DESIGN AND IMPLEMENTATION OF MOBILE BASED DEVICE MONITORING SYSTEM

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DEDICATION

This report is dedicated to Almighty God, for his love, guidance and blessing through my stay at the university, to my dearest Father Mr. GANIYU AFOLABI and my mother MRS. FUNMILAYO AFOLABI who made my academic succession a reality through their moral inspiration and financial support.

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CERTIFICATION

This is to certify that this project, the entire design and construction of the mobile based device monitoring system was carried out and submitted as true work of AFOLABI RIDWAN ABIODUN of matriculation number EEE/13/1095 under the supervision of Engineer G.K.Ijemaru of the Department of Electrical and Electronics Engineering, Federal University Oye Ekiti, in partial fulfilment of the requirements for the award of Bachelor of Engineering in Electrical and Electronics Engineering.

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ABSTRACT

This project present the design and construction of a mobile based device monitoring system which help in monitoring environmental temperature and the electricity status (ON or OFF) of a prescribe areas. The temperature monitoring section of this design utilizes the digital temperature sensor which comprises of LM35 sensor with LCD display for showing the change in temperature, also the electricity monitoring part of this project utilizes the Relay system for indicating the changes in electricity status either ON or OFF state. The monitoring components does finally gives their status condition report to the GSM module through microcontrollers, and the GSM module unit relate the conditional status report to the users through notification form (SMS alert and Phone call). The monitoring system is powered directly from the electricity source and also with rechargeable 12V batteries for backup while electricity source is not available.

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LIST OF ABBREVIATONS

SMS	Short Message Service
LCD	Liquid Crystal Display
GSM	Global System for Mobile Communication
AT	Attention

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CHAPTER ONE

1.0 INTRODUCTION

A mobile based device monitoring system is an electrical circuit project designed for monitoring and controlling electrical behavior of electrical machines and devices (analog & digital) situated within offices, homes, industries, engineering workshops, generating stations and transmission stations which is not convenient or health wise friendly for operator or workers to monitor manually. Remotely, the system allows the users to effectively monitor the machines and appliances via the mobile phone set in a way that the monitoring system itself will signal the user's phone number by calling and SMS form if there is a deviation in monitoring status. Earlier data loggers are used to monitor temperature manually. This project was designed and develop with a wireless communication link to monitor and control machines and other electrical gadgets that are far away from the user, also develop a high security system to keep a check on them. In an industry, during certain hazards it will be very difficult to monitor the parameters through wires and analog devices such as transducers. Embedded system plays a vital role in this design. The authors in [1] regard microcontroller as a single-chip with special purpose in computer dedicated to execute a specific application. As in general-purpose computer, microcontroller consists of memory (RAM, ROM, and Flash), I/O peripherals, and processor core. However, in a microcontroller, the processor core is not as fast as in general purpose-computer, the memory size is also smaller. Microcontroller has been widely used in embedded systems such as, home appliances, vehicles, and toys. It is a user-friendly application system. GSM plays a key role for transmitting and receiving the data from the user. The main advantage of this concept is the real time direct measurement of the parameter through GSM technique. The stoppage and accident caused by increase in temperature can be avoided. The data logger was done through manual measurements from analog instruments such as thermometers and manometers. For today's technology, this type of data logger can't fulfill time and accuracy. In later stage of development, it has been found that microcontrollers (integration of microprocessors and certain peripherals including memory on single chip) are more reliable as well as efficient. Use of microcontrollers in embedded design is not only increased but brought a revolutionary change.

In [2], the authors introduce the design of a room monitoring system which uses wireless sensor module with optimal communication conditions, it has a ZigBee communication module and a sensor module. A sensor module has various sensors that monitor temperature,

humidity and atmospheric pressure. Indoor air quality in a room or an office can be monitored and efficiently controlled by a ZigBee module. We can monitor sensing information from terminal PC modules that are attached to the wall of an office or a room. As we know, it is very difficult to monitor and control electrical parameters through wires and simple gadgets. Through utilization of microcontroller, Observing and controlling of physical parameters are especially viable in enterprises. Therefore, Embedded System plays an important role. The fundamental favorable position of this idea is the real-time direct estimation of the parameter through GSM strategy. Here, the temperature is checked specifically which at the same time shown in the LCD and can be sent as a message by GSM strategy. The monitoring and controlling of these electrical devices is done with the use of electronics components like GSM phone, modem, sensor, micro-controller and the rest of the components.

1.1 BACKGROUND OF THE PROJECT

In today's fast changing world, everything is becoming compact, portable and mobile. The mobile handsets for communication are the highest advancement in the area. These have made our lives much simpler and connected, almost everyone is familiar with its usage. It uses time division multiple access technique (TDMA). GSM digitizes and compress data, then send it down a channel with other streams of user data, each in its own time slot. It operates at either the 900MHz or 1800MHz frequency range. GSM provides with Subscriber Identity Module (SIM) to every user. It is a detachable card which identifies user's account to the network provider authentication, which allows appropriate billing. The unique roaming features of GSM allows cellular subscribers to use their services in any GSM service area in the world in which their provider has a roaming agreement.

In [3], monitoring is employed in various applications including temperature, pressure, flow rate, capacity, acceleration, and so on. According to the quantities, distribution and detected frequency of the monitored objects, there are different monitoring methods to acquire the measurements. The authors in [4] discussed on several problems that usually occur during the monitoring process of the temperature in a room. For example, a server room must be kept between 15 to 20 degree Celsius to monitor the temperature or else the server might crash and can cause a loss of hundreds thousands. Management have to choose either to place a person to monitor the temperature, or to save human capital by developing a system that can monitor the temperature from other places at any given time. In order to solve the problem, the web-based temperature monitoring system that can be access anywhere and anytime through the

internet is build. With this system, a user can remotely monitor the room temperature from anywhere which will save the human expenses. The monitoring system is widely used in various processes like in automotive industries, air conditioning, power plant and other industries that need the data to be saved and analyzed. The idea behind this project is to utilize the mobile nature of communication and application provided by GSM technology, namely SMS, SMS stands for (Short Messaging Service) to link the designed hardware project to the user or operator mobile phone for monitoring and controlling of the electrical devices situated at home or workplace digitally. The GSM modem is a wireless modem that works with a GSM wireless network. As the name specifies, it enables the mobile users to interact all over the world at any time. It is a hardware component that allows the capability to send and receive SMS from the system. Apart from supporting voice calls, a mobile phone can be used to send text messages as well as multimedia messages (that may contain pictures, graphics, animations, etc). Sending written text messages is very popular among mobile phone users. Instant messaging, as it is also known, allows quick transmission of short messages that allow an individual to share ideas, opinions and other relevant information. I have used the very concept to design a system that acts as a platform to signal and receive messages which in fact are commands sent to control different appliances and devices connected to the platform. The application of this system is immense in the ever changing technological world. It allows a greater degree of freedom to an individual whether it is controlling the household appliances or office gadgets. The need to be physically present in order to control appliances of a certain location is eliminated with the use of this monitoring system. In the near future, all electronic appliances at home will be networked: PCs, telephones, stereos, refrigerators, and even washing machines. Heating and air conditioning, previously controlled by a single, fixed, manual thermostat, can now be managed by an intelligent controller with remote access capabilities.

1.2 PROBLEM STATEMENT

Lots of electrical devices have been damaged by lack of proper monitor due to the use of human as the monitoring system itself, these causes increase in rate of destruction of devices in industry or organization that rely on the use of manpower for monitoring its machines and other electrical appliances. This project target to drastically minimize destruction of devices which occur due to high temperature which is not conducive for electrical devices operation and proper monitoring of electricity ON and OFF stage with instant signaling notification to the users contact programmed in its system.

1.3 MOTIVATION

With the increase in technology advancement in this 21st century, a lot of electronics project design have been constructed to help human in one way or the other. This improvement in fast growing technology motivate me to think of how to reduce the use of man power in monitoring ON and OFF stage of electricity in workplaces that deals with steady use of electricity for good conditioning of their product, also to know real and actual temperature of their product housing even in their absence.

1.4 SIGNIFICANCE OF THE STUDY

This project will help to enlighten public and private companies, industries and workplaces about the advantages of technology in reducing the use of manpower where it's not actually needed and how technological projects helps in boosting their equipment life time.

1.5 AIM AND OBJECTIVES

The aim of this project is to design and construct a Mobile-based device monitoring system.

The objectives are:

1. To design an electronic circuit system that will monitor the ON and OFF stage of electricity in a way that the users will be notify through text message and phone calling to eliminate stationing a workman in the building at all time.
2. To make the same circuit to monitor the temperature rising level of electrical devices in a workshop or other applicable places which is hardly done manually with human sensing.
3. Also, to sense and signal if there is an electrical burn in any part of the electrical connections or circuit with the aid of smoke detection in the project design.

1.6 SCOPE OF PROJECT

The project work is complete on its own in SMS and mobile phone calling notification of any electrical devices abnormal temperature, smoke occurrence due to electrical components burn and ON and OFF stage of electricity in the installed monitoring areas. This designed project gives a specific and precise location of the said abnormal devices area in the building and does relieve stressing the operator in search of where the abnormal signal come from in the whole building during a rise in temperature or fire outbreak. Also, feedback message indicating the new present state of the electrical devices or automatic detection of fault in the particular electrical device.

1.7 PROJECT OUTLINE

The entire project is composed of five chapters, each covering a section of the work as summarized below:

- Chapter one gives an introduction to GSM mobile system, scope, background, aim and objectives, statement of problems and motivation of the whole project.
- Chapter two covers an extensive literature review of previous works on mobile based monitoring system, the platform over which mobile based monitoring system can be implemented.
- Chapter three highlights the project methodology, comprehensive details on both hardware components and communication service used.
- Chapter four is on the project design and implementation with clear practical details of the project design, construction, testing, microcontroller coding and debugging.
- Chapter five is on the conclusion and recommendation based on the project work with emphasis on the reliability, maintainability and flexibility of the design. Also, recommendation based on the challenges encountered and further possible development of the project work are enumerated.

CHAPTER TWO

LITERATURE REVIEW

2.0 INTRODUCTION

Recently, there have been great improvements and innovations in information communication technology. This leads to a lot of designs and construction of different monitoring system assigned to monitor certain features of electrical devices and machines in workplaces and homes. This mobile based device monitoring system is design and assigned to monitor temperature and electricity supply in workplaces. Various researches have been done in the direction of this project, we review some previous work on mobile based device monitoring system.

2.1 RELATED WORKS

The authors in [5] described a design of monitoring system which was assigned to monitor Temperature using GSM Technique in form of SMS notification to the users. GSM modem is used to send and receive SMS through AT commands. At the transmitter side, the user sends an SMS to the GSM modem using AT commands. LM35 is an integrated circuit sensor that was used in this design to measure temperature with electrical output proportional to the temperature. The LM35 sensor is connected to PIC microcontroller and varying temperature is sent to GSM modem, which is simultaneously displayed in LCD. The temperature which is continuously monitored by using temperature sensor exceeds a particular level, then SMS is sent to particular mobile as an indication for avoiding damage or accidents. The limitation in this design is limiting the notification scheme to Short message service (SMS) which the user can only access when he or she check the inbox on the GSM mobile phone. Also, the monitoring system is only powered when been plugged to electricity source. The limitation in their project is being taken care of in this project by the introduction of phone call notification and self-powering source with the use of rechargeable 12V batteries which extend the duration of the monitoring system.

