KOFORIDUA TECHNICAL UNIVERSITY

FACULTY OF ENGINEERING

DEPARTMENT OF ELECTRICAL/ELECTRONICS

"DESIGN OF AN ANTI THEFT SYSTEM

A PROJECT WORK SUBMITTED TO THE DEPARTMENT OF ELECTRICAL AND ELECTRONICS IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF BACHELOR OF TECHNOLOGY (BTECH) IN TELECOMMUNICATION

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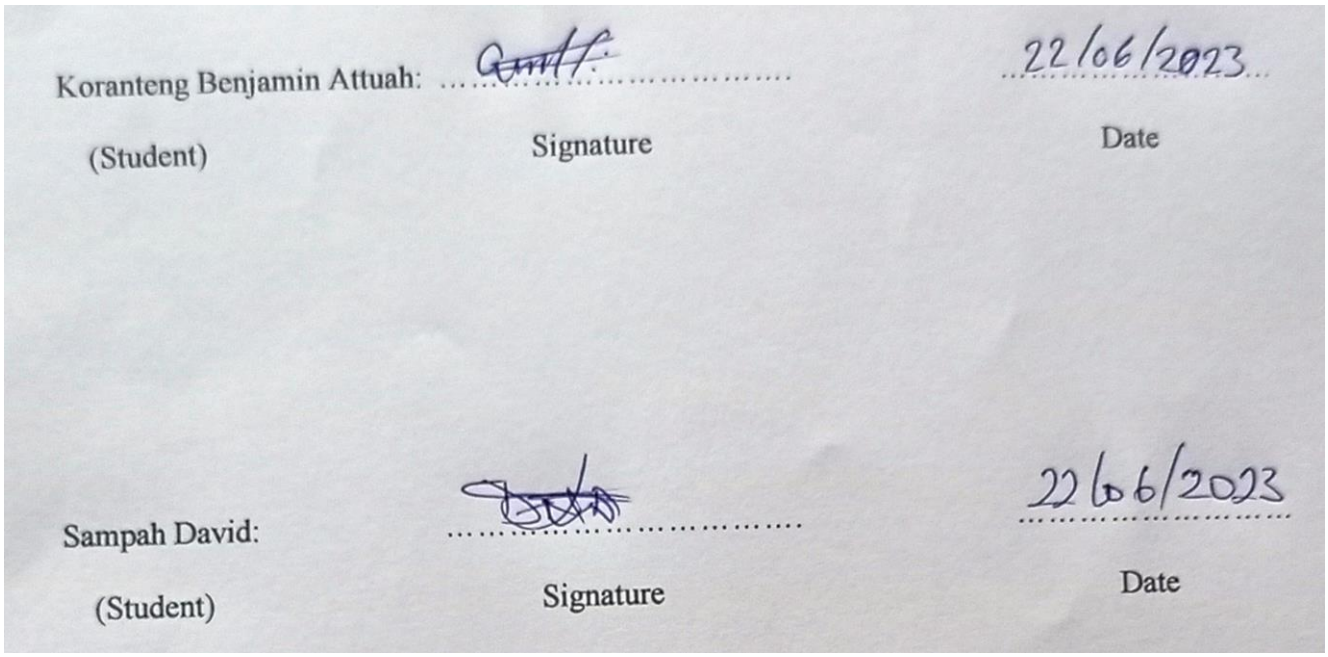
NOVEMBER, 2022

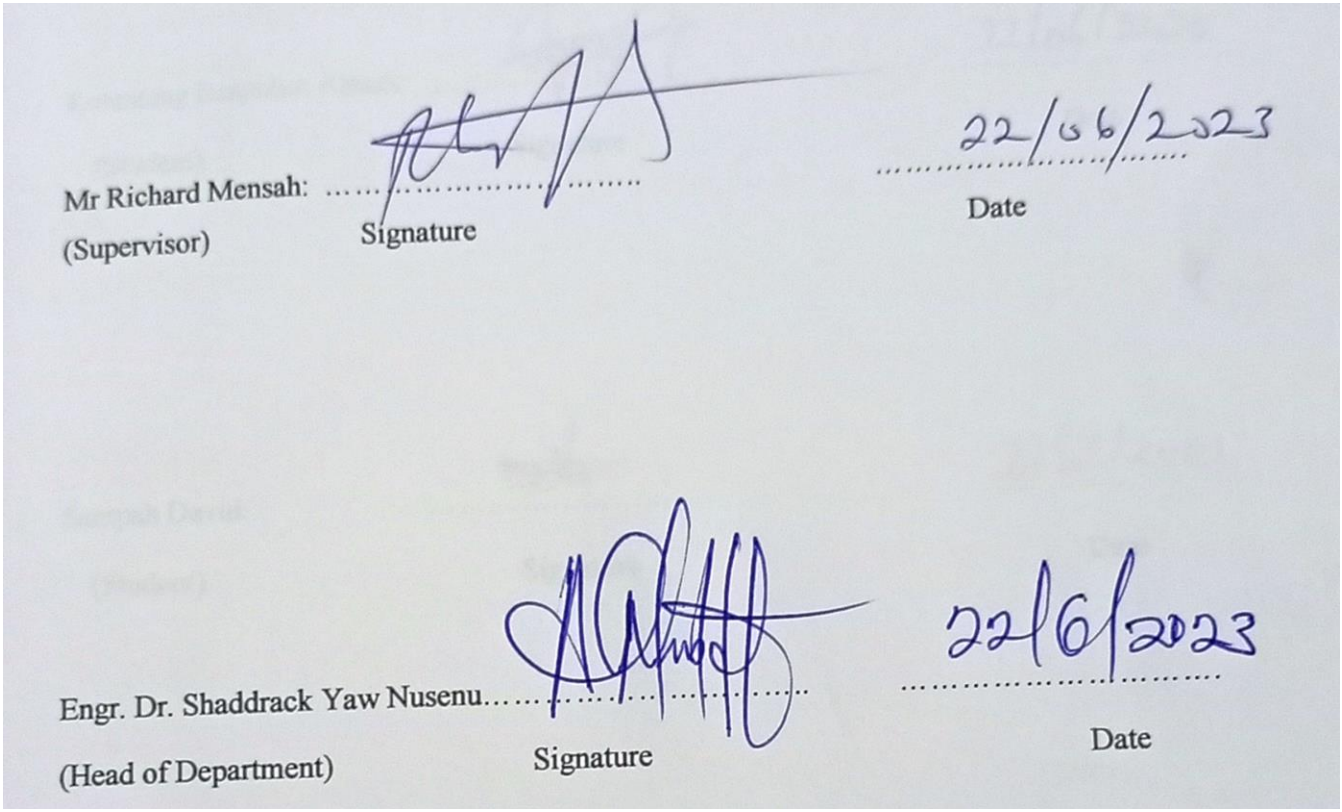
STUDENT'S DECLARATION

We thereby solemnly declare that this research work is the result of our own original work and no part of this research work has been presented for another certificate in this university or another.



SUPERVISOR'S CERTIFICATION

I hereby certify that this research work was duly supervised in accordance with the University guidelines for supervision of project.



ACKNOWLEDGEMENT

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ABSTRACT

Burglary has become one of the most increasing incidents in our society. From the invention of the first lock and key to the introduction of RFID tags and biometric identification, anti-theft systems have evolved to match the introduction of new inventions and the resulting theft by others.

The anti-theft system is designed to detect intruders or burglars and informing the owners or security personnel via SMS and alarm. Though it is not going to make it very difficult for theft or burglary but it will in case deter it from happening. This can be used or implemented in homes, offices, shopping malls, industries and institutions.

The aim of this project is to design a device that will serve as a system to alert the owners and security in charge of the vicinity. This will be done using an Arduino controller to control the various activity of the device with the aid of a camera to show the intruder who entered, also an SMS being sent to the owner or security personnel via a gsm module and a buzzer at the end of the security point or office to alert them.

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CHAPTER ONE

1.0 INTRODUCTION

Security is an ultimate concern in our day-to-day life. Everyone wants to be as much secure as possible. In recent times the world has experienced an exponential increase in the rate of crime. Criminals break into houses on a daily basis around the world carrying huge amount of money and precious items. Sensitive and confidential documents, materials and equipment by corporation are constantly declared missing from where they are kept. So there is a need to provide a device that can detect unauthorized persons in an environment. In a network or a system, any kind of unauthorized or unapproved activities are called intrusions. An Intruder Detection System (IDS) is a collection of the tools, methods, and resources to help identify, assess, and report intrusions. Intrusion detection is typically one part of an overall protection system that is installed around a system or device and it is not a stand-alone protection measure but it is an informative system that can send information to the user anywhere around the world. Intrusion is defined as: "any set of actions that attempt to compromise the integrity, confidentiality, or availability of a resource", However, as in any kind of security system, intrusions cannot be totally prevented. The intrusion and compromise of a node leads to confidential information such as security keys being revealed to the intruders. This results in the failure of the preventive security mechanism. Therefore, intruder defense system is designed to reveal intrusions, before they can disclose the secured system resources. IDSs are always considered as a second wall of defense from the security point of view. IDSs are burglar alarms that are being used in physical security systems today. As mentioned above, the expected operational requirement of IDSs is given as: "low false positive rate, calculated as the percentage of normalcy variations detected as anomalies, and high true positive rate, calculated as the percentage of anomalies detected".

