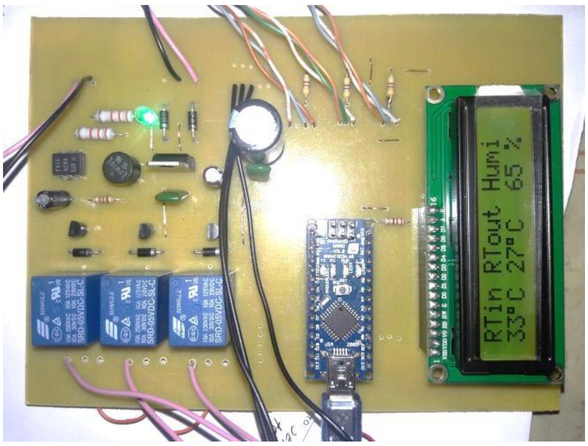

Figure 4: Implemented final result of the cooling system

In this system, a temperature sensor was used to measure inside and outside temperatures. But the sensor values changed quickly due to environmental factors. Therefore temperature sensor was changed to DS18B20 digital temperature sensor. For telecommunication equipment, temperature must be maintained in between 60 °F-85 °F and relative humidity range from 60%. The cost of producing this device is around Rs. 2550.

3.1 Features

- monitoring ambient temperature and relative humidity level
- low cost
- energy saving

The observed results are shown in figure 5. When site is working with AC, it can measure power units of AC from site meter reading. According to this reading it can calculate no of power units for air conditioner.

				AC Load Current (Amp)					
				BTS ON / AC ON / Batt. ON			BTS ON / AC OFF/ Batt. ON		
M2000 ID	Phase Received	Phase Using	Cooling System	L1	L2	L3	L1	L2	L3
GAM_Belummahara_01	3Ph	3Ph	2AC	12.30	13.50	0.00	9.30	10.10	0.00
GAM_Ganemulla_01	3Ph	1Ph	2AC	28.50	0.00	0.00	21.90	0.00	0.00
GAM_Gampaha_01	3Ph	1Ph	Heat Eech+AC	28.20	0.00	0.00	23.10	0.00	0.00
GAM_Niwandama_01	3Ph	1Ph	2AC	8.30	8.30	0.00	6.60	6.60	0.00
GAM_Bollate_01	3Ph	3Ph	2AC	3.50	3.50	9.80	3.50	3.50	4.10
GAM_Ja-Ela_01	3Ph	3Ph	AC+FCU	12.10	5.20	0.00	12.10	0.00	0.00

Figure 5: Observed results of general system

When site is working without AC, it can calculate power units without AC (P) using following equation where Cos Φ is the rectifier power factor, V is the generator phase voltage and I is the current through rectifier units.

$$P = VI \cos \Phi \qquad (3.1)$$

It is assumed that the power is consumed only by the rectifier when AC machines are not working. Difference between the number of power units with AC and without AC gives the power consumed by AC machines.

Both existing and design systems were tested in GAM_Ja-Ela_01 site for 7 days. In the existing system total power consumption by site for the period of one month was identified as 2643 kWh from last monthly bill. Also it can calculate power consumption for 7 days. It was determined as 616.7 kWh. The table 1 shows the power demands for designed system.

Table 1: Power demands for designed system

Day	Power consumption (kWh)
1	59.4
2	57.3
3	65.8
4	74.5
5	66.5
6	44.9
7	58.7
Total	427.1

By installing this proposed system 189.6 kWh power units for a week can be saved. The variation of power consumption is due to the changes in climate and environmental factors.

3.2 Limitations

- This system tends to fail when environmental temperature is very high.
- Humidity of environment is increasing; hence humidity cannot be controlled for decided conditions.

4. CONCLUSIONS

The basic idea of this system was to develop a method to save the air conditioner power by utilizing outside air. By implementing this system, ambient temperature can be controlled without using any air conditioner hence, saving the energy and the AC maintenance cost. This system consists with Arduino Nano based mechanical section and programming part. By installing the designed system it was able to fully automate the cooling system and save the electricity.

ACKNOWLEDGEMENTS

Authors would like to take this opportunity to express their deepest gratitude to the staff of the 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 ROOM LIGHT CONTROLLER

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ABSTRACT

The electronic devices nowadays are rapidly taking its best position to ease the complexity of lives. This paper proposes an "Automated Room Light Controller", which is a reliable circuit that takes over the task of controlling the lights in a room by as well as counting number of persons in the room very accurately. When somebody enters into the room then the counter is incremented by one and the lights in the room will be switched ON, when a person leaves the room, the counter is decremented by one. The lights will be only switched OFF when all the people in the room go out. The circuit detects the light intensity and maintains a sufficient luminance by controlling the number of lights. Therefore, this proposed system is to save energy and the efforts required to switch on/off the lights. This complete proposed system was implemented as a prototype.

Keywords: Infrared, Light intensity, Microcontroller

1. INTRODUCTION

The objective of this project is to make a room light controlling system with the count of bidirectional visitors and light intensity of the environment. With the increase in standard of living, there is a sense of urgency for developing circuits that would ease the complexity of life. The main purpose of this system is to save energy and the efforts required to switch on/off the lights. The typical user needs different light intensities in different places. Sometimes the light intensity from outside is sufficient for the user, and thus we don't need to turn on any light. But sometimes the user leaves but forgets to turn off the light. These factors cause energy waste. Therefore, a power management system is necessary in order to save energy. In this system, a microcontroller was used to control the light system. It receives the signals from the IR(Infra-Red) receivers, and it counts how many visitors entered to the room and went out from the room. When somebody enters into the room, the counter is incremented by one and the light in the room will be switched ON. When one person leaves the room, the counter is decremented by one. The light will be only switched OFF until all the persons in the room go out. And the microcontroller also receives signals from Light intensity detecting receivers and maintains sufficient light by switch on the number of lights.

2. EXPERIMENTAL

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

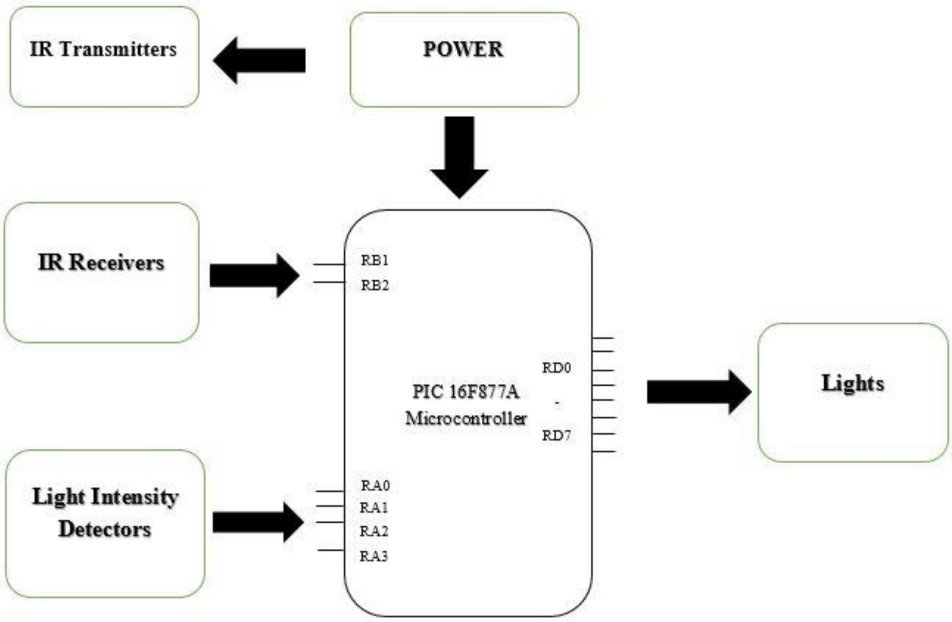

Figure 1: Block Diagram of the System

In the proposed system, the counting process of visitors was done using IR transmitters and IR receivers. The IR transmitter consists of a LED that emits the IR radiation. This is received by the photo diode, which acts as IR receiver at the receiving end[1]. Since the IR radiation is invisible to human eye it is perfect for using in this system to count visitors.

Four LDRs (Light Dependent Resistor) were used to measure the light intensity under the environment. The LDR is a light-controlled variable resistor. The resistance of a LDR decreases with increasing incident light intensity[2]. So, by using this 4 LDRs the microcontroller gets the intensity of 4 places currently in the room. Then it calculates the average of light intensity in the room. This is the room arrangement of the proposed system.

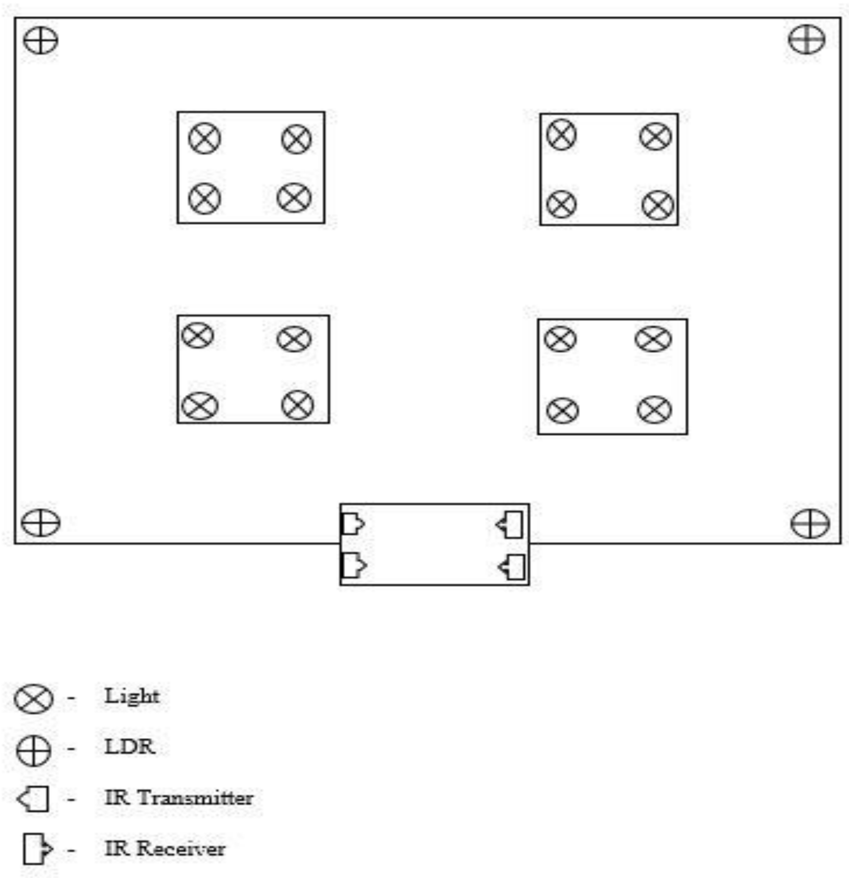

Figure 2: Room arrangement considered for the system

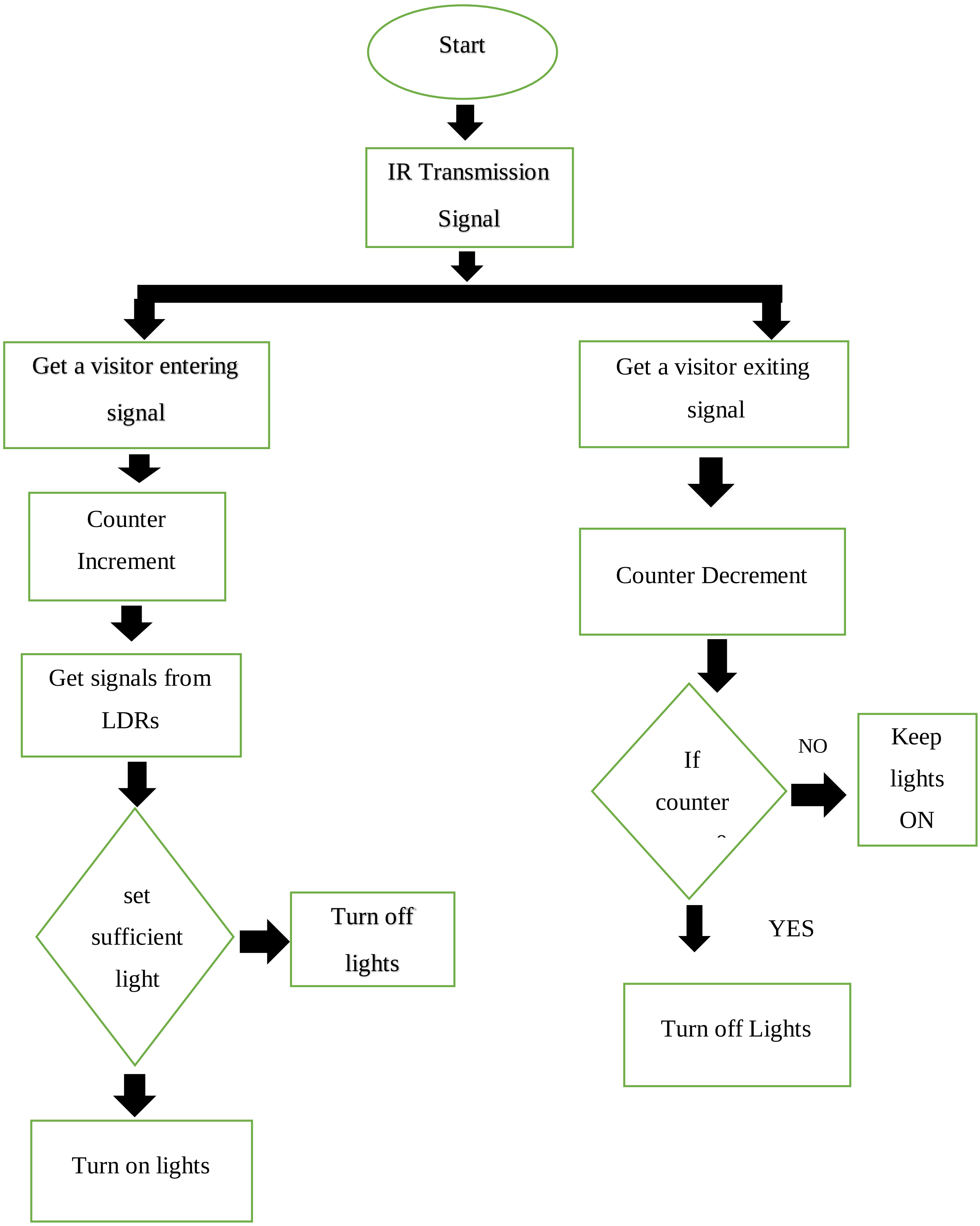

Figure 3: Flowchart of the system

A PIC 16F877A microcontroller was used to control the whole proposed system. It gathers the all information from the all sensors and turn on/off lights according to the instruction given.

The circuit diagram of the proposed system is shown in fig 4. Here, 2 push buttons were used for IR sensors.