In [6], the authors designed a GSM Based Water Level and Temperature Monitoring System (WLTMS). It detect the water level of the tank which is connected to the industry also monitor the temperature of the tank. For this purpose, the monitoring system used LM35 sensor which defines the parameters of the temperature sensor. Analogue output of LM35 is amplified through a process of signal conditioning, where OP-741 is used to amplify the signal. Amplified signal is fed into an ADC for the sake of digital data. This digital data is transferred to an LCD for displaying result. PIC microcontroller is used for this procedure. Modem is also

connected to this controller for the wireless communication of the data through GSM technology by receiving an alert through SMS. A series of tests were organized and we found the system working properly. But delay in receiving SMS can occur due to detecting the circuit and the programming of PIC. The limitation in their project is being taken care of in my project by using the latest SIM900 circuit board which receive and deliver roaming signaling without any circuitry delay.

Authors in [7] proposed the design and implementation of a Microcontroller-Based Room Temperature Monitoring System using Atmel ATmega8535 microcontroller and National Semiconductor's LM35 temperature sensor. The system is equipped with a Wavecom GSM modem to send and receive text message (SMS) and relay board to control electronic equipment. The experiment results show that the system works as expected. The system raises an alarm and send an alert message to administrator when the room temperature is above threshold, which is 28°C.it uses Atmel AVR ATmega8535 microcontroller and LM35 temperature sensor as the main components of the system. Liquid Crystal Display (LCD) and buzzer are used to display the server room temperature and as an alarm, respectively. In order to alert the server administrator, the system is equipped with a GSM modem to immediately send text message if the server room temperature is above a predefined threshold. The only limitation in this project is the issue with power which cannot be neglected, the project can only work when there is Alternating current and voltage (A.C current supplied from electricity). This limitation is been taken care of in my project by providing another alternative power source with the use of two (2) 6v (DC Direct Current) cells which are rechargeable to increase the reliability of the monitoring system.

In [8], the authors designed a Monitoring System for Temperature of Electric Cable Interface in Power Transmission, Based on Atmel AT89C51 Microcontroller. The system consists of a central PC machine, host control machines, and temperature collectors. Several temperature collectors are connected to a host control machine through RS-485 communication network, and the host control machine communicates and exchanges data with the central PC machine using General Packet Radio Service (GPRS) connection. The temperature collector itself consists of sensor temperatures (Maxim's DS18B20, 1-wire digital thermometer), decoders, and other circuits for interfacing purpose. Each temperature collector saves the temperature in SRAM and sent the temperature information back to the host control machine when requested. Each host control machine also stores this temperature data in its memory (SRAM), and send it back to the central PC machine when requested. In this system, the communication using RS-

485 network is limited by cable length (1200 meters). This design has a limitation which is that the administrator only read the level of temperature on the control PC only when he or she is present in the control room. This limitation is been taken care of in my project by incorporating GSM module circuitry to notify a number of users the situation of the temperature level through phone call and SMS notification form.

The authors in [9] designed a Wireless Temperature Monitoring System for Industrial Application. The temperature sensor detects the surrounding temperature before transmitting it to a receiver. At the receiver, the temperature will be displayed on a liquid crystal display and portable computers for ease of monitoring. In order to ensure the robustness of the system, the device has been tested in various environment and obstacle. The result shows that the device can accurately sense and monitor temperature with excellent accuracy. The application of temperature data acquisition and monitoring for a sensor network using ZigBee. This project uses a thermocouple as a sensor input, where it is connected to a cold junction compensator amplifier. After passing through an amplifier, the signal is fed into an analog to-digital converter (ADC) port at the ZigBee module. The temperature data will be transmitted using Zigbee protocol to a personal computer (PC) at a rate of four samplings per sec. the sensor detects the temperature and triggers the alarm when the temperature is too high or too low and sends the data wirelessly to the main serve. The temperature can only be monitor when the user or administrator is with the control PC. This limitation is been taken care of in my project by incorporating GSM module circuitry to notify a number of users the situation of the temperature level through phone call and SMS notification form. Also, my project was designed to monitor more than temperature in workplaces with its ability to monitor electricity ON and OFF status.

In [10], the authors designed a Temperature Monitoring System Based on Hadoop and VLC. The system includes two parts: temperature acquisition and temperature monitoring. Temperature acquisition section uses visible light communication to transfer temperature data. In the test for temperature acquisition, we used a CMOS camera to receive the temperature data of 20 nodes in the range of 40 meters, which realized efficient transmission of data. The main body of temperature monitoring section is the Hadoop cluster. Hadoop and its components enable distributed storage and remote monitoring for massive temperature data. Hardware environment of Hadoop is composed of six computers and the software environment is CentOS6.4 operating system based on the Linux 2.6 kernel. In the test of temperature monitoring, we monitored 200 rooms with 1000 temperature sensors in 10 floors totally.

Visible light communication is a wireless communication technology using the visible light spectrum from 380 to 780nm. Since the signal of VLC is the same as natural light, it does not have harmful effects. VLC have unlicensed visible light spectrum more than 300THz bandwidth to use, transmitters for VLC are high-speed flashing light sources and the most commonly used light source is the LED. The temperature can only be monitor when the user or administrator is situated with the control PC, SMS and phone call notification scheme was incorporated in my design to eliminate this limitation in this design.

In [11], the authors designed a Microcontroller Based Temperature Monitoring and Controlling System. This project incorporates the design and development of a temperature monitoring and controlling system using microcontroller and LCD. The main target for this system is to have it designed and implemented such that it is cost-effective, this design consists of two modules: one is the temperature monitoring and the other is the temperature controlling. The temperature sensor senses the temperature and the inbuilt ADC in the microcontroller produces corresponding analog signal which is further processed by the microcontroller and the temperature is displayed in the LCD. The user's temperature requirement is given in the form of a set point and the microcontroller then compares the ambient temperature against this set point and further necessitates the controlling action using relays. If the temperature goes above the set-point then the cooler goes on and if the temperature goes below the set-point then the heater is switched on. Microcontroller ATMega328 is used as the heart of this system which holds the monitoring and controlling program and the temperature is displayed on an LCD screen. For controlling the temperature, relays are used which are connected to a heater and a cooler. Here, the limitation is that the monitoring system has no notification form other than display screen of the LCD. This limitation is being taken care of in my project by incorporating phone call and SMS notification scheme which makes the system more digital in nature.

In [12], the authors explained the Real Time Hardware Design to Automatically Monitor Light and Temperature. In this design construction, temperature and light monitoring is done with the help of two sensors and displayed on an LCD screen and the desired values of temperature and light are set with the help of provided keypad. They have used PIC microcontroller and an ADC 0809 for analog to digital conversion for their system. In our system, we have used ATMega 328 microcontroller which has an inbuilt 6 channel 10 bit ADC. The desired set-point in this system is given through a potentiometer.

The authors in [13] considered using Microcontroller AT89S52 which is a 40 pin IC for Monitoring and Controlling Temperature and Light. In this system microcontroller AT 89S52 is used which is a 40 pin IC. The temperature measurement and light intensity from the channels of ADC 0809 are taken. The performances of the channels are distinguished on the basis of its accuracy. The accuracy indicates how accurately the sensor can measure the actual and the real world parameter.

In [14], the authors worked on Temperature Monitoring and Logging System Suitable for use in Hospitals incorporating GSM Text Messaging. This monitoring system is design using ATMega16 helps to manage the temperature of a patient that is possibly critically ill in the hospital or to monitor the operations of other hospital operations such as preservation of food, drugs, etc. The major limitation in this design is that the accuracy of the measured value may have an error of ±0.5 C which needed improvement by improving ADC resolution. Also, the LM35 sensor needed to be attached to the body of the patient which has been found to be very inconvenient. The improvement on this limitation was done by using an updated digital temperature sensing devices which has precise temperature reading rate.

In [15], the author described the implementation of a Temperature Monitoring System using a microcontroller with a high-level language. This Project is about the measurement of temperature using an analog temperature sensor and a serial A/D converter circuit. A low-cost PIC microcontroller is used with a digital display. The microcontroller is programmed using a high-level programming language. The operation of the temperature measurement system is very simple. Analog temperature is sensed by the temperature sensor. This temperature is then converted into digital format by the A/D converter. The microcontroller receives this data and displays the temperature on 3 digital displays. The above process is repeated every second. PIC Basic Pro [8] language is used for the program development. This is a very powerful PIC microcontroller high-level programming language, developed by the Micro Engineering Labs, Inc. This designed system has a limitation of no notification means but only display the temperature level on the LCD screen. This limitation was taken care of in my project by incorporating two notification system into my design (SMS and Mobile phone signaling).

In [16], the author present an Energy-Efficient Remote Temperature Monitoring System for Patients Based on GSM Modem and Microcontroller. This study presents a real-time remote monitoring system (RTRMS) for the temperature of patients admitted to hospitals. A GSM modem was interfaced with microcontroller PIC16F877A to alerts physicians in real time via

short message service (SMS) in emergency cases when the temperature of a patient rises. A sleep/wake energy-efficient algorithm has been implemented inside the microcontroller to reduce the power consumption of GSM and microcontroller. The microcontroller and GSM modem can be in a sleep mode when the temperature of a patient is steady. Consequently, power consumption can be improved and battery lifespan can be prolonged for RTRMS. The proposed system is a real-time monitoring, applicable, cost-effective, and efficient means for transmitting information because it utilizes the advantages of the infrastructure of GSM network and features a ready mobile device connected with physicians.

The author in [17] worked on implementation of Monitoring Environmental Parameters such as Humidity and Temperature using Arduino Based Microcontroller and Sensors. The work was successful in building a monitoring device which works as a thermometer for measuring temperature and humidity inside a building, it is capable of measuring humidity and temperature outdoor. Compared to expensive sensor, the Arduino-based monitoring system successfully reduces the power consumption, cost and complexity of the process. The performance of the system was accurate and reliable with some error in measurement and limitations of the used sensor. The limitation was taken care of in my design by using updated digital measuring devices while constructing the monitoring system.

In [18], the authors opined on how to program a Microcontroller and Build PC Software which Communicates with the Microcontroller, send commands to the microcontroller and receive data from a sensor. As a platform for the microcontroller we used the Arduino UNO R3 development board which is the most popular and documented product of the whole Arduino family. The Arduino UNO is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins, 6 analog inputs, a USB connection, a power jack and everything needed to support the microcontroller. For the scope of this project we used the Arduino UNO to control the MCP9808 digital temperature sensor, with a typical/maximum accuracy of ±0.25°C/±0.5°C over the sensor's -40°C to +125°C range. We used the Arduino IDE software to write the code for the microcontroller and uploaded it to the board. For the PC software we used the Visual Studio Community edition and wrote a windows form application in C# which communicates with the Arduino UNO via the COM port.

