

CONSTRUCTION OF A GSM BASED HOME AUTOMATION USING AVR

BY

**OKORAFOR CHINED HENRY
EE/2008/281**

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

FACULTY OF ENGINEERING
CARITAS UNIVERSITY
AMORJI-NIKE, ENUGU.

AUGUST, 2013.

TITLTE PAGE

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EE/2008/281**

**BEING A PROJECT SUBMITTED TO THE
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING**

**FACULTY OF ENGINEERING
CARITAS UNIVERSITY AMORJI-NIKE, ENUGU**

**IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE
BACHELOR OF ENGINEERING (B.ENG) IN ELECTRICAL AND
ELECTRONIC ENGINEERING**

AUGUST, 2013.

CERTIFICATION

This is to certify that this project research work from the department of Electrical/Electronic Engineering, Caritas University, Amorji-Nike, Emene, Enugu was solely carried out by OKORAFOR CHINEDU HENRY with Registration Number EE/2008/281

Engr. E. C. Aneke
(Supervisor)

Date

Engr. C. O. Ejimofor
(Head of Department)

Date

Date

(EXTERNAL EXAMINER)

DEDICATION

This report is dedicated to God Almighty who is the ultimate giver of wisdom and to my beloved parents for their financial support and encouragement throughout my stay in school.

ACKNOWLEDGEMENT

I wish to express my profound thanks and appreciation to God for his unending mercy, blessing and protection throughout this period. A tree cannot make forests, without some special people this project may not work well for us. This is why I'm pleased to acknowledge the following people;

My head of department, Engr. C. O. Ejimofor, My project supervisor, Engr. E. C. Aneke, and Engr. Augustine Able Ndubuisi (The director of Able Design & Construction Company) for their moral contribution, corrections and support.

ABSTRACT

With advancement of technology things are becoming simpler and easier for us. Automatic systems are being preferred over manual system. The purpose of this project is to design and construct A GSM based home automation using AVR. Using GSM networks, in this project a home power control system has been proposed that will act as an embedded system which can monitor and control appliances and other devices locally using built-in input and output peripherals. The system has a delay of 2 minutes after the first call to initiate the next command. This project is made up of four vital units. These units are as follows: GSM module unit, peripheral interface control (PIC) unit, driver unit and a power monitoring and control unit. The GSM module is a GSM transceiver which gives the system access to the GSM service provider. The peripheral interface control (PIC) is programmed to carry out the OFF/ RESET operation according to the GSM commands while the driver and control unit consist of capacitors, resistors, diodes, regulators and electromagnetic relay is to effect power switching. The major component that performed the power control of 220v main supply and the automatic voltage regulation (AVR) is the automated electromagnetic relay. The project was realized.

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CHAPTER ONE

1.1 INTRODUCTION TO THE PROJECT

With advancement of technology things are becoming simpler and easier for us. Automation is the use of control systems and information technologies to reduce the need for human work in the production of goods and services. In the scope of industrialization, automation is a step beyond mechanization. Whereas mechanization provided human operators with machinery to assist them with the muscular requirements of work, automation greatly decreases the need for human sensory and mental requirements as well. Automation plays an increasingly important role in the world economy and in daily experience. Automatic systems are being preferred over manual system. Through this project we have tried to show automatic control of a house as a result of which power is saved to some extent. GSM based home automation using AVR is an electronic device that allows a GSM cell phone to monitor and shut down electrical power supply at home where there are emergency or ugly situations such as fire outbreak, lightning strikes, switching surges, transients, neutral failure and other abnormal conditions or malfunctions that can destroy lives and properties.

GSM based home automation using AVR is a system that implements the emerging applications of the GSM technology which enable the users to carry out some task from anywhere in the world via a GSM network, and the system will automatically regulates power surge. The system is made up of a GSM amplifier unit, PIC12f629 microcontroller, power control and a power supply unit. These sub circuits are designed using passive and active electronic components like capacitors, resistors, diode, regulators, transistors, electromagnetic relay, microcontroller and battery.

1.2 BACKGROUND OF STUDY

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 capability.

