FEDERAL UNIVERSITY OYE-EKITI

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

DESIGN AND IMPLEMENTATION OF A HOUSE SECURITY SYSTEM

BY

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A PROJECT REPORT SUBMITTED TO DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING FEDERAL UNIVERSITY OYE-EKITI

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DEDICATION

This thesis is lovingly dedicated to: ***The Glory of the Lord Jesus Christ*** whose love and unflinching faithfulness has led me thus far.

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CERTIFICATION

This project work titled "Design and Implementation of a House security system" by Ogunleye Olamide Peter, meets the requirements for the award of Bachelor of Engineering (B.Eng.) degree in Electrical and Electronics Engineering Department, Federal University Oye-Ekiti.

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ABSTRACT

This thesis presents the development of a house security system which will be able to trigger an alarm when there is a barge into the house with the help of sensors and also notifies the owner immediately through calls and text messages. This project will focus on indoor and outdoor security for homes by the embedded system put in place. The project uses a programmed microcontroller and sensors in the development of the GSM based home security system which can help detect motion intrusion, criminal activities like theft, robbery can also be prevented. The detectors are wireless and will detect intrusion through their various mechanism, which will in turn activates the system by triggering of the alarm and instantly send an SMS or call the owner. To achieve the aim and objectives of this project, it includes the design and construction of circuits which automatically detect motion and break in to homes. The project on completion behaved and responded successfully when it was tested. Thus, the aim and objectives of the project is achieved.

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LIST OF ABBREVIATIONS

SMS	Short Message Service
LCD	Liquid Crystal Display
GSM	Global System for Mobile Communications
AT	Attention
IR	Infrared Radiation
PIR	Passive Infrared Detector

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CHAPTER ONE

1.0 INTRODUCTION

Security systems are important features of a modern house. A house security system is one that provides its owner comfort, security, energy efficiency (low operating cost) and convenience at all times, regardless of whether anyone is home or not. Furthermore, "house security system" is the term commonly used to define a residence that has appliances, lighting, audio and video or still image systems, camera system etc. for security purpose and that are capable of communicating with one another or can be controlled automatically.

The earliest house security systems date back to the early 1900's. These systems were generally expensive and very hard to monitor. In the past 100 years as technology has changed, house security systems have also changed. Early house security systems were very expensive and surprisingly ineffective. The requirement for an efficient and cost effective system to cater for the disastrous situations and in order to fulfill the security concerns of home owners when the user is away from home, there was a strong need to develop a cost effective and reliable system to satisfy the security related needs of occupants. House security has changed a great deal over the last century and will continue to do so as long as technology continues to progress.

This paper mainly focuses on achieving security purpose. The system is SMS based and uses wireless technology to revolutionize the standards of living. This system provides ideal solution to the problems faced by home owners in daily life. The system is wireless therefore more adaptable and cost-effective. The project is aimed at developing the security of Home against intruders. In any of the above cases if any one met while you are out of your home then the device sends SMS to the emergency number provided to it. The project is made up of teses basic components: one or more sensors set up in a remote array and the embedded microcontroller with the GSM module.

1.1 BACKGROUND OF THE PROJECT

House security systems are becoming common place in recent time. One of the reasons for the rise of the smart home is the increasing risk of burglary and robbery and the busy lifestyle. The busy lifestyle of people is leading to the necessity of controlling the devices at home remotely and increasing the necessity of keeping surveillance over their homes. In many areas of industry especially where there is need to protect certain goods or services, electronic security based on the use of embedded processors are employed.

In more recent times however, the development of the Global System Mobile technology has pushed the frontier of electronic security to a more sophisticated level. It's now possible for users to control and monitor systems and development in their household with the help of their Smartphones. The development also brings in other advantages like cost effectiveness and much needed efficiency.

A typical home security system should consist of a detector and an alarm system which is triggered once an intruder is detected. Detector systems could be as simple as a trip switch attached to movable part like the hinge of a door and even door handles in such a way that any movement around this area will toggle the switch and thus raise an alarm.

In more complex devices, detectors which can sense infrared radiation produced by body heat and fluctuation of such radiation as a result of movement have become common. Such detectors usually sense motion and then trigger the appropriate response. In other detectors, the characteristic sound produced by the shattering of glass windows or the banging of a door is picked up by high gain capacitive microphone and appropriate filters to isolate the characteristics sound necessary to activate or trigger an alarm system.

The development in embedded system design has also made possible the development of smart home security system, where the processing of signal received from a detector can be programmed. Such development allows for customized processes to suit specific home or industrial need.

This project tends to utilize the availability of GSM network, mobile module and electronics circuit to achieve an automated system which is programmed to work as a thinking device to accomplish this purpose. By simply calling and sending message to the phone number of the SMS attached to a slot in the circuit, this automatically puts the system to either "active or inactive" state, and on any attempt of theft the system sends a text message and also puts on a call to the device owner.

The total absence of sufficient security personnel in a house is a great discomfort to house owners. With this project "House security system", the house is always protected.

1.2 STATEMENT OF PROBLEM

So many security problems have affected the occupants of properties in homes all over some countries like Nigeria which this project has been introduced to minimize the problems and these includes:

1. Networking without cable through the help of GSM module embedded in the system which in turn sends a message, and also makes a call to the owner or any configured number, when someone barges into the homes of people.
2. Monitoring the properties of occupants in the absence of the occupants.

1.3 MOTIVATION

Insecurity of lives and properties among students in Ikole has actually motivated me towards the design and construction of a house security system that can in turn help to reduce theft within the IKOLE community.

1.4 SIGNIFICANCE OF THE STUDY

This project will help to reduce insecurity of lives in homes, offices, schools, laboratories, factories, supermarkets, cinemas, boutiques, shops, hospitals, libraries, hotels etc. This study will also contribute in impacting knowledge on individuals, groups, communities by enlightening them on security issues or challenges encountered in daily lives, and how proper precaution or measures can be taken.

1.5 AIM AND OBJECTIVES

The aim of the project is to design and construct a house security system. The system will be able to trigger an alarm when there is a barge into the house with the help of a PIR sensor and also notifies the owner immediately through calls and text messages, the alarm is being triggered using a GSM Module by the help of a microcontroller. The objectives are:

1. To detect break into homes using a PIR sensor detector and the wireless door/windows sensor.

2. To automatically call and send message to the owner and other configured numbers in case of theft.

3. To establish a wireless communication for transfer of data between the sensor and the mobile phone where an SMS alert is being received.

1.6 SCOPE OF PROJECT

This project will focus on indoor and outdoor security for homes by the embedded system put in place. The project uses microcontroller and sensors in the development of the GSM based home security system which can help detect motion intrusion, criminal activities like theft, robbery can also be prevented. The detectors are wireless and will detect intrusion through their

various mechanism, which will in turn activates the system by triggering of the alarm and instantly send an SMS or call the owner.

CHAPTER 2

LITERATURE REVIEW

2.0 INTRODUCTION

In the recent years, house security has been a major issue where crime is increasing reason being that insecurity has been a threat to many lives of people and their properties. Engineers have made a great effort to take proper measures to prevent intrusion. In addition there is a need to automate the house so that users can take advantage of the technological advancement in such a way that a person getting off his home does not need to think of the security of his house again and again. People have worked on detection of intrusion to overcome insecurity with various devices, but some of these devices are bulky, inaccurate and some are even unreliable therefore making these devices harmful and dangerous to lives and properties.

2.1 REVIEW OF PAST LITERATURES

In [1], the author worked on the design and construction of Home alarm system using motion detector sensor. It works with a PIR detector (passive infrared detector) to detect intrusion and using CCTV to capture the image of the intruder. In his work, the major limitations is that no control measure is put in place to determine the detection range of the PIR detector, and there is no provision for owners' notification during the course of the intrusion. This project helps to eliminate the limitations found in his work by the introduction of an improved wireless PIR detector capable of detecting in wide range. Also, a provision for notification of the owner during the course of intrusion was made by the introduction of a GSM module for call and an SMS alert.

In [2], the authors designed an Anti Theft Home Security System. They made use of the PIR detector and door sensor for the intrusion detection. The major limitation in their work is that no provision was made for the output, that is, there is no means for awareness of the owner/user and the neighbors due to the absence of the alarm system. The limitation in their project is being taken care of in this project by the introduction of an alarm system which is been triggered once intrusion is detected. Secondly, with the introduction of the GSM module, the limitation found in their work is minimized, which serves as a means of getting the user/owner informed (notification of the user) through SMS or call.

The authors in [3] considered GSM based Intelligent Home Security system for Intrusion detection. In their work, they made use of the fire detector, smoke detector and the PIR motion detector which detects fire, smoke, and human intrusion respectively. The only error I find in their work is just the complexity of their project, that is, the use of different detector (fire,

smoke and PIR), which made their project complex because these detectors cannot work simultaneously and thereby reducing the efficiency of the system and it is prone to malfunction. This project helps to minimize the malfunctions because it is honed only in one direction, which is to detect intrusion through the use of the PIR detector and thereby promoting the simplicity of the system, and not its complexity. The efficiency too is maximized.

In [4], the author worked on the design and construction of a House Security System using Active infrared detector. In his work, he made use of the Active infrared detector as the intrusion detector, to detect intrusion. The limitations in his project is that, firstly, he made use of the active infrared detector which can only detect when the intruder is closer to the detector. Secondly, no proper control measure is taken because there is no provision for means of alerting the user. The limitations in his work has been resolved by firstly introducing the Passive infrared detector (PIR detector) which can detect regardless of how far or how close the intruder is. The second limitation is taken care of by the introduction of the alarm unit and GSM module which initiates sound alarm immediately the intrusion is detected and carrying the user along through SMS alert or call whether he is home or not respectively.

In [5], the authors worked on designing and constructing of an Automatic Home Security System based on GSM Technology and Embedded Microcontroller Unit. They make use of the PIR detector, GSM module, and Alarm system for the detection of intrusion, alerting the user through sms and call, and as well as blowing of an alarm once the intrusion is detected respectively. It worked perfectly and accurate. But, the only limitation in their project is the issue with power, which cannot be neglected. It can only work when there is Alternating Current and voltage (A.C current supplied from electricity) which we know that it is one of the major factor we are facing in Nigeria. However, this limitation is been taken care of in my project, by providing another alternative for the power supply, the alternative is the use of two (2) 6v (DC Direct Current) cells which are rechargeable and therefore increase the reliability, and the efficiency of the system.

The authors in [6] worked on designing and implementing of a low cost Home Security System. In achieving the aim of their work which is to design a system capable of detecting break in to homes and fire outbreak, they made use of wireless based devices and sensors. My project is an advance on their work, and proper measure is taken in achieving the same aim, with less complexity.

The authors in [7] worked on GSM door intercom with keypad and security system. It served its purpose of security by means of using voice intercom and keypad by detecting anyone trying

to break into home without authorized access. Immediately wrong password is entered, the system immediately send a notification to the owner through SMS. The limitation of this project is that, anyone with the password can have access into that house. It is not that safe and smart, because, we have fraudsters that specialize in hacking and breaching of the password nowadays. It has been resolved by using devices and sensors that are smart to detect the intrusion, these devices are PIR detector and door/window sensor.