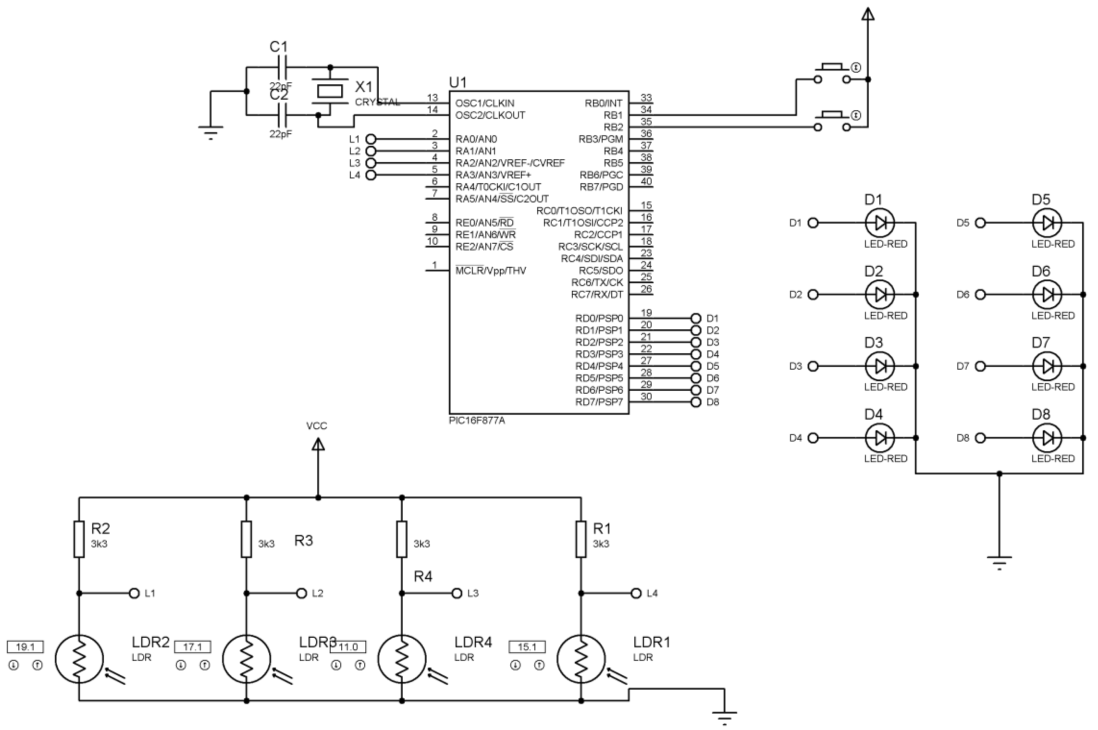

Figure 4: Circuit diagram of the system

3. RESULT AND DISCUSSION

Overall system was designed and tested by using a prototype of the system with LEDs to obtain the output and was able to obtain the expected outcomes.

In here, only two IR receivers and transmitters were used in the outside and inside of the door of the room. So if a child or a short person go through the door, it may not detect by the receivers. So, as further developments, I expect to use 3 or 4 IR receivers in each side vertically to cover the whole height of the door. Further, use of 4 LDRs is more accurate than using a single LDR. Because it can measure light intensity of 4 places in the room and calculate an average light intensity in the room. A PIC16F877A microcontroller satisfy the requirements to control the whole proposed system.

4. CONCLUSION

The aim of this project is to develop a system to control the lights in a room automatically. This project helps efficient usage of energy in this competitive world of electricity. Further, this design is inexpensive and easy to use. And also this system implements in a single door. So no need of two doors (entering door and exiting door). By using this circuit and proper power supply this circuit can be expanded to implement various applications such as fans, fluorescent lights, etc.

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Authors wish to extend their gratitude to the staff of Department of Electronics, Wayamba University of Sri Lanka, and also extend their sincere thanks to the staff of the Communication Division of Arthur C Clarke Institute for Modern Technologies, Katubedda.

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Department of Electronics - Wayamba University of Sri Lanka

DESIGNING OF AN AUTOMATED SYSTEM FOR CHECKING LINE OF SIGHT

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ABSTRACT

Dialog Axiata PLC operates at the largest and fastest growing mobile & fixed telecommunications network in Sri Lanka. As the company expanded throughout the country, Dialog Axiata PLC has mobile customers as well as cooperate customers. Dialog Axiata PLC needs to provide high bandwidth data links, as per cooperate customers’ requirements who are from remote areas that there is no line of sight between the base station and the customer location. The aim of this project was to design and construct a simple and low cost system to identify and measure the height for the customer-end antenna at non line of sight location. This system is setup at customer’s location and this system is totally controlled by a person who stays outside of the customer’s location and most probably the controller is on top of a base station. Basically this device has a GSM module, Stepper motor, Ardiuno uno board and bunch of balloons connected to a rope. The balloons are used to identify the proposed antenna location. The GSM module is used to send text messages to system for set height of the balloons that the controller can see. Uplift and down lift of the rope is powered by the stepper motor. The arduino board was used to control the whole system and store height details. Arduino language was to develop the code to provide a very efficient algorithm for carrying out required tasks. Finally the controller can get exact height of the antenna which should be fixed in the customer’s location quickly and easily.

Keywords: Arduino, Line of sight, Stepper motor

1. INTRODUCTION

Line of sight is a condition in which radio device antennas can actually see each other. High frequency radios, such as those used in Spread Spectrum Radio require line-of-sight between antennas.

Long-distance data communication is more effective through wireless networks but geographical obstacles and the curvature of the earth bring limitations to line-of-sight transmission. However, these issues can generally be mitigated through planning, calculations and the use of additional technologies.

When analyzing the options, it’s identified copper and fiber network solutions are very expensive due to construction costs. Additional expenditures can increase even further when traversing rivers, mountains, or other geographical and topographical challenges. Therefore, a microwave backhaul is an economical method of providing high-speed data service while maintaining 99.995% availability for Ethernet applications. The microwave backhaul solution is becoming more prevalent in communication services at reduced costs.

So this project proposes an automated system to find Line of sight easily and remotely. This system is a replacement for existing manual balloon survey system used in Dialog Axiata PLC Engineering Division(In manual balloon survey , one team goes to the customer location & set the balloons and other team goes to the nearest base station. These balloons are controlled manually by the team, based on the to the riggers information through a phone call). This main unit of the system is fixed in customer location. This unit is controlled by the rigger who is on the top of the nearest base station to find line of sight. Main Unit is controlled by using SMS.

In the main unit there is a motor and also there is a rope with bunch of balloons connected to the motor through a bobbin. The motor is powered by a motor drive and controlled by an arduino board. When the main unit gets a message from mobile phone, the balloons will lift up or lift down with the help of the motor, according to the content of the message. By observing the balloons, the rigger can stop the lifting process. Finally the rigger can get final height details using a SMS.

So this system is easy to set up and easy to handle. Also the systems helps to get height details without further delay. Thereby, Dialog Axiata PLC can reduce current problems of balloon surveys such having two teams for the same work, need of bulk system and measuring the rope length manually by using the newly suggested system.

2. EXPERIMENTAL/METHODS/METHODOLOGY

Basically this device has a GSM module, Stepper motor, Ardiuno uno board and bunch of balloons connected to a rope. The balloons are used to identify proposed antenna location. The GSM module is used to send text messages to system to set the height of the balloons that the controller can see. Uplift and down lift of rope is powered by the stepper motor. The arduino board was used to control the whole system and store height details. Arduino language was used in coding to provide a very efficient algorithm for carrying out required task. Finally the controller can get exact height of the antenna which should fix in the customer location quickly and easily.

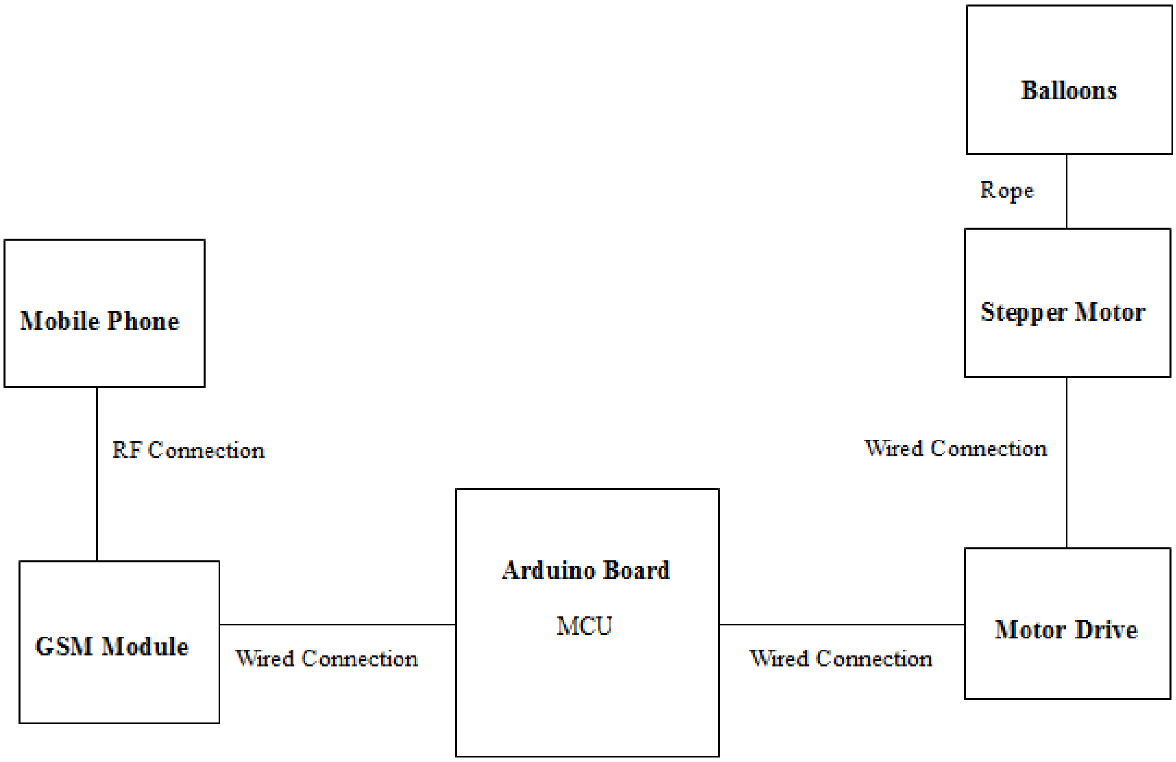

Figure 1– Block Diagram of the system

The activities of the modules which are used to develop the prototype, have been explained in below paragraphs.

2.1 GSM Module (SIM 800L)

SIM800 is one of the most commonly used GSM module among the Arduino community. There is a Mini GSM / GPRS breakout board is based on SIM800L module, supports quad-band GSM/GPRS network, available for GPRS and SMS message data remote transmission.

In this project GSM module is used to make the connection between Main Controller unit and the Mobile phone. The mobile phone is operated by the rigger who is on the top of the base station. When Rigger Send a message through the phone, the GSM module take will the message and send the information to the Arduino board. In here SIM 800L gsm module is used for this operation.

2.2 Arduino Uno

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. In this project Arduino uno is the main controlling device. Uno Controls all the processes of the system and get data signals from GSM module. Then check the details in the message and set appropriate steps and direction in the stepper motor.

The GSM module's TX/RX pins are connected to RX/TX pins of arduino. Motor driver is connected to output pins of the arduino board. As an example when rigger send a message "U 7.5 " , arduino board find the information and give a command to motor to rotate 7.5m to clock wise (for uplift the balloons).

2.3 Stepper Motor

Stepper motors are DC motors that move in discrete steps. They have multiple coils that are organized in groups called "phases". By energizing each phase in sequence, the motor will rotate, one step at a time. For this reason, stepper motors are the motor of choice for many precision motion control applications. By using a stepper motor, we could rotate motor to both direction and it helps to lift up or lift down the balloons. When arduino board gives the steps and direction to rotate, the stepper motor proceeded by the power of motor driver.

3. RESULTS AND DISCUSSION

It is not possible to get results easily in the existing balloon survey system due to various reasons. Through this project, it is possible to reduce the no of teams in to one team. The rigger who is on the top of the tower can control the height of the balloons; thereby help him to get an idea of which height is the balloons at the moment. This equipment is capable of detecting SMS from any distance and can get correct height for two points according to the content of the SMS. The arduino board is controlled the whole system. Arduino gets inputs using GSM module and thereafter do the calculations and get decisions and sent output signals to the stepper motor to control the length of the rope. So using this process, the rigger can correctly identify the balloon since; there is a clear line of sight between base station and customer location.

3.1 Strengths of the Research

- Only one team can do the whole survey process.
- Low risk & low work load for the respective team.
- Minimum cost for the system.
- Easy to fix in the customer location.
- Rigger can remotely control the device.
- Final can get exact height using a SMS without measuring the length of the rope.

3.2 Limitations of the Research

- Not suitable for coastal areas and windy areas.
- Height measurement is limited to the length of the rope.

4. CONCLUSION

This project introduces a device to automate the existing balloon survey system in Dialog Axiata PLC. The company can find the line of sight at no line of sight areas by developing the prototype. Therefore the proposed system will help to reduce the existing problems and get a better system at low cost. Using this system it is possible to get an easy controlling process and correct results quickly.

ACKNOWLEDGEMENTS

Authors wish to express their indebt gratitude to the staff of Department of Electronics, Faculty of Applied Sciences, Wayamba University of Sri Lanka and Access Network Planning Division of Dialog Axiata PLC.

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DIGITAL SYSTEM FOR MEASURE THE HUMIDITY AND SURFACE TEMPERATURE OF SERVO MOTORS ATTACHED TO THE OLD CORE CUTTING MACHINE

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ABSTRACT

In this study, the attempt was made to observe the humidity and surface temperature of servo motors used for old manual core cutting machines which use to cut the core of transformers made in Sri Lanka at the largest transformer providing company for Ceylon Electricity Board and etc. In such machines continuously working for long hours, so that the temperature is increased as well the humidity level effects on the temperature. Obtaining the idea of environmental parameters effecting for such machines is important and hence focused for our research study. Servo Motors are used in order to place the core cutting machines at different cutting widths during the process. They have to operate those servo motors for many hours continuously. Because of the servo motor's heat loss, the internal temperature of the core cutting machine is increased. Increasing the environmental parameters may have high threat to damage the servo motors use for the purpose. So, that the proper awareness of such parameters becomes critically important. Furthermore, due to the heat and sound generated by those machines, it is difficult to observe these parameters manually. Therefore we design and implement remote parameter measuring system with the use of wireless communication system implemented with Wi-Fi module. Moreover, in such environments, the traditional wired systems are failed to do the parameter measurement of remote places. Wireless Sensor Technology (WSN) which combines sensor, information processing and communication technologies has the characteristics of low power consumption and low costs. Wireless Sensor Technology (WSN) has wide applications in environment data sampling, security monitoring, and target tracking. [1] It is important to solve the inefficiency of traditional wired monitoring mode and realizing the convenient data sampling and data transmission. The transmission mode of traditional data sampling system mostly adopts the wired mode. Because of the transmission distance and geography environment, the wired mode causes high cabling costs and more maintenance cost. This paper represents the use of wireless sensor network technology (WSN) for monitoring temperature and humidity of servo motors. Real time temperature and humidity parameters data were recorded and graphically illustration was done.

Keywords: Wireless Sensor Technology, Core cutting machine, Wi-Fi Adapter, Servo Motors

1. INTRODUCTION

LTL transformers (pvt) Ltd had a problem of automating old core cutting machine, they wanted a system to measure humidity and temperature of servo motors. A monitoring system generally refers to an automated system that simultaneously and continuously records one or more physical parameters such as temperature, relative humidity. Continuous monitoring of any sensitive environment helps to meet security and regulatory compliance needs. Monitoring temperature and/or humidity conditions is an essential ingredient of a wide range of quality assurance applications. Monitoring deterioration would provide an early warning of incipient problems enabling the planning and scheduling of maintenance programs, hence minimizing relevant costs. Furthermore, the use of data from monitoring systems together with improved service-life prediction models leads to additional savings in life cycle costs. Temperature and humidity are key issues to be taken care of in manufacturing plants and particularly that of electronic assemblies. Lack of control over any of them will not only affect the component and equipment but also the process and the operators' comfort, all ultimately leading to loss in production. Because of this infirmity, servo motors of old core cutting machine are used temperature and humidity measuring system on their automating process of old core cutting machine.