Technologies such as Infra-red, Bluetooth, etc which has developed in recent years goes to show the very fact that improvements are in fact possible and these improvements have eased our life and the way we live. Remote management of several home and office appliances is a subject of growing interest and in recent

years we have seen many systems providing such controls. An appliance of a certain location is eliminated with the use of our system. 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. We have designed a control system which is based on the GSM technology that effectively allows control from a remote area to the desired location. The application of our 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 equipments. There is no need to be physically present in order to control.

1.3 PROBLEM STATEMENT

Technology has advanced so much in the last decade or two that it has made life more efficient and comfortable. The comfort of being able to take control of devices from one particular location has become imperative as it saves a lot of time and effort. Therefore there arises a need to do so in a systematic manner which we have tried to implement with our system. The system we

have proposed is an extended approach to automating a control system. With the advancement and breakthroughs in technology over the years, the lives of people have become more complicated and thus they have become busier than before. With the adoption of our system, we can gain control over certain things that required constant attention. The application of our system comes in handy when people who forget to do simple things such as turn ON or OFF devices at their home or in their office, they can now do so without their presence by making a call from their mobile phone. This development, I believe, will ultimately save a lot of time especially when people don't have to come back for simple things such as to turn OFF switches at their home or at their office once they set out for their respective work.

1.4 AIMS AND OBJECTIVES

The objective of this project is to develop a device that can automatically regulate power surge in the home and allow its users to remotely control and monitor multiple home appliances using a cellular phone. This system is a powerful and flexible tool that will offer this service at any time, and from anywhere with the constraints of the technologies being applied. Possible target appliances include (but are not limited to) climate control system, security systems, lights; anything with an electrical interface.

The proposed approach for designing this system is to implement a microcontroller-based control module that receives its instructions and command from a cellular phone over the GSM network.

The project “GSM based home automation using AVR” as the title suggests is aimed to construct a control system that enables the complete control of the interface on which it is based.

General objectives of the project are defined as;

- To co-ordinate appliances and other devices through phone call.
- To effectively receive and transmit data via phone call
- To eliminate the need of being physically present in any location for tasks involving the operation of appliances within a household/office.
- Minimize power and time wastage

1.5 SCOPES AND PURPOSE OF SYSTEM SPECIFICATION

The system specification shows the description of the function and the performance of system and the user. The scope of our project “GSM based home automation using AVR” is immense.

The future implications of the project are very great considering the amount of time and resources it saves. The project we have undertaken can be used as a reference or as a base for realizing a scheme to be implemented in other

projects of greater level such as weather forecasting, temperature updates, device synchronization, etc. The project itself can be modified to achieve a complete Home Automation system which will then create a platform for the user to interface between himself and the household.

1.6 LIMITATIONS

Our project has certain limitations and a list of such is mentioned below:-

- A. The receiver must reside in a location where a signal with sufficient strength can be received from a cellular phone network.
- B. Only devices with electrical controlling input ports will be possible targets for control.
- C. Operation of the controlling unit is only possible through a cell phone and SIM card with the capability of receiving phone calls.
- D. The Control unit must be able to receive and decode phone calls.

CHAPTER TWO

LITERATURE REVIEW

The first machines to be operated by remote control were used mainly for military purposes. Radio-controlled motorboats, developed by the German navy, were used to ram enemy ships in World War I. Radio controlled bombs and other remote control weapons were used in World War II. Once the wars were over, United States scientists experimented to find non-military uses for the remote control. In the late 1940's automatic garage door openers were invented, and in the 1950's the first TV remote controls were used. Zenith began playing around with the idea of a TV Remote control in the early 1950's. They developed one in 1952 called "Lazy Bones," which was a long cable that was attached to the TV Set. Pushing buttons on the remote activated a motor that would rotate the tuner in the set. This type of remote wasn't popular for long considering that, at the time, there were very few channels to choose from.