In [8], the authors worked on Home security alarm system using Arduino. Their work involved the use of Arduino, motion sensor, buzzer, LCD display and a simple program. The sensor would detect any motion in its permissible range and triggers the alarm. It will also send the signal to Arduino which processes the signal and set off the alarm along with detection message on display. The limitation in this project is that when the owner is not around, there is no provision for notifying the owner, which makes it more subtle and prone to imperfection. This is improved on by the use of GSM module which makes it easier for notifying the user when he is not around.

The authors in [9] opined a Microcontroller Based Security System with Intruder Position. It featured a system that will track the presence of an intruder in restricted area and also inform the user about the position of the intruder using microcontroller and other electronic designs.

In [10], the author used password protected door system methodology in home automation and security system. The door lock is password protected with an LED based resistive screen input panel which operates by detecting difference in light intensity captured by the photodiode which is emitted by surrounding red (Light Emitting Diodes) LEDs and reflected by the finger. The display is a 16X2 LCD panel. Infrared (IR) Laser sensors are used to detect any obstacle while monitoring the windows and doors at night or when away. Fire alarm system uses temperature sensor LM35 which senses sudden considerable increase in temperature and raises alarm. They uses the following components in those automation system i.e. IR sensors, LCD Display, Temperature Sensor, Microcontroller, Relay, Power Supply, GSM Modem.

In [11], the authors opined a security system for car protection. In that concept, in case of theft, it automatically demobilizes the car by disconnecting the ignition key supply from the car battery. This now makes it impossible for anybody so start the car, let alone moving with it. In an attempt of theft through the car doors or boot, the system sends the message to the car owner and at the same time starts the alarm. This design popped out due to the increasing rate at which packed cars are stolen especially in our country, but with this design this packed car is being monitored irrespective of where it is packed, provided there is GSM network coverage.

The authors in [12] proposed that Automated home or intelligent home which indicates the automation of daily tasks with electrical appliances used in homes and security is an important aspect or feature in smart home applications. The new and emerging concept of smart homes offers a comfortable, convenient, and safe environment for occupants. Conventional security systems keep homeowners, and their property, safe from intruders by giving the indication in terms of alarm. However, a smart home security system offers many more benefits. They proposed two system in their work i.e. one is based on GSM technology and the other uses web camera to detect the intruder. First security system used a web camera, installed in house premises, which is operated by software installed on the PC and it uses Internet for communication. It detects motion of any intruder in front of the camera dimension and camera range. The second security system is SMS based and uses GSM technology to send the SMS to the owner. The proposed system is aimed at the security of Home against Intruders and Fire. In any of the above cases happens while the owners are out of their home then the device sends SMS to the emergency number which is provided to the system.

In [13], the authors designed a Wireless Sensor Network (WSN) and GSM based Remote Home Security System by combining the advantages of Wireless Sensor Networks and GSM technology. It can detect intrusion, fire etc. and inform the user remotely about the incidence with distance playing no barrier. In the security system, the intruder is detected if he comes near this WSN.

The authors in [14] proposed that they have tried to increase the standard by combining new design techniques and developed a low cost home and industrial automated security systems. They aim to overcome the flaws made by many other security device as it is most effective in security purpose. It is cheaper and can be maintained easily than any other security device.

This device works in two way modes. i.e.

a) Internal mode

b) External mode

When the internal mode is selected by the user when they are inside the wireless security area, the entire sensor except sensor will be activated and the buzzer connected with the microcontroller will give an alarm and the reason for the insecurity will be displayed in the LCD connected to the microcontroller. When the external mode is selected by the user when they are outside the wireless security area, all the sensor will be active and the security area address which is pre- programmed, along with the problem will be sent as SMS to the specified police station, fire station, security room and also to the user at the time of insecurity, fire accident, unwanted movement of persons etc. which is sensed by the respective sensor.

In [15], the authors worked on implementation of house security system using GSM module and Microcontroller. The system is a wireless home network which contains a GSM modem and magnet with relay which are door security nodes. The system can respond rapidly as soon as intruder is detected and GSM module will alert the home owner. In this system a relay and magnet is installed at entry point to a precedence produce a signal through a public telecom network and sends a message or redirect a call that that tells about your home update or predefined message which is embedded in microcontroller. Suspected activities are conveyed to remote user through SMS or Call using GSM technology.

The author in [16] designed and implemented of a PIR-based house security system. The project was designed to assure home security through surveillance. The project is based on PIR sensor connected to an integrated circuit for the generation of an alarm. HDMI transmits pictures and videos to a displaying screen which saves this information and sends an alert to a specified mail recipient. Raspberry pi is responsible for the operation and control of motion. Detectors and video cameras, on the other hand, sense movement and give surveillance and stream live video or record occurrences for later playback. The sensor perceives Infrared Radiations (IR) emitted from humans within their field of view then provides a digital output. The output is applied to the UM3561 IC generating sound upon detection of human intrusion. The design also will provide the number of persons located, with the help of a Passive Infrared sensor. When PIR Sensor detects motion, the camera automatically initiates re-cording and Raspberry pi device alerts the owner of a possible intrusion having a display on the screen and sending an email alert to a specified email address. The circuitry is expensive, and its electronic security system is highly secure. This system is expensive and complex which is a great limitation and has been taken care of in my project by using affordable *microcontrollers* instead of the Raspberry pi.

In [17], the authors worked on the Design and Implementation of a House security system with Arduino based password protection. They made use of 5v Arduino board and 5v-2A power adapter power supply for running the machine. They also use PIR sensor for detection of intrusion. They designed and developed the whole control system and tested using keypad. The limitation in their work is that, firstly, there is no provision for alerting the user either through an alarm buzzer or SMS or call which has been taken care of in my project. Secondly, Microcontroller is used in place of the Arduino so as to reduce cost and complexity of the security system. Finally, the power supplied in their project is so limited, and has been fixed in my project by supplying sufficient power to the system thereby increasing the efficiency of the system.

The author in [18] designed and implemented a Smart Home security system with Automatic snapshot. In this smart home security system, he included some efficient features. The smart home security system also uses mobile phone camera for snapshot and as well using 5V solar power supply for relay correction, and also use LED Light and speaker. When there is any motion detection by PIR sensor, then the camera take automatic snapshot and also the security system gives an alarm which turns on the light. All of the control system has been developed using Arduino Uno R3 microcontroller development board. This system is incomplete because it can not notify the user when an intrusion is detected when the user is not around the location, making it not smart enough contrary to its supposed name. This has been taken care of in my project by introduction of GSM module. Secondly, the limited power supply has been resolved and improved.

In [19], the author proposed a GSM based security system. The work aimed at integrating the features of home automation with that of security system to build a concrete home control system. His work took into consideration of all the existing products and merged them together to create a system which will not only provide automation to the building but will also take into consideration of all the security features of the building. It uses gas sensors to detect any gas leakage that might occur in the building. It is also equipped with smoke and temperature sensors to look out if any fire breaks out in the building. It also features the function of intrusion detection by proper placement of passive infrared sensor (PIR sensor). All of the above sensor is well connected to a centralized microcontroller section which will generate a proper output in case of any tragedy. It consists of three basic modules along with a GSM modem. The GSM modem is used to send the message to the respected authorities in case of emergency. The first module consists of lock keypad which can be used to lock the doors. If more than three attempts are made emergency signal will be sounded. The second module consist of intruder checkers which consists of an array of PIR sensors to detect the presence of a person in the house. Lastly the third module is the fire detection module which consists of LPG gas sensors and temperature sensors. This system limitation is only that no proper measure is taken in the aspect of power supply, which makes it not reliable. This is resolved in my project by introduction of two (2) rechargeable 6v cells as redundancy, and therefore increasing the reliability of the system. My project is also honed in one direction which is to only detect unauthorized break in to homes, using PIR sensors and Door/Window sensor placed at remote location to achieve this – this also increases the system simplicity as well as increasing the system efficiency.

In [20], the authors worked on home security system, which is a digital home security system with voice feature which can monitor room temperature, smoke, motion, and windows and

doors. The goal of their work is to utilize the after-market parts and build an integrated home security system. Besides traditional magnetic switch equipped on doors and windows, we have also incorporated temperature sensor, smoke detectors, and motion sensor. Hence the security system will sound an alert when there is an attempt of break-in or if there is possible smoke or fire. The system is fully digital and can also be fully customized. It incorporated a 16x2 LCD display with a 4x4 keypad. Each sensor can be enabled or disabled, and alarm frequency and skim can also be chosen by users. It is also equipped with a voice playback chip, and it will speak which sensor has gone wrong. The problem in their work which is its limitation is that, power consumption of the system is very high and no alternative is been made for that. I have looked into this in my project, and got it fixed.

The author in [21] designed and constructed a GSM Based House Security System. This system unlike the traditional magnetic switch alarms equipped on doors and windows, has incorporated in it fire detectors and motion sensors so that a short message service, SMS is sent to the house owner on any attempt of a break in or possible smoke or fire. The system was built using a programmed microcontroller interfaced with mobile phone (NOKIA 1209) such that their three major buttons are switched at intervals to send a message to three different people anytime there is an intruder or fire accident. The intruder sensor is also connected to one of the microcontroller pin and is accomplished by the use of laser and LDR arrangement. An improvement on his work is made in the aspect of communication interface of the system which was initially a wired system, but to make it smarter with improved efficiency, at a low cost, a wireless system is introduced.

In [22], the authors worked on Arduino based Home security system. The system has been designed that has a special feature and which make a dial with the owner of the house to inform him that his house has been hacked. Arduino card was used, which is considered one of modern programmable device and utilize from speed dial function in mobile phone. The system has its limitation in the area of power supply, because it is been powered with limited volt from the laptop computer, which has been improved in my project. Also the arduino board used in the project is a bit expensive, and it has been replaced with microcontroller which is cheaper.

In [23], the authors worked on Design and Implementation of Microcontroller Based Security Door System (Using Mobile Phone & Computer Set). This door system is equipped with magnetic door detector, which detects intrusion when the door is opened and triggers an alarm. The limitation found in their work is that, a thief can bypassed the magnetic door sensor by not passing through the door and come through the roof, and therefore insecurity emerges. This is solved and improved

on with the introduction of the PIR detector sensors placed at strategic points which senses body movement.

In [24], the authors designed and implemented a Smart Home Security system. It is a Vision-based security system which have the advantages of being easy to set up, inexpensive and non-obtrusive. Here, a security system has been developed that uses sensors to detect any security violation and sends out the alert signal by high intensity Buzzer. It uses three level security systems. NFC tag use, providing Password and PIR motion sensor. To open the door a person should provide NFC tag and password. If one of them absence the door will not open. The door will open by servomotor with a lock coupled in its shaft. When wrong password is pressed, error text is displayed in the LCD. When an authorized person leaves the door, he has to show his tag in the reader. Otherwise the door will not close. Now if an unwanted man enters the room by password breaking or without NFC the PIR sensor works .It sounds the buzzer. NFC card reader, PIC 16F877A, Arduino Uno, PIR sensor is used for this project. There is no system with 100 percent reliability, the thief can bypass the password and make the house prone to insecurity. This been looked into, and has been solved by the introduction of GSM module so that the user can get notified when there is break in into the house.

The authors in [25] worked on Tele-safe home security system, this home security system is assembled using an embedded system with a microcontroller that would be: AFFORDABLE in order to appeal to the general public, RELIABLE in order to operate without failure, and EFFECTIVE in order to provide a sense of security. The Arming Unit, or the black box, which is the "brain" of the system, which contains the microcontroller and the auto-dialer. Secondly, it contains Infrared Transmitter and Infrared Receiver. This system is not really cheap as it is proclaimed to be, due to complexity of the devices. This has been improved on.