The authors in [19] designed a Smart Sensor Network for Indoor and Outdoor Air Quality Monitoring. In this system sensor nodes are installed in different rooms and it consist of tin dioxide sensors which was hardwired or wirelessly connected to the central unit. It also

measure the concentration of temperature and humidity for accuracy. In this the concept of multiple

input single output neural networks was implemented to compensate temperature and humidity influence on gas concentration. Wi-Fi technology was used for communication. The only limitation in this project is the issue with power which cannot be neglected, the project can only work when there is Alternating current and voltage (A.C current supplied from electricity). This limitation is been taken care of in my project by providing another alternative power source with the use of two (2) 6v (DC Direct Current) cells which are rechargeable to increase the reliability of the monitoring system.

In [20] the authors worked on Environment Monitoring System and Energy Efficiency. Environment monitoring is one of the major application of wireless sensor network. WSN consist of different sensors which are widely distributed to monitor different environment parameters like temperature, humidity, gases, pressure, wind speed etc. WSN consists of sensor nodes which are low cost devices with limited power. Energy efficiency is the biggest problem when these sensors are used for large scale environment monitoring as the sensors are battery powered. Therefore it is necessary to improve the energy efficiency of monitoring system. Several techniques are used to improve the energy consumption. The only improvement on this project was making the system to monitor additional parameter which is electricity ON and OFF status.

[21], described the Design of Remote Temperature Monitoring System Using LM35 Sensor and Intimate Android User via C2DM Service. This designed construction presents an embedded wireless sensor network for remote room temperature monitoring. This network is used for management of fire rescue operations. It give the Android registered user freedom to continuously monitor the remote room temperature and in this way it provides better fire controlling technique. The system provides an android user interface for registered user to access the current temperature and a flash/beep message in case of fire. LM35 sensor sense the remote room temperature and temperature status is transmitted to the smart phone via GPRS. Remote room temperature data transfer between the smart phone and application server that is connected to temperature sensor via USB cable is done using Google's C2DM service. The application server which analyzes the temperature data, then inform a registered user for taking proper action in case of fire. This work is used for monitoring of remote room temperature. Thus provides opportunity to quickly respond to fire emergencies. They lack the capability of providing temperature information when GPRS connection is not made on application server

as well as on Android user's handset. The system is limited to SMS alert alone, this limitation was improve by notifying the users through mobile phone calling in addition to the SMS means. Also, by making the monitoring system to monitor not ordinary temperature alone but also electricity status in the building.

The authors in [22] worked on Temperature, Humidity, Monitoring and Control System Based on Arduino and SIM900A GSM Shield. This design represents the Wireless Sensor (WS) data communication using DHT11, Arduino, SIM900A GSM module, a mobile device and Liquid Crystal Display (LCD). Experimental setup includes the heating arrangement of DHT11 and transmission of its data using Arduino and SIM900A GSM shield. The mobile device receives the data using Arduino, GSM shield and displays it on LCD too. Heating arrangement is used to heat and cool the temperature sensor to study its characteristics, this project to monitor data through wireless sensor network for measurement of temperature and humidity. All the measured data is transmitted from the site to the mobile device (control station) through SMS. The experimental setup includes temperature and humidity sensor (DHT11), LCD, SIM900A GSM Module. Microcontroller is used in my project in place of the Arduino so as to reduce cost and complexity of the monitoring system.

In [23], the authors proposed a Microcontroller Based Digital Thermometer with Timer (Digithermo). A microcontroller based digital thermometer with timer (DigiThermo) was designed and constructed. The device employs the AT89C4051 CMOS microcontroller (MCU), interfaced with the CA3162 ADC and a 16 x 1 character LCD display. Temperature is measured with a precision IC linear temperature sensor (LM35D) and time is counted using the MCU"s timer circuits. The circuit was assembled on a prototype board, tested, modified and finally assembled on a set of matrix boards, and cased in a portable, stylish plastic casing with the sensor attached to a 28.0 cm long probe. Results during testing showed that the device displays time count in seconds and temperature in degrees Celsius. The device can be used in the chemistry and engineering laboratories as well as in industrial, agricultural and in other applications requiring simultaneous temperature/time measurements. Improvement on this great design is by incorporating extra monitoring scheme in my design which does monitor electricity and temperature simultaneously.

The author in [24] worked on Intelligent Temperature-cum-Humidity Monitoring Device. This designed system can be used for alarming the user via short message sending (SMS) in the wake of a criticality of an event which is predefined by the user. The system can also be used

to log data in a remote computer. Any deviation or change in the environmental controlled conditions can lead to financial loses in agricultural and pharmaceutical industries and can be life threating to the users of biomedical industries. By the alerting the user in immediately this loses can be prevented. Wireless system using ZigBee was implemented so as to reduce the complexity of the device during handling. The ZigBee module which consists of a transmitter and receiver was utilized to record data to the monitoring station from the sensor. Additional GSM module was used to alarm the user in the wake of a critical event. To build an intelligent temperature-cum-humidity sensor the temperature and the humidity measuring sensor (DHT11) sensor was used. The Arduino development board was used acquired the signal provided by the DHT11 sensor. If there is any deviation in the neighboring environment of the sensor the measured parameters being temperature and humidity. If the preset range parameters gets out the GSM module is activated for sending messages. A mobile number is already predefined in the Arduino program. The GSM module send this messages to the mobile number mentioned in the program as soon as the GSM module is activated. The next message will be send only after 10 minutes. This is a brilliant design but it was limited to SMS alert and also 10minutes delay after first temperature notification. GSM phone call is an improvement to support the notification system, the delay was corrected by making use of updated devices like SIM900 while constructing the system.

In [25], the authors designed an Embedded Based Temperature Monitoring System. This project is designed to monitor the temperature of any devices or any place. The system is developed using DS1621 temperature sensor, AT89C52 microcontroller and LCD. The output of temperature senor is fed to the microcontroller which converts it to an appropriate digital value according to the set of pre-defined values stored in its memory and displays it in the LCD. This system is designed to monitor temperature from -550C to 1250C.Real time temperature measurements ensure that today's smaller and faster systems operates in the safe thermal zone. Hence this system is useful for the industries to monitor temperature during manufacturing process, for calibrating thermostats and it can also be used as fire warning system by using a buzzer.

The author in [26] proposed a Temperature Monitoring System. In this project, Visual Basic 6 was used as the interface to display the temperature data, it will use two circuit that is Temperature Control System using LM 35 with Serial Interface Circuit. The main component in Temperature Control System using LM 35 consists of PIC Microcontroller which was used to control the operation of the circuit, Temperature Sensor to sense the temperature, LCD

display that will display the temperature that has been sense by the Temperature Sensor. The Serial interface circuit will consists of IC MAX 232. This circuit connect between PIC with the PC by using serial cable RS232. At PC, by using Visual Basic 6 the temperature will display temperature data and this can be used to monitor. The data also will be store for further action and also as the reference to make a maintenance and to know the machine performance from time to time. The limitation in this project is that the temperature level was designed to be send to the administrator PC and not his or her mobile phone. This limitation was taken care of by designing the monitoring system in a way that it notify the administrator through his or her mobile phone using SMS and phone call.

In [27], the authors worked on Application Research on Temperature WSN Nodes in Switchgear Assemblies Based on TinyOS and ZigBee. This project discusses the application of temperature data acquisition and monitoring for a sensor network using ZigBee. This work uses a thermocouple as a sensor input, where it is connected to a cold junction compensator amplifier. After passing through an amplifier, the signal is fed into an analog to-digital converter (ADC) port at the ZigBee module. The temperature data will be transmitted using Zigbee protocol to a personal computer (PC) at a rate of four samplings per sec.

In [28], the authors worked on Design of Wireless Monitoring and Warning System for Protection of Agriculture Environment. This report discusses remote monitoring for agriculture using a wireless sensor and short message service (SMS). This system sends SMS messages to the farmer when the farm's temperature is either too high or too low.

The authors in [29] designed a 5.1-μW UHF RFID Tag Chip Integrated with Sensors for Wireless Environmental Monitoring. The wireless temperature monitoring system discussed in this design uses an active RFID-based system to collect data from locations worldwide. In this project, the sensor detects the temperature and triggers the alarm when the temperature is too high or too low and sends the data wirelessly to the main server. The monitoring system only send collected data to the main server which only permit the server administrator to know the temperature status when he is present at the server room. This limitation was fixed in my project by allowing the server administrator and other workers to be inform with the temperature level through SMS and phone call notification scheme.

In [30], the authors worked on Wireless Monitoring System for the Greenhouse Temperature and Humidity, to achieve wireless intelligent monitoring of the temperature and humidity in the greenhouse. In this system, data is firstly collected through temperature and humidity

sensors. After data preprocessing, it is transferred to the ZigBee Coordinator via ZigBee end-node through ZigBee network. Through the RS485 bus, ZigBee Coordinator sends the packaged data to the host computer. Monitoring and control software is run in the host computer to make real-time display of environment parameters collected from each node and store them for historical queries. The hardware of this system is mainly made up from three parts: data collection circuit, wireless data transmission circuit and data communication interface circuit. The main duty of data collection sub-nodes is to collect and preprocess the data of environment parameters, and then to send it to the coordinator.

The authors in [31] worked on Microcontroller Based Temperature Monitoring and Closed Loop Control to study the reaction of controlled variable with respect to load changes. The project was aimed at designing 8051 microcontroller based temperature control system to study the reaction of controlled variable with respect to load changes. The process temperature under control is measured using RTD. Then using a microcontroller and suitable software, this instantaneous value of temperature is compared with the desired temperature. The resulting error has been used by the microcontroller to control the firing angle of a TRIAC for controlling the power applied to the heater. The trigger pulse for the TRIAC is delayed by the microcontroller to provide the required voltage to be fed to the heater to get the desired temperature. Thus a continuous closed loop temperature monitoring and control has been achieved. There was no mobile notification in their project which was taken care of in my project.

In [32], the authors proposed on Design and Construction of Condition Reporting System Based on GSM Technology for Power Station. This project describes a condition reporting system of Power plant components using GSM technology. Most of the reporting systems commonly used in Myanmar are manual. The objective of this project is to transform manual system to automated reporting system with the help of GSM technology, there are three portions in automated reporting system. They are GSM modem system, microcontroller system and sensing system. A dedicated microcontroller based hardware unit (DHU) has been developed to continuously measure the parameters of the viz. voltage, current and temperature of generation of the alternator to monitor the running condition of it also. Other than the generator there are subsystems which also need continuous monitoring. In this monitoring system equipment is connected with one such DHU which is also connected to a Global System for Mobile Communication (GSM) modem. This system is mainly constructed with PIC 16F877A and GSM modem. PIC 16F877A is mainly used as control unit. Three sensors are

mounted in power station and its surrounding. The three sensors sense the voltage, current and temperature and the sensing data are sent to PIC. PIC receives the sending data and checks overload or not according to the programmable. The three sensors are Voltage Level sensor, current level sensors and Temperature sensor. Initialization the microcontroller is operated and the sensors sense the data. If the over voltage or under voltage are occurred in the operating time, the microcontroller close the circuit and then one message is sent to the user mobile phone from the GSM modem.