1.2 PROJECT BACKGROUND

The new age of technology has redefined communication. Most people nowadays have access to mobile phones and thus the world indeed has become a global village. At any given moment, any particular individual can be contacted with the mobile phone. But the application of mobile phone cannot just be restricted to sending SMS or starting conversations. New innovations and

ideas can be generated from it that can further enhance its capabilities. Technologies such as Infrared, Bluetooth, etc. which have developed in recent years go to show the very fact that improvements are in fact possible and these improvements have eased our life and the way we live. Sound, heat, obstacle, detection and touch sensing security system is a subject of growing interest and in recent years we have seen many systems providing such security systems these days, apart from supporting voice calls a mobile phone can be used to send text messages as well as multimedia messages (that may contain pictures, graphics, animations, etc.). Sending written text messages is very popular among mobile phone users. Instant messaging, as it is also known, allows quick transmission of short messages that allow an individual to share ideas, opinions and other relevant information. This very concept will be used to design a system that acts as a platform to receive messages which in fact are commands sent to control different appliances and devices connected to the platform. The proposed design is a security system which is based on GSM technology capable to effectively allow control of different security systems concerned with different factors. The application of the suggested system is immense in the ever changing technological world. It allows a greater degree of freedom to an individual whether it is controlling the household appliances or office equipment. The need to be physically present in order to control appliances of a certain location is eliminated with the use of this proposed system.

1.3 PROBLEM STATEMENT

Even people may fully arm themselves in their homes; however their inability to detect the presence of an intruder earlier before such and intruder attacks the occupants is so alarming.

1.4 AIM OF PROJECT

The aim of the project is to design and construct reliable and user friendly security system to automate home security using microcontroller circuitry synchronized with GSM module.

1.5 OBJECTIVE OF PROJECT

. The main objective of this project is to provide maximum possible securities based on an automatic emergency care response using detection system are defined as;

- To construct the circuit for a motion sensor, obstacle sensor and a door contact sensor.

- To interface the GSM module with the microcontroller.
- To configure the three sensors with microcontroller unit
- To write appropriate control program using C++ software
- To test the artifact for evaluation

16 PROJECT JUSTIFICATION

The construction of super sensitive intruder alarm system is of much importance in today's modern and highly automated world. This is evidenced by the fact that, many newly built gadgets have a means for remote control. Remote controlled devices are safer, faster and smarter to operate. However, it had been observed that, many homes and offices are not comfortable about burglars and intruders; hence, our project and its relevance can be justified through this fact. To further justify and solidify our topic as relevant in today's society, we provide the following as significance:

- It notifies you of an intruder problem when you are away

1.7 SCOPE OF THE PROJECT

The system specification shows the description of the function and the performance of system and the user. The scope of the project GSM Based home security system is immense. The control system will include two separate units: the cellular phone, and the control unit. There will therefore be two operating environments. The cellular phone will operate indoors and outdoors whereas the control unit will operate indoors within the temperature and humidity limits proper operation of the hardware.

1.8 ORGANIZATION OF PROJECT

This project work is organized into five chapters as follows:
Chapter one consists of background, problem statement, aim and objectives, justifications and scope of work.
The second chapter introduces the infrared remote control system by way of an overview of literatures related to the research topic.

The third chapter talks about the various components used in the proposed system and each unit is explained in detail.

The fourth chapter explains the results obtained from testing the artifact and its discussion.

In the last chapter a summary, limitations, and recommendations of the project work are given.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

This section discusses related literature, contributions of other authors and their limitation as it relates to the topic under consideration. It also shows the design that will be carried out in the subsequent chapters.

In this chapter a review on other related work will be used to develop a better solution, history of burglar system as well as types of burglar system will be reviewed.

2.2 ALARM SYSTEM

2.2.1 HISTORY OF ALARM SYSTEM

Long before the invention of electronic alarm system, people use animal such as dogs to alert them when someone is trying to steal the belonging from them or enter certain area. In the middle age, people use large gong to alert people when there is invasion. Things started to change when Tildesley invented the first home alarm system, which contain a series of bells connected and link to the door [1].When someone is open the door, the bells will ring and alerting the people inside. Soon after that, Edwin Homes invented first electro-mechanical alarm system [1]. The alarm system contains a spring connected to the switch which attach to door and whenever the door is open, the circuit will close and the bell will ring. This alarm system only uses simple electrical circuit such as switch, relay and bells. With the invention of integrated circuit, the size of alarm system has becomes smaller and the features has increased. The alarm system nowadays no longer works on only switch, but also can work on infrared, ultrasonic, microwave, photoelectric and more. Some alarm system even has integrated circuit which can send alert to property owner when an emergency case occurs.

2.2.2 TYPES OF ALARM SYSTEM

Alarm system can be categorized into two main types. First type is the alarm system that uses wired sensor nodes and another type uses wireless sensor nodes. Wired alarm system has hard

wire connected between the sensor network and the main processing unit while wireless alarm system utilizes wireless local area network (WLAN), wireless USB and Bluetooth for communication between sensor and the main processing unit.

Research done by Ahmed, A., Ali, J., Raza, A. & Abbas,[2] shows that wireless sensor network has advantages over wired sensor network in the sense that the sensor can be placed at any terrain without having to worry about the wiring problem. However, most of the wireless sensors run on battery supply. Battery lifetime becomes the most deadly disadvantages to the wireless network especially the distance is long. Longer distance require stronger signal which also means higher power require to drive the signal. In another words, power efficiency of wireless sensor determines the operating lifetime of sensor network. Once battery is drained up, it can no longer provide any protection to the perimeter and are vulnerable to any attack.

On the other hand, wired sensor network does not suffer power source problem but it does have disadvantages where the quantity of sensors is limited due to the wiring problems. The network becomes complicated with the number of sensors buildup. However, the transmission speed of wired network is fast when compare with wireless network. Additionally, the wired sensor network can provide more reliable security over wireless sensor network as wired sensor network does not suffer signal lost where wireless sensor network did. Besides, wired sensor network is easier to setup compare with wireless sensor network[3].

Based on the survey done by [4]indicate the cost for wireless sensor networks vary by technology used. Both WLAN and Bluetooth are high cost and high-power consumption technology while wireless USB offer low on both cost and power consumption. To inform the user when any event occurs, it can be done via Internet or GSM network. For a user to get the information as soon as possible, GSM network is preferable as user will carry phone almost all the time compare to Staying in front of computer all the time. According to research done by Huang, H. P., Xiao, S. S., Meng, X. Y. & Xiong,[5], GSM is a mature technology and hence, high security, wide coverage and can transmit over long distance.

2.3 USB BASED EMBEDDED SYSTEM

With the growth of USB technology, USB has been gradually replacing traditional serial protocol and parallel protocol. Due the ease of use, fast transfer rate and high stability, USB

becomes a favorite choice of most people. USB can support control transfer, bulk transfer, interrupt transfer and isochronous transfer. Control transfer enable USB host to read the configuration of device connected to it. Bulk transfer can transfer non-fixed amount of data with error correction while interrupt transfer is use to transfer small amount of data. For isochronous transfer, the data is transfer at a constant rate and no retransmission if error occurs [6]. Most electronic appliances in the market nowadays uses USB interface.

2.4 SHORT MESSAGE SERVICE (SMS)

SMS is a technology which enables a short message to send and receive between mobile phone. SMS can send up to 140 bytes or equivalent to 1120 bits of data. If these 1120 bits is fully utilized, SMS can include 160 characters of 7-bits character encoding which is the English character and 70 characters of 16-bit Unicode used for many languages. SMS is compatible for all GSM phones. GSM 07.05 is a standard for short message rules for SMS [7].

2.4.1 HISTORY OF SMS

SMS was first appeared in 1992 in Europe. SMS is included in Global System for Mobile Communication (GSM). Both SMS and GSM standard was developed by European Telecommunication Standard Institute (ETSI). The development and maintenance of GSM and SMS standard was then turn to Third Generation Partnership Project (3GPP) [7].