The author in [26] opined on Wireless Home Security System with the aim to design the home security by alarm system. The alarm system should check the status of the transmitter of the system regularly to ensure that the system could function without any failure. The failure of the transmitter will be indicated at the receiver through LEDs and the buzzer beeping sound. The project is to develop an alarm system for a house. The system can be operated through a password secured remote control. The remote can arm and disarm the whole system or each individual zone. The components that the project use are PIC16F877A microcontroller, encoder HT12E, LCD, 4X4 keypad, transmitter and receiver module. The limitation in his work is that only one transmitter and one receiver is built for this project, and so cannot perform bi-directional communication which allows the receiver to send signals to transmitter to request

the status of the transmitter because the communication between the transmitter and the receiver is only one way communication.

In [27], the author worked on the Design and Construction of a House security system which uses Radio Frequency (RF) transmission and covers 4 to 5 zones. The components that are used in his work are encoder, voltage regulator, RF module, Antenna, decoder, PIC 16F877A microcontroller and alarm. The project limitations are:

1. Expensive due to the voltage regulator is an end product purchased from the market.
2. Big in size.
3. Encoder-decoder not fully utilized; 15 data only used for 5 zones.
4. The PIC micro-controller which can do more functions beside trigger alarm.
5. Difficult to control because the system can be activated and deactivated through switching the power supply only. These limitations has been improved on in my work.

In [28], the authors proposed a Microcontroller based home security system with GSM technology. In this paper, design and implementation of a microcontroller based home security system with GSM technology have been presented and analyzed. Two microcontrollers with other peripheral devices which include Light Emitting Diode (LED), Liquid Crystal Display (LCD), Buzzer and Global System for Mobile Communication (GSM) Module are responsible for reliable operation of the proposed security system. In addition, a mobile phone is interfaced with microcontroller through a Bluetooth device in order to control the system. Moreover, a manual keypad is another way to lock or unlock the system. A Compiler Code Vision AVR is used to design a program that controls the system along with maintaining all security functions. The designed program is applied in Proteus Software for simulation. At last, the results of practical circuit show the proper functions and also verify the reliable security within reasonable cost.

The authors in [29] proposed a Home Security System, which is a digital home security system with voice feature and which can monitor room temperature, smoke, motion, windows and doors. This is a wired home security system built using different type of sensors. It also uses the traditional magnetic switch equipped on doors and windows. Besides that, their work is also using the temperature sensor, smoke detectors, and motion sensor. In this project the security system will sound an alert when there is an attempt of break-in or if there is possible smoke or fire. This project is built without considering how the owner of the system could switch off the system when he enters the armed house from outside. This is because the main control unit of the system is attached inside the house.

In [30], the author worked on Home/Office Security System. The aim of the work is to design and develop a home security system that can provide security against intrusion. Beside that, it also alerts during emergency (fire) situation. This system would send a short message service (SMS) to the owner and also to the authority when those two cases occur. Owners will know what happened to their home/office when they are not there. The main component used in developing the project is PIC 16F877A microcontroller. The two detectors heat detector sensors and door alarm (magnetic contact sensor) are used as the input of the PIC. The limitation of this project is that the components used in the course of this project have a lesser frequency, and therefore it has a lesser detection range. It has been considered and improved on in my own work.

The authors in [31] worked on designing and implementing a Wireless security system using RF Technology. In their work, they proposed that in the current world, the high value objects such as ipads, laptops, are prone to the theft and are required to be monitored to ensure safety. Monitoring the objects within a short distance by the use of a wireless security system is implemented with the help of modules which are capable of communicating with each other. The buzzer attached to the modules sounds instantly when the portable object moves approximately six meters away from the owner to the fixed location. The modules are designed with two ARMLPC2148 microcontrollers and CC2500 RF transceivers which are powered by a battery source. This project only monitors the devices in a home which means lives of individuals are still insecure, and therefore renders the project useless. This has been looked into and also worked on in the course of my work and has been improved on.

In [32], the author proposed the design of anti-theft alarm systems that it is an important safety measure to keep a portable property safe. The main idea of this design is to give an alarm or any kind of notification to the owner of the property when his property is moved from its original position. A personal property alarm device was designed and patented which works on a position sensing principle and gives out an audible alarm in case of theft. The device is housed in a sealed box with an opening for the sound signal to come out and is comprised of an alarm, sensing switch and a battery source. The device has two position sensitive switches which are employed in the design to overcome any faulty errors that may occur with the use of the single switch. The opening and closing of switches is dependent on the external physical movement of the property to be monitored. Any vibration or slight movement closes the switch, giving power output to the alarm and thus alerting the owner of the property. This design is prone to errors like malfunctioning of the switches, any kind of loose connections in the circuitry, and improper timing of the alarm giving a false indication to the owner to take necessary actions.

In [33] the authors combine efforts and knowledge in working on Home Automation and Security using Arduino. At entry point the system would secure the home and this was the main purpose to design the system .It aims to develop a low-cost means of home security system using sensors like motion sensor, PIR sensor etc. This system also deals with the OTP (One Time Password) generation which will be used as entry password for user. Data from all these sensors is continually received and processed by Arduino Uno board which acts as a control unit. In case of untoward situations, the Arduino will trigger an alarm and alert messages will be sent to user's mobile via GSM. It is an expensive system which has been the major challenge of this work. It has been considered, moderated and improved on in the course of my work.

The authors in [34] proposed an advanced low cost security system using sensors, Arduino and GSM communication module. In their work, the importance of home security measures are elaborated using easily available programmable sensors like PIR sensors. This also helps in the variation and also maintains low cost. Also Digital Signal Processors and finger print reading is added to the current installation of security system so as to eliminate any occurring ambiguities in the current system. Also the work for developing a smart GUI using an Android application is under the purview with Ethernet servers using an HTTPS internet website, so as to communicate with the standalone system from anywhere. This will also help in the versatility and bring down the operation cost. The high cost is the major limitation of their work brought about the complexity of the devices and components and it has been improved by using low cost devices and equipment.

In [35], the authors worked on Smart Surveillance system using PIR network and GSM. In this security system, it is based on the embedded system along with GSM and sensor networks. The human movement is detected using the PIR sensors. In this time, the system triggers an alarm detecting the presence of person in a specific interval of time and simultaneously sends how many persons are intruder via message to the SMS through GSM Modem. When the security system is activated, the CCTV camera is activated. This highly reactive approach has low computational requirement. This surveillance security system is implemented using PIC micro controller, camera, GSM and sensors. It is a brilliant and logical system but has its limitation in terms of its affordability cost due to the methodology and the complexity of the devices used and it has been improved by using low cost devices with higher efficiency to achieve the same aim.

In [36], the authors opined a GSM Based Home Automation, Safety and Security system using Android mobile phone, they used an anti theft reporting system which will report to the owner by ringing an alarm and by sending a SMS once an intrusion is detected by the system. The

limitation of their work is that too many devices in a different system are working on different functions thereby reducing the system efficiency and high power consumption which has been improved on my project by using high efficiency with low cost devices.

The authors in [37] proposed the design and development of a House-mobile Security system. The objective of the work is to design, develop and implement an alarm system that triggers the alarm and alerts the owner via a mobile text message if the house has been opened or an attempt has been made to open it illegally. The system will also feature two different forms of activation/deactivation and will automatically open or close the door for the user. The advantages of this house-mobile security system (HMSS) are its high security level, robustness, low cost and ease of use (uncomplicated) and that there is no distance limitation for contact. The system integrates different sensors via a microcontroller, which is the brain of the system, in order to avoid the problem of false alarms sent by other alarm monitoring systems to "Alarm Receiving Centers" or Police departments. An improvement made on the work is just the supplementary power supply to improve its reliability.

In [38], the authors proposed on working on Microcontroller based Home security system with remote monitoring. The door lock is password protected with an LED based resistive screen input panel which operates by detecting difference in light intensity captured by the photo diode which is emitted by surrounding red LEDs and reflected by the finger. The display is a 16X2 LCD panel. IR Laser sensors are used to detect any obstacle while monitoring the windows and doors at night or when away. Fire alarm system uses temperature sensor LM35 which senses sudden considerable increase in temperature and raises alarm. The major limitation of their work is found in the output (i.e. the notification of the owner), the user won't know what is going on in his house when he is not around. And so the use of GSM module is an improvement on this project.

The author in [39] worked on the design of a Burglar Alarm system capable of detecting and warning on external intrusion. This project is aimed at designing, simulating and implanting a cheap and reliable alarm system using Small Scale Integrated and Medium Scale Integrated chips that can detect and warn on external intrusion. The system satisfied the following i.e. it ensure the security of an office by deterring person intending to burglar and warning the occupants of office of any unauthorized entry into their premise and secondly provide psychological satisfaction of being secure to the office occupant. Project was designed in the following modules:

a. House Intrusion Module: This module consists of motion detectors placed strategically in concealed location this sensors when activated should activate the following devices in the following sequence:-

· Activate buzzer to warn the occupants.

· If present, activate the cameras

· Finally it should set off the alarm

b. The Control Unit Module: This is the decision making center that interprets the various inputs from the sensor and makes the appropriate logic decision.

c. Arm and Disarm Module: This is for arming and disarming the system.

d. Alarm Module: This is for warning and deterring the intruders.

The major limitation is that there is no provision for notification when the owner / the user is not around, and it has been improved by the introduction of GSM module which is capable of calling or sending short message service SMS to the owner.

In [40], the authors designed and developed a Home Security System based on Internet of things via Favoriot platform. It entailed the development of home security system using Internet of Things with online database server, FAVORIOT. The system is equipped with Passive Infrared sensor and Infrared sensor. This sensors will monitor the presence of intruder and any unauthorized entry. The usage of Blynk application on this device as the main switch which can activate the device even the users are across the world. The data receive from the sensor then send to the microcontroller which has already equipped with internet module. The FAVORIOT platform will received data that can helps the user to monitor the house and sending a real-time alerts to the users. Due to the advancement in technology, using internet of things for house security system is advantageous and as well has its limitations. One of the major limitation in this work is that when the user/owner is not around where there is availability of internet usage which is almost the case, in case of theft as at that time, the user won't be aware of what is going on at home. This has been considered and given so much thoughts and concern and has been improved by using GSM/GPRS module instead of wasting resources on the internet of things, which will notify the user instantly through call and short message service SMS.

CHAPTER 3

DESIGN METHODOLOGY

3.0 INTRODUCTION

The hardware of this project is divided into the following units. These are:

i. The input unit: this unit consist of the wireless sensors or detectors, which are the Passive Infrared sensor Detector and the Door/Window magnetic sensor.

ii. The control unit: this consist of the embedded microcontrollers on a board

iii. The output unit: this consist of the Alarm/Siren buzzer and the GSM (Global System for Mobile Communication) module.

iv. Power supply unit: this consist of the transformer, two (2) 6v DC cells, the rectifier and the LCD (Liquid Crystal Display).

This project is designed in such a way that is simple to operate and control even by an illiterate. The *input unit* detect intrusion using the appropriate sensors or detectors when there is break in to homes, or when it senses body movement and sends the signal to the *control unit* which then processes the signal and triggers the *output unit* by instantly triggering of the alarm and by calling the user and other configured numbers.