The authors in [33] worked on GSM Based Remote Patient Monitoring System. The authors presented the methodology for monitoring patients remotely using GSM network & Very large scale integration (VLSI) technique. Patient monitoring systems consist of equipment, devices and supplies that measure, display and record human physiological characteristics, including blood pressure, body temperature, heart activity, various bodily substances (e.g. cholesterol, glucose, etc.), pulse rate, respiration rate and other health-related criteria. A patient monitoring system for providing continuous monitoring of a patient includes a data acquisition and processing module receiving physiological data from the patient This unit may be inserted in a bedside display unit to display the physiological condition of the patient. The major reason for the development of the said system is to reduce the product size, power consumption & cost of the system. The remote monitoring & control of the physiological parameters can be obtained by interfacing GSM mobile unit with the patient monitoring system.

In [34], the authors designed a GSM-Bluetooth Based Remote Monitoring and Control System with Automatic Light Controller. The authors explained the systems based on existing technologies and also proposes a GSM-Bluetooth based light controller and remote monitoring system. This system has simple features designed with the objective of minimum power consumption using infrared sensor for controlling lights, fans and other appliances which are controlled via SMS using a GSM module. A Bluetooth module is also interfaced with the main microcontroller chip. This Bluetooth module eliminates the usage charges by communicating with the appliances via Bluetooth when the application is in a limited range of few meters. The system informs user about any abnormal conditions like intrusion detection and temperature rise via SMS from the GSM module or by Bluetooth module to the user's mobile and actions are taken accordingly by the user.

The authors in [35] proposed the Design of a Room Monitoring System for Wireless Sensor Networks. They designed a wireless sensor module that uses a designed ZigBee

communication module, a sensor module that uses WSN for monitoring a room environment. Most of the system components were designed and fabricated for system optimization. We utilized an integrated sensor module consisting of sensors that are used in industry to check the atmospheric pressure, O2, CO2 concentration, and an imported ZigBee communication system. Using ZigBee technology of 2.4 GHz Industrial, Scientific, and Medical (ISM) band in the IEEE 802.15.4 standard, we could monitored the information from terminal PC modules that are attached to the wall of an office or a room.

In [36], the authors worked on Microcontroller-Based Remote Temperature Monitoring System. This design presents an efficient monitoring system, using microcontroller, which will monitor patient temperature remotely and send result to phones through Short Message Service (SMS) and Personal Computer (PC).The controller circuit was designed and interfaced to a sensor and thermistor and also interfaced inside with configured Single Inline Module (SIM) cards of phones to be connected. From the controller circuits, a system is interfaced with which would serve as Server, and from the server system, other system can be connected which would serve as Clients. The designed system was used to take temperature of different patients and it was ascertained that the result of our application gives accurate result when compared with clinical thermometer.

In [37], have proposed System to Control Air Temperature and Humidity Concentration in Greenhouses is described by means of simultaneous ventilation and heating systems by using Takagi-Sugeno (T-S) fuzzy models and the Parallel Distributed Compensation (PDC) concept. And showed that the robust fuzzy controller effectively achieves the desired climate conditions in a greenhouse, using this T-S fuzzy model, the stability analysis and control design problems can be reduced to sufficient conditions expressed as Linear Matrix Inequalities. Microcontroller is used in place of the T-S fuzzy models so as to reduce cost and complexity of the monitoring system.

In [38], the authors have compared the advantages of ZigBee with other two similar wireless networking protocols, Wi-Fi and Bluetooth, and proposed a Wireless Solution for Greenhouse Monitoring and Control System Based on ZigBee Technology. As an explorative application of ZigBee technology in Chinese greenhouse, it may promote Chinese protected agriculture. With the capabilities 7 of self-organizing, self-configuring, self-diagnosing and self-healing, the ZigBee based monitoring and control system provides nearly unlimited installation flexibility for transducers, increases network robustness, and considerably reduces costs. Therefore, they concluded that the ZigBee-based monitoring and control

system can be a good solution for greenhouse monitoring and control.

The authors in [39] have suggested a different approach for Implementing WSN in Greenhouse Environment by making use of a commercial wireless sensing platform provided by Sensinode Inc. The hardware design of the system consists of Sensinode's Micro 2420U100 operates as basic measuring node, with four commercial sensors (*e.g.* humidity, temperature, light and CO2). The idea behind this development is to test the reliability and feasibility of a prototype wireless

environment monitoring system in commercial greenhouse. The experimental result showed that the network can detect local difference in the greenhouse climate caused by various disturbances in the environment.

In [40], the authors worked on Embedded Greenhouse Monitoring and Control System to provide a highly detailed micro-climate data for plants within a greenhouse environment with an innovative method of growing temperate crops in a tropical environment using microclimatic conditions. The greenhouse was equipped with conventional wired sensors that provide readings of the air temperature, light intensity and nutrient solution temperature in the mixing tank. The acidity and concentration of the nutrient solution were manually measured, and adjusted accordingly, and high resolution data, collected with the deployment of a network of wireless sensors to provide sufficient data to develop a model for the growth of these crops under aeroponic conditions.

The authors in [41] have proposed a measurement device which is capable of detecting the level of temperature to develop a Remote Temperature Monitoring System Using Wireless Sensor and Short Message Service (SMS) Technology. This system also has a mechanism to alert farmers regarding the temperature changes in the greenhouse so that early precaution steps can take and testing several types. This extended to include more environmental variables to be monitored in

the agricultural greenhouse which relate to the increment of fruits and vegetables productivity.

In [42], the authors worked on Designed and Implemented of a WSN that can monitor the Air Temperature, Humidity and Ambient Light Intensity in Greenhouse. This can help farmers to understand the environmental conditions and they can adopt different methods to increase the crop production. The system is integrated with small size application specific sensors and radio frequency modules. All monitored parameters are transmitted through a wireless link to cellular device for analysis. A cell phone is used instead of computer terminal keeping mind that system will be used by farmers and considering power management.

In [43], the authors discussed and reviewed Wireless Sensor Network Applications for Environmental Monitoring. Development in the technology of sensor such as Micro Electro Mechanical Systems (MEMS), wireless communications, embedded systems, distributed processing and wireless sensor applications have contributed a large transformation in WSN recently. It assists and improves work performance both in the field of industry and our daily life.

Wireless sensor network has been widely used in many areas especially for surveillance and monitoring in agriculture and habitat monitoring. Environment monitoring has become an important field of control and protection, providing real-time system and control communication with the physical world.

The authors in [44] have designed a Hardware for Greenhouse Monitoring. Various sensors are used to control the environment. The parameters *e.g.* temperature, humidity, light intensity for green house and soil wetness for crop growth. The system comprises of sensor, ADC, microcontroller and actuators. When any of the above mentioned climatic parameters cross a safety threshold which has to be maintained to protect the crops, the sensors sense the change and the microcontroller reads this from the data at its input ports after being converted to a digital form by the ADC. The system has successfully overcome quite a few shortcomings of the existing systems by reducing the power consumption, maintenance and complexity, at the same time providing a flexible and precise form of maintaining the environment. The continuously decreasing costs of hardware and software, the wider acceptance of electronic systems in agriculture, and an emerging agricultural control system industry in several areas of agricultural production, will result in reliable control systems that will address several aspects of quality and quantity of production.

In conclusion, regarding which wireless technology is more superior, since the suitability of wireless technology is solely dependent on the application. For example, ZigBee wireless technology cannot be applied to high data implementations applications such as audio/video streaming and graphic web browsing because of their high bandwidth requirements. Bluetooth and Wi-Fi on the other hand are not suitable for battery powered applications of their high power consumption characteristics. For this particular design, GSM module of wireless technology was chosen for a number of reasons: it has very low power consumption, Low network complexity, it is designed for monitoring and control applications. Also, all the above reviews elaborate on temperature monitoring which makes my design superior with its additional electricity ON and OFF status monitoring ability.

CHAPTER 3

DESIGN METHODOLOGY

3.0 INTRODUCTION

The design and construction of a mobile based device monitoring system can be implement using so many techniques, based on so many related designs that have been carried out on this project. It was deduced that techniques such as using GSM module , ZigBee, Bluetooth module, Arduino system and different kind of sensors are used to achieve related goals. The readings can be read on an LCD Screen or on an android mobile app. Comparing different authors with the project been worked on, their major aim is to monitor Temperature system be it temperature, humidity, soil moisture etc. But different approach have been applied to get the desired goal which is an additional electricity ON and OFF status monitoring feature. Here are the fundamental units that form the Mobile based device monitoring system:

i. Power supply unit

ii. Detector unit

iii. GSM Module unit

3.0.1 REVIEW OF SOME FUNDAMENTAL CONCEPTS

3.0.1.1 POWER SUPPLY UNIT

This unit serves as power house and reservoir of electrical energy to the entire system. Here are some components that make up the power supply unit:

i. Transformer.

ii. Relay.

iii. Bridge Rectifier.

iv. Storage Battery.

TRANSFORMER

It is an electrical component that allow the flow of current from the current source to the rechargeable cells in this design. It does have the primary and secondary winding, if the transformer voltage is lower than battery voltage, the opposite situation will take place (the current will flow from the battery to transformer). Although the pass transistor in the circuit will not let this happen, neither the battery will be charged.

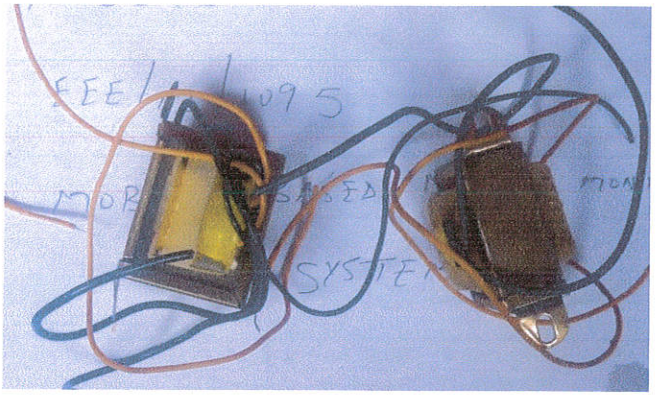


Figure 1. Transformer

SELECTION OF TRANSFORMER

In order to get a reliable DC power supply from the 220/240 V, a step down transformer of primary winding voltage of 240v and secondary winding voltage of 12v is used.

Transformer turn ratio calculations

Vp = voltage induced at the primary winding

Vs= Voltage induced at the secondary winding

Ns= Number of turn induced in the secondary winding

Np= Number of turn induced in the primary winding

$\frac{240}{12} = \frac{NP}{NS}\ Therefore\ \frac{NP}{NS} = 20$

Therefore the transformer has rated turn ratio of 20:1

RELAY

A relay is an electrical switch that uses an electromagnet to move the switch from the OFF to ON

position instead of a person moving the switch. It takes a relatively small amount of power to turn on a relay but the relay can control something that draws much more power. Single Pole Double Throw (SPDT) type of relay has three contacts. The contacts are usually labeled Common (COM), Normally Open (NO), and Normally Closed (NC). The Normally Closed contact will be connected to the Common contact when no power is applied to the coil. The Normally Open contact will be open (i.e. not connected) when no power is applied to the coil. When the coil is energized the Common is connected to the Normally Open contact and the Normally Closed contact is left floating.