Wireless sensor network (WSN) has revolutionized the field of remotely monitoring the process. Wireless sensor network or wireless sensor and actuator network (WSAN) are spatially distributed sensors to monitor physical or environmental conditions such as temperature, humidity, fire etc. and to cooperatively pass their data through the network to the main location. [2]

The aim of this paper is to design and develop a system which fulfils company requirements and avoid by hazards. In this study digital humidity temperature composite (DHT11) sensor is used to sense the environmental temperature and relative Humidity. Arduino microcontroller is used to make complex computation of the parameters and then to transmit the data wirelessly by using

ESP8266 Wi-Fi module to the receiver. At the receiver section ESP8266 Wi-Fi module is used to capture the serial data, which is transmitted, by transmitter and using PC Wi-Fi adapter. The data is logged onto PC. Moreover the LCD display is indicated the temperature and humidity near by the old core cutting machine for worker's awareness.

2. EXPERIMENTAL/METHODS/METHODOLOGY

The proposed system is interfaced with the Arduino development board. Programming in the Arduino system is used to convert the analog output of the sensor into the digital form. After that, the digital information is given to the ESP8266 Wi-Fi module for transmission. The ESP8266 Wi-Fi module will transmit data from the microcontroller board. At the receiving node, the ESP8266 Wi-Fi module will receive the data transmitted by the transmitter node. This digital signal is received by the Arduino development board. The program in the microcontroller will convert the digital data into the corresponding temperature and humidity. Finally this data is displayed on the LCD display and analyzed using Matlab graphs. All the different parts of the experimental is obtained from a single power source. Transmitter and receiver block diagram is shown in Fig. 1 and 2 respectively.

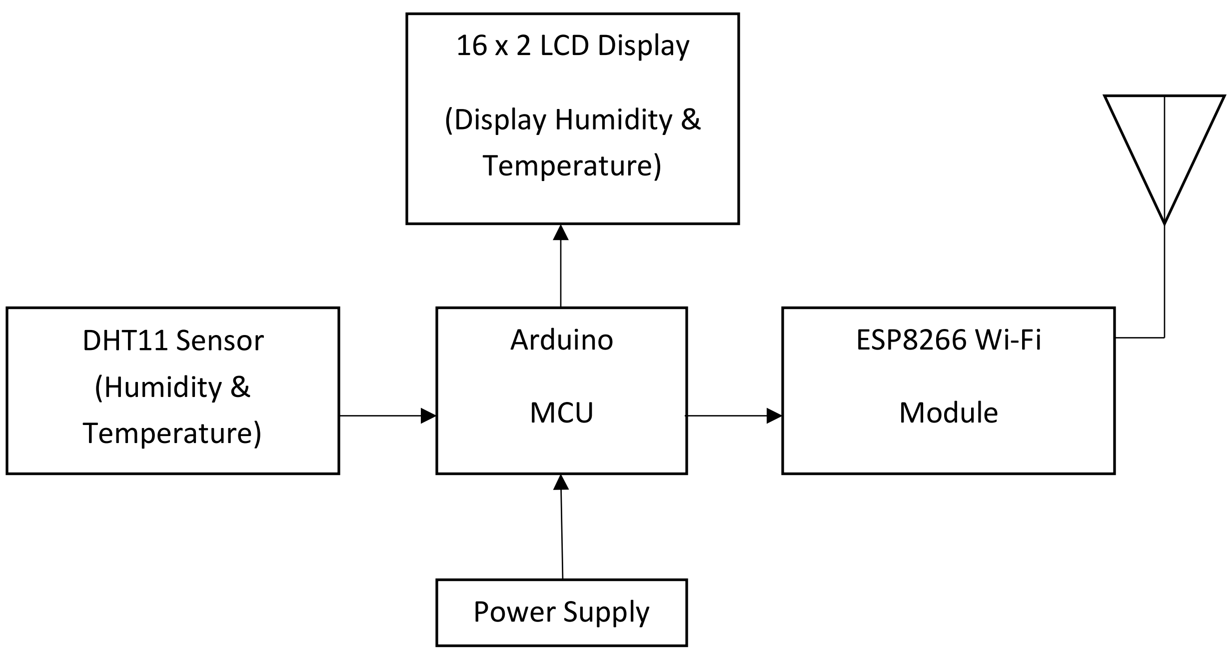

Fig: 01 Transmitter Section

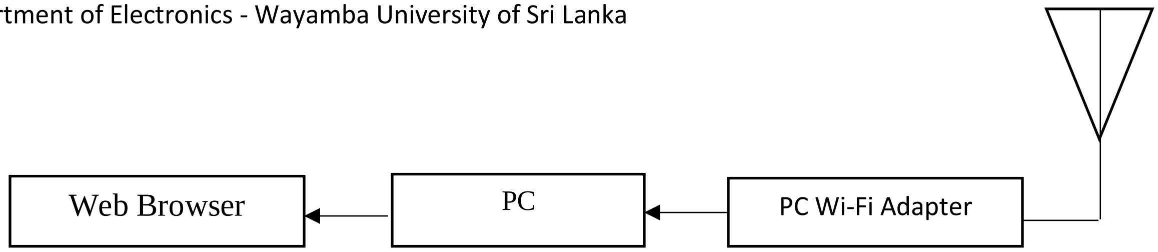

Fig 02: Receiver Section

3. RESULTS AND DISCUSSION

The measurement of temperature (in Celsius) were plotted on two different graphs, where the parameter values are on Y-axis and time (in seconds) is indicated on X-axis. The online plotting software [3] is used for prototype system.

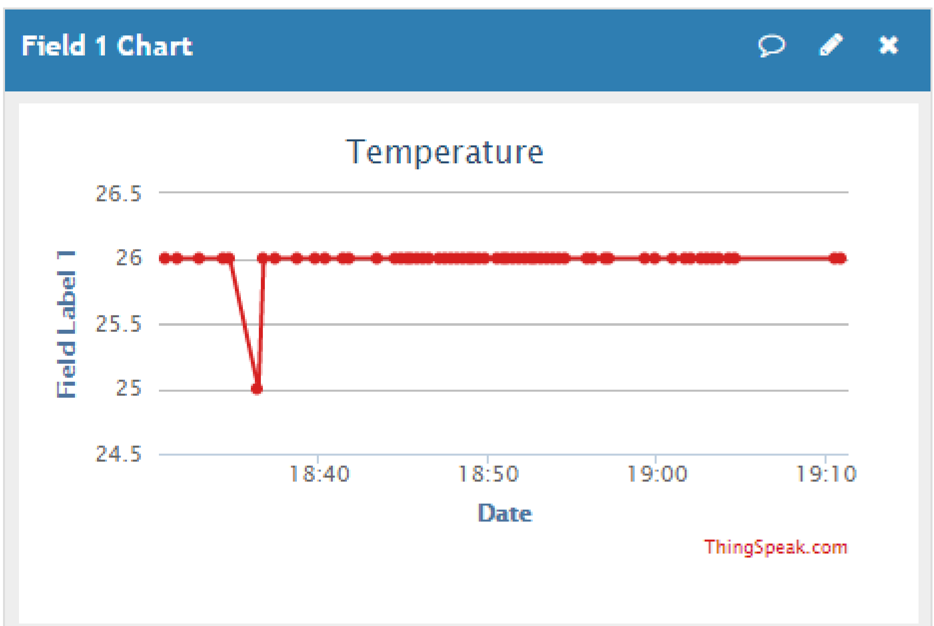

Fig: 03 Temperature readings of System

Likewise, the Relative Humidity (percentage values) readings were recorded and the plotted and shown in the Fig. 04

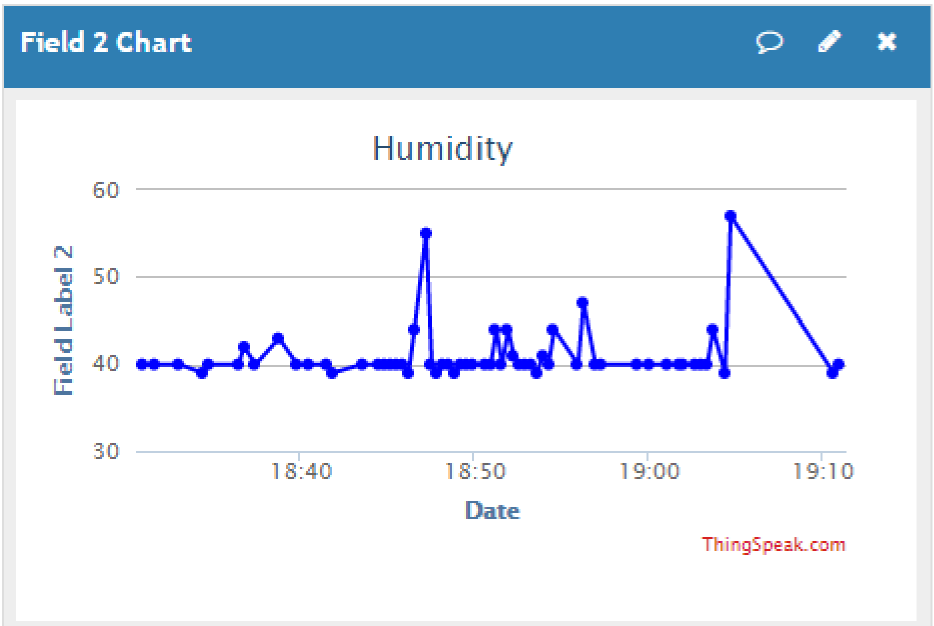

Fig.04: Relative Humidity readings for the system

4. CONCLUSION

In this work, applications of wireless sensor network is proposed to carry out using online measurements and real time graphical plotting is proposed to do remotely for monitoring of humidity and temperature of servo motors in the old core cutting machine. The aurdino uno board has been proposed to use with Wireless sensor network (WSN) system to measure the physical quantities. From the above analysis, it can be proposed that the nested wires systems can be replaced by wireless sensor networks in order to get the remote data as well as to avoid many hazardous issues for the older core cutting machine.

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Department of Electronics - Wayamba University of Sri Lanka

ENERGY STORAGE DEVICES BASED ON CONDUCTING POLYMER POLY 3, 4-ETHYLENEDIOXYTHIOPHENE.

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ABSTRACT

Future electricity generation will progress with diminishing reliance on fossil fuels, growing use of renewable energy sources such as wind, wave and solar energy with a greater respect to the environment. However, most renewable energy sources are intermittent, experiencing both long and short time power fluctuations in their nature. Energy storage devices (ESDs) has been recognized as one of the most promising approaches as a solution. In this study, conducting polymer (CP), poly 3,4 ethelenedioxythiophene (PEDOT) based rechargeable cell with Zn anode and a redox capacitor were fabricated using Gel polymer electrolyte (GPE) as the separator and tested for energy storage. PEDOT electrodes were galvanostatically deposited on a stainless steel (SS) and on FTO glass using 0.2 M EDOT monomer with the film thickness of 1 µm. GPEs were prepared with optimized proportions of 0.5 Poly vinylidenefluoride (PVdF): 1 Ethylene Carbonate (EC): 1 Propylene Carbonate (PC): 0.7 Zinc Trifluoromethanesulfonate (ZnTF) (by weight) using hot press method. Electrochemical Impedance Spectroscopy (EIS), Cyclic Voltammetry (CV) and charge-discharge tests were carried out to characterize the rechargeable cell and a redox capacitor. Open circuit voltage (OCV) of the battery was 1.178 V. Bulk resistance for the rechargeable cell and the redox capacitor was 7.44 Ω and 25.35 Ω respectively. Charge transfer resistance for the rechargeable cell and the redox capacitor was 2270.32 Ω and 76.65 Ω respectively. Maximum discharge capacity obtained for the rechargeable cell was 3.72 mAh/g and maximum specific capacity obtained for the redox capacitor was 20.24 F/g.

Keywords: Poly 3,4 ethelenedioxythiophene, Gel Polymer Electrolyte, Rechargeable cell, Redox capacitor.

1. INTRODUCTION

Since the discovery of electricity, people have sought effective methods to store that energy for use on demand. One of the distinctive characteristics of the electric power sector is that the amount of electricity that can be generated is relatively fixed over short periods of time, although demand for electricity fluctuates throughout the day[1,2]. Future electricity generation will progress with diminishing reliance on fossil fuels, growing use of renewable energy sources such as wind, wave and solar energy with a greater respect to the environment. However, most renewable energy sources are intermittent, experiencing both long and short time power fluctuations in their nature, which presents a great challenge in energy generation and load balance maintenance to ensure power network stability and reliability. Amongst all the possible solutions, ESDs have been recognized as one of the most promising approaches[3]. Today, Lithium based ESDs dominate the technology. But Lithium based ESDs suffering from safety issues such as sudden explosions or fires due to over-charging, internal short circuiting are still unsolved[4]. Also they rely on nonrenewable active materials. Raw material supply is scarce, higher production cost and toxicity are main drawbacks. Due to low cost, easy synthesis and high mechanical flexibility, high conductivity and non-toxicity, CPs have been applied as a promising alternative electrodes for Lithium based ESDs[5]. In this study a redox capacitor and a rechargeable cell fabricated with conducting polymer PEDOT is reported.

2. EXPERIMENTAL

2.1 Preparation of PEDOT electrodes

In order to prepare a 0.02M EDOT monomer solution, EDOT was magnetically stirred well for 30 minutes in a 0.05 M aqueous SDBS solution at 80 ^{0}C. PEDOT was galvanostatically polymerized on a Platinum (Pt) wire and several samples with the thickness of 0.4 µm were obtained for different current densities. CV tests were carried out to characterize the PEDOT electrodes electrode capacity was calculated from CV curves[6] and optimized current density was found. PEDOT films with 1µm thickness were electropolymerized on to the SS electrode (area of 1.54 cm^2) as the cathode for the rechargeable cell and on to a Fluorine-doped Tin Oxide (FTO) glass plates (area of 1.0 cm^2) as the electrodes for the redox capacitor. Polymerization was carried out using galvanostatic electrochemical technique with optimized current density of 0.0625 mAcm^{-2}.

2.2 Preparation of GPE

Optimized composition of 0.5 PVdF: 1 EC: 1 PC: 0.7 ZnTF (by weight) was used to prepare the GPE[7]. Appropriate amounts of polymer, salt and solvents were magnetically stirred well and heated at 120 ^{0}C for 30 minutes. GPE was prepared by hot pressed method and vacuum dried at room temperature overnight[8].

2.3 Fabrication of the rechargeable cell

Zn electrode and GPE was cut into the size of the SS electrode. The rechargeable cell was assembled inside a spring loaded brass sample holder by sandwiching the GPE in between PEDOT cathode and the Zn anode. OCV of the rechargeable cell was measured using a digital multimeter soon after the battery was assembled[8].

2.4 Fabrication of the redox capacitor

Piece of GPE was cut into the size of the PEDOT electrode on FTO glass. Redox capacitor was fabricated by sandwiching GPE in between two PEDOT coated FTO glass plates[7].

2.5Characterization of devices

Electrochemical impedance spectroscopy

EIS tests were carried out for both the cell and the redox capacitor in the frequency range from 400 KHz to 10 mHz using a computer controlled Frequency Response Analyzer (Metroham-M101)[9].

Cyclic voltammetry test

CV tests were carried out for the cell in the potential window of 0 V to 1.0 V and for the redox capacitor in the potential window of -1.0 V to 1.0 V with the scan rate of 5 mVs^{-1}. Then the capacity variation with the cycle number was calculated for the redox capacitor.