2.4.2 ADVANTANGES OF SHORT SERVICE MESSEGES

According to the survey done by CTIA Wireless Association in year 2009, there are about 4.1 billion messages being sent daily. According to Bodic, the core reason why SMS is so successful is mainly due to its conveniences.

i. SMS can be sent or read at anytime

When a SMS is received, the message will store into the memory. User can either read it immediately or read it later. Nowadays, most people have their mobile phone with them most of the time. SMS can be read or sent anytime regardless the user is in office, home, street or even in the bus.

ii. SMS is less disturbing than phone call

If user is on a phone call, every word the user says will immediately pass to another side of the phone. Sometimes, user may require some thinking before replying the question. Furthermore, SMS will not create load noise as talking on phone. This enable user to send or receive SMS while they are in library or theater without going outside. This enable users to keep in touch all the time without causing much disturbing.

iii. SMS can be sent to offline mobile phone

One benefit of SMS is that even if the destination phone is turned off, the user can still receive the message after he or she is turn on the phone. Most of the time, the network signal may be weak on some area especially rural area. The message can still be receive by user if the user moves to a place with better network coverage.

2.5 AT COMMAND

AT Command is the modem command code and it is defined in GSM 07.07 standard. GSM 07.07 provides AT Command which enable mobile platform to communicate with Data Terminal Equipment in serial communication [8].

2.5.1 HISTORY OF AT COMMAND

In early 1980s, a company named Hayes has developed a modem called Hayes Smart modem 1200. Shortly after that, the company releases another modem call Hayes modem. They call the modem as smart modem because of the ability of the modem to autodial a number. Furthermore, this modem can send Morse code, work with Radioteletype (RTTY) and amateur radio repeaters. These two modems accept same programming command with only the operating speed is different. This has a great advantage where the old driver can be use by new model of modem. Few modems makers have followed what Hayes did, where they develop modem that accept same command set as previous modem and called it “Hayes Compatible”. Soon after that, Hayes sued these modems makers for using the word “Hayes” in their product. Subsequently, these modem makers have change to “AT Command Set compatible”.

AT command is taken from the words Attention, where the first two letters is used. AT command is the programming command that modem receive from the input and execute it. However, mobile usually do not implement full AT command and some of the command used in mobile phone may varied from manufacturer to manufacturer and model to model. Overall, the GSM/GPRS modem will have better support on AT command.

2.5.2 TYPES OF AT COMMAND

There are two types of AT commands, which categorize as basic commands and extended commands. Basic commands are the commands that do not start with "+". For example, ATA stands for Answer, ATD stands for dial and ATH stands for hook control. On the other hand, extended command is a command that start with "+". As for example, AT+CMGS will send the message and AT+CMSS will send message from storage. Following is some example of extended AT command

(Developer's Home, 2004-2010).

+CSMS Select message service

+CPMS Preferred message storage

+CMGS Message format

+CESP Enter SIM block mode protocol

+CMS ERROR Message failure code

+CSCA Service center address

+CSMP Set text mode parameter

+CSDS Show text mode parameter

+CSCB Select cell broadcast message type

+CSAS Save setting

+CRES Restore setting

+CNMI New message indication to TE

+CMGL List message

+CMRG Read message

+CNMA New message acknowledgement

+CMGS Send message

+CMSS Send message from storage

+CMGW Write message to memory

+CMGD Delete message

+CMGC Send command

+CMMS More message to send

2.5.3 AT COMMAND MODE

Control of SMS function can be made via AT command in three mode which is Block mode, Text mode, and Protocol Data Unit (PDU) mode. AT stands for Attention. Block mode is a binary communication protocol including error protection.

Text mode is a character-based protocol suitable for high level software application while PDU mode is a character-based protocol with hexadecimal-encoded binary transfer of command. PDU mode is usually for low level software driver that do not understand the content of command while text mode is suitable for high level programming language [7].

PDU is harder for people to read it but it has advantages where it has lots more features compare to the simple text mode. Thus, PDU mode can support better on GSM modem and some of the mobile phone will only understand PDU mode.

PDU mode has three encoding mode namely 7-bit code, 8-bit code, and 16-bit code. 7-bit and 8-bit code is use for normal ASCII code which is English message while 16-bit code is use for Unicode character which supports not only English but Chinese and other language as well. To use other language in sending message,

PDU mode in 16-bit code must be adopted since text mode does not support 16-bit mode.

When come to encoding in PDU mode, we need to know the meaning of each of the string. Since the syntax is fixed, the PDU string can easily be created with the reference of the meaning for

each word. The only tricky part of the PDU string is the semi-octets string. For example, an international number +60123456789. To encode it into PDU string, we need to remove the "+" sign and add "F" to the end of the string. Then, each of the pair is twisted to convert to PDU string. +60123456789 will become 0621436587F9[1].

One example of PDU string contains the following information.

07910621000010F511000B910621436587F90000AA08C7F79B0C2287F3 will have the meaning as shown in the table below.

Octet(s) Description Example

07 Length of the SMSC information 7 octets

91 Type of address of SMSC International format

0621000010F5 SMSC number +601200000150012

First Octets of SMS-DELIVER

message -

0B Length of sender address 1191

Type of address of the sender

number International format

0621436587F9 Sender number +60123456789

00 Protocol identifier -

00 Data encoding scheme -

08 Length of User data 8

C7F79B0C2287F3 User data Good Day

2.6 PROBLEM STATEMENT

After studying all the papers, we have come to know that lots of work have already been done in the field of Home automation and Home security but the real problem is each system have

different area of work and perform different task that means, there are systems which is used to measure the temperature or fire in the building and systems which used Cameras and GPRS System. But there is no such system available yet which have all the features and could perform every task, in short one for all system. There is one more problem in all these systems and that is every decision is to be taken by the system itself and there is no intervention of the owner of the system that means the system will behave same even in the situation of false alarm. These are some of the area where a little bit of work is required.

The security system purpose by Zhoa & Ye and Huang et al. has a disadvantage where it runs on battery supply. User will never know when the power of battery will drained up and causing the security system failed to work. Besides, they use RS-232 serial interface which normally found on GSM modems and rarely on cellular phones.

2.7. FUTURE WORK

As we have discussed in the problems, first thing is to combining all the related systems to make an overall system which could work with high efficiency and might perform several task such as Prevention of entry of unauthorized person in the house, Detection of fire in the house and to let the owner know about any mis-happening going on in the house in the absence of the owner. We could use the GSM Module to let the owner stay connected with the house and to control the system from any location outside the house. Forthcoming system should also be capable enough to recognize the owner and must be connected to the various government department for the emergency case.

2.8 CONCLUSION

As we have seen in literature section that lots of work have been done in the field of Home Security but yet there is something which is not touched. In any of the security system there must be coordination among all the system for proper functioning. Security is the issue which is needed in the time of emergency; hence the system must be connected with those who could help in the time of emergency. A lot of work has done in this field and many more is required to make the shelter of individual safe from any fraudulent or any mis-happening.

CHAPTER THREE
METHODOLOGY

3.1 INTRODUCTION

This chapter deals with the research approach and strategy, data collection method and the equipment used for this project work.

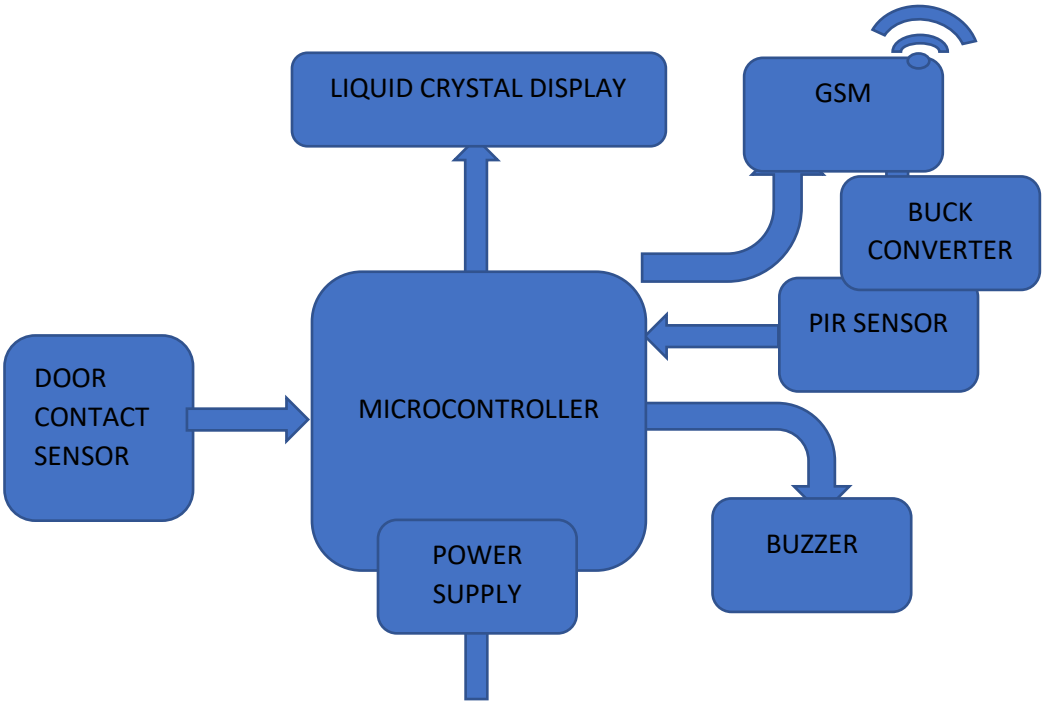
3.2 RESEARCH DESIGN

Type of research design; Experimental Design

The experimental design is an attempt by the researcher to maintain control over all factors that may affect the result of an experiment. In doing so there will be an attempt to determine or predict what may occur and based on this deduce valid conclusion in the framework within which the experiment will be constructed by;

- Identifying and defining the problem.
- Formulating hypotheses and deducing their consequence.
- Constructing an experimental design that represents all the elements, conditions, and relations of the consequence.
- Making corrections or adjustments that needs to be done based on the performance of the experimental design.
- Constructing the device taking into consideration the adjustments that needs to be done to ensure effective functioning of the device.