REVIEW OF SOME FUNDAMENTAL CONCEPTS

The design and construction of the house security system can be implemented using so many techniques. Based on so many related designs that has been carried out, it can be deduced that not only the microcontroller can be used as the mother control unit, we can also make use of the Arduino, Raspberry, Zigbee etc. to transmit and receive data as imbibed in this project. Comparing different author with the project being worked on, their major aim is to construct a security system that detects intrusion of any intruder, but different approach has been applied in getting the desired goal.

3.0.1 SENSORS

The American National Standards Institute defines a sensor as a device which provides a usable output in response to a specified measured (input). A sensor acquires a physical quantity and converts it into a signal suitable for processing (e.g. optical, electrical, mechanical).

Recently, common sensors convert measurements of physical phenomena into an electrical signal. The active element of a sensor is called a transducer (device which converts one form of energy to another). There are various physical phenomena that can be detected, such as;

biological, chemical, electric, electromagnetic, motion, radioactivity, optical, etc. These various sensors have their conversions achieved, based on readily available physical principles, some of which are;

- **Ampere's Law:** A current carrying conductor in a magnetic field experiences a force (e.g. galvanometer)
- **Curie-Weiss Law:** There is a transition temperature at which ferromagnetic materials exhibit paramagnetic behavior
- **Faraday's Law of Induction:** A coil resists a change in magnetic field by generating an opposing voltage/current (e.g. transformer)

In choosing a suitable sensor, to meet the desired specifications, some key factors must be considered such as; environmental factors, economic factors, and the sensors intrinsic characteristics.

3.0.1.1 MOTION DETECTOR SENSOR

Motion detectors are mainly used in security systems. It is typically positioned near exterior doorways or windows of a building to monitor the area around it. Since motion detectors are so flexible and have so many uses, it offers feelings of protection and security for the average homeowner as well as commercial organizations. An electronic motion detector is a device used to detect any physical movement in a given area and transforms motion into an electric signal. It consist of sensor that electrically connected to other devices such as security system, lighting, audio alarms, and other applications. Motion sensors are used in a wide variety of applications and as a result, many different types of motion sensors are available including the infrared sensor.

3.0.1.2 INFRARED DETECTOR SENSOR

Infrared sensors are widely known in the arts of intrusion detection and in fire or smoke detection. It is a device that is often used in automatic light switches and security systems to turn on a light or to activate some other form of alarm or warning indicator when a person enters a monitored area.

The infrared sensors have basically two forms; the active infrared sensor and the passive infrared sensor.

(a) **Active infrared sensor:** An active infrared detector includes a radiation source and an infrared sensor which is sensitive to interruptions in the radiation sensed from the source. These detectors are used as intrusion detectors by providing a path of radiation from the source to the sensor in a place where the path is likely to be interrupted by an intruder.

(b) **Passive infrared detector sensor:** Passive infrared motion detector detects heat energy radiated or emitted by an object, such as a body of a person, moving across a field of view of a heat sensor of the motion detection system. It generally uses an optical collection system and multiple sensing elements of alternating polarity to create a detection pattern in the volume of interest.

PIR detectors employ a group of radiation sensors coupled through amplifiers to a logic circuit. The radiation sensors detect changes in ambient infrared radiation. The detection system has an electrical circuit operatively coupled to the heat sensor for producing a detection signal in response to the heat sensor detecting a change of temperature caused by the body heat of a person entering the detection pattern. PIR motion detectors are perhaps the most frequently used home security device. Passive Infrared motion detectors are usually designed to provide an indication to an alarm panel in response to detecting infrared radiation that is indicative of motion of the object. The alarm panel is responsive to receipt of the breach indication to cause an alarm condition to occur.

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. For that reason they are commonly found in appliances and gadgets used in homes or businesses. They are often referred to as PIR, "Passive Infrared", "Pyro electric", or "IR motion" sensors.

For the sake of this project, we will be using the Passive Infrared detector sensor because of the following advantages and features it has over the Active infrared detector:

i. Detection range and trigger time are adjustable

ii. True temperature compensative

iii. Low battery alarm indicator

iv. Alarm delay function

v. Anti-frequency interference (20V/M-16Hz)

vi. Wireless signal transmission

vii. Ultra-low power consumption design

viii. Using SMT process, Anti-RFI, EMI interference.

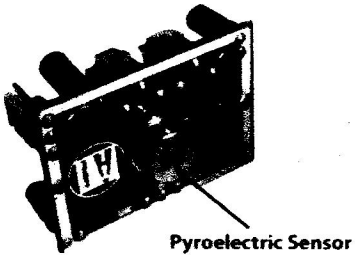


Figure 1. Passive Infrared Detector

3.0.1.3 DOOR/WINDOW SENSOR

The Wireless Magnetic Door / Window Contact Sensor is a protective device that can send notification when the opening and closure of doors and windows occurs. It is designed to send a wireless signal to a compatible home security system when the contact between the transmitter and corresponding magnetic sensor is broken.

- Magnetic contact used to monitor normally closed entry points such as doors and windows
- Wirelessly communicates with a compatible home security system up to 300 feet away
- Adjustable radio frequency settings and built-in technology prevent missed signals and transmission errors.

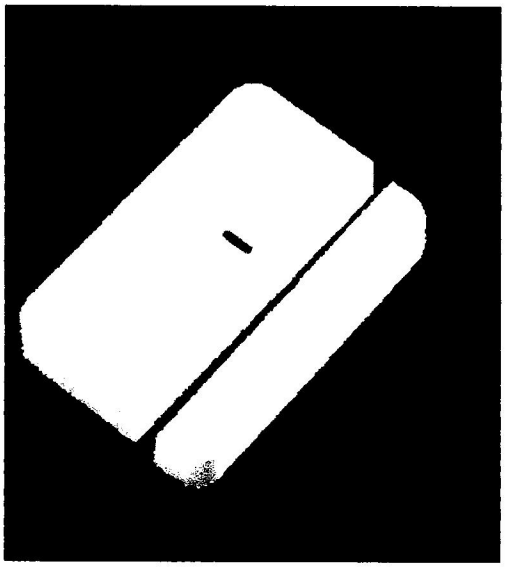


Figure 2. Door/Window sensor

3.0.2 MICROCONTROLLERS

A microcontroller (or MCU or *microcontroller unit*) is a small computer on a single integrated circuit. In modern terminology, it is a system on a chip. A microcontroller contains one or more CPUs (processor cores) along with memory and programmable input/output peripherals. Program memory in the form of Ferroelectric Random Access Memory (RAM), non-volatile NOR flash or One Time Programmable Read Only Memory (OTP ROM) is also often included on chip, as well as a small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purpose applications consisting of various discrete chip. 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. The devices are self-contained and rarely have any bus structures extending outside their package. Microcontrollers are so versatile that they can replace almost all circuits that previously require several discrete devices. Their low pricing scheme made it feasible for designers to dispense with many combinational or sequential logic circuits, replacing them with a single circuit emulating the desire function by running a simple program. The simple programming language and free support tools have ensured that development time and expenses can match or undercut the cost of designing conventional circuits.

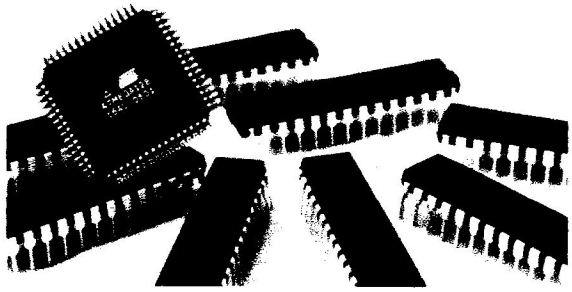


Figure 3. Microcontrollers

3.0.3 GSM OVERVIEW

The GSM module is a device that can be integrated into a micro controller that can send and receive messages from phone numbers programmed to the device's memory. It can also help to send signal to the micro controller based on the message received from the numbers programmed to its memory. A Subscriber Identity Module (SIM) is placed in the module which is then activated by the operator. GSM is a mobile communication modem; it stands for global system for mobile communication (GSM). The idea of GSM was developed at Bell Laboratories in 1970. It is widely used mobile communication system in the world. GSM is an open and digital cellular technology used for transmitting mobile voice and data services operates at the 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands. GSM system was developed as a digital system using time division multiple access (TDMA) technique for communication purpose. A GSM digitizes and reduces the data, then sends it down through a channel with two different streams of client data, each in its own particular time slot. The digital system has an ability to carry 64 kbps to 120 Mbps of data rates.They can feature all the functionalities of a mobile phone through computer like making and receiving calls. SMS, MMS etc. These are mainly employed for computer based SMS and MMS services. The GSM/GPRS module demonstrates the use of AT commands. They can feature all the functionalities of a mobile phone through computer like making and receiving calls,SMS, MMS etc. These are mainly employed for computer based SMS and MMS services. The AT commands are called so because every command line starts with "AT" or "at". AT commands are instructions used to control a modem. AT is the abbreviation of ATtention.

Some tasks that can be done with the AT command includes:

i. Get basic information about the mobile phone or GSM/GPRS modem. For example, name of manufacturer (AT+CGMI), model number (AT+CGMM), IMEI number (International Mobile Equipment Identity) (AT+CGSN) and software version (AT+CGMR).

ii. Get basic information about the subscriber. For example, MSISDN (AT+CNUM) and IMSI number (International Mobile Subscriber Identity) (AT+CIMI).

iii. Get the current status of the mobile phone or GSM/GPRS modem. For example, mobile phone activity status (AT+CPAS), mobile network registration status (AT+CREG), radio signal strength (AT+CSQ), battery charge level and battery charging status (AT+CBC).

iv. Establish a data connection or voice connection to a remote modem (ATD,ATA,etc).

v. Send and receive fax (ATD, ATA,AT+F*).

3.0.3.1 SIM300S GSM MODULE

The GSM module SIM300s used in the course of this project, is a GSM modem which has a serial interface and plug and play facility. The modem can be used to send SMS, receive and make calls, and do the basic GSM operations with the help of AT commands. A standard RS232 interface is used so that we can use it to interface with the microcontrollers and PCs. It has power regulation, SIM holder and external antennas.

The **features** of this SIM300 GSM module are as follows:

i. Uses SIM300 GSM module transmission

ii. Operating voltage: 7-15V AC or DC (board has an onboard rectifier).

iii. Can be used for Data/Fax, GSM based Voice communications, TCP/IP stack, GPRS and SMS.

iv. SIM300 allows an adjustable baud rate from 1200 to 115200 bps (9600 default).

v. Provides RS323 interface for connection to computers and other devices

vi. Can add external antenna with SMAconnectors.

vii. Power, RING and Network LEDs for easy debugging.

viii. Provides serial TTL interface for easy and direct interface to microcontrollers.

ix. Can be controlled through standard AT commands.