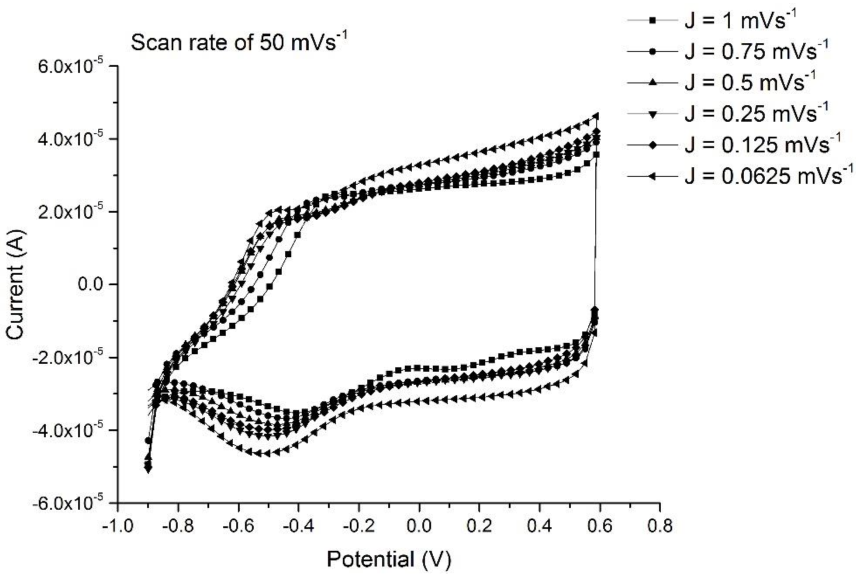
Charge-discharge test

Rechargeable cell was galvanostatically discharged to 0.2 V. Immediately after the discharge, it was galvanostatically charged to 1.0 V and kept for equilibrium state until the desired current (20% of maximum charge current) was reached. Similarly, continuous charge-discharge cycles were obtained in the potential window of 0.2 V to 1.0 V under a constant charge-discharge current of 50 µA[8]. The redox capacitor was charged to the potential of 1.0

V and immediately after, it was discharged to zero potential. Charge-discharge current was kept at 20 µA. In a similar way, continuous charge-discharge cycles were carried out in the potential window of 0 V to 1.0 V[7].For both the cell and the redox capacitor, specific capacity was calculated and capacity variation with cycle number was plotted.

3. RESULTS AND DISCUSSION

CV tests were carried out to characterize the PEDOT electrodes which were electropolymerized on Pt wire with different current densities and CV tests were carried out with different scan rates. From CV curves, 5th cycles of each scan rate were used to calculate the capacity of the PEDOT electrodes. It was observed that the highest capacity values were obtained for the scan rate of 50 mVs^{-1}. The 5th cycles obtained at 50 mVs^{-1} scan rate for each current density were plotted as shown in the Figure 1. The capacity values calculated were tabulated in the Table 1. According to the results obtained in Figure 1, two peaks can be identified correspond to the oxidation and reduction reactions of PEDOT[7].



Scan rate (mVs^{-1})	Capacity ($x10^{-3}$ F)					
	J= 1.0 $mAcm^{-2}$	J= 0.75 $mAcm^{-2}$	J= 0.5 $mAcm^{-2}$	J= 0.25 $mAcm^{-2}$	J= 0.125 $mAcm^{-2}$	J=0.0625 $mAcm^{-2}$
5	1.6781	1.7778	1.8137	1.8238	1.9335	2.1768
10	1.8316	2.1043	2.1516	2.2368	2.2936	2.5650
20	2.0720	2.3723	2.4169	2.4399	2.5009	2.8429
50	2.1660	2.4269	2.5331	2.5640	2.5804	3.0498
100	2.1532	2.3788	2.5039	2.5245	2.5248	3.0279

Figure 1: 5th cycle of PEDOT electrodes on Pt wire at 50 mVs^{-1} scan rate. Film 0.4 µm thickness

Table 1: Capacity calculation from CV for 0.4 µm thickness PEDOT electrodes on Pt wire

According to the results obtained in Table 1, capacity increases when the current density decreases. Also, the capacity increases when the scan rate increases with an exception at the scan rate of 100 mVs^{-1}. A sudden decrease in the capacity can be seen at 100mVs^{-1} scan rate. The highest capacity obtained was $3.0492x10^{-3}$ F for the current density of 0.0625 $mAcm^{-2}$ at the scan rate of 50 mVs^{-1}. Therefore, 0.0625 $mAcm^{-2}$ current density was used to prepare the electrodes for the rechargeable cell and the redox capacitor.

The rechargeable cell which was fabricated with the optimized PEDOT cathode showed an OCV of 1.178 V.

The impedance plots obtained from the EIS results for the rechargeable cell and the redox capacitor are shown in the Figure 2 and Figure 3 respectively.

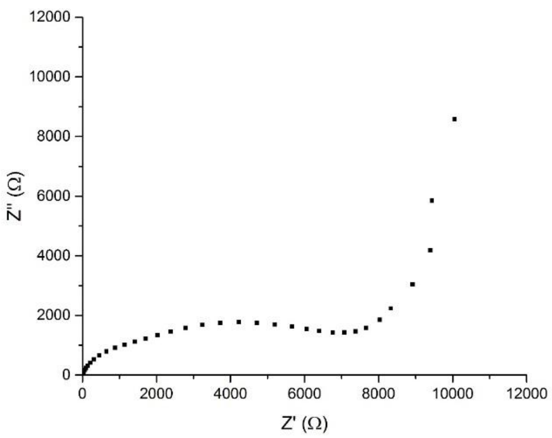


Figure 2: Impedance plot for the cell

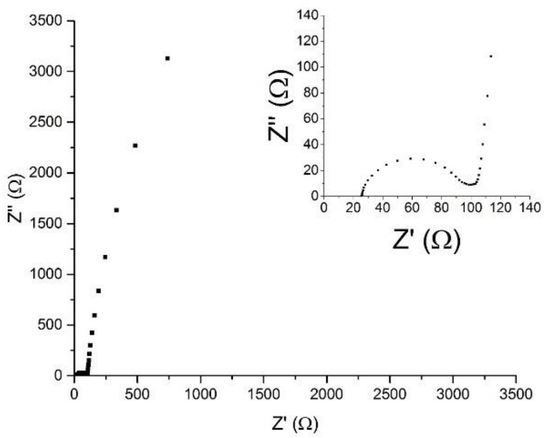


Figure 3: Impedance plot for the redox capacitor

By analyzing the EIS data using non-linear least square fitting[10], bulk resistance for the cell and the redox capacitor were calculated as 7.44 Ω and 25.35 Ω respectively. Charge transfer resistance of the cell and the supercapacitor were 2270.32 Ω and 76.65 Ω respectively. According to the EIS obtained for the redox capacitor (Figure 3), straight lines sharply increasing at the low-frequency region represents the dominance of capacitive behavior[7].

The CV results of 1st and 5th cycles obtained for the cell are shown in the Figure 4. The 1st and 50th cycles obtained for the redox capacitor are shown in the Figure 5.

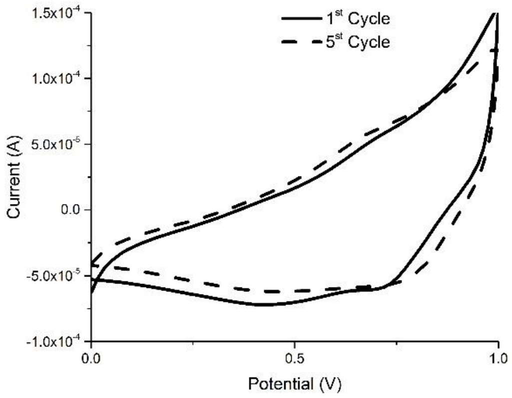


Figure 4: CV curves for 1st and 5th cycles for the cell

Figure 4: CV curves for 1st and 5th cyclesfor the cell

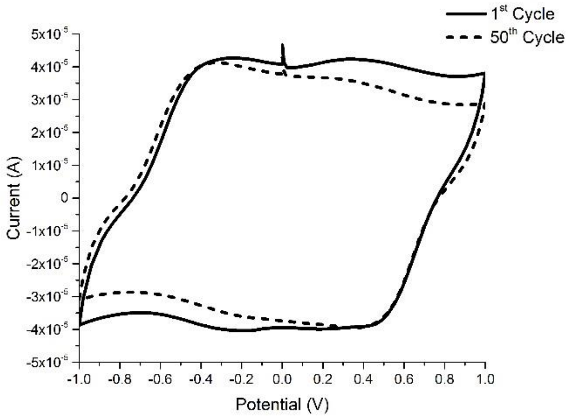


Figure 5: CV curves for 1st and 50th cycles for the redox capacitor

Figure 5: CV curves for 1st and 50th cyclesfor the redox capacitor

According to the results obtained for the rechargeable cell (Figure 4) and the redox capacitor (Figure 5), two peaks can be identified during the oxidation and reduction. However, for both the rechargeable cell and the redox capacitor, the two redox peaks are asymmetrical, which may due to difference in the rate of reactions during oxidation and reduction[7].

Capacity values were calculated for both the cell and the redox capacitor from the results obtained from charge-discharge tests. Maximum discharge capacity obtained for the cell was 3.72 mAh/g and maximum specific capacity obtained for the redox capacitor was 20.24 F/g. The variation of the capacity with the cycle number for the cell and the redox capacitor are shown in the Figure 6 and Figure 7 respectively.

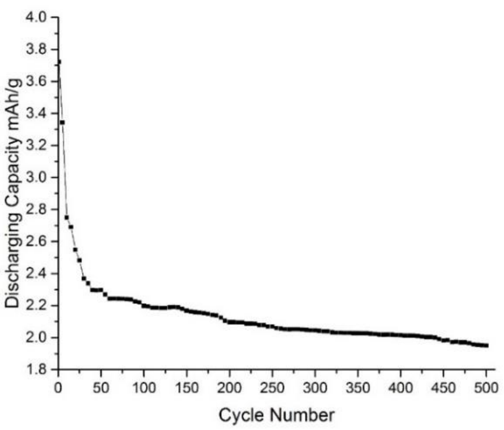


Figure 6: Specific capacity variation of the cell with cycle number

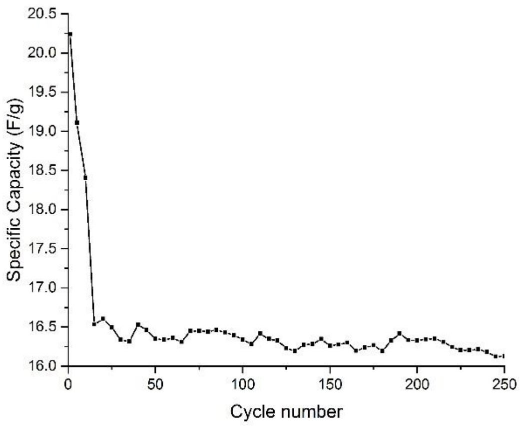


Figure 7: Specific capacity variation of the redox capacitor with cycle number

4. CONCLUSION

In this study, a rechargeable cell and a redox capacitor were fabricated using PEDOT electrodes. It was found that a higher capacity can be obtained for PEDOT electrodes with lower current densities. Although this is a preliminary study, OCV obtained for the cell was 1.178 V. A maximum discharge capacity of 3.72 mAh/g was obtained for the rechargeable cell and a maximum specific capacity of 20.24 F/g was obtained for the redox capacitor. The results obtained through this study predict the possibility of fabricating ESDs based on PEDOT with appreciable performances.

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FABRICATION OF A REDOX CAPACITOR TO STORE SOLAR ENERGY

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ABSTRACT

With the diminishing of fossil fuels, the focus has been moved towards renewable energy sources. Photovoltaic cell is one of the main renewable power generation devices that is used in the world today. The storage method of the generated energy is vital. In this study a super capacitor was fabricated using a gel polymer electrolyte (GPE). It consist with polyacrylonitrile (PAN), ethylene carbonate (EC), propylene carbonate (PC) and sodium thiocyanate (NaSCN). The composition was fine –tuned by varying the salt and the polymer concentrations in order to obtain a mechanically stable, thin and flexible film with a high ionic conductivity. The optimized GPE gives a maximum conductivity of 1.62×10^{-3} Scm^{-1} at room temperature. A redox capacitor was fabricated using the prepared GPE. Electrochemical Impedance Spectroscopy (EIS), Cyclic voltammetry technique and galvanostatic charge-discharge test were used to evaluate the performance of the redox-capacitors. It was observed that the average discharge specific capacitance is 63.34 Fg^{-1}. GPE with the composition of PAN, EC, PC & sodium iodide (NaI) was used to fabricate the dye-sensitized solar cell (DSSC). Under 100 mW illumination, fill factor (FF) and efficiency (η) were calculated. Further, fabricated redox-capacitor was charged through the DSSC under the 100 mW illumination. Then, it was discharged and observed a discharge specific capacitance was 71.31 Fg^{-1}.

Keywords: Gel Polymer Electrolyte, Supercapacitor, Solar Cell

1. INTRODUCTION

Current consumption rate of the fossil energy has alarmed the world that the day on which run out of these limited resources is not far away. Hence, the research intensity has been increased in the field of renewable sources, such as wind turbines, photovoltaic cells, biomass plants etc[1]. Sunlight is a major conserve in the renewable energy sector. The main disadvantage of these kinds of renewable energy is its generation discontinuity as well as the fact that its energy generation is not controlled by the system operator thus making it more difficult to integrate these plants in the generation pool than in the case of conventional plants [2].

Energy storage becomes a critical factor that can be used to solve the problems described above. The conventional energy storage method such as batteries tends to fail in such applications due to incapability of quick charging and life time etc[1]. Hence, it is vital to develop a reliable mechanism to transfer energy from photovoltaic cells to a storage device. There is a potential in developing super capacitors as a renewable energy storing device to use in renewable energy storing applications. Redox capacitors also known as pseudo capacitors, are type of super capacitors which are fabricated using conducting polymers or electroactive oxide as the active electrodes[3]. In recent years, there has been a growing interest in the investigation of super capacitors with an electrolyte that can offer redox activity. Such redox capacitors have shown to offer increased charge storage capacity, and possibly other benefits[4]. This paper presents a study about fabricating a redox capacitor with a gel polymer electrolyte (GPE) to store energy produced by a solar cell.

2. EXPERIMENTAL

2.1 Preparation of Gel Polymer Electrolyte

First, required amount of sodium thiocyanate (NaSCN) (Aldrich, 99%) was dissolved in ethylene carbonate (EC) (Aldrich, 98%) and propylene carbonate (PC) (Aldrich, 98%) using magnetic stirring. When NaSCN was completely dissolved, required amount of polyacrylonitrile (PAN) (Aldrich, 99%) was added to the mixture and stirring was continued until a homogeneous mixture was formed. Then, it was heated at 120 °C for 40 minutes inside a glass tube furnace. The resultant hot mixture was pressed in between two well cleaned glass plates and left overnight in a vacuum desiccator. Several samples were prepared with different PAN and NaSCN concentrations to find the composition that has highest room conductivity. EC and PC weight ratio was fixed as 1:1 throughout the study.

2.2 Conductivity measurements

Impedance measurements were taken using Metrohm Autolab M101 frequency response analyzer in the frequency range 0.4 MHz to 0.01 Hz and in the temperature range 28 – 55 °C. The conductivity of the GPE, σ, was calculated using the equation, $\sigma = (1/R_b)(l/A)$, where R_b is the bulk electrolyte resistance obtained from the complex impedance plot, l is the thickness and A is the area of the GPE sample. The thickness and diameter were measured by a micrometer screw gauge [5].

2.3 DC polarization test

DC polarization test using blocking electrodes was performed to identify the contribution from ions and electrons to the conductivity. The GPE pellet was sandwiched in between two stainless steel (SS) electrodes and the current through the GPE pellet was measured as a function of time by applying 1.0 V DC bias potential. Ionic transference number, t_i *was* calculated according to the equation, $t_i = (I_T - I_e) / I_T$, where, I_e and I_T are stabilized current and initial total current respectively[6].