Fig 1 BLOCKS DIAGRAM OF ALARM SYSTEM WITH GSM MODULE



Components, Instrument and Tools

Arduino uno

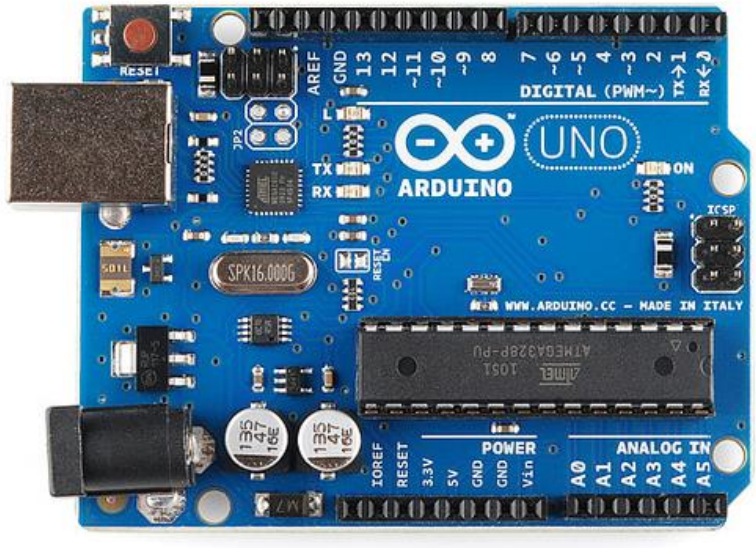


Fig 2

The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc.[5][6] The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits.[4] The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a type B USB cable.

SIM800L

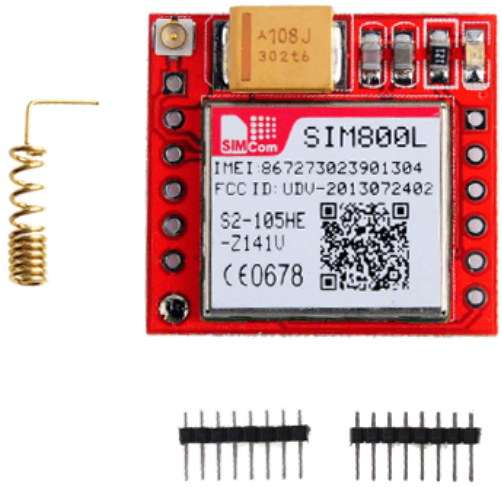


Figure 3

The SIM800L is a quad band GSM/GPRS Module which works in a wide range of frequencies. It is small and fits most of your space requirement and it consumes very little power (approx. 0.7mA) in sleep mode[1].

FEATURES

1 Support Bluetooth function.

2 Frequency band GPRS multi-slot class 12.

3 One sim card interface.

4 Audio channels which include a microphone input and receiver output.

5 One USB port can be use as debugging and firmware upgrading.

Liquid Crystal Display

Fig 4

A liquid crystal display (LCD) is a thin, flat display device up of any number of color or monochrome pixels arrayed in front of a light source or reflector. It is often utilized in battery-

powered electronic devices because it uses very small amounts of electric power. JHD 162A is LCD that has following features.

- Number of characters:16 characters *lines.
- Module dimension: 80.0mm*9.7mm.
- Area:66.0mm*16.0mm.
- Active area:0.55mm*11.5mm.
- Dot size:0.55mm*0.65mm.
- Dot pitch:0.60mm*0.70mm.
- Character size:2.95mm*5.95mm.
- Character pitch:3.55mm*5.95.
- LCD type: positive, reflective, yellow green**.**

The LCD is an electronic display module which uses liquid crystal to produce a visible image. The 16×2 LCD display is a very basic module commonly used in DIYs and circuits[2]. The 16×2 translates and display 16 characters per line in 2 such lines. In this LCD each character is displayed in a 5×7pixel matrix.

PIR Motion Sensor

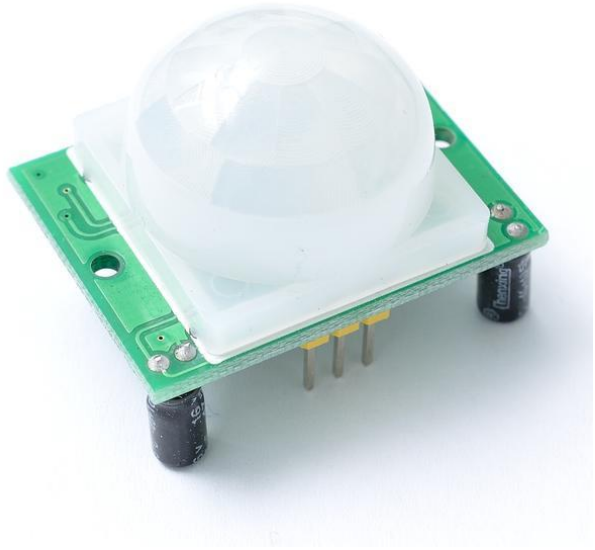


Fig 5

PIR Sensor is short for passive infrared sensor, it is used to detect human or particle movement in a certain range, and it can also be referred as PIR(motion) sensor, or IR sensor. Since its powerful function and low-cost advantages, it has been adopted in tons of projects and widely accepted by the open-source hardware community for projects related to Arduino and raspberry pi. All this can help the beginners learn about PIR sensor more easily.

PIR is basically made of pyroelectric sensors to develop an electric signal in response to a change in the incident thermal radiation. Every living body emits some low level radiation and the hotter the body, the more is emitted radiation commercial PIR sensor typically include two IR-sensitive elements with opposite polarization housed in a hermetically sealed metal with a window made of IR-trans missive material (typically coated silicon to protect the sensing element). When the sensor is idle both slots detect the same amount of IR, the ambient amount radiated from the room and an animal passes by, it first intercepts one half of the PIR sensor which causes a positive differential change between the two halves. When the warm body leaves

the sensing area, the reverse happens, whereby the sensor generates a negative differential change. These change pulses are what is detected. In order to shape the field of view of the sensor, the detector is equipped with lenses in front of it. The lens used here is inexpensive and lightweight plastic materials with transmission characteristics suited for the desired wavelength range. To cover much larger area. detection

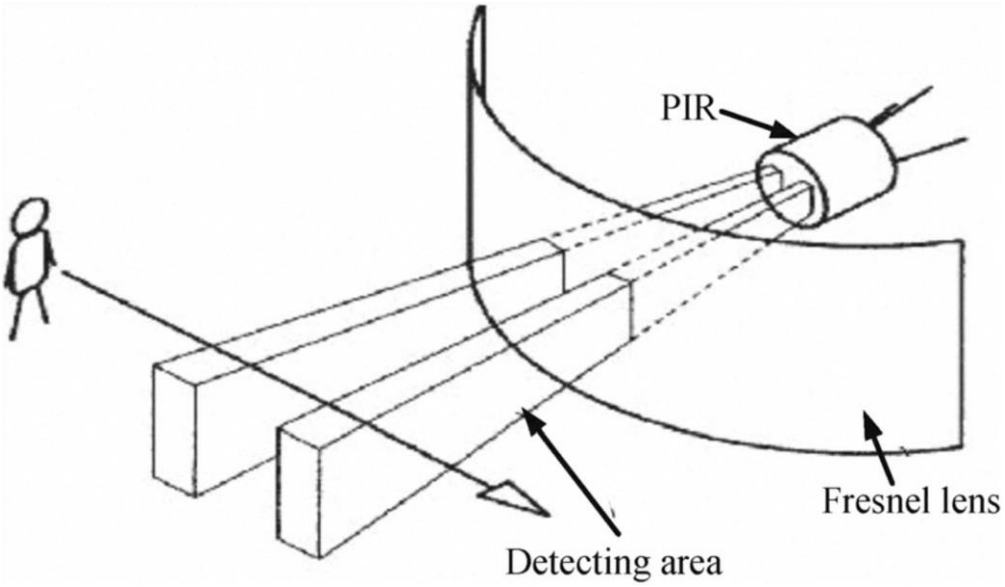


Fig 6

Resistors

Fig 7

Resistor is an electrical component that reduces the electric current. The resistor's ability to reduce the current is called resistance and is measured in units of ohms (symbol: Ω).If we make an analogy to water flow through pipes, the resistor is a thin pipe that reduces the water flow.