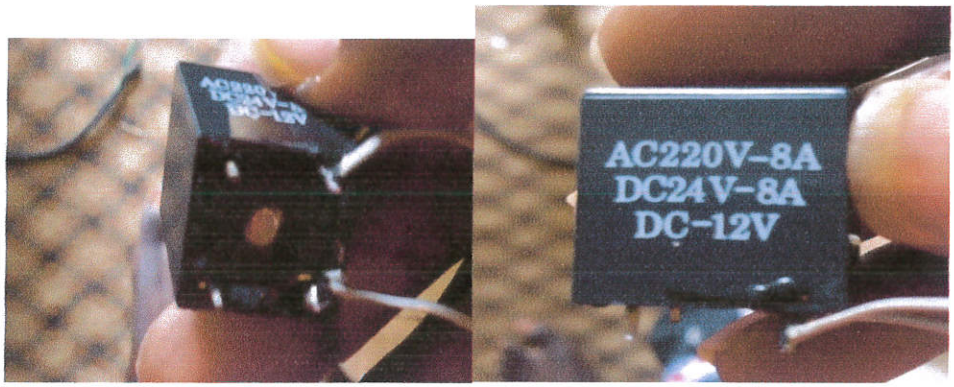


Figure 2. Relay

BRIDGE RECTIFIER

The conversion of A.C to D.C is known as rectification. The rectifier circuits comprise of either

diodes or thyristors. A rectifier is also known as ac-dc converter. It has 4 diodes connected in two cycles; positive half cycle and the negative half cycle. In the positive half cycles, two diodes say D3 and D4 are forward biased and conduct, while the remaining two diodes D1 and D2 are reverse biased and behave as open circuits. During negative half cycle, diodes D1 and D2 are forward biased and conduct while D3 and D4 are reverse biased and behave as open circuits.

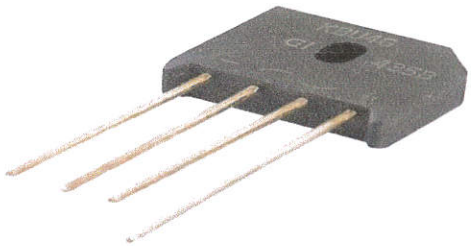


Fig 3. Rectifier

STORAGE BATTERY

A battery is an electrical device which is a combination of several electrochemical cells, used to converts stored chemical energy into electrical energy or vice versa for rechargeable batteries. A rechargeable battery is made up of several cells. When a battery is connected to

the load, energy stored in it gets utilized, this is known as 'discharging of battery'. The energy stored gets depleted after some time leaving a discharged battery. The battery can be given energy from an external source to restore its energy again in a process called 'charging of the battery'.

Fig 4. Two 6V Rechargeable Battery

3.0.1.2 DETECTOR UNIT

The hardware components that make up this unit include:

1. Temperature Detector.
2. Power Relay.

TEMPERATURE DETECTOR

The temperature detector used for this project is the LM35 temperature sensor. It is a precision integrated-circuit sensor. It has an output voltage that is linearly proportional to temperature in Centigrade. It is accurate to a temperature of ± ¼ °C at room temperature and ± ¾ °C over a temperature range −55°C to 150°C at full scale. The device has low self-heating of less than 0.1°C in air as it draws only 60μA from the supply. As shown in its circuit diagram below, the LM35 capability to sink current is limited to just 1μA. Fig. 5 shows the circuit diagram of an LM35.

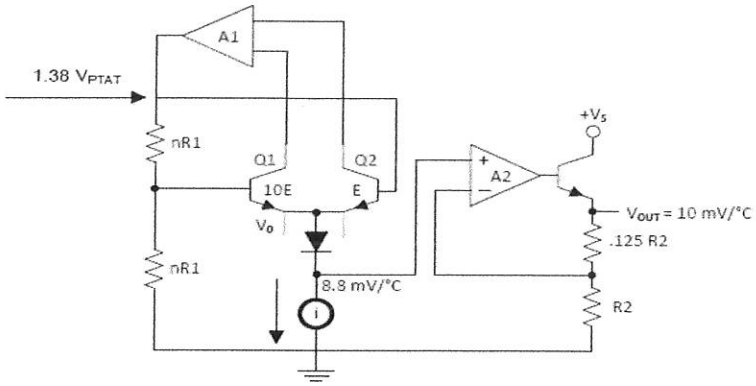


Fig 5. Circuit Diagram of LM35 temperature sensor

POWER RELAY

The 12V D.C relay which is an electrically operated switch uses an electromagnet to mechanically control the state (either open or closed) of the electric source. When the electric source is open i.e (OFF state) and when it is closed (ON state), the relay does a special function by triggering the GSM module circuit about any change in the electricity supply and the GSM module does notify the users through phone call and SMS notification form . A diode is connected in parallel to the coil of the relay to short out the kickback generated. This diode is usually referred to as a fly-back diode.

3.0.1.3 GSM MODULE UNIT

GSM

Global System for Mobile Communications or GSM (originally from Groupe Spécial Mobile), is the world's most popular standard for mobile telephone systems. A GSM modem is a wireless modem that works with a GSM wireless network. Global Positioning System is one of the widely used mobile standards. As the name specifies, it enables the mobile users to interact all over the world at any time. It is a hardware component that allows the capability to send and receive SMS to and from the system. GSM services include telephony, asynchronous and synchronous data services (2.4/4.8/9.6 Kbps), value added features (SMS, fax) and more. Speech is digitally encoded and transmitted as digital stream standards. As GSM is the main backbone, the parameters (Temperature and Electricity) which are continuously monitored by using temperature sensor and relay exceeds a particular level the SMS and mobile phone call is sent to particular mobile as an indication for avoiding damage or accidents. This operation is processed by PIC microcontroller in which the program

written in Embedded C is dumped into it. It is thus referred as precaution for avoiding damage and alert given to persons by sending message to mobiles.

SIM300S GSM MODULE

SIM300 is a complete Tri-band GSM solution in a compact plug-in module. The GSM modem consist of SIM card named as a SIM300 is fixed with the modem. The SIM300 offers GSM/GPRS for performing operations like voice, SMS, Data and also Fax. It is small in size to handle easily and perfectly in any device. AT commands also can be easily used because it has a TTL interface with microcontrollers, computers and also other device. AT commands are used to send and received SMS. SIM300 works with 3.4V to 5V.

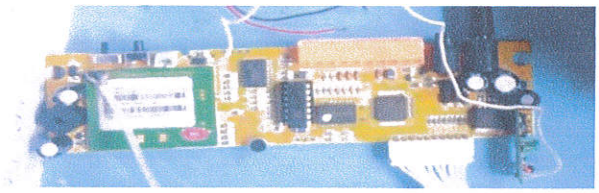


Fig. 6 SIM300 GSM Module

AT COMMENTS

AT+CSMS - Select short message service

AT+CMGF - Set short message service mode (1 for text mode ,0 for PDU mode)

AT+CMGS - Sent short message

AT+CSCA - Short message service number

MICROCONTROLLER

Microcontroller is a (stripped-down) processor which is equipped with memory, timers, input and output pins and other on-chip peripherals. The driving element behind all this is cost: integrating all elements on one chip saves space and leads to both lower manufacturing costs and shorter development times. This saves both time and money, which are key factors in embedded system. A microcontroller is a component that has its core building block the same as a microprocessor but is optimized to interact with the outside world through on board interfaces. A microprocessor is normally optimized to coordinate the flow of information between separate memory and peripheral devices, which are located outside itself. Connections to a microprocessor include address, control and data buses that allow it to select one of its peripheral devices and send or receive data from it, because the microcontroller processor and peripherals are built on the same silicon.

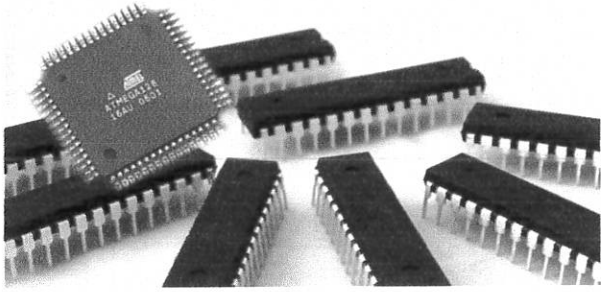


Fig. 7 Microcontrollers

3.1 SPECIFICATIONS

The specification for the components used during the construction of this project are analyzed below:

3.1.1 POWER SUPPLY UNIT

Relay Ratings

Supply voltage: 12V

Rated current: 33.3mA

Coil resistance: 360Ω

Operating temperature: -40°C to 85°C

Liquid Crystal Display

4×2 display for voltage level of the system.

Storage Battery

Two (2) rechargeable 6v cells connected in series to give 12v DC cells.

Transformer

50Hz of 220/240v AC

12V, 500mA DC.

3.1.2 DETECTOR UNIT

LM35 Temperature Sensor Ratings

Supply voltage: 5V

Operating voltage: 4V to 30V

Operating temperature range: -55°C to 150°C

Interface: Analog output

Relay Ratings

Supply voltage: 12V

Rated current: 33.3mA

Coil resistance: 360Ω

Operating temperature: -40°C to 85°C

3.1.3 GSM MODULE UNIT

SIM300 GSM Module

Operating voltage: 7-15V A.C or D.C.

Adjustable baud rate from 1200 to 115200 bps (9600 default).

Microcontroller

Low power requirement of 0.05- 1W.

3.2 PRINCIPLE OF DESIGN AND OPERATION

This project is design to monitor electricity ON and OFF state and temperature level of a given building, and it does display the output values on the LCD screen. The monitoring system is powered by an external source of power supply and also by a 12V rechargeable battery. The external source of power is the 230/220V, 50Hz input A.C source which is stepped down by a transformer to deliver a secondary output of 12V, 500 mA. The System consists of the Hardware sections. The Hardware is divided into five sections: Power supply, Temperature sensor, Relay system, Microcontroller, Liquid crystal display (LCD) and GSM module.

3.3 DESIGN

There are basic pattern and structure which guided me while designing the hardware of the project and they are shown below:

i. The circuit diagram.

ii. The block diagram.

3.3.1 FUNDAMENTAL CIRCUIT DIAGRAM

This project encompasses interconnection of temperature sensor, the power supply unit, the microcontroller board, switch, red light command indicators, a GSM module and an LCD Screen as illustrated below.