2.4 Fabrication of redox-capacitor

Pyrrole was electrochemically polymerized in the presence of sodium perchlorate ($NaClO_4$) (Aldrich, 99%) on well cleaned fluorine-doped conducting tin oxide (FTO) glass plates by electrochemical polymerization using a computer controlled potentiostat (Metrohm Autolab M101). The three electrode electrochemical cell used for electrochemical polymerization consisted of a working electrode (FTO), a Ag/AgCl reference electrode and a platinum (Pt) counter electrode[7]. Polypyrrole (PPy) films of the thickness of 2 µm and were prepared. A GPE film was sandwiched in between two PPy electrodes each of area 1 cm^2 to fabricate the redox capacitor.

2.5 Characterization of redox capacitor

The redox capacitor was tested using electrochemical impedance spectroscopy. Impedance measurements were taken using the Metrohm Autolab impedance analyzer over the frequency range of 0.01 Hz – 0.4 MHz at room temperature. Cyclic Voltammetry measurements were carried out within the potential range of -1 to 1 V Cycling was done at the scan rate of 10 mVs^{-1} and the specific capacity was calculated. In the galvanostatic charge discharge test, redox capacitor was first galvanostatically charged to 0.5 V, then immediately subjected to a galvanostatic discharge up to 0.1 V. The maximum charge discharge currents were set to 1.67×10^{-4} A. Using the discharge curves, the discharge capacitance of the redox capacitor was calculated[7].

2.6 Preparation of photo anode

A slurry was prepared by grinding titanium dioxide (TiO_2) (P 25 Degussa) with Triton X, Acetic acid and ethanol. Well cleaned FTO glass strips with a surface area of 5 mm × 10 mm were taken and the electrodes were prepared by doctor blading the TiO_2 paste on 5 mm × 5 mm surface area on them. The electrodes were sintered at 450 ^{0}C for 45 minutes. Then the strips were dipped in Ruthenium dye for 24 hours[5].

2.7 Fabrication of DSS cell

A platinum coated glass strip was used as the cathode and the DSS cell were fabricated in the configuration, FTO/TiO_2/Dye/Gel polymer electrolyte (PAN (122.6 mg), EC (250 mg), and PC (250 mg), sodium iodide (NaI) (Aldrich, 99%) (44.9mg)) /Pt [5]. The photo current – voltage characteristics of the cells were measured under the 100 mW illumination.

2.8 Charging and discharging of the redox capacitor using the solar cell

Fabricated solar cell was positioned under a 100 mW illumination. To take the voltage measurements, a multimeter was connected to the fabricated redox capacitor. Then, the multimeter-redox capacitor setup was coupled with the solar cell and the voltage was measured against time. The charged redox capacitor was discharged using Metrohm Autolab M101. The discharging current was given as $1.67 \times 10^{-4}\ A$ which is obtained from the peak value of the cyclic voltammetry study of the super capacitor.

3. RESULTS AND DISCUSSION

3.1 Determination of the optimum composition

Conductivity variations with PAN concentration and NaSCN concentration at room temperature are shown in Figure 01 and Figure 02 respectively. When increasing the PAN concentration, assistance for ion motion from polymer network may increase. This might be the reason for initial conductivity increment. As PAN concentration increases further, viscosity of the system also increases so that there will be a resistance for the ion mobility. Due to this, the conductivity may be reduced. The initial increase of conductivity with salt concentration is evidently due to the increasing of charge carrier concentration. The subsequent decrease of conductivity after reaching the maximum value is very likely due to formation of ion pairs in the GPE which do not facilitate conductivity [7]. The highest conductivity achieved from fine-tuning process was 1.62×10^{-3} Scm^{-1} for GPE composition of PAN (202.5 mg), EC (250 mg), and PC (250 mg), NaSCN (35 mg).

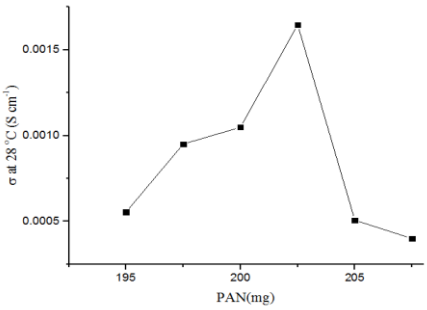


Figure 01: Variation of conductivity with PAN concentrations at room temperature

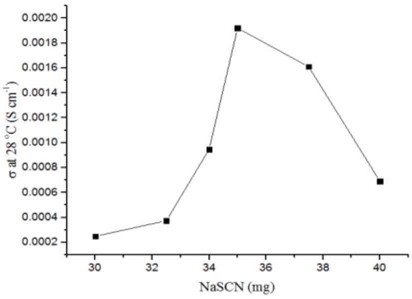
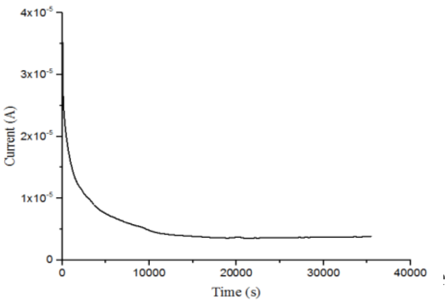


Figure 02: Variation of conductivity with NaSCN concentrations at room temperature

3.2 DC polarization of GPE

The ions and electrons contribution for the conductivity was evaluated using the resultant polarization graph shown in Figure 03. Observed ionic transference number (t_i) from the calculation was 0.9. The value of t_i, implies the fact that ionic contribution is dominant than electronic contribution for the conductivity.



cell having the configuration SS|GPE|SS under a DC potential of 1.0 V

3.3 Electrochemical Impedance Spectroscopy (EIS)

According to Figure 04, initial intercept of high frequency range represent the bulk electrolyte resistance. Semi – circle at intermediate frequencies represent the charge transfer resistance. In lower frequency range two spikes can be seen. Spike with about $\pi/4$ inclination represents diffusion control kinetics and the other with about $\pi/2$ inclination represents capacitive behavior of the redox capacitor[7, 8].

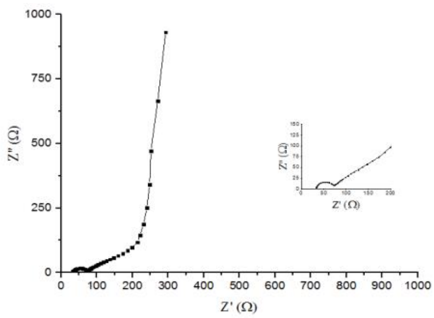


Figure 04: Nyquist plot of the redox capacitor

3.4 Cyclic voltammetry measurements of a fabricated redox capacitor

According to Figure 05, the resulting peaks corresponding for reduction/oxidation redox reaction. Current values in a wide potential window demonstrate the behavior of the GPE/PPy as charge-storing electrodes in the GPE medium for capacitor application[7]. The specific capacitance was calculated using the equation, $C = \frac{2\int i\,dv}{m(\Delta V)S}$ where, C is the specific capacitance (F/g), $\int i\,dv$ is the integrated area of the CV, m is the mass of the active material of one electrode (0.4 mg), ΔV is the voltage window and S is the scan rate. The observed specific capacitance was $102.7\ Fg^{-1}$.

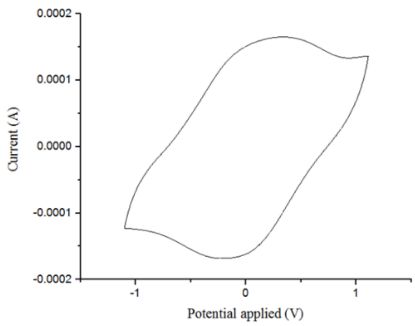


Figure 05: Cyclic voltammogram of a fabricated redox capacitor

3.5 Charge discharge cycles for redox capacitor (GCD)

The investigation was carried out for 1000 cycles, only 500 to 505 cycles are shown in the Figure 06. The charge-discharge curves are nearly linear. The specific capacitance was calculated using the equation, $C_s = \frac{2.i}{m.\frac{dv}{dt}}$ where, C_s is the specific capacitance (F/g), i is the discharge current (A), m is the mass of the one electrode (g) and $\frac{dv}{dt}$ is the slope of the discharge The average specific capacitance was 63.34 Fg^{-1} which is lower than

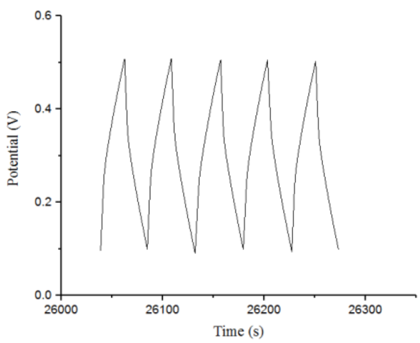


Figure 06: Galvanostatic charge-discharge curves of a redox capacitor (500 to 505 cycles)

the value obtained from the cyclic voltammetry technique. This deviation may be due to the different in scan rate used in two techniques[7].

3.6 Photovoltaic performance of DSSC

Open circuit voltage (V_{OC}) and short circuit current (J_{SC}) values were obtained from the current density voltage (J-V) characteristic curve shown in Figure 07. Fill factor (FF) and efficiency (η) were calculated using the equations, $FF = J_{opt} \times V_{opt} / J_{SC} \times V_{OC}$, $\eta = (J_{SC} \times V_{OC} \times FF / P_{in})100\%$ where, J_{opt} and $V_{opt.}$ are the current density and the voltage at maximum power. Observed results from the calculations were, $J_{SC} = 9.2128 \times 10^{-4}$ A, V_{OC} = 0.689 V, FF= 0.779 and η = 0.005 %. The iodide/triiodide redox mediator based DSSC cells, charge recombination takes place between the electrons ejected to TiO_2 and triiodide in the gel polymer electrolyte. J_{sc} depends on the mobility of iodide ions [9].

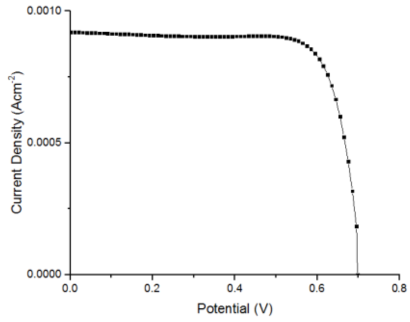


Figure 07: Observed current density vs potential curve for solar cell

3.7 Charging of the redox capacitor under the 100 mW illumination using the DSSC

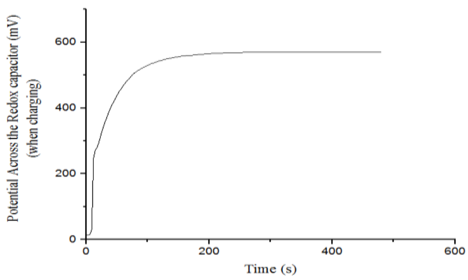


Figure 08: Observed curve for charging the redox capacitor under the 100 mW illumination using the DSSC

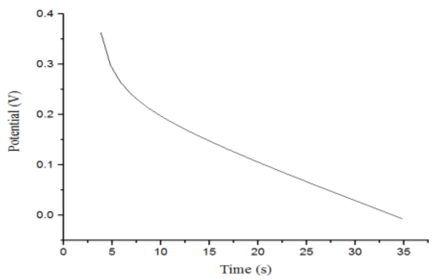


Figure 09: Observed curve for discharging the redox capacitor (using Metrohm Autolab M101)

From Figure 08 and Figure 09, capacitor behavior of the redox capacitor can be observed. Although it was discharged instantly, this system has potential to develop to a system with better performance.

4. CONCLUSION

It was observed that the highest room temperature conductivity of GPE 1.62×10^{-3} Scm^{-1} can be obtained with PAN (202.5 mg), EC (250 mg), PC (250 mg), NaSCN (35 mg). The average specific capacitance which was obtained after 1,000 charge-discharge cycles was at 63.34 Fg^{-1}. Fabricated solar cell had a fill factor of 0.779 and an efficiency of 0.005 %.

Based on the results obtained in the study, it was evident that redox capacitor can be charged using photovoltaic cells. Hence the concept can be further developed to achieve better performance. From the results of redox capacitor it is confirmed that, redox capacitors can be used to store the electricity generated by the photovoltaic cells.

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REAL-TIME FACE TRACKING SYSTEM USING FPGA

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ABSTRACT

Face detection and tracking in an image sequence has been an active research area in the computer vision field in recent years due to its potential applications such as monitoring and surveillance, image enhancement, human computer interfaces, smart rooms and intelligent robots. Many complex algorithms have been implemented for face detection using computer programming languages. But these algorithms require considerable processing power. Hence these kinds of algorithms are not frequently used on real-time face detection systems or low power face detection systems. When real-time face detection is required, face detection algorithms which require low processing power are used. In this study, the hardware implementation of a real-time face detection system is implemented on a Xilinx Spartan 3 (XC3S1000) FPGA (Field Programmable Gate Array) device on a XESS XSA-3S1000 FPGA development board using Verilog HDL (Hardware Description Language). The developed system can be used in many useful applications. While implementing, different algorithms for some processes were tested for better accuracy and optimum resource utilization. Skin-tone filtering algorithm was used to detect the faces in the input image and the noise was filtered with spatial filtering algorithm. The center of the face was detected by centroid calculation of the area of the face. OV7670 camera module was used to capture the input images at 30 fps rate. The VGA (Video Graphics Array) output available on the used development board is used to show the detected faces on a VGA monitor. The system was tested for different skin colors under different lighting conditions for accuracy.

Keywords: face tracking, FPGA, real-time detection

1. INTRODUCTION

Face detection is the determination of whether or not a face is present in an image. Face detection is based on identifying and locating a human face in images regardless of size, position, and condition. Unlike face recognition, which distinguishes different human faces, face detection only indicates whether or not a face is present in an image. In addition, face tracking determines the exact location of the face in the image. Face detection and tracking in an image sequence has been an active research area in the computer vision field in recent years due to its potential applications such as monitoring and surveillance, image enhancement, human computer interfaces, smart rooms and intelligent robots[1-3].

However, face detection requires considerable computation power because a complex process like this checks all pixels in the image. Almost all of the available literature on face detection is theoretical or describes a software implementation. Only a few papers have addressed a hardware design and implement of face detection[4-7]. Although real-time face detection is possible using high performance computers, the resources of the system tend to be monopolized by face detection. Therefore, this constitutes a bottleneck to the application of face detection in real time.

Many complex algorithms have been implemented for face detection using computer programming languages (such as Face detection using Haar classifiers). As mentioned above, these algorithms require considerable processing power. Also, most of these algorithms have to be trained with few hundreds of training input data (sample images containing faces). But these algorithms have a very good advantage. These algorithms detect faces very accurately. Hence, these kinds of algorithms are used in many systems where the speed of detection is not highly concerned. Since these kinds of algorithms requires higher processing power, the systems designed using these algorithms also have a higher power consumption. When higher detection speed with higher accuracy is required, (specially for real-time face detection) these kinds of algorithms have to be executed on super computers with parallel processing techniques. Hence these kinds of algorithms are not frequently used on real-time face detection systems or low power face detection systems.

When real-time face detection is required, face detection algorithms which require low processing power are used. Even though the accuracies of these simple algorithms are low relative to the accuracies of algorithms mentioned in above paragraph, these algorithms can be still used for face detection. Since these algorithms does not require higher processing power, they can be implemented on normal personal computers (software implementation) or on configurable hardware devices (FPGAs) (hardware implementation). However, for real-time face detection, FPGA devices are more suitable than computers because of their very high processing speed and low power consumption.

Color Spaces

This study is based on a color-based face detection algorithm. Normally, the color of pixels in an image is presented in RGB color space. Filtering the skin colors using this color space is not efficient and practical. The reason is all three channels (RGB) changes from one skin color to another. So, most of the time, color filtering is achieved by converting the RGB color space to a different color space. Such as HSV, HSL, YCrCb and YUV. YCrCb and YUV color spaces are specially used for skin color filtering.