Capacitors

FIG 8

A capacitor is a passive two-terminal electrical component that stores electrical energy in an electric field. The effect of a capacitor is known as capacitance. While capacitance exists between any two electrical conductors of a circuit in sufficiently close proximity, a capacitor is specifically designed to provide and enhance this effect for a variety of practical applications by consideration of size, shape and positioning of closely spaced conductors, and the intervening dielectric material.

A capacitor was therefore historically first known as an electric condenser.

The physical form and construction of practical capacitors vary widely and many capacitor types are in common use.

Light Emitting Diode (LED)

Fig 9

A light emitting diode is a two-led semiconductor light source. It is a p-n junction diode that emits light when activated. When a suitable voltage is applied to the leads, electrons are able to recombine with electron holes within the device, releasing energy in the form of photons. This effect is called electroluminescence, and the color of the light (corresponding to the energy of the photon) is determined by the energy band gap of the semiconductor.

Lm7805 Voltage Regulator

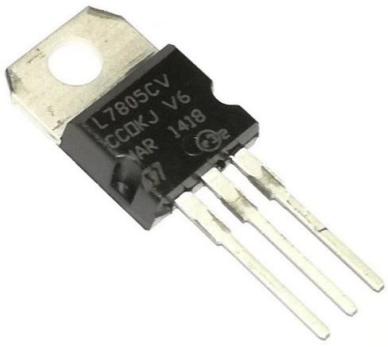


Fig 10

The LM7805 is a voltage regulator that outputs +5 volts. It is a three-pin IC; input pin for accepting incoming DC voltage, ground pin for establishing ground for the regulator, and output pin that supplies the positive 5 volts.

230/12v Transformer

Fig 11

This transformer is a passive electrical device that steps down alternating current from 230V to 12V. This device uses the principle of electromagnetism to convert one voltage or current to another. It consists of a pair of insulated wire wound around a magnetic core.

Lm2596 Dc-Dc Buck Converter Step-Down Power Module

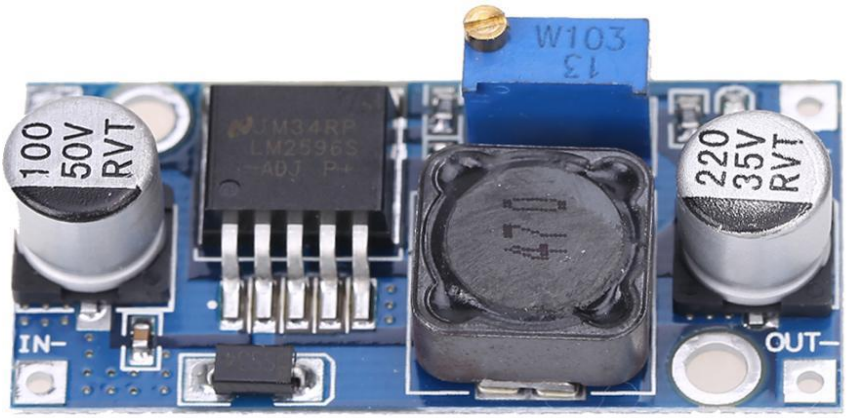


Fig 12

DC-DC Buck Converter Step Down Module LM2596 Power Supply is a step-down(buck) switching regulator, capable of driving a 3-A load with excellent line and load regulation. These devices are available in fixed output voltages of 3.3 V, 5 V, 12 V, and an adjustable output version. The LM2596 series operates at a switching frequency of 150kHz, thus allowing smaller sized filter components than what would be required with lower frequency switching regulators.

APPLICATION OF DC-DC BUCK CONVERTOR

- It converts high voltage to low voltage efficiently.
- It reduces heat.
- It extends battery life.
- It is used in quadcopters.

TOOLS AND INSTRUMENTS

ELECTRIC DRILL AND DRILL BITS

Fig 13

Electric drill and drill bits in the range of 1/8 inch to 1/2 inch will come in handy when you need to drill holes on the printed circuit board that has been etched. Drilling of plastic or metal enclosure that houses the printed circuit board (PCB) is required. A suitable PCB high speed drill can be easily obtained from any electronic shop.

SOLDERING IRON

Fig 14

A 20W to 30W soldering iron with tips of 1/8 inch to 1/2 inch can be used for soldering of through whole components. Soldering of surface mount components may require smaller tips depending on the sizes of the components. Soldering iron normally will last a long time if it is taken care of properly by keeping the tips clean and well tinned.

WIRE STRIPPER

Fig 15

Wire stripper is used to strip off wire insulator from its conductor before it is used to connect to another wire or soldered into the printed circuit board. Some wire stripper or wire cutter has a measurement engraved on it to indicate the length that will be stripped.

LONG NOSE PLIER

Fig 17

A 4-inch long nose plier will come in handy when you need to hold components that have short leads that need to be soldered onto the PCB but will be too hot to handle with bare hands. It will also be useful to hold the component that needs to be de-soldered from the board.

SIDE-CUTTING PLIER

Fig 18

A 4-inch side cutting plier will come in handy as one of the electronic tools when one need to trim off excess component leads on the printed circuit board. It can also be used to cut wires into shorter length before being used.

TWEEZERS

Fig 19

Small tweezers are used to hold small components especially when doing soldering and de-soldering of surface mount components.

.**PHILIPS HEAD SCREWDRIVERS**

Fig 20

Various sizes of Philips head screwdrivers will be handy as a lot of electronics projects that use screws are Philips Head type.

FLAT HEAD SCREWDRIVERS

Fig 21

Flat head screwdrivers of various sizes are also necessary as many screws that are used are of this type.

DIGITAL MULTIMETER

Fig 22

Digital Multimeter: it was used to measure the voltage, current and resistances of the components. A multimeter can be a hand-held device useful for basic fault finding and field service work, or a bench instrument which can measure to a very high degree of accuracy. They can be used to troubleshoot electrical problems in a wide array of industrial and household devices such as electronic equipment, motor controls, domestic appliances, power supplies and wiring systems. The multimeter conducted tests of AC/DC voltage, DC current, resistance, transistor, diode and battery.

CHAPTER FOUR

SYSTEM DESIGN

4.1 INTRODUCTION

This chapter of the report provides the information about the design requirements, design, implementation, testing of the product and demonstration of the output functionality of the artefact construction. A real focus on converting the design idea into a prototype is manifested in this chapter. The research method adopted in the previous chapter, provided a means of implementing the design on a software platform to achieve key findings and design lapses which will help us in the practical implementation. In addition to the main research point, this chapter provides much information about how to design the circuit that includes ATMEGA328 microcontroller for processing signal received from the sensors and an LCD display the state of the sensors while the gsm sends SMS intruder alert to predefined number.

Limitations and other constrains through which the design was realized are all shown in this section. The final circuit is demonstrated in the form of simulation results as well as the artefact and need to be evaluated through engineering procedure to be justified for both academic assessment and a form of deliverable. The process in this section shall therefore undergo hardware testing at instrumentation level. The individual modules are therefore tested separately for comparison and evaluation; and finally put together for the overall system response with reference to how the modules relate with one another. The effect on system variables in the form of functionality is also achieved based on the activities of this chapter. The main tool for the testing is multimeter.

The System analysis and design chapter in this research reports on the planning process for development of the prototype through understanding and specifying in detail what the prototyped system should do and how the components of the system should be implemented and work together. The chapter also contains data analysis for data collected in the research.

4.2 REQUIREMENT SPECIFICATION

Requirements specification is a complete description of the behavior of the prototype to be developed. Requirements are categorized in several ways. This section covers functional and non-functional requirements of the prototype.

4.3 FUNCTIONAL REQUIREMENTS

Functional requirements explain what has to be done by the prototype by identifying the necessary task, action or activity that must be accomplished. They include:

1. The prototype should sensor motion by the use of a Passive Infrared sensor (PIR)
2. The prototype should detect when door is open by the use of Door contact sensor.
3. The prototype should process the signal form the sensors and send an intruder alert to a predefined number.

4.3.2 NON-FUNCTIONAL REQUIREMENTS

Nonfunctional requirements are requirements that specify criteria that can be used to judge the operation of a system, rather than specific behaviors. The key non-functional requirements identified for the prototype are security, performance, availability and reliability.