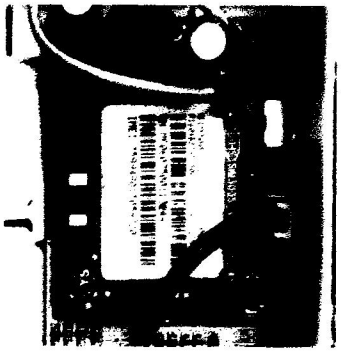


Figure 4. SIM300s GSM module

3.0.4 ALARM BUZZER / SIREN

A siren is a loud noise making device. Electronic sirens incorporate circuits such as oscillators, modulators, and amplifiers to synthesize a selected siren tone (wail, yelp, pierce/priority/phaser, hi-lo, scan, air horn, manual, and a few more) which is played through external speakers. For this project an Alarm Siren Buzzer Speaker was chosen. The device is made of fireproof ABS material and operates at a rated voltage: DC 12V Power with an output of 15W. The sound pressure level is 110dB with a time delay of 1s.

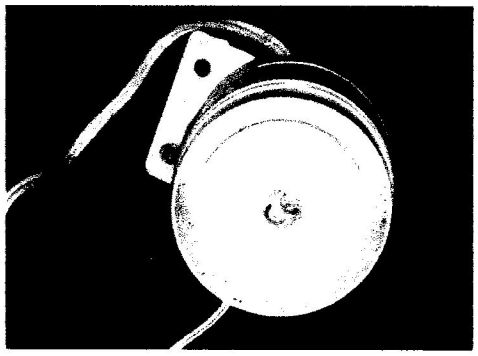


Figure 5. Alarm Buzzer

3.0.5 POWER SUPPLY

The 220/240V, 50Hz input supply of the device is an AC source which is stepped down by a transformer to deliver a secondary output of DC (Direct Current) 12V, 500 mA. The transformer output is rectified by a full-wave rectifier comprising of diodes, smoothened by capacitor and regulated by a voltage regulator. This is coupled to a LCD (Liquid Crystal Display) which shows or display the Voltage level of the system.

3.1 SPECIFICATIONS

The system and its components have specifications at which they can operate and have maximum efficiency. The specification of each component is analyzed below.

3.1.1 PASSIVE INFRARED DETECTOR

Power supply: 9v DC

Transmission current: $\leq$ 20mA

Static current: $\leq$ 10mA

Wireless frequency: 433MHz $\pm$ 0.5MHz

Transmission Distance: About 30m with one barrier

Detective speed: 0.3 – 3m/s

Detective distance: 5 – 12m

Detective range: Horizontal 110°, Vertical 60°.

Working condition: Temperature -10degree ~ +40 degree

3.1.2 DOOR/WINDOW MAGNETIC SENSOR

Power supply: 12v/23A DC Battery

Transmission current: ≤ 15mA

Static current: ≤ 20mA

Transmission frequency: 433MHz ± 0.5MHz

Transmission Distance: About 30m with one barrier

Internal distance: 15mm.

Working condition: Temperature -10degree ~ +40 degree

Humidity: 90% rh

3.1.3 G.S.M AND ALARM SIREN BUZZER

Input Voltage: DC 9-12V / 1.2A

Standby current: < 55mA

Alarming Current: < 450mA

Wireless frequency: 433MHz, PT2262/4.7MΩ

GSM frequency: 900/1800/1900MHz

Alarm loudness: 110dB

Siren: One wired siren

3.1.4 POWER SUPPLY UNIT

Components in this unit and their specifications:

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

ii. Transformer 50Hz of 220/240v AC, 12V, 500mA DC.

iii. Bridge Rectifier, a full wave for converting AC power source into DC source.

iv. Liquid Crystal Display 4×2 display for voltage level of the system.

The power supply unit (figure 6) consists of 240V/12V; 500mA; step down transformer, bridge rectifier, 1000μF/35V capacitor, 7805 voltage regulator status indicator LED, and 1KΩ resistor to limit the voltage entering the LED. The 240V/50Hz input supplies the transformer and the voltage is then stepped down to 12V, which then passes through the rectifier where it is then converted to D.C voltage. Smoothening the direct current (D.C.) is

carried out by the capacitor. The 7805 regulates the voltage to give a voltage of 5Vdc required as Vcc. This Vcc is delivered to various loads that need the supply. The characteristics of the power supply unit and distribution of the D.C. voltage to various parts of the system have some effects on the performance of the circuit. D.C. voltage is isolated from the mains by the 240V/12V transformer before delivering to the output of the bridge rectifier. The rectifier circuit consists of diodes configured into a full wave bridge rectifier mode. The regulator used in the design provides regulated and stable D.C. voltage (5v+/-0.1%) and these output drive all chips used for the design .The capacitor is designed to filter and remove surges that appear on either the input or output of the supply.

3.1.5 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

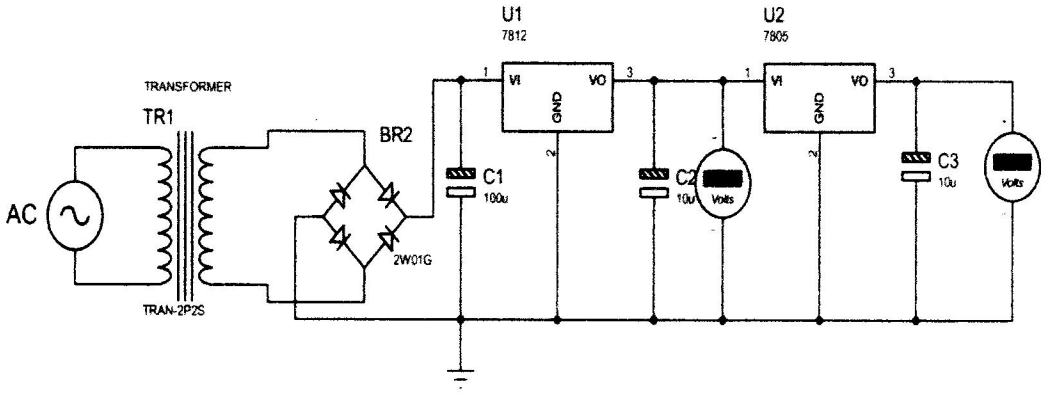


Figure 6. Regulated power supply

3.2 DESIGN

In order to design this system, there are basic structures and patterns followed and this includes

i. The block diagram

ii. The flow chart

iii. The circuit diagram.

3.2.1 FUNDAMENTAL BLOCK DIAGRAM

The block diagram includes blocks of components used in making the circuit functional, the various components involved in the circuit includes PIR Sensor, Microcontrollers, Door/window magnetic sensor, Alarm buzzer, and GSM module.

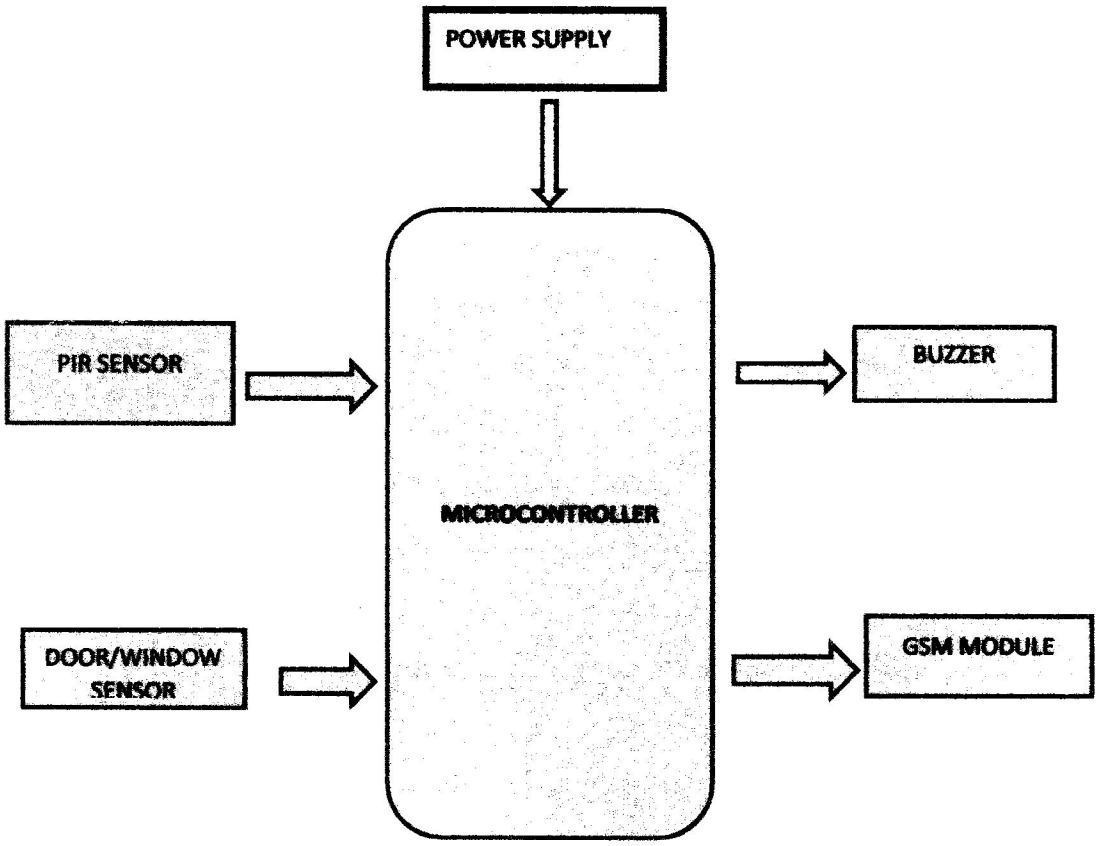


Figure 7. Generalized block diagram of the system

3.2.2 FUNDAMENTAL FLOW CHART

The operation of the system is shown in the next figure which is called the *flow chart* in the following algorithm