RGB Color Space

This is an additive color model. The primary colors are red, green, and blue light. They are added together in various ways to reproduce a broad array of colors. The name comes from the initials of the three colors Red, Green, and Blue.

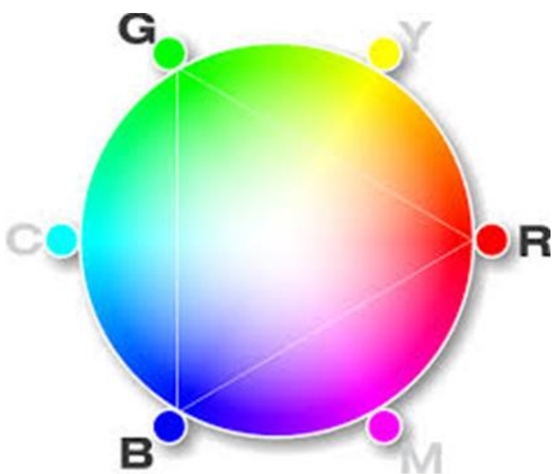

Fig. 1 - RGB color space

The main purpose of the RGB color model is for sensing, representation, and display of images in electronic systems, such as televisions and computers. The RGB color model is an additive in the sense that three light beams are added together to make a final color. To form a color with RGB, three colored light beams (one red, one green, and one blue) should be superimposed. Each of the three beams is called a component of that color, and each can have arbitrary intensity, from fully off to fully on, in the mixture. Zero intensity for each component gives the darkest color (no light, considered the black), and full intensity of each gives a white. A color in the RGB color model is described by indicating how much of each of the red, green, and blue is included in each component which can vary from zero to a defined maximum value which depends of the application[8]. In computing, the component values are often stored as integer numbers in the range 0 to 255.

Modified YUV Color Space

This modified YUV color space is specially designed for fast filtering algorithms. Conversion of RGB to this color space is very fast and memory requirement is very low. This is because the calculation does not involve float numbers. Yet, the accuracy is not degraded. Colors can be converted from RGB to this color space by using the Equation (1).

$$\begin{bmatrix} Y \\ U \\ V \end{bmatrix} = \begin{bmatrix} (R + 2G + B)/4 \\ R - G \\ B - G \end{bmatrix} \tag{1}$$

Where: R, G, B = Intensities of red, green and blue lights

Y = Luminance component

U, V = Chrominance component

Spatial Filtering

This filter is used to reduce the Gaussian noise in an image. This filter may also blur the image a little bit. But for face detection purposes, this side effect is not a huge affection. In spatial filtering, the resultant value of a pixel after the filtering is determined by taking the summation of values of each neighboring pixel after multiplying by the weight given to the pixel. The neighbor mask size may be 3x3 or 5x5 or so on…

However, the spatial filter used in this study has a different operation. The reason is, the filter is applied to the image after filtering the skin color. Hence, a pixel may have one of two values, zero or one (0 or 1). The spatial filter in this study uses a 5x5 neighbor mask and the resultant value of pixel is one (detected as skin colored pixel) only if all neighboring pixels are skin colored. (has the value one)[9].

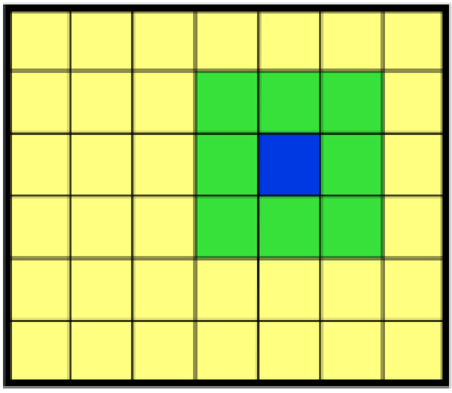

Fig. 2 - A 3x3 neighbor mask

In this study, the hardware implementation of a real-time face detection system is implemented on a Xilinx Spartan 3 (XC3S1000) FPGA device on a XESS XSA-3S1000 FPGA development board using Verilog HDL. While implementing, different algorithms for some processes were tested for better accuracy and optimum resource utilization. Software implementation of these algorithms using Python language was very helpful and time saving. Skin-tone filtering algorithm was used to detect the faces in the input image and the noise was filtered with spatial filtering algorithm. The center of the face was detected by centroid calculation of the area of the face. OV7670 camera module was used to capture the input images at 30 fps rate. The VGA output available on the used development board is used to show the detected faces on a VGA monitor. The system was tested for different skin colors under different lighting conditions for accuracy.

2. EXPERIMENTAL

An architecture for a real-time face detection system was proposed. Fig. 3 shows the architecture of the proposed face-detection system. The system consisted of five modules. Camera controller, skin-tone filter, spatial filter, centroid calculator and VGA interface. All these modules are implemented in the FPGA device using Verilog HDL. Skin-tone filter, spatial filter and centroid calculator modules were tested by writing python programs before their hardware implementation.

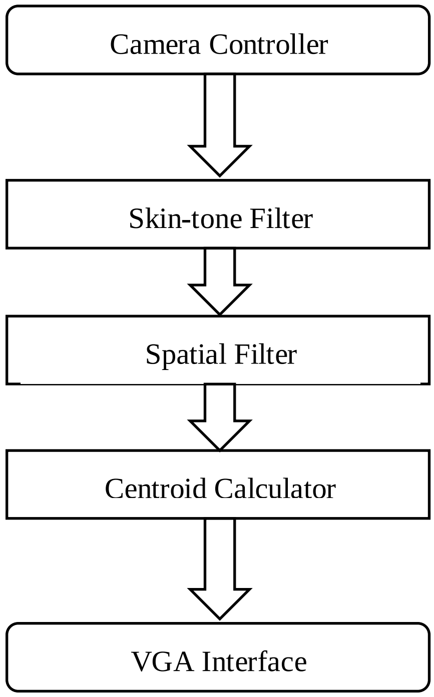

Fig. 3 - Flow chart of the proposed real-time face detection system

Camera Controller Module

Camera controller is for operating and configuring the camera and capturing images from the camera. This module controls the SCCB (Serial Camera Control Bus) interface as well as reads the 8-bit data bus for pixel data. The input clock signal of 24 MHz for the XCLK input of the camera module is also generated by this module.

Skin-tone Filter Module

This module determines whether or not a pixel is skin-tone colored. The pixel data read from the camera module by the camera controller module are directly given to this module. According to the intensities of each RGB value, this module determines the pixel as skin colored or not. If the pixel is skin colored, then the module outputs ‘1’ (HIGH) and ‘0’ (LOW) otherwise. So, the module has a 16-bit input and 1-bit output. This determination is done using the modified YUV color space. The 16-bit RGB input to this module is converted to modified YUV color space and then, if following two conditions are true, the pixel is identified as a skin colored one.

$$15 < U < 100$$

$$-60 < V < 5$$

Spatial Filter Module

Using the output of Skin-Tone filter module, a binary image of 640x480 pixels is generated. Due to the noise in the original image and background objects within skin color range, this binary image may be noisy. For reducing these noises and detected false skin pixels, the binary image is filtered by this module. This module determines a pixel as a skin-toned pixel only if all 24 neighboring pixels (5x5 neighbor mask) are skin-toned pixels. Otherwise, the pixel is determined as a background pixel.

After cleaning the noise in the input image using the spatial filter module, the center of the area with skin-colored pixels can be found by centroid calculation. The resultant position may be correct if there was only one face in the input image. If there were two faces in the image, the resultant position shows the middle point between these two faces.

Such a case can be detected by checking the neighboring pixels of the calculated centroid position. If most of the neighboring pixels are skin-toned pixels, then most probably the input image contains one face and the calculated centroid shows the center of that face. Otherwise, there can be two or more faces in the image. To get the center of each face separately, the image is divided into two areas according to where the centroid was. Then a centroid is calculated for each region separately. These two points are then considered as the centers of two faces. However, this solution is valid only when the faces are side by side.

Finally, the calculated centroid point(s) are then sent to the VGA interface module to indicate in the monitor.

3. RESULTS AND DISCUSSION

Skin-tone filter, spatial filter and the centroid calculator algorithms have been tested using python programming language before their hardware implementation on the FPGA. Followings are the results of those tests.

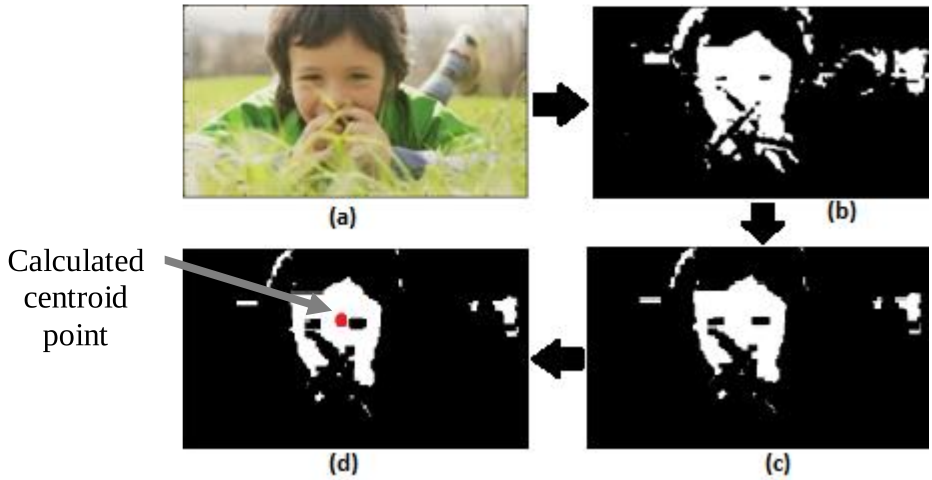

Fig. 4 - Results of software implementations of algorithms. (a) Original image, (b) Skin-Tone filtering, (c) Spatial filtering, (d) Centroid computation

- All the modules shown in Fig. 3 were implemented on the FPGA device and tested.
- The system was able to detect and track faces without any detectable delay.
- The system was able to track maximum of two faces separately when present.
- But the lighting condition of the testing area affects the accuracy of the system.
- The noise filtering was good enough for filtering the background noise.

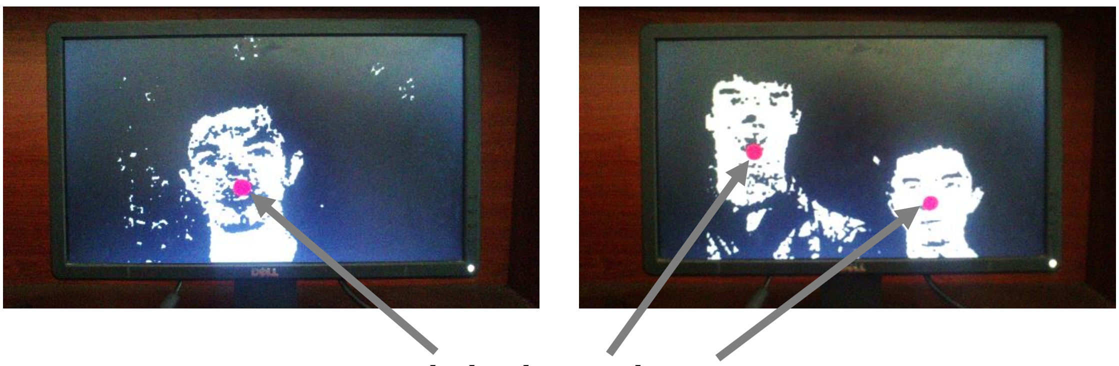

Fig. 5 - Results of the hardware implemented system when single and two faces are present

Python software was very useful for testing and optimizing the algorithms before they are actually implemented on the FPGA device. This method was very helpful and time saving. Configuring and interfacing the OV7670 camera module was a bit difficult since the configuration of this device is very long and if not well configured, the quality of the captured images gets very low and the noise gets very high. The accuracy of the face detection was not high for very light or very dark colors. The reason is the parameters of skin-tone filter are optimized for detecting skin colors of south-Asian people. Hence, it was at an acceptable level for optimized skin-color range. The reason is that the method of face detection is a color-based algorithm. A feature based algorithm may have better accuracy. The system can be further developed to track more than two peoples by applying a connected component labeling algorithm. But such algorithm requires high processing power. When two persons are present, they must be side by side to each other. Otherwise the system may not be able to track the faces. One of the biggest advantages of using FPGA devices for this kind of image processing tasks is the low cost and low power consumption than when computers are used. This system can be used in many applications such as monitoring and surveillance, image enhancement, human computer interfaces, smart rooms and intelligent robots[1-3]. Modified YUV color space is very useful for high speed systems because converting to YUV color space is not efficient since it requires floating point calculations. Color-based face detection algorithm was found to be most efficient as it required low computational cost while being robust to variations in lighting, facial expressions, and skin colors.

4. CONCLUSION

The goal of this study was to implement a real-time hardware system that is capable of detecting and tracking human faces. Before implementing the hardware system, the algorithms were tested and optimized using python language. The face detection algorithm was based on skin color filtering algorithm. Noise reduction algorithms were used to reduce the noises in the captured images and false detected areas. After filtering, centroid calculation algorithm was used to determine and track the center of the face. The system was capable of tracking maximum of two faces. According to the final observations, it can be concluded that the developed system is capable of working real-time without any lagging and under varying conditions of facial expressions and skin tones.

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PHOTOLUMINESCENCE PROPERTIES OF QUANTUM DOTS AND THEIR APPLICATIONS.

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ABSTRACT

Quantum Dots (QDs) thin film solar cell was prepared as the first study by using Cu/p-CuI/n-Cu_2O photoelectrode. A simple method was used to prepare the p-CuI layers by immersing the copper plates in a KI (0.02 M)/$CuSO_4$ (0.025 M) solution and n-Cu_2O was fabricated on a Cu/p-CuI surface by boiling in a $CuSO_4$ (0.005 M) solution very easily. The band gap of n-Cu_2O was ~ 1.9 eV and CuI was ~ 3.1 eV. In this paper the diffuse reflectance spectra, photocurrent action spectra, I-V characteristics and stability curves were used to discuss of photoluminescence properties of QD solar cell. As the second study, CdSe was synthesized as a resultant yield of CdSe QDs vary in color from green- yellow to orange-red and luminescence from blue to yellow. The resulting two samples of CdSe solutions yield absorbance as 6 nm, 8 nm and emission wavelength of the samples gives as 560 nm, 620 nm. Furthermore, this paper discussed about the photoluminescence properties of QDs and their applications in detail.

Keywords: QD Sensitized Solar Cells (QDSSC), Nanocrystals, Photoluminescence, Quantum Dots.

1. INTRODUCTION

Recent years have seen a rapidly development in the size and speed of electronic devices and dominant technology is the nano-technology. So the size of the particle is the key feature of the researchers. Now a days researchers accustom to QD fabrications in the field of nanotechnology. And also the usefulness and application of QD technology continues to expand and research is striving to bring their benefits to more and more technologically applied fields. Quantum dots are semiconducting nanocrystals whose properties vary with size. CdSe nanocrystals have a crystal lattice of alternating cadmium and selenium atoms that exhibits the same structure as bulk CdSe. When a photon is absorbed by the bulk crystal, an electron-hole pair is created and the particles maintain a characteristic distance apart. However, when the size of the crystal is small enough (less than 112 A^o in diameter for CdSe), the electron-hole pair can no longer achieve the desired distance and the particles become confined to a box. As a result, these nanocrystals demonstrate quantum mechanical behavior and their transition energies can be explained using the particle in a box model, where the electron is the particle and the nanocrystals is the box. Because of varying the size, it gives the considerable photoluminescence. As a result, CdSe photoluminescence properties that can be used in the field of optics and bio medical applications etc.