In 1955, the Flashomatic was invented. A flashlight was shined toward light sensitive cells in each of the four corners of the TV. Each corner had different function. They turned the TV on and off, changed the channel, and controlled the volume. However, people often forgot which corner of the TV operated which control. Also, if the set was in sunlight, the sun's rays would affect the operations of the TV. In 1957 a group of engineers developed the Zenith "Space Command,"

a wireless remote control using ultrasonic waves. The problem with the ultrasonic control was that clinking metal, such as dog tags, could affect the TV set. High frequencies sometimes also made dog bark. The ultrasonic remote was used for two decades until engineers discovered a better way to operate TV's, the infrared remote control. On the infrared control, each button has its own command, and is sent to the TV set in a series of signals. There is a digital code for each button, and in the TV there is a tiny sensor called a photo detector that identifies the infrared beam, and translates the code into a command. Manufacturers used to only make remote controls that operated one TV set. However, they've recently begun making universal remote controls that can operate any TV set. Experts predict that someday remote controls will control almost every device in the home. R.C. Goertz developed a mechanical manipulator in 1948 to aid in radioactive lab work. Goertz gave the machine mechanically and geometrically similar "master" and "slave" parts. The master was the part of the machine the Goertz controlled, and used to send the slave commands. The slave followed the master's movements exactly. In 1954 an electric machine was made to replace Goertz's machine, which was operated by cables. Since '54 better design has been developed, but the electric manipulator remains relatively unchanged to this day.

2.1 REVIEW OF RELATED WORKS

Here, some research such as Home Automation system and its application, Tone recognition devices, Automatic Speech recognition, the technical detail of GSM will be looked into as they relate to remote control systems.

2.2 HOME AUTOMATION SYSTEM

A common definition of Home Automation is of an “electronic networking technology to integrate devices and appliances so that the entire home can be monitored and controlled centrally as a single machine”(Pragnell et al., 2000). Another term that describe the same technology is “domotics”, which derives from the Latin word domus, meaning home, and informatics, meaning the study of the processes involved in the collection, categorization, and distribution of data. However, since this technology is still very much in flux, other terms are also used in the literature with equivalent meaning, such as: “smart home”, “smart house”, “digital home” or electronic home”.

Furthermore, note that although the terms “house” and “home” have different meaning in the English language, they are often used alike in this context. (Delgado, et al., 2006) consider the problems with the implementation of home automation systems. Furthermore the possible solutions are devised through various network technologies. Several issues

affecting home automation systems such as lack of robustness, compatibility issue and acceptability among the old and disabled people are discussed. (Ciubotaru-Petrescu, et al., 2006) present a design and implementation of SMS based control for monitoring systems. The paper has three modules involving sensing unit for monitoring the complex applications. A processing unit that is, microcontroller and a communication module that uses GPRS modem or cell phone via serial port RS-232. The SMS is used for status reporting such as power failure. In their paper, (Scaradozzi et al., 2003) view home automation systems as multiple agent systems (MAS). In the paper home automation system has been proposed that includes home appliances and devices that are controlled and maintained for home management. The major task is to improve performance. In their paper, (Alkar et al., 2005) propose an Internet Based Wireless Home Automation System for Multifunctional Devices. This paper proposes a low cost and flexible web-based solution but this system has some limitations such as the range and power failure.

Murthy (2008) explores primary health-care management for the rural population. A solution proposes the use of the mobile web-technologies providing the PHC services to the rural population. The system involves the use of SMS and cell phone technology for information management, transactional exchange and personal communication. (Jawarkar, et al., 2008)

propose remote monitoring through mobile phone involving the use of spoken commands. The spoken commands are generated and sent in the form of text SMS to the control system and then the microcontroller on the basis of SMS takes a decision of a particular task. (Potamitis, et al., 2003) suggest the use of speech to interact remotely with the home appliances to perform a particular action on behalf of the user. The approach is inclined for people with disability to perform real-life operations at home by directing appliances through speech. Voice separation strategy is selected to take appropriate decision by speech recognition.

2.3 BRIEF HISTORY OF TONE RECOGNITION DEVICE

Despite the fact that the largest stride in the development of tone recognition devices has occurred in the past two decades, this aspect of technology really began with Alexander Graham Bell's invention at about 1870. In his discovery, conversion of sound waves into electrical signals started the process of exploring scientific and mathematical basis for understanding Bell Laboratories in the 50's developed the first effective tone recognition for numbers. At about 1970, the American Research Project Agency (ARPA) after various researches on speech understanding developed the technology further focusing particularly on the fact that the objective of automatic tone

recognition is the understanding of speech not merely words. By the 80's distinct types of products are available, they offered speaker independent recognition systems such that document could be created by voice dictation. The last two decades has invariably a development of voice recognition to the point of real-time continuous speech systems with exceptional high accuracy.