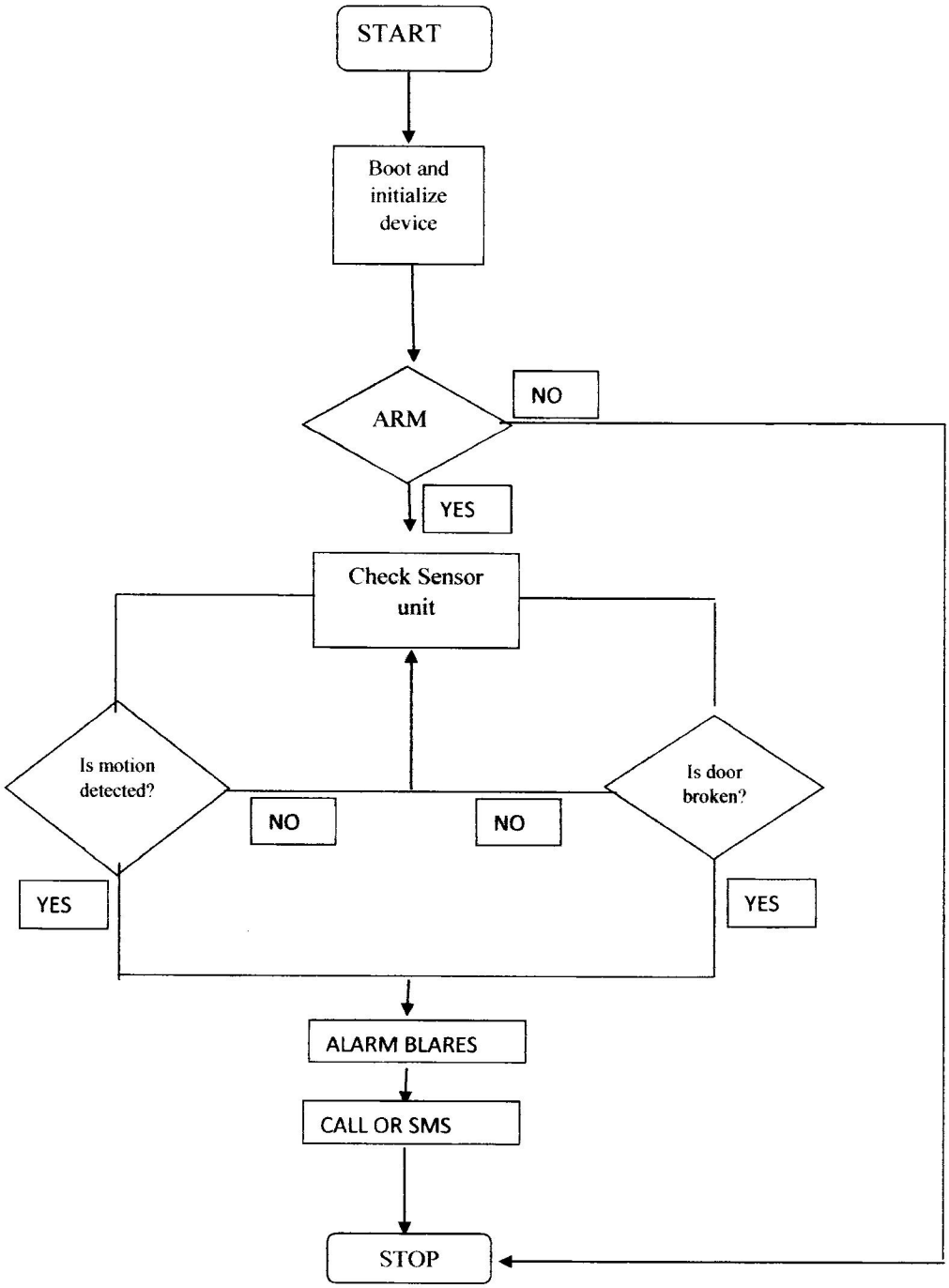


Figure 8. Schematic Flow Chart

3.2.3 FUNDAMENTAL CIRCUIT DIAGRAM

This project required an interconnection of sensors, the power supply unit, the microcontroller board, a GSM module and an LCD Screen as illustrated below.

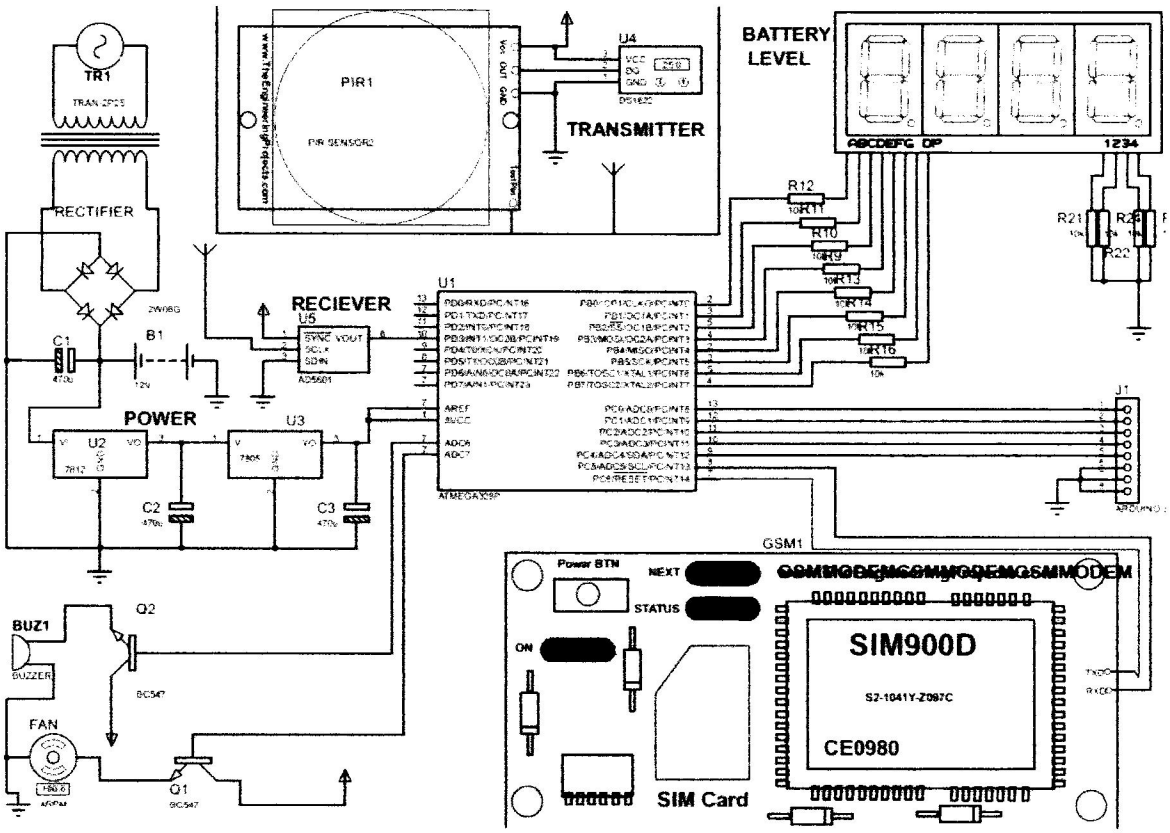


Figure 9: circuit diagram of the system

CHAPTER 4

4.0 TESTING, ANALYSIS OF RESULTS AND DISCUSSION

The processes and steps taken during the implementation of this project is explicitly analyzed in the following subsections.

4.0.1 PRE-IMPLEMENTATION TESTING

The components were bought and tested to ensure that none was faulty and was in a good condition before implementation.

4.0.2 TOOLS USED DURING IMPLEMENTATION

i. MULTI-METER: - for measuring the level of voltage, current, etc.

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

iii. SET OF SCREW DRIVERS: - for driving in and out of bolts and nuts.

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

v. LAPTOP COMPUTER: - for designing and simulation of the circuit.

4.0.3 IMPLEMENTATION OF THE SYSTEM

In implementing any electronic circuit, there are some step to step procedures which are needed to be put into consideration before achieving the desired result. Steps taken during the design of the project includes:

1. Circuit design

2. Simulation of circuit

3. Hardware implementation

4. Control Unit Programming

5. Interconnection of 3 and Liquid Crystal Display (LCD)

6. Soldering

7. Casing of the project

4.0.3.1SIMULATION OF CIRCUIT

The required components were picked and dropped, then interconnected as shown in the figure below. Below is the simulation of the circuit designed with Proteus software.

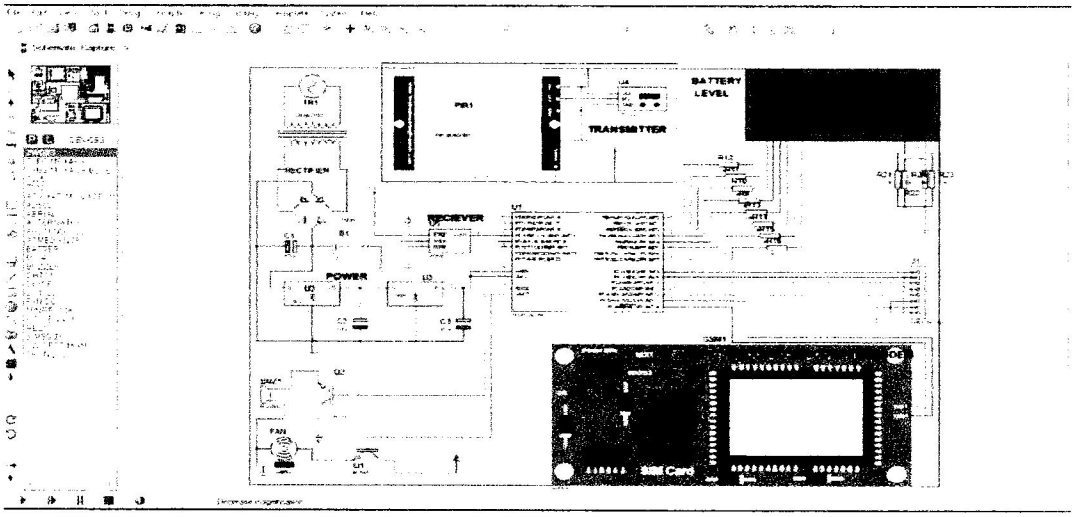


Fig. 10: Simulation on Proteus

4.0.3.2 HARDWARE IMPLEMENTATION

The hardware implementation is done by connecting the components in different units as it is shown in the circuit diagram.

i. The power supply unit which comprises of the Transformer, Fan (of which the function is to cool the system), two (2) 6v rechargeable cells, rectifier, etc. is connected together and the components were individually tested and their component values were verified. After the construction of this unit, a 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. The voltmeter section of a digital multi-meter was used to read out and confirm the various stages.

ii. The control unit which consists of the embedded microcontrollers is connected on the PCB (Printed Circuit Board) with the output unit (the buzzer and the GSM module). Then the components are tested. The buzzer was tested to be in a perfect working condition after it was correctly connected to the circuit. The GSM module was also tested to be in good working condition. Once connected to the circuit and intrusion was detected, a message and a call was received by the mobile numbers that was included in the programme code uploaded unto the microcontroller.

iii. The input unit consist of the sensors which are the passive infrared detector (PIR detector), door/window magnetic sensor are connected wirelessly and synced with the control unit. The passive infrared detector was tested after the implementation by bringing human body close to it. Once it detected the body, a signal was been sent to the microcontroller and the buzzer was activated as audible alarm was sounded. The door/window magnetic sensor was tested to be in good working condition. It was placed at the door entrance. Once the door was opened, the buzzer sounded an audible alarm.

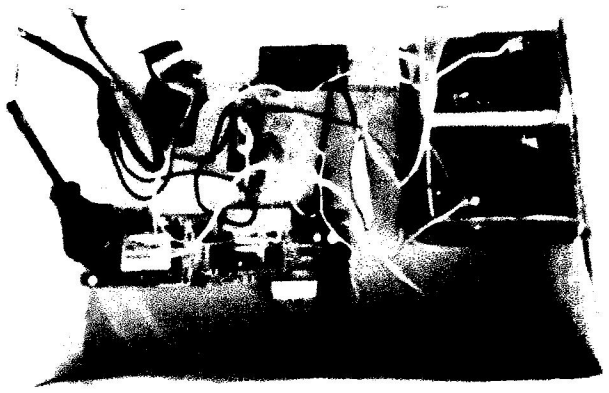


Figure 11: iHardware implementation

4.0.3.3 CONTROL UNIT PROGRAMMING

The control unit (embedded microcontrollers) is programmed by connecting or syncing the wireless sensors to the system and by uploading the desired mobile numbers on it.

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.