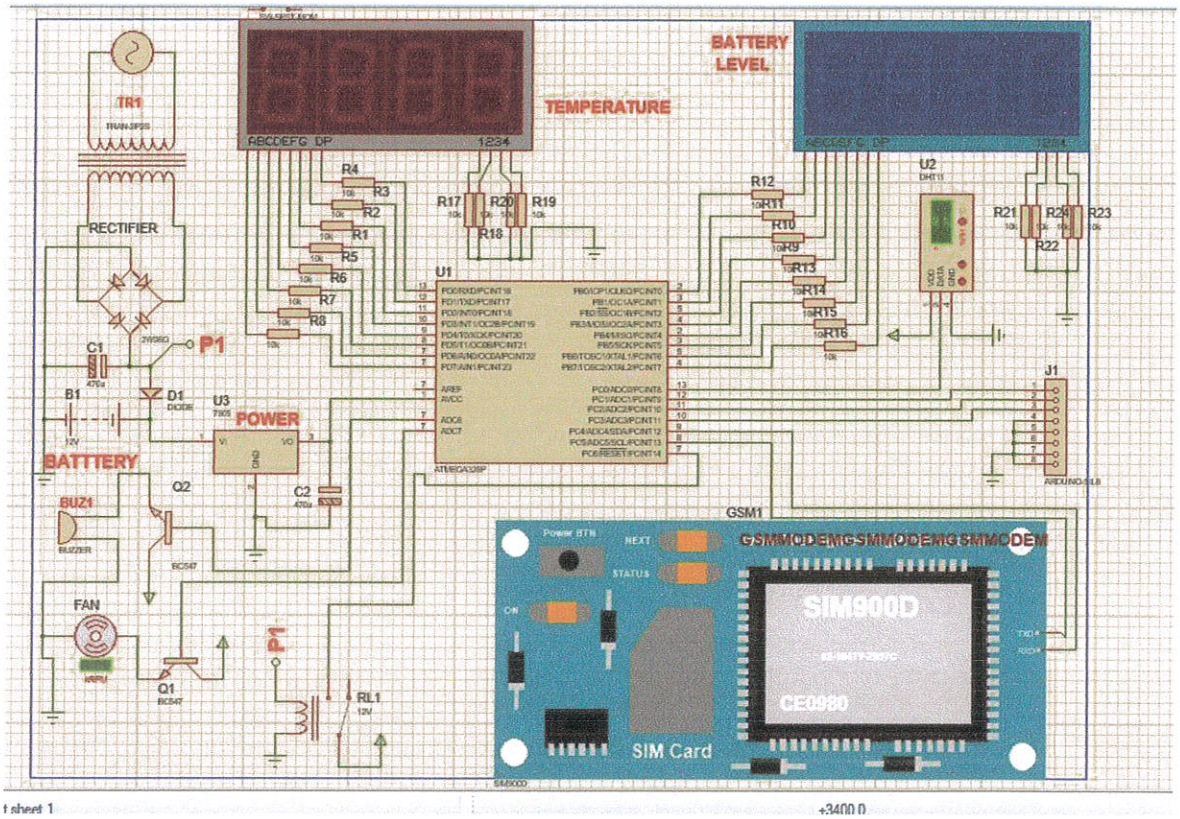


Fig. 8 The Fundamental Circuit Diagram

3.3.2 FUNDAMENTAL BLOCK DIAGRAM

The block diagram includes blocks of components used in making the circuit functional, the various components involved in the circuit includes the Temperature Sensor, Relay, microcontroller, GSM module and LCD screen.

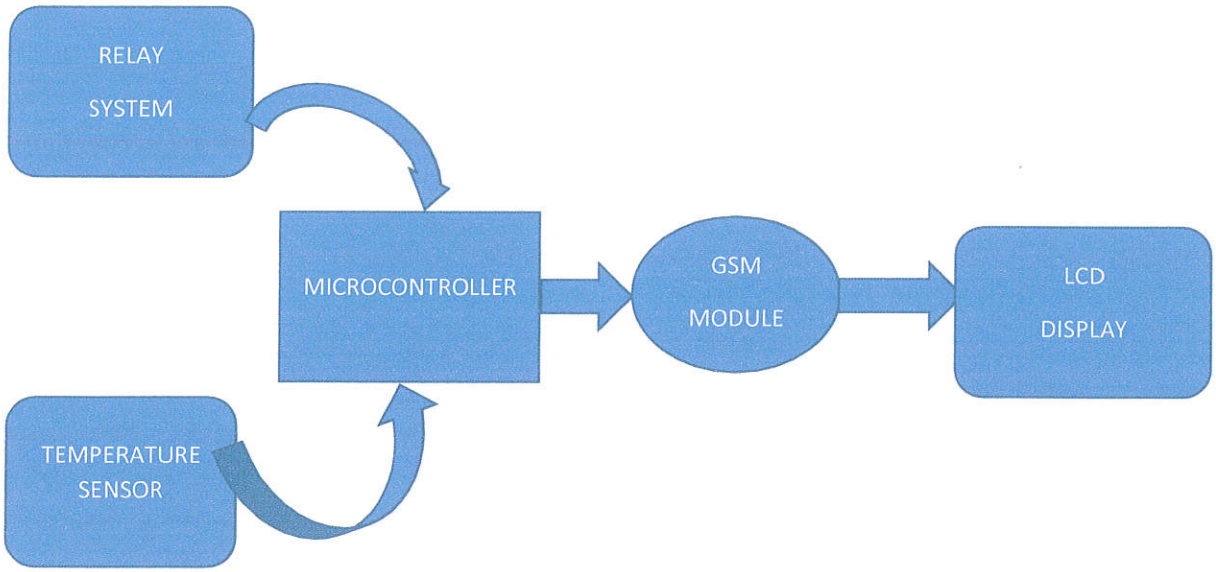


Fig. 9 The fundamental block diagram

CHAPTER 4

4.0 TESTING, ANALYSIS OF RESULTS AND DISCUSSION

The step by step breakdown during the implementation of this project is analyzed in the subsection below:

4.0.1 PRE-IMPLEMENTATION TESTING

The components were bought and operational test was carried out on each of them to ensure individual working condition before implementation.

4.0.2 TOOLS USED DURING IMPLEMENTATION

i. PLIER: - for twisting and cutting connection wires to appropriate length.

ii. SET OF SCREW DRIVERS: - for the purpose of driving in and out of bolts and nuts.

iii. MULTI-METER: - for measuring the value of each components and level of voltage, current in the system.

iv. SOLDERING IRON: - for the purpose of fusing and joining of wires of the hardware.

v. MOBILE PHONE: - for calling and receiving short message service (SMS) when requested.

vi. LAPTOP COMPUTER: - for designing the monitoring system circuit and simulation.

4.0.3 IMPLEMENTATION OF THE SYSTEM

In implementing any electronic circuit, there are some step to step procedures which are required to be put into consideration before the desired goal can be achieve. Below are the implementation steps taken in this system:

1. Circuit design

2. Simulation of circuit

3. Hardware implementation

4. Control Unit Programming

5. Interconnection of hardware implementation and Liquid Crystal Display (LCD)

6. Soldering

7. Casing of the project

4.0.3.1 SIMULATION OF CIRCUIT

The simulation was carried out on Proteus software. This software application allows the interconnection of all the components used in the hardware design on its simulation platform to know the exact value of each component to be use while implementing on the hardware board. Below is the simulation of the circuit designed with Proteus software.

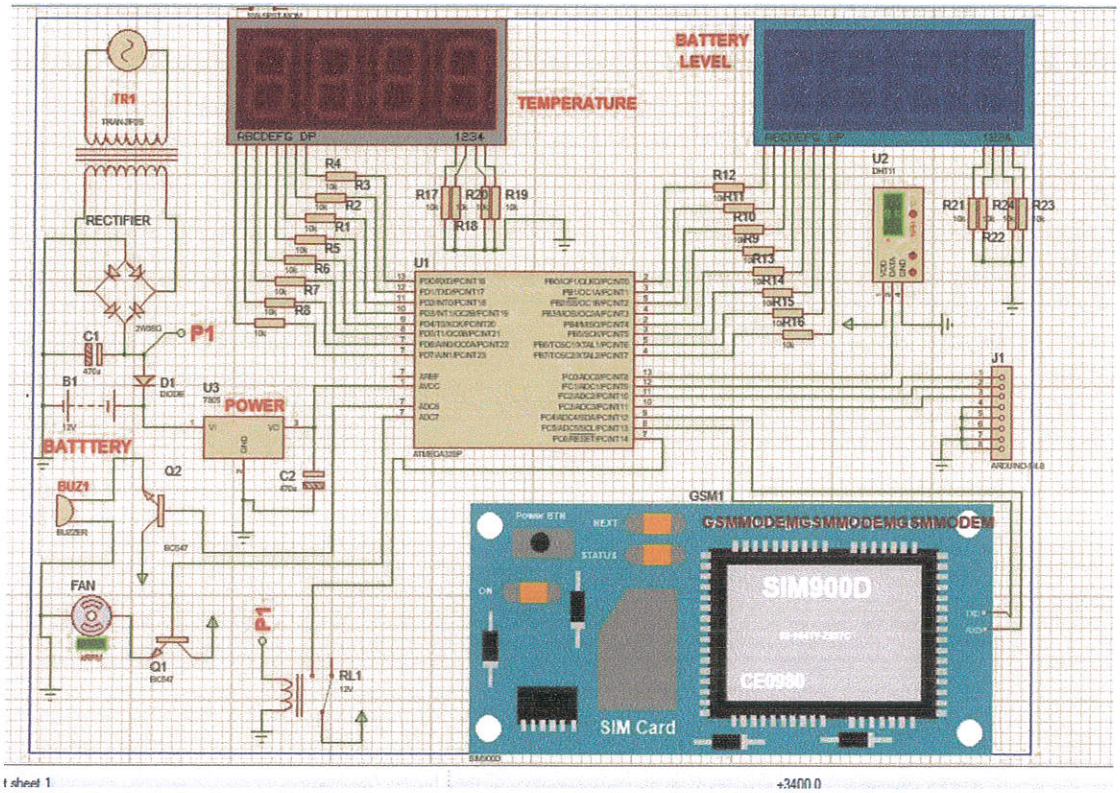


Fig. 10 Simulation on Proteus

4.0.3.2 HARDWARE IMPLEMENTATION

The hardware implementation is the process of interconnecting all the required components to form the monitoring system as a single body. The interconnection is done by following the way it was connected in the circuit diagram to achieve the expected result.

i. Connection in the power supply unit consist of the transformer, relay, rectifier, two (2) 6v rechargeable cells, cooling fan, etc. which are all connected together by connection wires to form a power chain. Each component in this unit is been measured using the multi-meter to ensure selecting correct value of each component as it was used while designing on Proteus.

ii. The input unit consist of GSM module board (with SIM300), relay and temperature sensor. Relay and temperature sensor are both connected to different port on the GSM module board with connection wires to link the condition and operation of both electricity status and temperature threshold to the programmed user contact. Also, the SIM300 board has a SIM card slot that allow the insertion of SIM card for the GSM module to signal the programmed users contact by SMS and phone calling notification form whenever there is change in the environmental monitoring state.

iii. The input unit is linked to the power supply unit through the GSM module power adapter. The adapter does allow current to flow from the power supply unit to the entire system, be it directly from A.C source or from the rechargeable 12v cells.

iv. Output unit in this system is the LCD display which display the temperature state and also another LCD which display the amount of voltage in the rechargeable cells.

v. Embedded microcontrollers and switches are used in this design as the control unit that allow the users to turn ON and OFF the monitoring system. The microcontrollers does the trigger function to the GSM module whenever there is change in the monitoring status. All connected joints in this design are properly insulated with black tape to prevent bridge in the connection wires.