4.5 HARDWARE DESIGN

Hardware of the system contains Passive infrared sensor, Door contact sensor, IR sensor,

Atmega644p microcontroller, sim800 (GSMmodule), and a Buzzer. The system

Design is shown in Fig 23

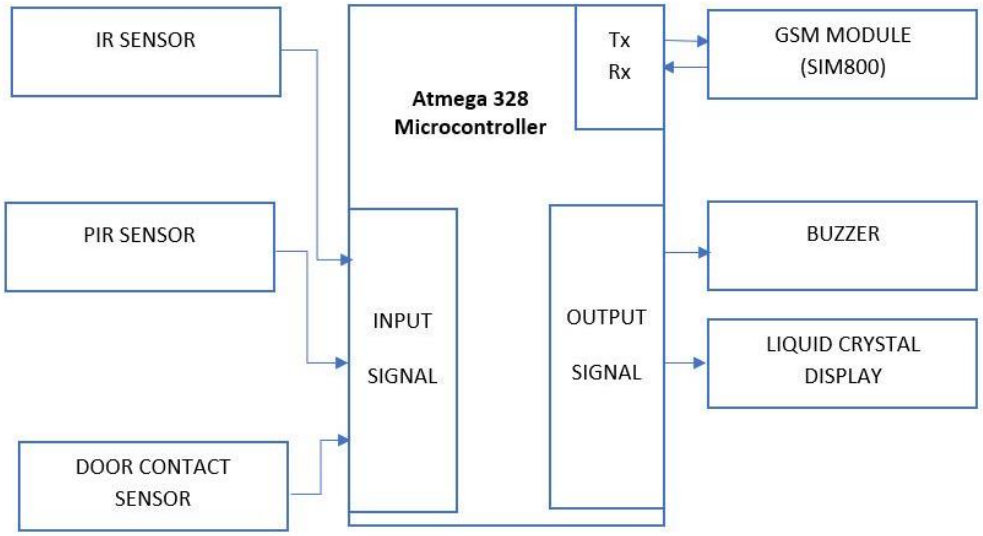


Fig 23 (Proposed System Design)

4.3.1 POWER SUPPLY

The power supply consists of a 230/12V, 600mA transformer that is used to convert 230V AC to 12V AC. The 12V AC is then rectified by using a Full-wave bridge rectifier rectification circuit made up four-diode bridge into DC 12V. The DC is then filtered by 470uF capacitor. Finally, a voltage regulator LM7805 is use to step down 12V DC to 5V DC for the microcontroller. While a Buck Convertor is use to step down 12V DC to 3.4V for the GSM module(sim800).

Circuit Diagram

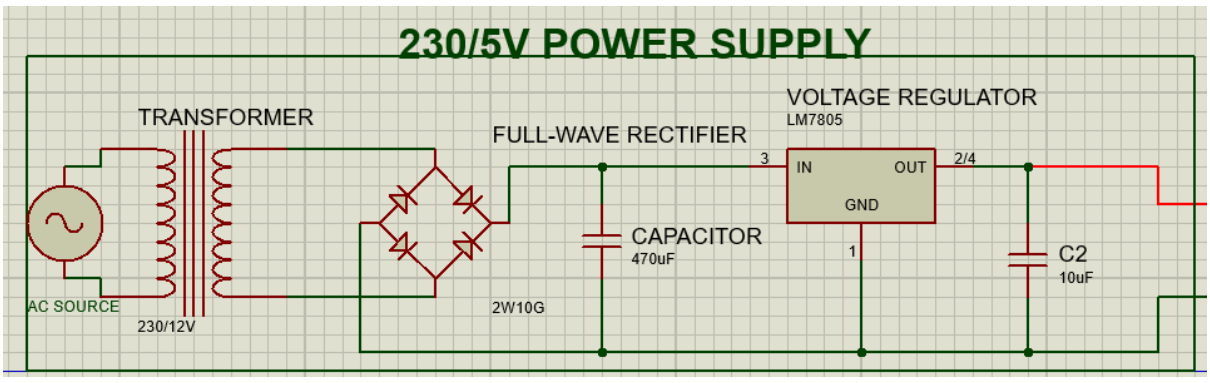


Fig 24 (Circuit diagram of Power Supply)

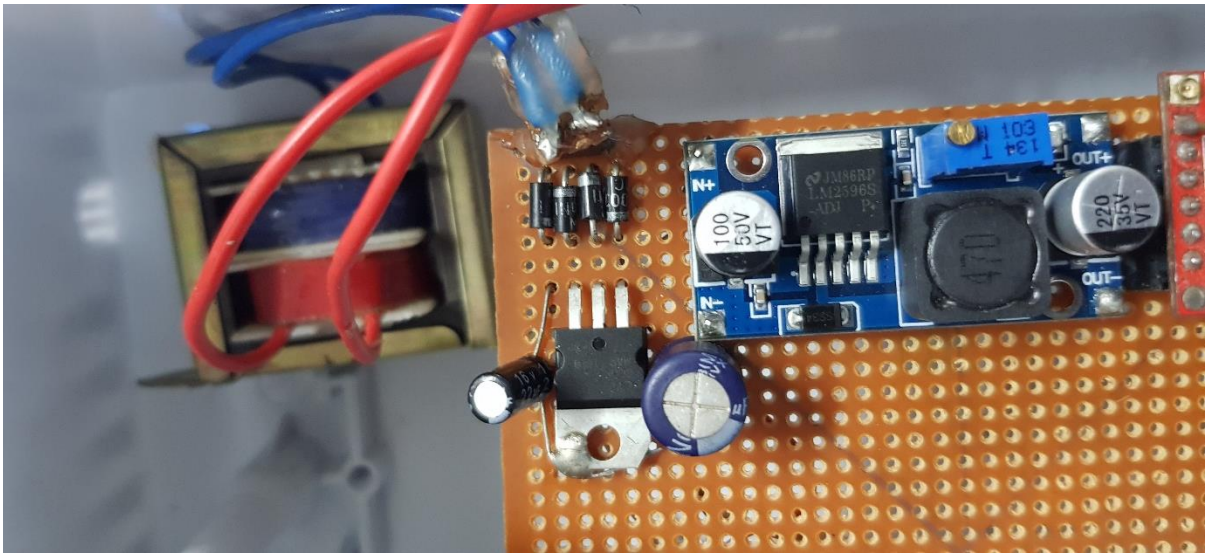


Fig 25 (Picture of Power Supply Circuit on PerfBoard).

4.4 SYSTEM DESIGN AND ANALYSIS

The circuit designed uses Passive Infrared (PIR) sensor that can detect infrared radiation emitted by the human body so that it can detect even dark conditions.

The IR circuit is also use to detect any movement and trigger the microcontroller to send intruder alert. The IR circuit is based on IR sensor where an IR LED emits IR radiations which will reflect back to the Photodiode when an intruder pass by the IR sensor. The Door Contact sensor is a peripheral security sensor that send signals to the microcontroller when the door opens. Its circuit works like a normal switch, it is normal open when the door is open and normally closed when the door is closed.

These three sensors are connected to the central unit microcontroller (ATmega328) that process the signal received and sends Intruder alert through a GSM module (Sim800).

ATmega microcontroller is the brain of the entire controlling circuit. The control circuit requires 5V DC to operate which is obtained from the rectifier circuit which also include a step-down transformer and a voltage regulator with capacitors that filters out the ripples in the stepped

down power. The sensors, PIR, IR and Door Contact sensors sends digital signal to the microcontroller when any of the sensor detect an intruder.

The design of the system is divided into two major sections.

i. The hardware design and

ii. The software designs

For every electronic component, there are maximum values of operating parameters (e.g.voltage, current, power etc.), set by the manufacturers to safe guard the performance of the component. For instance, the GSM module (Sim800) requires a specific voltage and current to operate (3.4V to 4.3V). So, using 5V could damage the module and also using 3.3V supplied by the Arduino board will not be enough to power it.

Due to this, components were not subjected to conditions rather than those recommended by the manufacturer.
A technique was used called COMPONENT DERATING. Derating is a technique usually employed in electrical power and electronic devices, wherein the devices are operated at less than their rated maximum power dissipation.

Usually, a derating factor is used to ensure a margin of safety between operating values and maximum values.

The software design section covers the software structure for the system to be interfaced with the hardware development.

4.4.1 HARDWARE DEVELOPMENT

The hardware design consists of different block diagrams of the different units which when brought together form the complete electrical structure of the system. These blocks are

i. The active infrared motion sensor

ii. The power supply unit.