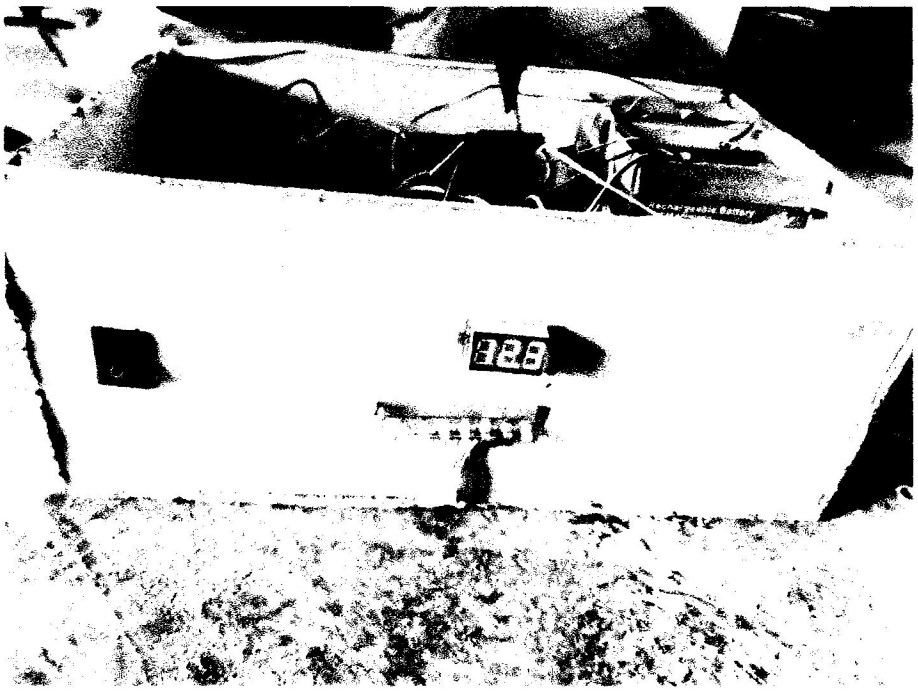


Fig. 12: Interconnection with the LCD

4.0.3.5 SOLDERING

After the positioning of the components as provided on the circuit diagram of the project, the joining of components to one another was done using a soldering iron with rating of 60W/220V and soldering lead. Most components are very sensitive to heat, so extra care was taken in handling and soldering to avoid burning of the components. Also, each joint was ensured to be electrically sound to allow conduction of electricity and mechanically sound to avoid getting disjointed on receiving considerable mechanical stress.

4.0.3.6 CASING

The casing serves as housing for the whole unit that makes up the system. The casing was made of plywood wrapped with brown leather material which is unaffected by corrosion. The casing was made of considerable size to accommodate the components with considerable spacing and to achieve device portability. The figure below shows the typical casing:

Figure 13. Casing of the project

4.0.4 FINAL COUPLING AND OVERALL PERFORMANCE EVALUATION

4.0.4.1 COUPLING

The system board was attached to the base of the casing by screwing it tightly to it. This is to prevent vibration. Vibration can cause the system to malfunction, it can also loosen wires and joints. The detectors were attached to the respective openings on the cover of the casing. In the process of doing this, the individual circuits were observed for burning, excessive generation of heat and failure.

4.0.4.2 PERFORMANCE EVALUATION

It is relevant to know the working principle of this electronic circuit before going to its actual testing. The operating sequence of this circuit includes the following:

1. Intrusion is been detected by the Passive Infrared Detector (PIR) detector and/or by the door/window magnetic sensor.

2. The microcontroller then triggers the buzzer, and make a call or send a short message service (SMS) to the user.

EXPECTED PERFORMANCE UNDER NO INTRUSION CONDITION

Having understood the above analysis, we can now analyse the operational principles of the circuit under no intrusion condition and then under the intrusion condition performance method. Under no intrusion condition, the detectors tends to remain in their default state as

programmed, then no signal is sent to the microcontroller. Once intrusion is detected, a signal is sent to the microcontroller which shows that the house is no longer secure.

EXPECTED PERFORMANCE UNDER INTRUSION CONDITION

When intrusion is detected, the PIR sensor or the door/window magnetic detector as the case may be will send a signal to the microcontroller. The microcontroller will in turn send signals to the buzzer, and the GSM module. The buzzer then sounds an audible alarm, while the GSM module in turn call or sends a SMS to the user.

RESETTING THE CIRCUIT

When the buzzer switches "on", it will continue in this state i.e. it will continue sounding until SMS has been sent to all the mobile numbers programmed unto the microcontroller and until it is been disarmed. In case, the user wants to switch off the supply to the circuit completely, an option is to use the switch button on the system, but switching off the supply is not ideal for one may forget to switch it on again after the intrusion situation has been contained and the circuit will then not be able to detect intrusion when it occurs any further.

In order to overcome this challenge, the user can switch off the device remotely using his or her mobile device. This can be achieved by calling the system and choose the option "3-to disarm", which will help in deactivating the buzzer and reset the detectors to their initial state.

4.1 TESTING

4.1.1 TESTING OF POWER SUPPLY UNIT

The components in this unit consist of a 12V DC battery which is rechargeable. The components were individually tested and their component values were verified. After the construction of this unit, a 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. The voltmeter section of a digital multi-meter was used to read out and confirm the various stages.

4.1.2 TESTING OF THE BUZZER

The buzzer was tested to be in a perfect working condition after it was correctly connected to the circuit. The transistor connected to the output pin of the microcontroller helps to trigger on the buzzer to make an audible alarm.

4.1.3 TESTING OF THE PASSIVE INFRARED DETECTOR

The PIR detector was tested after the construction by walking around where it is positioned and it generated heat in form of infrared radiation close to it. Once it detected the body, a signal

was been sent to the microcontroller and the buzzer was activated as audible alarm was sounded.

4.1.4 TESTING OF THE DOOR/WINDOW MAGNETIC SENSOR

The door/window magnetic sensor was tested to be in good working condition. It was placed at the door entrance. Once the door was opened, due interference in the magnetic field, the buzzer sounded an audible alarm.

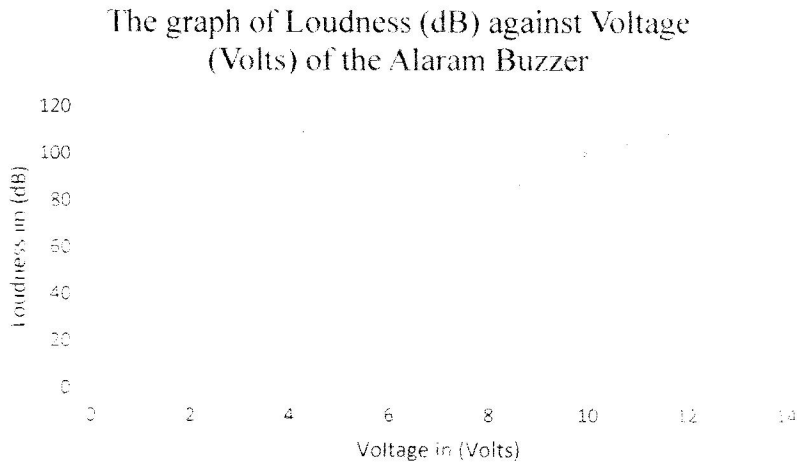
4.1.5 TESTING OF THE GSM MODULE

The GSM module was also tested to be in good working condition. Once connected to the circuit and intrusion was detected, a message was received and as well as call by the mobile numbers that was programmed on it.

4.2 ANALYSIS

The work deals with assembling, soldering, casing etc. The circuit components used was locally sourced while the detectors were ordered from the foreign marketplace. Once they were gotten, the components were then assembled and soldered according to the specifications of the circuit diagram. After soldering, the testing of the circuit design took place across the nodes of the circuit. A side of the casing had to be drilled in order for the power jack to fit in and for ventilation. 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 THE BUZZER

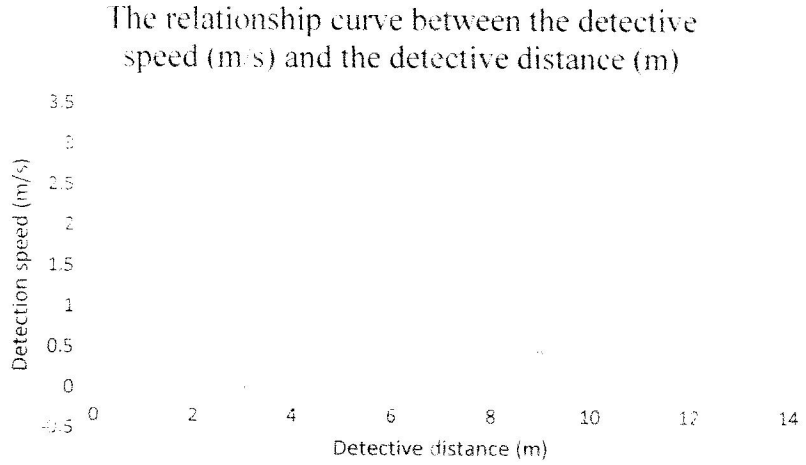


The graph above shows the relationship between the loudness of the buzzer and the input voltage. As the voltage input increases, there is an increase in frequency which brings about

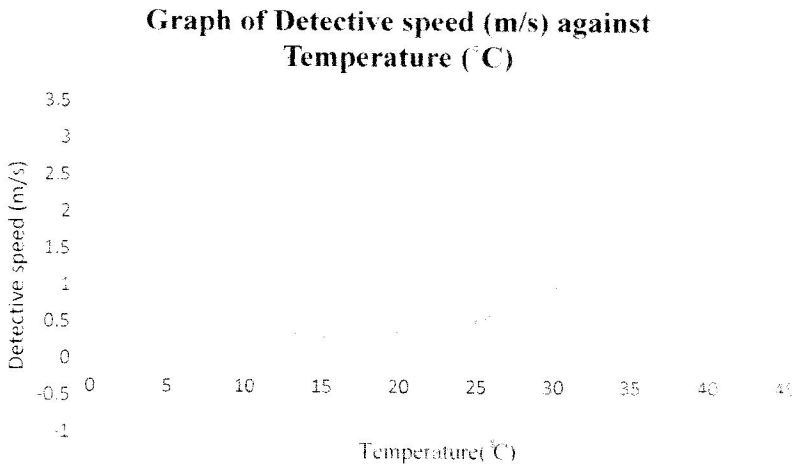
an increase in the loudness of the alarm buzzer. The threshold decibel of the buzzer is 110dB, so for maximum efficiency of the buzzer, the voltage input can not be above or below 12V.

4.2.2 ANALYSIS OF THE PASSIVE INFRARED DETECTOR

The graph below shows the relationship between the detective speed and the detective distance of the passive infrared detector. From the graph, as the detective distance increases, the detective speed decreases. An increase in the distance from 0 to 4 shows there is no increase in the detective speed (i.e. no detection will occur). The highest detective speed is 3m/s while the highest detective distance is 12m. The lowest detective speed is 0.3m/s and the lowest detective distance is 5m.



4.2.3 ANALYSIS OF THE PASSIVE INFRARED DETECTOR BASED ON THE TEMPERATURE WORKING CONDITION



The graph above shows the relationship between the temperature in degrees Celsius and the detective speed of the passive infrared detector. The passive infrared detector generate heat measured in degree Celsius through infrared radiation. An increase in this temperature brings about an increase in the detective speed of the detector. As shown in the graph, any temperature below 10°C and above 40°C cannot be detected.

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 of the tasks and resources needed to complete a project, which shows ranges of possible start and end dates and the relationship between tasks, used to pinpoint bottlenecks and assign priorities.

The authors in [41] opined on a Surveillance Robot to address the need for a self contained home security system by eliminating the drawbacks of using of both wired and wireless security systems. In achieving this, they made use of two (2) Gantt charts (spring and fall) in their project scheduling. As a result of proper planning, they were able to achieve the aim and objectives of their work.