The importance of the generation of electricity from renewable or carbon natural sources is becoming more relevant as the human race enters the 21st century. Fossil fuels are a finite resource and the combustion of which has been taken for the consume more than last 50 years. As economies of countries around the world grow, an increase in the demand for energy is inevitable. An attractive to fossil fuels are photovoltaics or solar cells which convert sunlight into DC electricity. Key advantage are that they have no moving parts and that most are quoted to have a useful shelf life of 20-30 years. Another interesting thing is the QD sensitized solar cells which are more efficient than others. In here, QD thin film solar cell was fabricated using Cu/p-CuI/n-Cu_2O as the first study. p-CuI was sensitized from n-Cu_2O QDs successfully and material characterization, photocurrent measurements are presents from this study.

And Also as the second study, CdSe QDs were synthesized and their material characterization, photoluminescence properties, absorption spectrum, emission spectrum, scanning electron microscopy images were discussed from this in detail.

2. METHODOLOGY

2.1 Preparation Cu/p-CuI/n-Cu_2O photo electrode.

The copper plates (1×4 cm^2) with 99.99% purity were cleaned using sandpaper to remove outer most layer of copper sheet. Well cleaned copper sheets were immersed into a solution containing KI (0.02 M), $CuSO_4$ (0.025 M) solution for several minutes. Cu/p-CuI photo-electrodes were immersed in $CuSO_4$ (0.005 M) solution and boiled until the formation of Cu_2O QDs in the p-CuI nano-particles at Cu/p-CuI photo-electrode. Analytical grade chemicals and double distilled water were used for the experiment.

2.2 Preparation of CdSe QDs

30 mg of Se and 5 ml of ocatadecene were added to a 10 ml round bottom flask over a stirrer hot plate to prepare the Se stock solution and 13 mg of CdO was added to a 25 ml round bottom flask clamped in a heating mantle. Then, 0.6 ml oleic acid and 10 ml octadecene was added to the same flask by pipet. The flask was swirl to mixed the liquids. A thermometer was inserted, capable of measuring 225 ^{o}C. The cadmium solution was heated. When the temperature was reached to 225 ^{o}C, a clean and dry pipet was used to quickly transfer 1 ml of the room temperature selenium solution to the 225 ^{o}C cadmium solution and time was started. The injection was happened as quickly as possible. Approximately 1 ml samples were removed at frequent intervals using a 9-inch glass Pasteur pipet as the CdSe particles grow in size. Then, it was continued for longer intervals so there is a noticeable color change. The absorption spectra and the emission spectra of the solution were recorded to find the maximum wavelength peak.

3. RESULTS AND DISCUSSION

3.1Material Characterization

3.1.1 Cu/p-CuI/n-Cu_2O sensitized solar cell

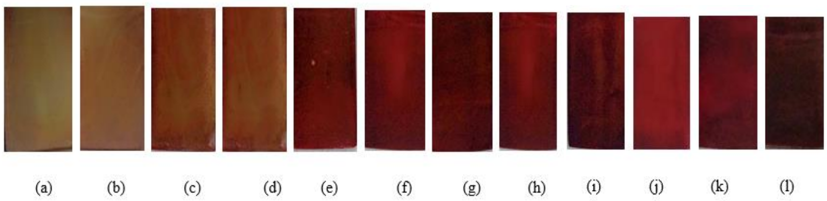

Fig. 3.1: Color variation of Cu/p-CuI various boiling time in the $CuSO_4$ solution. Boiling times of (a), (b),(c),(d),(e),(f),(g),(h),(i),(j),(k) and (l) are 1 min, 2min, 3 min, 4min, 5 min, 6 min, 7 min, 8 min, 9 min, 10 min, 20 min and 30 min respectively.

Properties that vary with the particle size are an important feature of nanoscale materials which are shows photoluminescence property clearly. The Fig.3.1 clearly shows the n-Cu_2O QDs vary in color from green-yellow to dark brown with the various boiling times in the $CuSO_4$ solution. When we go beyond that the p-CuI boiling time in the $CuSO_4$ solution, n-Cu_2O layers were sweeping away from the surface. And the best photocurrent property was given in the 14 min boiling time of $CuSO_4$ (0.005 M) solution.

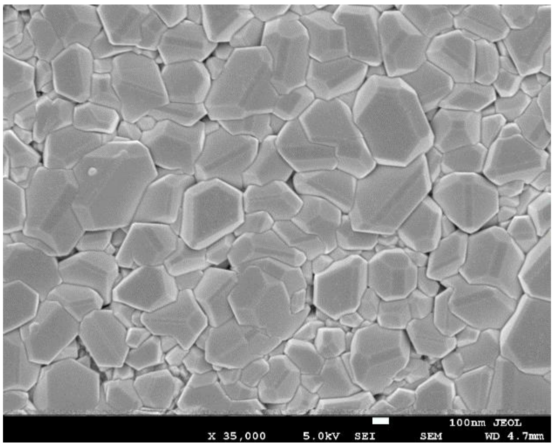

Fig. 3.2: SEM image of Cu/p-CuI before sensitize QDs

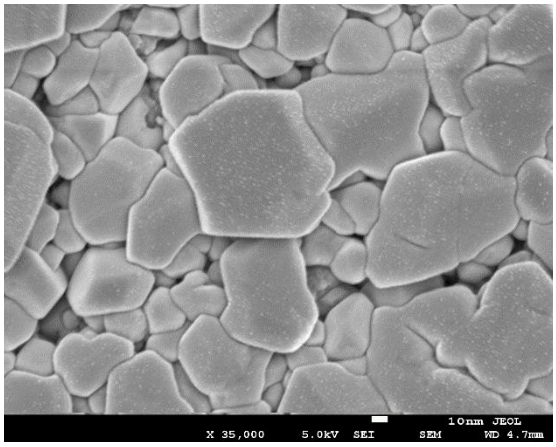

Fig. 3.3: SEM image of Cu/p-CuI/n-Cu_2O

The major goal in fabricating Cu/p-CuI/n-Cu_2O solar cell is to measure the photoluminescence properties. The photoluminescence properties varies according to the particle size of the n-Cu_2O nanocrystals. Scanning Electron Microscopy (SEM) is a powerful technique for examination of particle size (grain size). Fig. 3.2 shows the SEM image of Cu/p-CuI and Fig 3.3 shows the SEM image of Cu/p-CuI/Cu_2O. The image clearly exhibits the crystal nature of the Cu/p-CuI layer. This structure of crystals of Cu/p-CuI helps in the sensitization of QDs in QDSSC because when QDs are embedded on Cu/p-CuI electrode, QDs actually go and sit on these crystals where they get produced. Fig 3.3 clearly shows the QD of n-Cu_2O on p-CuI crystals.

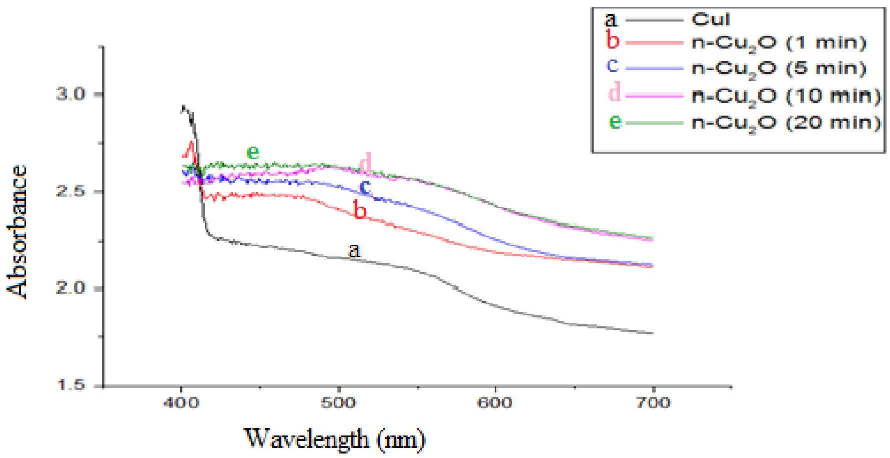

Fig. 3.4: Diffuse reflectance spectra for Cu/p-CuI and Cu/p-CuI/n-Cu_2O cells for various boiling time in $CuSO_4$ solution for make various n-Cu2O layers. a) 1 min, b) 5 min, c) 10 min, d) 20 min

Fig 3.4 (a) shows the diffuse reflectance spectrum for Cu/p-CuI (2 min) electrode. According to the figure a sharp absorption edge can be found nearly at 420 nm corresponding to the band gap of ~ 3.0 eV. It confirms that p-CuI is a wide band gap material and absorbs only UV light. Fig 3.4 (b-e) shows the diffuse reflectance spectra for Cu/p-CuI/n-Cu_2O electrode for various n-Cu_2O forming times. According to these spectra, an increment of absorption in visible region due to the formation of Cu_2O. When increasing the boiling time of $CuSO_4$ solution, diffuse reflectance spectra red shifted gradually due to the increase of the QD sizes formed on p-CuI thin film as shown from the curves. It is interesting to mention that the absorption properties in the visible region was remarkably improved by QDs deposited on p-CuI compared to the diffuse reflectance spectrum of Cu/p-CuI (curve a).

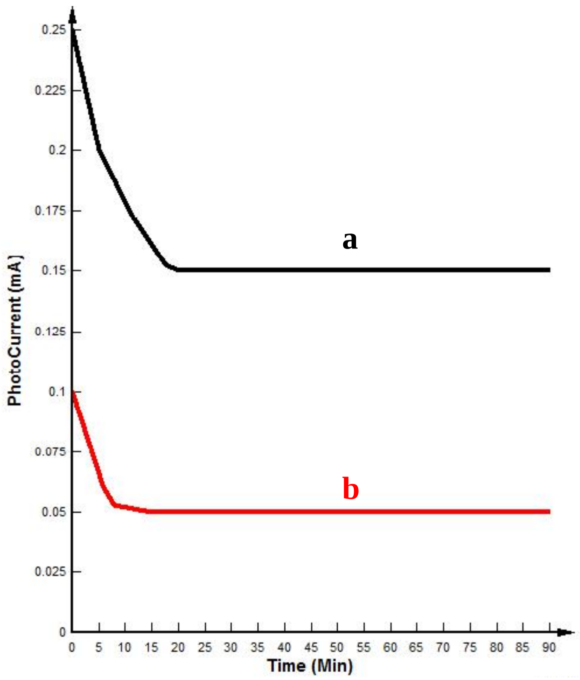

Fig. 3.5: Time development of photocurrent for curve a – Cu/p-CuI/Cu_2O photo electrochemical cell and curve b – Cu/p-CuI electrode before sensitize QDs.

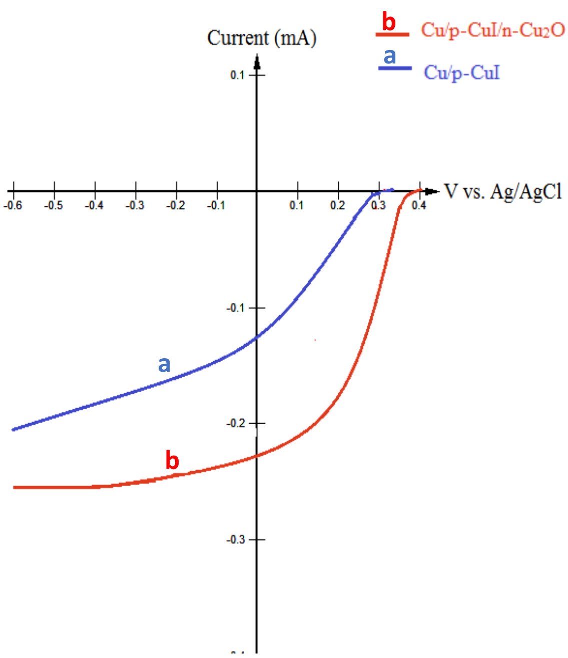

Fig. 3.6: Variation of photocurrent with applied potential (vs. AgCl/Ag) for Cu/p-CuI/n-Cu_2O and Cu/p-CuI

The time development of the photo current under visible light is shown in Fig. 3.5. According to the figure, relatively high photo current can be seen in Cu/p-CuI/Cu_2O photoelectrode than the Cu/p-CuI photoelectrode. Highest steady state photocurrent was observed for the samples prepared by boiling Cu/p-CuI photoelectrodes in $CuSO_4$ for 14min.

Fig. 3.6 shows the variation of photocurrent with applied potential (vs. AgCl/Ag) for Cu/p-CuI/n-Cu_2O and Cu/p-CuI. Onset potential of p-CuI occurs at +0.26 V (vs. Ag/AgCl). It is assumed that the onset potential is nearly equal to the flat band potential. But onset shift for higher boiling time may be due to the formation of n-Cu_2O layer on top of the p-CuI forming p-CuI/n-Cu_2O junction at electrolyte interface.

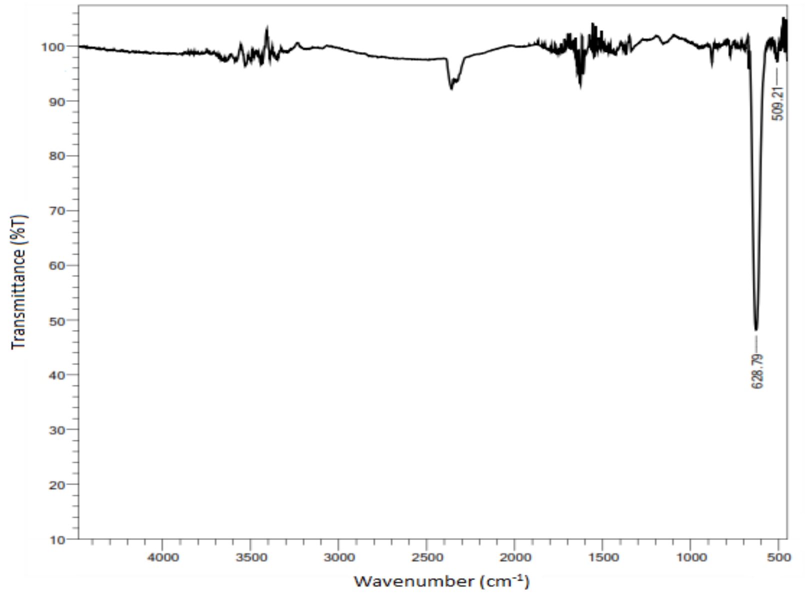

Fig. 3.7: Fourier Transform Infra Red (FTIR) spectra for the p-CuI/nCu_2O powder using KBr pallet method

FTIR spectra of CuI and Cu_2O were observed at 628.79 cm^{-1} and 509.21 cm^{-1}, respectively by using KBr pallet method as shown in Fig. 3.7. Moreover, the very strong band at 628.79 cm^{-1} is attributed to the stretching vibration of the Cu_2O. These results further prove that the properties of CuI and Cu_2O were exist in the sample[6].

3.1.2 CdSe QDs characterizattions

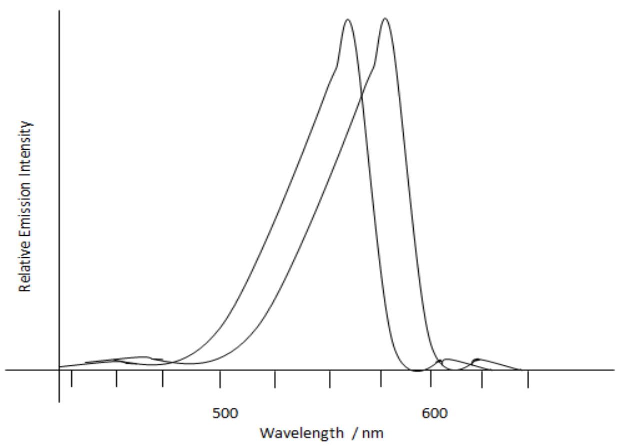

Fig. 3.8: Normalized emission spectra of the samples using 400nm excitation.