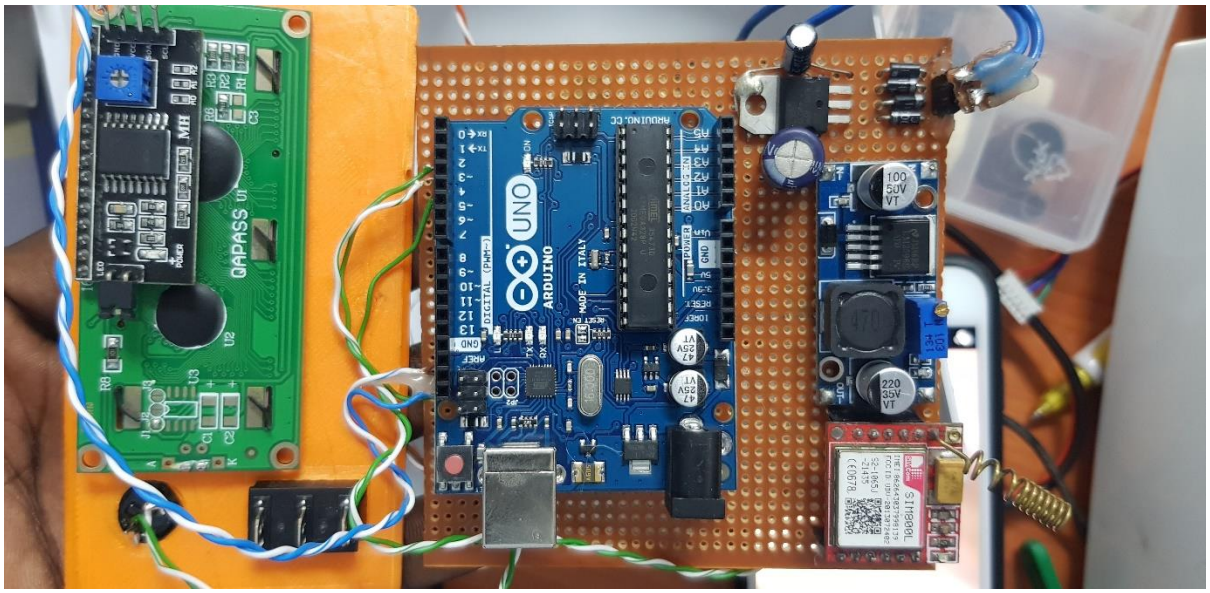
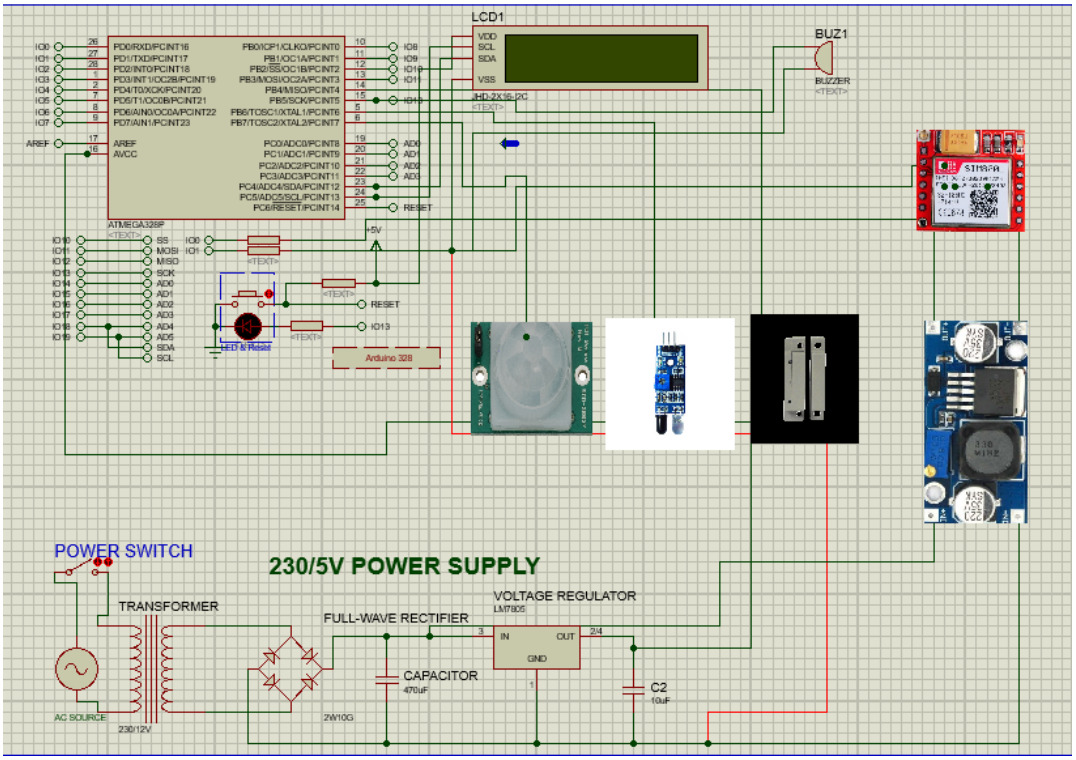


Figure 26 The System

CIRCUIT DIAGRAM OF PROJECT



Software Design

The proposed system uses AVR microcontroller, programming is done in C++ language and the Integrated Development environment (IDE) used for the writing the code is Arduino IDE.

System Flow Chart

This diagram illustrates the system flow chart which is the graphical representation of the flow of data in the prototype system and represents the work progress of the system. It illustrates the capturing of data from the sensors, the conversation of the data and the decision-making section of the prototype system.

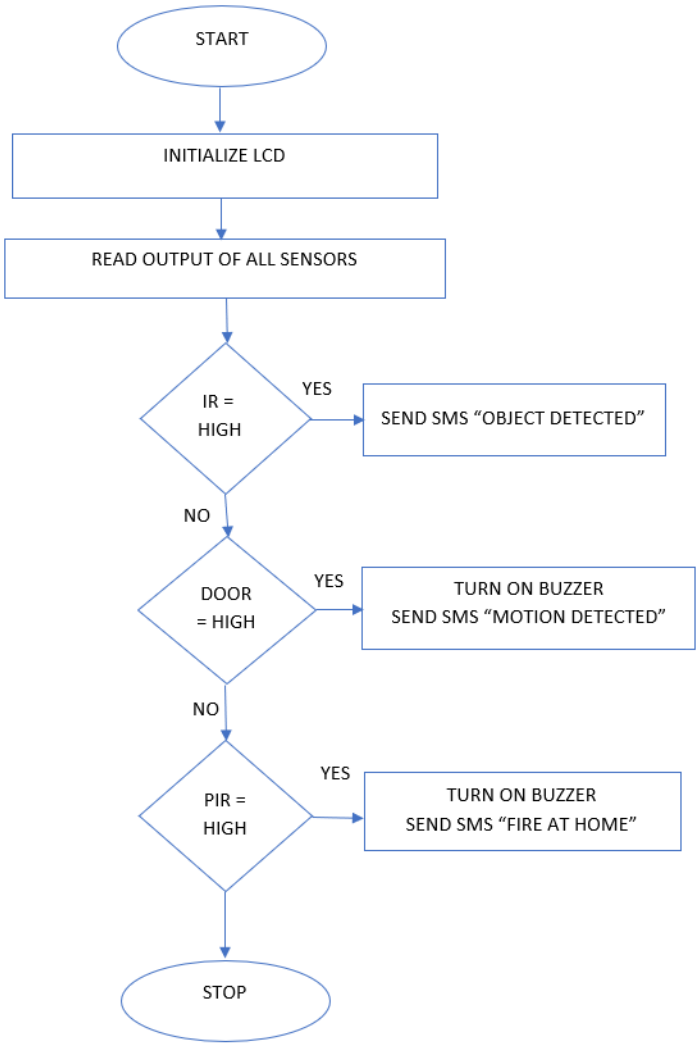


Fig 27(Flow Chart of the System)

4.5 LIMITATION OF DESIGN

This project basically emphasizes on the use of GSM module in an intruder alert system over other mediums used to send intruder alert. The main drawback to this system is; when the airtime on the sim card in not recharge in time, the system will not be able to send a GSM intruder alert. Which will make the property vulnerable to intruders.

4.5.2 DESCRIPTION OF HOW THE CONSTRUCTION WAS DONE

LCD screen: The LCD is connected to the Arduino, the ground from the LCD is connected to the ground on the Arduino, VCC is connected to the A4 and SCL is connected to the A5. The LCD displays when the light and fence energized or de- energized.

PIR sensor: Pin 1 of the motion sensor connects to the 5V DC voltage terminal of the Arduino. Pin 3 connects to the ground (GND) pin of the Arduino. Pin 2, the output connects to the digital pin D3. Pin1 and Pin 3 are powered with 5V by the Arduino, so it is through these pin connections that the PIR motion sensor gets the 5V that it needs to power on and operate. And buzzer connected to arduino, negative terminal from the buzzer to ground of Arduino and positive terminal to 5V of Arduino which power the buzzer to operate.

CHAPTER FIVE

RESULTS AND ANALYSIS

5.1 INTRODUCTION

The Results and analysis chapter in this research presents the analysis and discussion of quantitative data gathered and gathered reports. The findings are also discussed in the light of previous research findings and available literature, where applicable, in order to identify similarities and differences between this study and previous studies and literature. A comprehensive description of the research methodology was given in Chapter 3.