In [42], the author made use of the Gantt chart in achieving the aim of his project which is to design and implement a security system alert via SMS within the stipulated time. This system made use of sensor, microcontroller, keypad, buzzer and GSM modem to enhance the security system which enable the user to be alerted in real time as soon as intrusion is detected.

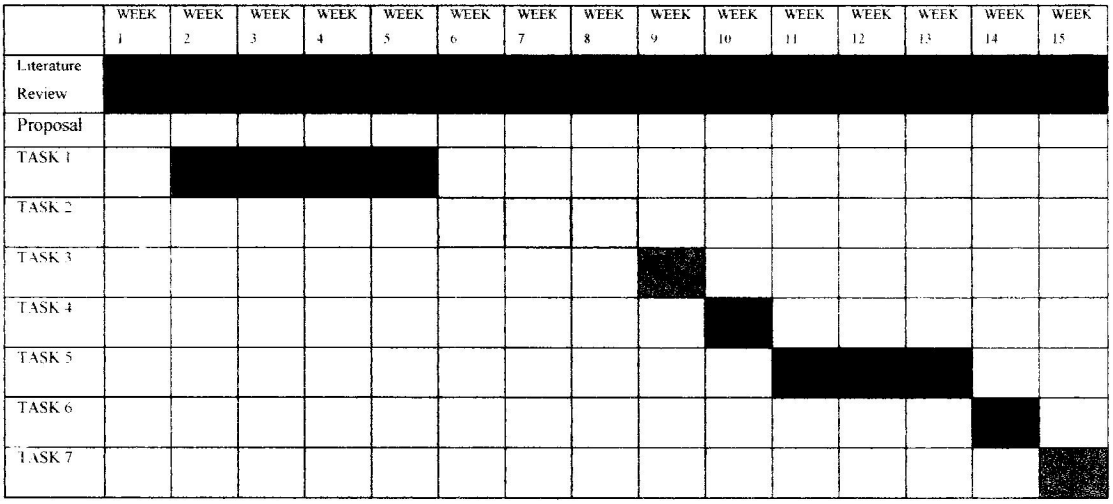
In [43], the authors worked on garage door security system using three (3) different Gantt charts to analyze their project management. They defined Gantt chart as a type of bar chart that illustrates a project schedule which lists the task to be performed on the vertical axis and time interval on the horizontal axis. The aim of their project which is to design a garage door security system was achieved because of adequate planning following the Gantt charts.

The authors in [44] proposed a fast track safety and security system. They made use of the Gantt chart in their project management and scheduling to achieve the aim of their project which is to design a security system at the entrance of their company using Arduino microcontroller, sensors etc. which can detect and scan the intruder into their company.

In [45], the authors worked on a home security system with mobile application for fire detection and intruders. They employed the use of Gantt chart to manage their project so as to achieve the aim of their project using proximity intruder sensors and detectors, microcontrollers and Global System for Mobile communication module as the components.

THE FUNDAMENTAL GANTT CHART OF THIS PROJECT

The fundamental Gantt chart of the 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- Hardware implementation.

Task 6- Soldering.

Task 7- 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. System error

iii. Electric shock.

These threats are been mitigated by:

i. Provision of surplus components so as to serve as redundancy thereby improving the reliability of the system.

ii. It was ensured that the project is handled by an expert.

iii. I ensured I put on my safety wears.

In the course of this project, no risk actually materialize simply because of the proper planning.

4.3.3 SOCIAL, LEGAL, ETHICAL AND PROFESSIONAL CONSIDERATIONS

This project was ensured to have been designed and implemented to meet and conform to the standards of Institute of Electrical and Electronics Engineers (IEEE). It was also ensured that all safety rules and regulations were duly observed during the course of the project.

CHAPTER 5

5.0 CONCLUSION AND RECOMMENDATIONS

This chapter concludes the chapters in this thesis. It includes conclusion, recommendation of the project, its limitations, likely future works etc. This project has undergone the process of construction, implementation, testing, and analysis and has been completed. Therefore, the aim and the objectives of the project was achieved.

5.1 CONCLUSION

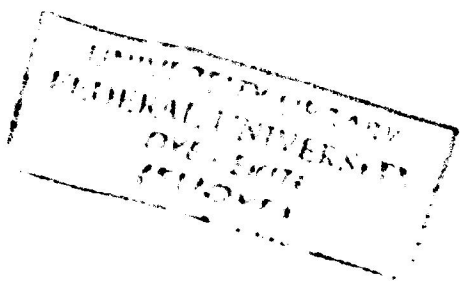
In conclusion, this work has presented the design and implementation of a house security system. After the construction and component assembly, it was tested and the developed house security system gave good response to the sensors, sends SMS, or call when it detects intrusion at the windows or indoor. When intrusion is detected, the user can get alerts (sms or call) anywhere through the GSM technology thus making the system location independent. This security home feature is expected to draw much attention in the next decades. People are getting more and more concerned about how to protect themselves and their houses from emergencies. These emergencies are criminal activities like intrusion, theft, robbery etc. This device provides a means for being able to securely monitor a house by use of sensors integrated with a microcontroller and a GSM unit. SMS or call provides an economical and convenient way to alert users of a possible intrusion. The use of mobile handsets as a client for alert implies that the user will not have to carry an additional piece of equipment as most people already have a mobile phone with them most of the time. By using this system the security services of a nearby region can also be informed about the intrusion instantly and they can take steps rapidly. So this system is safe, smart and cost effective as well.

5.2 RECOMMENDATIONS

It is encouraged that this house security system should be used by all in their homes, offices and everywhere there is a possibility of criminal activities. The device should be installed and powered on. The battery provided should be charged so as to ensure regular supply of power to the device. Despite the advantages of this work, there are still things that can be done to increase the reliability and efficiency of this project work. These include:

i. An embedded system seems to be the direction in which electronics technology is headed, so smart systems should be incorporated in the design.

ii. An alternative to short message service (SMS) notification such as notification via the internet or Wi-Fi can be included in the project to reduce failure rate that may be posed by network unavailability.



5.3 CONTRIBUTION TO KNOWLEDGE

The development, design and implementation of this project has helped me in various ways by impacting me with more knowledge. First off, now I have a bright exposition on the topic of "Security". Secondly, the design and implementation of house security system helped me to make researches in different aspects of physics/electronics technology; this include; power electronics, physical electronics, operational amplifier, telecommunication, and software engineering.

5.4 LIMITATIONS

Upon the completion of this project I realized some limitations which are discussed below

1. Due to the effect of poor GSM Network coverage, the design of GSM module becomes an issue because this can lead to delay of the expected SMS or call.

2. Components used in the design of this project cannot be found in Ikole Ekiti. A lot of travelling was done to achieve this project.

5.5 FUTURE WORKS

The future implications of the project are very great considering the amount of time and resources it saves. This system can be used as a reference or as a base for realizing a scheme to be implemented in other projects of greater level. It is suggested that more researches can be carried out towards the improvement of the project and suggested future works are listed below:

i. A solar panel can be implemented so as to charge the system thereby making it less dependent on AC power source.

ii. A CCTV camera module can also be implemented so as to capture the face of the intruder immediately the intrusion is detected.

iii. More sensor modules can also be introduced into the system. For example, temperature sensor, fire sensor, smoke detector with arrester etc.

5.6 CRITICAL APPRAISAL

With the lack of an efficient state security agency, there has been a focus on the deployment of home security/alarm systems, sponsored by different privately own security outfit in other to combat the high level of crime. This project "house security system" is designed and implemented to mitigate the number of burglar incidences rising in different states in Nigeria. With the advancement in technology particularly the Global System Mobile (GSM) technology, securing our home is now been simplified. It's now possible for users to control and monitor systems and development in their household with the help of their smartphones.

The development also brings in other advantages like cost effectiveness and much needed efficiency. The system consists of passive infrared motion detector and a magnetic sensor as transducers for detecting intruders motion or break in through a door. The signals are then processed by an embedded microcontroller unit which then activate the GSM module and send SMS message or make a call to the householders' mobile phone device, and activating an attached alarm system simultaneously. Initial testing of this system shows that it worked as expected.

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APPENDICES
APPENDIX I
USEFUL PROGRAM CODE

```
#include <LiquidCrystal.h>
int ledPin = 13; // choose the pin for the LED
int inputPin = 7; // choose the input pin (for PIR sensor)
int pirState = LOW; // we start, assuming no motion detected
int val = 0; // variable for reading the pin status
int pinSpeaker = 10; //Set up a speaker on a PWM pin (digital 9, 10, or 11)
LiquidCrystal lcd(12, 11, 5, 4, 3, 2); // initialize the library with the numbers of the interface
pins
void setup() { pinMode(ledPin, OUTPUT); // declare LED as output pinMode(inputPin,
INPUT); //
declare sensor as input
pinMode(pinSpeaker, OUTPUT);
Serial.begin(9600);
lcd.begin(16, 2);
lcd.setCursor(2, 0); // Set LCD cursor position (column, row)
lcd.print("P.I.R Motion"); // Print text to LCD
lcd.setCursor(5, 1); // Set LCD cursor position (column,row)
lcd.print("Sensor"); // Print text to LCD
delay(4000); // wait 4s // Delay to read text
lcd.clear(); // clear LCD display // Clear the display
lcd.setCursor(2, 0); // Set LCD cursor position (column, row)
lcd.print("Developed By"); // Print text to LCD
lcd.setCursor(2, 1); // Set LCD cursor position (column, row)
lcd.print("Suman Ssk Vinit"); // Print text to LCD
delay(5000); // Delay to read text
lcd.clear(); // Clear LCD
lcd.setCursor(0, 0);
lcd.print("Processing Data.");
10
delay(3000);
lcd.clear();
```

```
lcd.setCursor(3, 0);
lcd.print("Waiting For");
lcd.setCursor(3, 1);
lcd.print("Motion....");
}
void loop(){
val = digitalRead(inputPin); // read input value
if (val == HIGH) { // check if the input is HIGH
digitalWrite(ledPin, HIGH); // turn LED ON
playTone(300, 300);
delay(150);
if (pirState == LOW) {
// we have just turned on
Serial.println("Motion detected!");
lcd.clear() ;
lcd.setCursor(0, 0); // Set LCD cursor position (column 0, row 0)
lcd.print("Motion Detected!");
// We only want to print on the output change, not state
pirState = HIGH;
}
} else {
digitalWrite(ledPin, LOW); // turn LED OFF
playTone(0, 0);
delay(300);
if (pirState == HIGH){
// we have just turned of
Serial.println("Motion ended!");
11
lcd.clear() ;
lcd.setCursor(3, 0);
lcd.print("Waiting For");
lcd.setCursor(3, 1);
lcd.print("Motion...."); // We only want to print on the output change, not state
pirState = LOW; } } } // duration in mSecs, frequency in hertz
```

```
void playTone(long duration, int freq) {
duration *= 1000;
int period = (1.0 / freq) * 100000;
long elapsed_time = 0;
while (elapsed_time < duration) {
digitalWrite(pinSpeaker,HIGH);
delayMicroseconds(period / 2);
digitalWrite(pinSpeaker, LOW);
delayMicroseconds(period / 2);
elapsed_time += (period);
}
}
```

APPENDIX II

COMPLETE CIRCUIT DIAGRAM