Fig. 3.8 shows the normalized emission spectra of the two samples using 400 nm excitation. The samples were withdrawn from the reaction mixture in order from left to right an initial time of 8 seconds after selenium. Its implies that the longer wavelength, smaller energy emission corresponds with longer particle sizes.

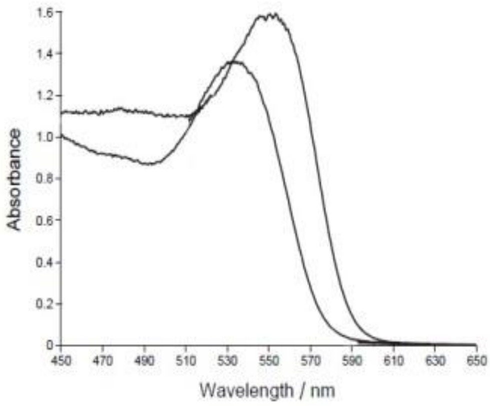

Fig. 3.9: Visible absorption spectra of the samples.

Fig. 3.9 shows the diffuse reflectance spectra for different CdSe formation for various time intervals as same samples that obtained in previously, the samples were withdrawn from reaction order from left to right. Its implies that the same scenario as earlier discussed in emission spectra that is longer wavelength, smaller energy emission corresponds with longer particle sizes

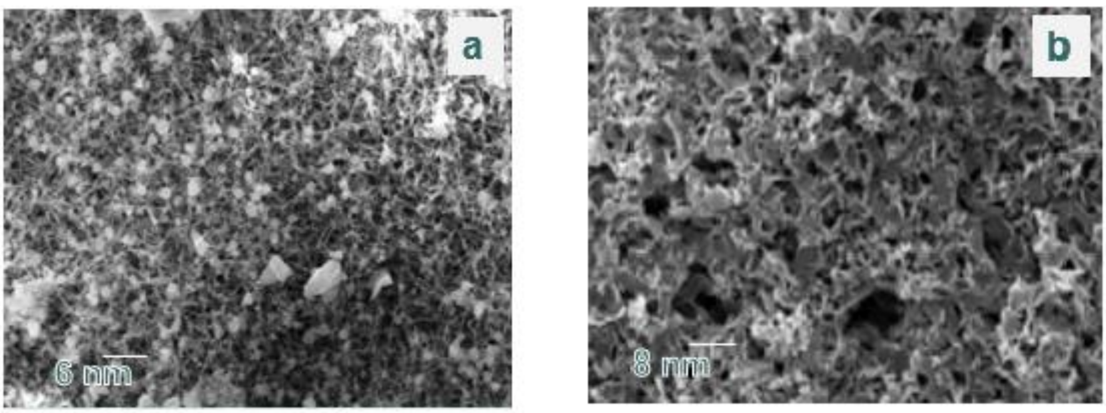

Fig. 3.10: SEM image of CdSe samples which were taken from the reaction mixture in order from left to right at an initial time of 8 seconds after selenium addition.

The SEM results of CdSe samples clearly shows the particle size of the QDs as shown in Fig. 3.10 and they were in the range of QD scale. The shapes of the nanocrystal of CdSe are not that much vary with the withdrawn time from reaction order and with the particle size. But there is highly luminescence can be obtained of this two sample.

4. CONCLUSIONS

Cu/p-CuI/n-Cu_2O QDs were fabricated successfully and it clearly shows the visible color differences when varying the boiling time as discussed earlier in detail. Thus its gives the considerable photoluminescence property and it can be used in optical applications in future practical devices. And also, Cu/p-CuI/n-Cu_2O junction photo-electrodes were fabricated successfully for solar energy conversion devices at relatively low cost. Photocurrent enhancement were observed for the junction photoelectrodes due to efficient charge separation processes operating from the space charge electric fields in the junction with two semiconductor compared to that of the bare semiconductor systems. p-CuI was sensitized by Cu_2O quantum dots for the photo-electrochemical cell at low cost and easy fabrication processes on a well cleaned commercially available copper sheets. Stable photocurrent for considerable time and thereafter decay the photocurrent were obtained from the time development of photo current profiles. In second study, CdSe QDs were synthesized successfully and CdSe QDs the most prominent QDs that gives the best photoluminescence property than the other QDs. Also, it was fabricated efficaciously. But cadmium oxide and cadmium selenide as both are carcinogens and its synthesis process is very costly.

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RADIO FREQUENCY EXPOSURE LEVELS DUE TO MOBILE BASE STATION ANTENNAS AND INDICATOR DEVICE

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ABSTRACT

Since 1990s mobile phones usage has increased dramatically. The widespread use of mobile phones has led to mobile base stations to being placed in many cities. The Radio Frequency radiation produced at the base station are off to the environment, where people can be exposed to them. The energy of RF radiations given off by base station antennas is enough to cause cancers or other health problems. The main objective of this project is doing the research about RF exposure level due to mobile base stations antennas and design a low cost, hand-held indicator device. The indicator device is a perfect solution to measure the safety factor of RF radiation. The filed measurements are taken from 10 main urban cities in the country using Spectrum analyzer MS2712E and set of standard RF measuring antennas. The city safety can be determined by analysing collected data. The total exposure quotient is calculated and results are compared with the internationally recognized FCC standards. The Indicator device can be used to check whether RF radiation is safe or unsafe, and the status will display on a LCD display. The highest exposure level recorded was 0.2338 at Gampaha and the lowest was 0.00169 at Kaluthara. These exposure levels are below the maximum limits set by standards. Hence the general public who lives in that cities are safe from the RF radiation due to the mobile base stations. However, in some cities, such as Gampaha and Kandy this total exposure quotient is much higher when compared with other cities.

Keywords: Exposure Quotient, Radio Frequency Radiation, Total Exposure Quotient

1. INTRODUCTION

Radio Frequency (RF) is any of the electromagnetic wave frequencies that lie in the range extending from around 3 kHz to 300 GHz. RF sources of type which are essentially involved in mobile communication is extend from 300MHz to 3 GHz. It is a type of non-ionizing radiation. In Sri Lanka network provides use 800/900MHz ,1800MHz and 2GHz bands for the mobile communication. This band divided in to two-part uplink band and downlink band [1].

People exposure to electromagnetic radiation (EMR), or electromagnetic fields (EMF) has dramatically increased in recent years because of the developing technology. Human body interacts with radio waves at different frequencies in numerous ways [2].

Several international and governmental organizations, e.g. the International Commission on Non-Ionizing Radiation Protection(ICNIRP), the Institute of Electrical and Electronic Engineers (IEEE), the European Union (EU), Federal Communications Commission (FCC) and the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), have developed guidelines to protect the general public and workers from excessive RF or microwave radiation emitted from the antennas of RF source [3].

The Signal strength is high at ground near the base stations. But based on the results of some research papers, members of the public would not be exposed more than the ICNIRP and FCC guidelines whilst standing on the ground near any of the representative microcell base stations. Here, this research was conducted to measure the RF exposure level from mobile base stations antennas in main cities of the country.

2. EXPERIMENTAL

2.1 Creating the device

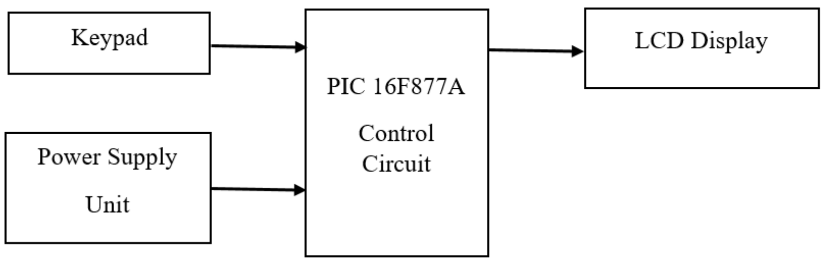

Figure 01: Block diagram of the complete circuit

The device need three inputs, antenna factor, system loss or cable loss and reading take from the oscilloscope (Signal strength and center frequency). The 16-button keypad were used to input the data. The PIC16F877A microcontroller was used as the main control unit of the indicator device. The LCD display which was connected to the microcontroller is used to show the output. Power supply unit consists with a 3.7V Lithium-polymer battery and charger circuit.

Device can be powered up using battery and the battery can be charged without removing from the device. This PIC microcontroller was programmed using the MikroC software.

Figure 02: Complete version of the indicator device

2.2 Surveying procedures

The field measurements were taken using Anritsu MS2712E spectrum analyzer and set of dipole antennas. The measurements were made at some different location which made along the costal belt, hilly areas, populated flat urban areas. After reaching the particular location, antennas were mounted on a tripod and connected with spectrum analyzer using coaxial cable. For a particular frequency, maximum received voltage (in dBμV) was obtained by rotating the antenna to the direction in maximum field strength.

The measured value was converted to the field intensity using equation 1

$$E\ (dB\mu V/m) = K\ (dB/m) + Vm\ (dB\mu V/m) + L\ (dB) \qquad [1]$$

Where, E is the field intensity, K is the antenna factor and L is the total system loss.

The antenna factor is the ratio of electric field strength at the antenna to the voltage developed at antenna connector. The value of K is given by the antenna manufacturer.

Table 01: Antenna Factor Values.

Types of antenna	Antenna Factor
800/900 MHz range	17.7 dB
1800MHz range	24.1 dB

2GHz range	33.4 dB

This signal is only from one direction which is the direction of maximum received signal. For the worst case, suppose that this field comes from three orthogonal directions.

Hence,

E_worst^2=E_X^2+E_Y^2+E_Z^2 [2]

Where, the Eworst is the field intensity at the worst case

E_X=E_Y= E_Z=E_Max [3]

Where, the EMax is the Maximum field intensity

Therefore,

E_worst (V/m)=√3 E_Max [4]

The power density in the worst-case situation becomes,

S_worst (W/m^2)= (E_worst^2)/η

[5]

The Exposure Quotient (EQ) at particular location can be calculated by using direct comparison of the measured power density with the reference power density advised by FCC guidelines.

Table 02: EMR reference levels according to FCC standards

Frequency range (MHz)	Power density (S) (mW/cm^2)
0.3-1.34	100
1.34-30	$180/f^2$
30-300	0.2
300-1500	$f/1500$
1500-100,000	1

$$EQ = \frac{S^{meas}}{S^{ref}} \quad [6]$$

Where, S^{meas} is the measured power density and S^{ref} is the power density of the reference level.

The Total Exposure Quotient (TEQ) is equal to the sum of the quotients for each signal and is expressed as,

$$TEQ = \sum_{i=1}^{n} \frac{S_i^{meas}}{S_i^{ref}} \qquad [7]$$

Where, S_i^{meas} is the power density at the i^{th} signal.

S_i^{ref} is the reference level of the power density at the i^{th} signal.

n is the total number of signals.

Finally, The TEQ value was compared with FCC guidelines. If the TEQ does not exceed 1, then the location is safe [4,5].

3. RESULTS AND DISCUSSION

The results are shown in Table 03 which gives the estimated maximum possible exposure quotients for each location.

Table 03: Exposure Quoitient due to all Frequency band

Site number	City	Exposure Quotient			
		800/900 MHz	1800 MHz	2000 MHz	Total
1	Chilaw	8.403×10^{-3}	3.349×10^{-3}	5.786×10^{-3}	17.538×10^{-3}
2	Colombo Fort	4.128×10^{-3}	19.91×10^{-3}	9.226×10^{-3}	33.264×10^{-3}
3	Gampaha	139.28×10^{-3}	42.729×10^{-3}	51.813×10^{-3}	233.822×10^{-3}
4	Kandy	69.703×10^{-3}	38.696×10^{-3}	43.442×10^{-3}	151.841×10^{-3}
5	Kaluthara	0.715×10^{-3}	0.674×10^{-3}	0.301×10^{-3}	1.69×10^{-3}
6	Kurunegala	21.787×10^{-3}	11.498×10^{-3}	70.945×10^{-3}	104.23×10^{-3}
7	Matale	16.299×10^{-3}	2.1×10^{-3}	10.385×10^{-3}	28.784×10^{-3}
8	Negombo	9.901×10^{-3}	2.056×10^{-3}	6.96×10^{-3}	18.917×10^{-3}
9	Puttlam	1.953×10^{-3}	0.195×10^{-3}	2.159×10^{-3}	4.307×10^{-3}
10	Kuliyapitiya	10.007×10^{-3}	4.489×10^{-3}	3.535×10^{-3}	18.031×10^{-3}

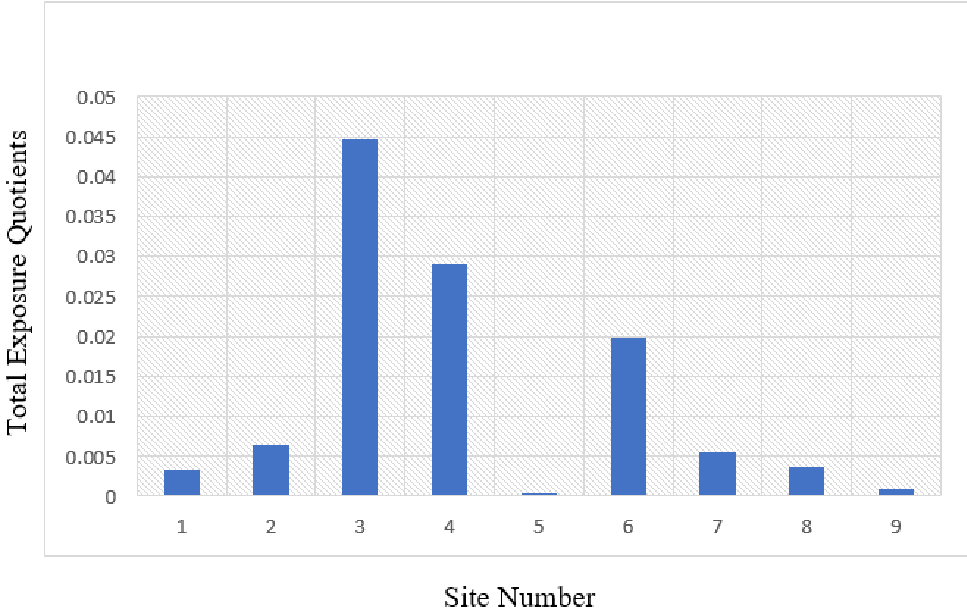

Figure 03: The graph of TEQ value of each city

The above figure shows the graphical representation of the TEQ. In that bar chart, horizontal axis represents the site number and vertical axis represent the TEQ.

The highest exposure level is at Gampaha railway station site. However, the total exposure quotient is below the standard hence public is safe even in Gampaha.

There are many advantages of this newly designed indicator device. The frequency and the signal strength (readings) can be given to the device using keypad. Because of that device can be used to measure safety of RF exposure level for necessary frequency range individually. It is a cost effective and a portable device. It can easily be charged without removing the battery form device and it can be used even though the device is in charging.

Because of the time factor, in a certain location, the measured values were saved in spectrum analyzer and analysis part done at the end.

4. CONCLUSION

The purpose of this project is to measure the RF radiation due to the mobile base stations in different locations and create an exposure level indicator device. When considering the field measurement, the highest exposure level was at Gampaha. Even at Gampaha, TEQ was 0.2338 and this exposure value is below the FCC specified safety standards. Hence, it can be concluded that the general public who live in that cities are safe from the RF radiation due to the mobile base stations according to the field measurement. The indicator device works properly and it can be used to measure the safety of RF radiation at the survey time. This device is low cost, hand held and can be easily access and modify.

This research value can be used for various purposes; if the network providers need to build base antenna or increase the signal strength they must consider about the exposure level. Such information may be valuable for a national authority developing guidance or legal restrictions. This research method can be used to find RF exposure level in all around the country, not only for the mobile signal but also for FM, TV etc.

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