5.2 CREATING INTRUDER DETECTION RULES

Three final states that were defined to determine the presence of an intruder. The three states are:

i. Motion detection
ii. Obstacle detection
iii. Unauthorized door opening detection

The following were some of the rules that were used to determine a positive detection of an intruder i.e the “Intruder” state and intruder detection. The rules were defined as functions in the Arduino IDE.

i. **IF** the Motion detection signal is HIGH **THEN** Buzzer should sound and send Intruder Alert SMS(Motion Detected).
ii. **IF** Obstacle is detected **THE**N Buzzer should sound and send Intruder Alert SMS (Obstacle detected).
iii. **IF** Door contact Sensor is LOW **THEN** Buzzer should sound and send Intruder Alert SMS (Door Opened).

5.3 TESTING

The tests conducted were intended to ensure the accuracy of each sensor before incorporation into the main prototype. The final prototype system was tested to ensure that it was accurate in Intruder detection implying that it was free from false alarms

5.3.1 INTEGRATION TESTING (SYSTEM TESTING)

This was the testing done on the integrated prototype to verify combined functionality of the entire system. For the test to be carried out, an object was introduced. The infrared signal generated by the IR sensor bounced from the surface of the object and the signal was received at the infrared receiver.

Also, the door contact was open, which sent a LOW signal to the microcontroller. Finally , the passive infrared sensor was used to measure infrared light radiating from objects in its field of view.

PARAMETERS FOR BOTH IR SENSOR AND MOTION SENSOR

PIR Motion sensor

It detects a human being moving around within approximately 10m from the sensor. This is an average value, as the actual detection range is between 5m and 12m. PIR are fundamentally made of a pyro electric sensor, which can detect levels of infrared radiation.

IR Sensor

IR LED emits light, in the range of Infrared frequency. IR light is invisible to us as its wavelength (700nm – 1mm) is much higher than the visible light range. IR LEDs have light emitting angle of approx. 20-60 degree and range of approx. few centimeters to several feet,

Fig (Obstacle sensor detecting an object that is reflecting back the infrared ray)

Fig (Door sensor detecting security breach)

Fig (Motion sensor Detecting a moving object in its field of view)

5.3.3 PERFORMANCE TESTING

Performance testing was carried out to assess the notification service (Text alert) based on a speed metric. It was important for the prototype to send timely text SMSs to the relevant parties once an intruder is detected. This test was carried out using a stopwatch to investigate and record the amount of time taken between intruder detection and the arrival of the alert to a mobile phone. 3 tests were done and the results are as tabulated below.

Table 7: Performance Testing

Alert Name	Time before text arrived
Door contact Alert 1	Alert 1min 45 seconds
Motion detection Alert 2	1 min and 20 seconds
Obstacle detection Alert 3	1 min 4 Seconds
Average Time (In seconds)	83 seconds

The average time before the text notification was received by the end user was about 83 seconds. This is still within the incipient period of invasion. The variations in time were due to network connectivity issues since the GSM module relies on a mobile service provider platform.

5.4 CHALLENGES IN IMPLEMENTATION

The major challenge faced during implementation was the unavailability of some of the sensors required for the prototype in the Ghanaian market. This led to modifications to the prototype to suit what was available. Notably, due to the number of sensors used, a lot of power was drawn by the sensors as well the communication unit(sim800) of the system. This led to unforeseen fluctuations in the readings read by the sensors.

5.5 SUMMARY

To summarize, there are keys functionalities/techniques that were implemented to ensure the prototype was used to achieve its main objectives which was to reduce false alarm rates and its sub-objectives which were affordability and making home intruder detections reliable. They are as follows:

i. Using GSM instead of Wi-Fi for sending text notifications.
ii. Using Motion sensor, Obstacle sensor and door sensor to detect presence of intruders.

CHAPTER SIX

CONCLUSION AND RECOMMENDATION

6.1 CONCLUSION

Home security has been a major issue where crime is increasing and everybody wants to take proper measures to prevent intrusion. In addition, there is the need to automate homes so that the user can take the advantage of technological advancement. This project presents a low-cost model that will provide security to their home, via SMS using GSM technology.

The Basic Idea of our project is to provide GSM Based security even if the owner is away from the restricted areas. For this we adopted wireless mode of transmission using GSM. Beside this there are many methods of wireless communication but we selected GSM in our project because as compared to other techniques, this is an efficient and cheap solution also, we are much familiar with GSM technology and it is easily available.

This project is designed to provide ubiquitous access to the system for the security using extensive GSM technology for communication purposes and microcontroller for device control. The detailed sensors above are used to sense the disturbance and inform to the programmed microcontroller and then information is sent between controlling unit and home owner for security purpose. The end product will have a simplistic design making it easy for users to interact with.

6.2 RECOMMENDATION

The following are recommendation based on the research results that were analyzed by the researcher and challenges faced during implementation:

i. The device can be extended to enable it use rechargeable batteries as a power source.
ii. Backup battery can also be used because electrical power of the system may be interrupted due to certain accidental cases
iii. To identify whether men arrived in the homes are authorized or unauthorized, a camera could be used to take the photograph of authorized and unauthorized person

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APPENDIX

```
#include<SoftwareSerial.h>
SoftwareSerial mySerial(3,2);
#include<LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd (0x27,16,2);

const int pir = 10;
const int door = 8;
const int ir = 9;
const int buz =4;
int pirval = 0;
int doorval;
int irval;

void setup() {
 lcd.init();
 lcd.backlight();
pinMode(pir,INPUT);
pinMode(door,INPUT_PULLUP);
pinMode(ir,INPUT_PULLUP);
pinMode(buz,OUTPUT);

Serial.begin(9600);
 //Begin serial communication with Arduino and SIM800L
  mySerial.begin(9600);

  Serial.println("Initializing...");
  lcd.println("Initializing...");
```

```
  delay(1000);



}

void loop() {

pirval = digitalRead(10);
doorval = digitalRead(8);
irval = digitalRead(9);
lcd.clear();
lcd.setCursor(0,0);
lcd.print("SECURITY SYSTEM");

if (pirval == HIGH)
{
  mySerial.println("AT"); //Once the handshake test is successful, it will back to OK
  updateSerial();
  mySerial.println("AT+CMGF=1"); // Configuring TEXT mode
  updateSerial();
  mySerial.println("AT+CMGS=\"+233243377832\"");//change ZZ with country code and xxxxxxxxxxx with
phone number to sms
  updateSerial();




  mySerial.print("SECURITY ALERT | MOTION DETECTED"); //text content
  updateSerial();
  mySerial.write(26);
```

```
 Buzzer();



 lcd.clear();
 lcd.setCursor(0,0);
 lcd.print("SECURITY BREACH");
 lcd.setCursor(0,1);
 lcd.print("Motion Detected");
 //Serial.println("Motion Detected");
 delay(1000);

}
else if ( doorval == HIGH)
{
 mySerial.println("AT"); //Once the handshake test is successful, it will back to OK
 updateSerial();
 mySerial.println("AT+CMGF=1"); // Configuring TEXT mode
 updateSerial();
 mySerial.println("AT+CMGS=\"+233243377832\"");//change ZZ with country code and xxxxxxxxxxx with
phone number to sms
 updateSerial();

 mySerial.print("SECURITY ALERT | DOOR OPEN"); //text content
 updateSerial();
 mySerial.write(26);
 Buzzer();

 lcd.clear();
 lcd.setCursor(0,0);
```

```
 lcd.print("SECURITY BREACH");
 lcd.setCursor(0,1);
 lcd.print("Door is Opened");
 //Serial.print("Door opened");
 delay(1000);
}
else if (irval == LOW)
{

 mySerial.println("AT"); //Once the handshake test is successful, it will back to OK
 updateSerial();
 mySerial.println("AT+CMGF=1"); // Configuring TEXT mode
 updateSerial();
 mySerial.println("AT+CMGS=\"+233243377832\"");//change ZZ with country code and xxxxxxxxxxx with phone number to sms
 updateSerial();

 mySerial.print("SECURITY ALERT | OBSTACLE DETECTED"); //text content
 updateSerial();
 mySerial.write(26);
 Buzzer();

 lcd.clear();
 lcd.setCursor(0,0);
 lcd.print("SECURITY BREACH");
 lcd.setCursor(0,1);
 lcd.println("Obstacle Detected");
 //Serial.print("Obstacle Detected");
 delay(1000);
```

```
}
else {
  delay(500);
  }



}

void updateSerial()
{
  delay(500);
  while (Serial.available())
  {
    mySerial.write(Serial.read());//Forward what Serial received to Software Serial Port
  }
  while(mySerial.available())
  {
    Serial.write(mySerial.read());//Forward what Software Serial received to Serial Port
  }
}
void Buzzer (){
  for (int i = 0; i<=2; i++){
    digitalWrite(buz,HIGH);
    delay(500);
    digitalWrite(buz,LOW);
    delay(500);
  }
}
```

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