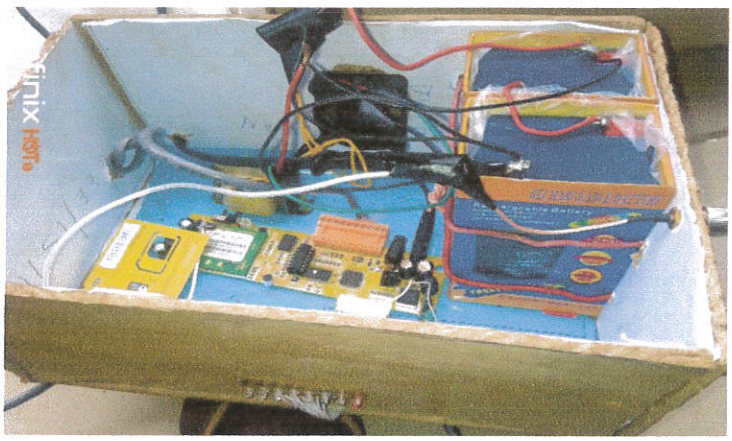


Fig. 11 Hardware implementation

4.0.3.3 CONTROL UNIT PROGRAMMING

The embedded microcontrollers are programmed with different task in the monitoring system. Sending SMS and phone call is taken care of by a microcontroller, also acquiring monitoring status from temperature sensor and relay is done by another microcontroller in the system.

4.0.3.4 INTERCONNECTING THE HARDWARE AND LCD SCREEN

i. The hardware was combined with the control unit.

ii. The hardware was powered by an Alternating Current and after a while switched to DC current.

iii. A connection was established with the LCD Screen as the power supply unit was paired with the screen.

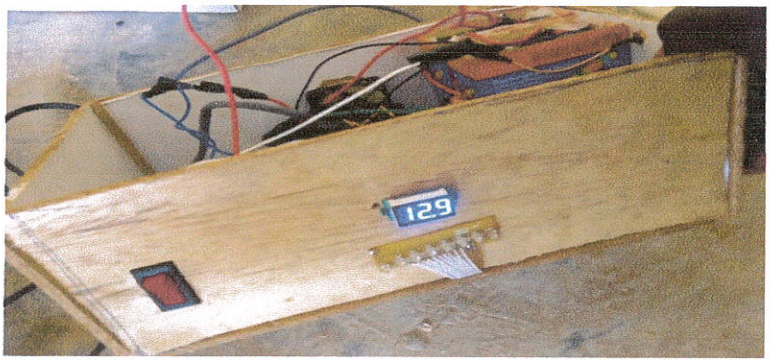


Fig. 12 Interconnection with the LCD

4.0.3.5 SOLDERING

This is a gradual process where all the components used in this design are soldered together based on how it was connected in the circuit diagram. Soldering iron and soldering lead was used in soldering components to the printed circuit board and all connection wires were soldered too to avoid bridging in the circuit. Most components are very sensitive to heat, so extra care was taken in handling and soldering to avoid burning of the components.

4.0.3.6 CASING

The casing was made of plywood wrapped with brown leather material which is unaffected by corrosion. The Figure below shows the typical casing used in my design casing.

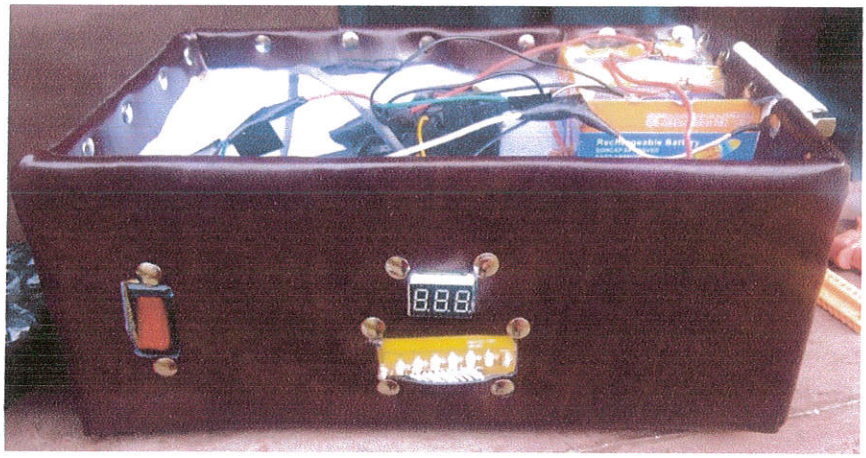


Fig. 13 Casing of the project

4.0.4 OVERALL PERFORMANCE EVALUATION

4.0.4.1 PERFOMANCE EVALUATION

The working principle of this electronic circuit under stable and unstable state of its monitoring system is discussed below:

1. Electricity state is monitor by the relay and temperature level is known by the temperature sensor.

2. The microcontroller does trigger the GSM module about the change in monitoring state.

3. The SIM300 circuit then make a phone call and send SMS to all the mobile number programmed in its circuit.

EXPECTED RESULT UNDER PERFECT CONDITION

Perfect condition as used above implies that when the electricity status is ON and temperature level is below defined threshold, the monitoring system as a body remain idle and continue its monitoring function till monitoring parameter status change or deviate from prescribe ranges.

EXPECTED RESULT UNDER UNBALANCE CONDITION

When the temperature level rises above the defined threshold, the microprocessor does trigger the GSM module circuit and SIM300 will notify the mobile number programmed in its circuit about the change in temperature level or electricity status through SMS and phone call. The system continue its monitoring activities as soon as notification is sent to the users contact.

4.1 TESTING

4.1.1 TESTING GSM MODULE FOR VARIOUS DISTANCES

The GSM module was tested for relative distances with the LCD screen of more than 300 Kilometers within a GSM network coverage, because from any part of the world where there is GSM network coverage the monitoring status parameters can be received i.e. temperature and electricity status as SMS and phone call on a mobile phone.

4.1.2 TESTING OF POWER SUPPLY UNIT

The components in this unit were individually tested and their component values were verified. After the construction of this unit, another test was properly carried out to ensure that the voltage delivered by the power supply unit was within the specified range of values needed for the project using voltmeter.

4.1.3 TESTING THE TEMPERATURE SENSOR

The temperature sensor was tested initially before soldering it to the GSM module board and its readings was noted. After soldering and connecting it to the GSM module board, another measurement was carried out with it and the same readings was achieved again proving its stable measuring ability before and after connecting it to the rest of the system.

4.1.4 TESTING THE RELAY

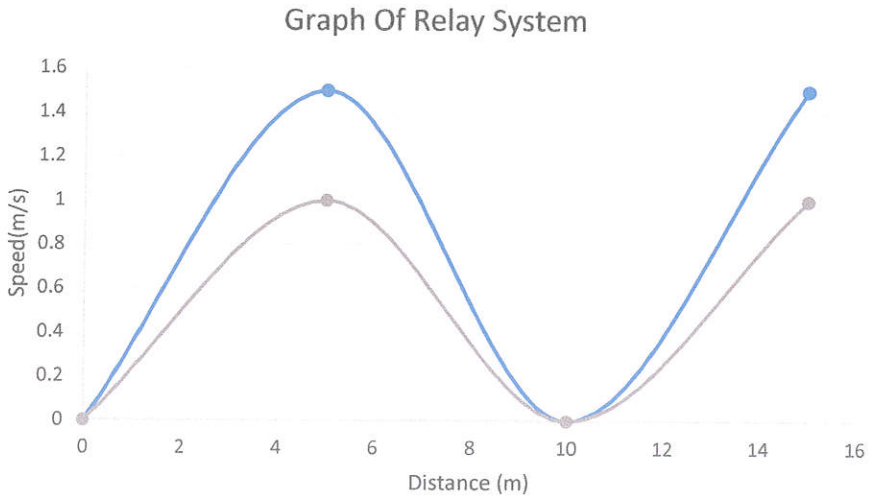
The relay used in this design was tested before soldering into the monitoring system to ensure its working perfectly, two connection wires were connected to two legs of the relay and the wires was connected to a 6v cell battery to know it working state. The relay does gives a one-time sound which means the relay was working well. After soldering the relay to the system, another test was carried out again to ensure the relay is still intact and it was perfectly working well.

4.2 ANALYSIS

The project construction deals with assembling, soldering, casing etc. Some of the components used were ordered from online market store while the rest was locally sourced. The system circuit diagram was design to give proper guide on how to connect and solder the component. The components were assembled and soldering process took place, this system was tested on the latest technology available in smartphone which gives a proper result. This system is easy to use and very simple. The model can be installed with a low economical cost.

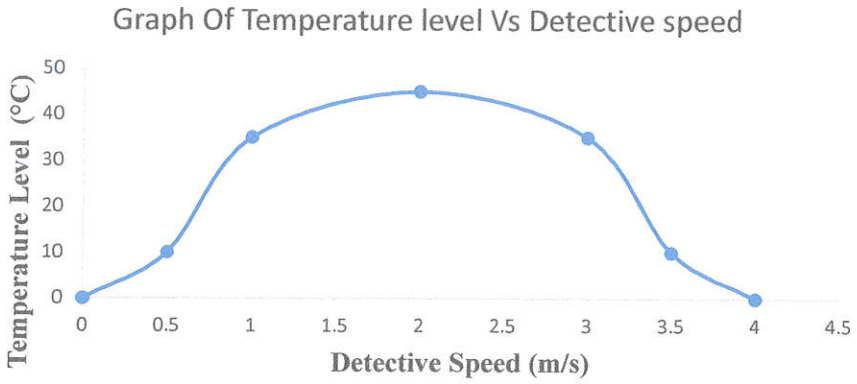
4.2.1 ANALYSIS OF RELAY SYSTEM

The graph below show the electrical working operation of the relay used in this design. When the electricity status is ON, there is rise in the graph which is represented with blue line and the graph fall back after the GSM module does the notification operation to the users contact. Also, when the electricity status is OFF, another graphical line rises with purple colour to indicate the OFF state on the graph and this graphical illustration does explain the operation of the relay system in the monitoring body.



4.2.2 ANALYSIS OF THE TEMPRATURE SENSOR

From the graph below, when the temperature level is within 0°C and 40°C. The temperature sensor will be in its state of sensing but no signaling will occur. A rise above 45°C will cause the temperature sensor to trigger the microcontroller to inform the GSM module about the temperature level and the temperature graph will rise to the temperature level on the graph at that instant time. The monitoring system is programmed to signal only when the temperature level reach the threshold which is 45°C and a notification process will follow directly from the GSM module unit to the users contact. After the temperature level is been restore back to its normal condition, the rise in the temperature sensor graph will fall back to its initial level.



4.3 PROJECT MANAGEMENT

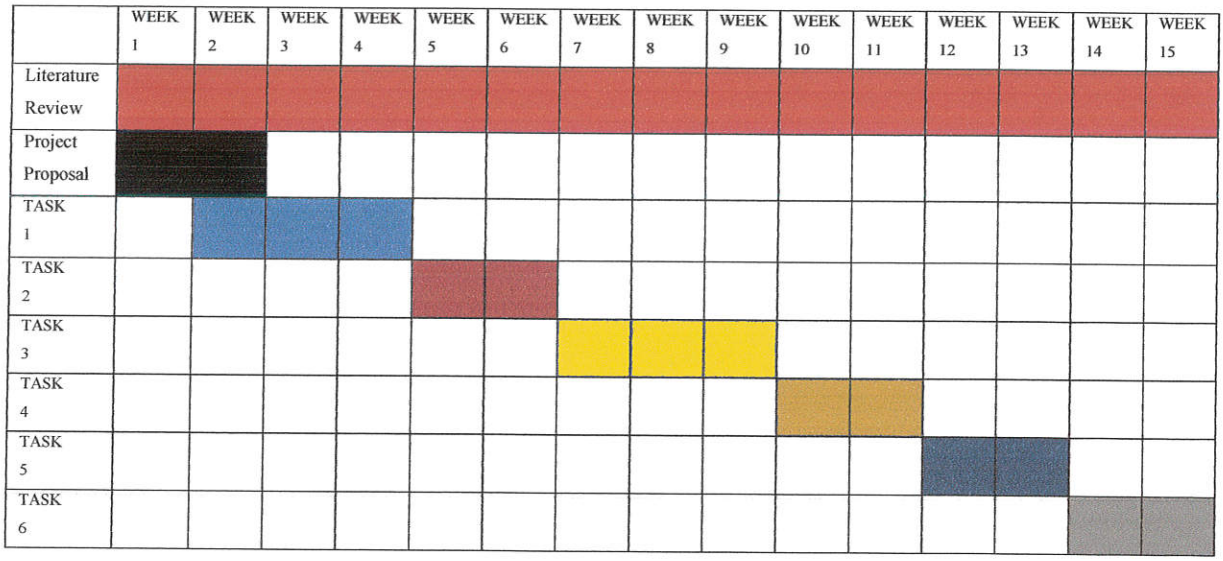
The following subsections show how the achievement of the aim of this project is managed.

4.3.1 PROJECT SCHEDULE

The chart below shows the tasks involved in this project and the time period to complete each of this task.

4.3.1.1 GANTT CHART

A Gantt chart is defined as a graphical representation that illustrate a project schedule with the tasks to be perform. It does shows the duration of each activity with ranges of possible start and end dates and the relationship between tasks. Gantt chart can be used to show current schedule status using percent-complete shading style. The fundamental Gantt chart for this project is shown below:



Task 1 – Gathering of materials for project.

Task 2 – Design of project circuit.

Task 3 – Programming of code for the design.

Task 4 – Acquisition of components.

Task 5 – Construction and soldering of hardware components.

Task 6 – Testing and casing of the project.

4.3.2 RISK MANAGEMENT

In the design and implementation of this project, the likely threats to encounter are:

i. Components failure.

ii. Electric shock.

These threats are been taken care of by:

i. Provision of additional components to serves backup for faulty components during the hardware design implementation.

ii. I ensured putting on engineering safety kit while dealing with the hardware part of the design.

4.3.3 SOCIAL, LEGAL, ETHICAL AND PROFESSIONAL CONSIDERATIONS

The design and implementation of this monitoring system conform and meet the standards of Institute of Electrical and Electronics Engineers (IEEE) and all safety rules and regulation was properly implored during the construction process.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.0 CONCLUSION

During the course of undergoing this project has disclosed important things about cable fault measurement to instrumentation engineering, the importance of iterative testing, cost management and project management techniques. The importance of automatic systems for cable fault measurement, a more efficient way of ensuring the product works without errors for a long time.

In this project I have used the combination of LCD, Arduino Uno R3 and voltage regulators to build a simple and accurate underground cable fault measuring technique.

This project is designed to be used in the industries, commercial areas with underground cables, and in buried telecommunication lines. This product should be operated by a certified professional and should be kept away from water and dangerous gasses to ensure continuous accuracy of the device.

5.1 CONTRIBUTION TO KNOWLEDGE

By successfully finishing this project, I now fully understand how Arduino feedback loop works, how to write programs into a microcontroller and conceptualizations of circuit layout and design into a real-life product. Cost management was also learnt in the course of building this project.

5.2 LIMITATIOINS

A perfect Engineering project is desirable but seems not to exist, which means research must be made continually to improve in technologies and the various ways engineering problems can be solved and projects can be improved. This project in discussion suffers some drawbacks which includes.

i. Lack of proper understanding of the components involved, the project involved a lot of components, Arduino Uno R3 was very difficult to integrate with the project because the value of the resistors must be subtracted from the final output of the Arduino Uno R3 to ensure that the final output is accurate as possible.

ii. Inserting the various materials into the casing was also a challenge involved in the project, the casing must be as small as possible to ensure that the device is as cheap as possible.

iii. The selection of microcontroller was also a challenge, microcontrollers needs to provide fast and efficient feedback loop to ensure accurate result at all times. Arduino Uno R3 was the most cost-effective selection for that.

iv. The heat generated by components if not properly managed can reduce the life span of the device.

5.3 FUTURE WORKS

The following are possible future advancement of this project:

i. Increase the range of the cables that can be measured with the device

ii. An I/O can be added system in which users can communicate with the device to increase the range of the system

iii. The system can be incorporated directly with underground cable network and sends signals to the control room whenever a cable fault is detected.

5.4 CRITICAL APPRAISAL

The importance of underground cable fault measurement in the field of instrumentation engineering cannot be underemphasized the project is very useful in making the project automated instead of random manual digging which wastes time and money and also eliminates trial and error method in checking for faults in cables.

The system is user friendly which allows the user to easily read a cable fault without needing to do another rigorous calculation, the system is very codes allow necessary calculations to be made before returning the cable fault to the user, it is easy to operate, mount and maintain.

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APPENDICES

APPENDIX I

PROGRAM CODE

The microcontrollers used was programmed with the below code in C programming language.

```
/*
* TemHumidityGsmBase.c
*
* Created: 15/09/2018 10:34:11 AM
* Author: Afolabi
*/
#include <avr/io.h>
#include <stdlib.h>
#include <stdio.h>
#include <avr/interrupt.h>
#define F_CPU 1000000UL
#include "util/delay.h"
#define Usart_BaudValue 9600
#define BaudValue (F_CPU / 4UL /
Usart_BaudValue - 1) / 2
#define DHT11_PIN 0
uint8_t
c=0,I_RH,D_RH,I_Temp,D_Temp,Che
ckSum;
#define Input PINC
#define InputDir DDRC
#define InputPort PORTC
43
#define LCD_RS 2 //define
MCU pin connected to LCD RS
```

#define LCD_RW 5 //define

MCU pin connected to LCD R/W

#define LCD_E 3 //define

MCU pin connected to LCD E

#define LCD_D4 4 //define

MCU pin connected to LCD D3

#define LCD_D5 5 //define

MCU pin connected to LCD D4

#define LCD_D6 6 //define

MCU pin connected to LCD D5

#define LCPP PORTC

#define LCDRR DDRC

#define LCD_D7 7 //define

MCU pin connected to LCD D6

#define LDP PORTD //define MCU

port connected to LCD data pins

#define LCP PORTD //define MCU

port connected to LCD control pins

#define LDDR DDRD	//define
MCU direction register for port	
connected to LCD data pins	
#define LCDR DDRD//define MCU	
direction register for port connected to	
LCD control pins	

#define LCD_CLR 0 //DB0:

clear display

#define LCD_HOME 1

//DB1: return to home position

#define LCD_ENTRY_MODE 2

//DB2: set entry mode

```
#define LCD_ENTRY_INC 1
//DB1: increment
44
#define LCD_ENTRY_SHIFT 0
//DB2: shift
#define LCD_ON_CTRL 3
//DB3: turn lcd/cursor on
#define LCD_ON_DISPLAY 2
//DB2: turn display on
#define LCD_ON_CURSOR 1
//DB1: turn cursor on
#define LCD_ON_BLINK 0
//DB0: blinking cursor
#define LCD_MOVE 4
//DB4: move cursor/display
#define LCD_MOVE_DISP 3
//DB3: move display (0-> move
cursor)
#define LCD_MOVE_RIGHT 2
//DB2: move right (0-> left)
#define LCD_FUNCTION 5
//DB5: function set
#define LCD_FUNCTION_8BIT 4
//DB4: set 8BIT mode (0->4BIT
mode)
#define LCD_FUNCTION_2LINES 3
//DB3: two lines (0->one line)
#define LCD_FUNCTION_10DOTS 2
//DB2: 5x10 font (0->5x7 font)
#define LCD_CGRAM 6
//DB6: set CG RAM address
#define LCD_DDRAM 7
//DB7: set DD RAM address
// reading:
```

```
#define LCD_BUSY 7//DB7:
LCD is busy
#define LCD_LINES 2
//visible lines
45
#define LCD_LINE_LENGTH
16 //line length (in
characters)
// cursor position to DDRAM mapping
#define LCD_LINE0_DDRAMADDR
0x00
#define LCD_LINE1_DDRAMADDR
0x40
#define LCD_LINE2_DDRAMADDR
0x14
#define LCD_LINE3_DDRAMADDR
0x54
// progress bar defines
#define PowerSwitch 0
#define PowerSource PORTB
#define PowerLine DDRB
#define cost_per_unit 10//60//unit
charge per time
#define
PROGRESSPIXELS_PER_CHAR 6
#define NumDigit 16
charMin,Hour,VoltsErro,Alert,PhoneNu
mber[NumDigit];
intRxCount;
int
Ampers,Ampers2,AdcSwap,AdcCount,i
,output_volt_memo,output_volt_memo2
,setP_temp,Ac,input[15],k[10],MgsCou
nt,RecString[200],askey[]={'0','1','2','3','
```

```
4','5','6','7','8','9'};
46
intj,m,l;
int Time;
float
AmpersMemo,Ampers2Memo,current,t
otal_unit,watt,
kilowattHour,kWhTime,last_kWhTime,
MeterPower1,MeterPower2;
intwatts,unit_place,fract,watts_fract;
voidCheckSms();
void Control();
voidReadSms();
voidWritePhoneNumber();
voidWriteDate();
voidResetGsm();
void serial_init(void)
{
UBRRH=(BaudValue>>8);
UBRRL=BaudValue;
//UCSRA=0x02; // Communication
Parameters: 8 Data, 1 Stop, No Parity
UCSRA|=(1<<U2X);// Communication
Parameters: 8 Data, 1 Stop, No Parity
UCSRB|=(1<<TXEN);//|(1<<TXCIE);
//UCSRB|=(1<<RXEN);//|(1<<RXCIE);
//UCSRB|=(1<<RXCIE);// ensble serial
interrupt
UCSRC=(1<<URSEL)|(1<<UCSZ0)|(1
<<UCSZ1);
}
```