2.4 HISTORY OF HOME AUTOMATION

Although the term “home automation” was first used in 1980s, the concept is far from new. The early documented attempt to envisage something very similar dates back to the 1960s, with Walt Disney's Experimental Prototype Community of Tomorrow (EPCOT), presented in 1966. A smart home will not be able to accomplish much without appliances to control, nor will it be able to communicate to these devices in the absence of a control network (“home network”). Since appliances and home network are so interlinked with a smart home, the following sections provide a brief history on how these come into being.

2.4.1 THE MECHANICAL EVOLUTION

The first question that might come to mind is why we would need a Smart Home and why we would want to find different ways of doing ordinary things, such as washing clothes, cooking, or even turning a light on or off. A similar question could have been asked at the beginning of the 20th Century, at the dawn of what can be called the “mechanical revolution”. In late 1800’s, the middle class was experiencing a shortage of domestic servants which created the need to find new ways to provide help in the home (Harper, 2003). Such necessity was the initial driving force behind the inventions of the first domestic appliances, which had the purpose of making household chores easier and do more with less. In 1911, Frederick Winslow Taylor published “The Principles of Scientific Management”, which advocated the use of efficiency to maximize results through minimal effort. This theory is today known as Taylorism and, though it was originally intended to be applied in industrial settings, this concept soon spilled over into the domestic realm due to the need at hand. Christine Frederick (1911) was one of the first to recognize that the challenges tackled by Taylorism were also directly applicable to domestic issues and captured these in her book “Household engineering: Scientific Management in the Home”, published in 1915. In her book, Frederick predicts that mechanical appliances would be the ones which were to take up the work originally performed by servants “where every possible purely manual task is done

by arms of steel and knuckles of copper”. She also puts forward the idea of a Smart Home where she foretells that “such machinery will be far more unified than at present with various pieces related to one another”, as reported by D. Heckman (2008).

2.4.2 THE ELECTRICAL EVOLUTION

In spite of the first inventions, most of this new domestic technology would have still been easily recognized by people who had lived in the previous Century.

However, electricity, the driving force behind the electrical revolution, would soon change this familiar landscape beyond recognition. Electrical energy first arrived in the homes around 1920s and, although initially used for lightning purposes only, by 1940s mains electricity was readily available to around 65 per cent of the total of houses in the UK. (Harper, 2003). Soon after it reached a critical mass, producers of electrical appliances inundated the market with all sorts of items.

Although some of them were nice-to-have-devices, such as electric popcorns poppers, egg cookers and waffle irons, others were really life changing for the household: refrigerators, washing machines, electric cookers, vacuum cleaners, just to mention the most important. Regardless of their importance, all these electrical appliances were still made with the original need in mind, which was often reminded to people as producers marketed these products with time-saving slogans

such as “no longer tied down by housework” or “automatically gives you time to do those things you want to do” (Heckman, 2008). It is interesting to note how some later devices could be hardly classified as time savers and how, in spite of this, they were still quite readily adopted. By early 1980s, around 65 per cent of UK homes had a colour television set and half of them a video recorder (Harper, 2003). More interesting still, the adoption curve was different from one to another, sometimes regardless of the comfort that they could bring.

2.4.3 THE INFORMATION REVOLUTION

Disney’s original vision for EPCOT was to create both a laboratory for new technology and a home for its inhabitants with the promise of offering an “integrated living environment” (Heckman, 2008). Due to his untimely death, just a few months after the official presentation of the project, EPCOT was never implemented, at least not in its original idea. The concept behind the original vision was however to live on. In the 1960s, a number of hardware and software innovations made possible for home owners to have access to the first computer like appliances in their homes. Perhaps the first attempt to create a “home automation” system occurred in 1966 when Westinghouse proposed the experimental – and quite bulky – Electronic Computing Home Operator (ECHO) IV. Although the original system was supposed to automate the family finances, it

was soon extended to include recipes, shopping lists, family inventory, and, in its final versions, added home temperature control and the ability to control appliances. In 1975, it was the turn of the Altair 8800, followed by the Apple II in 1977 and the IBM PC in 1981. While these computers were slowly finding their ways into the home, they also contributed to the creation of the idea of “smart machines”. In 1978, after a few years of experimentation and refinement, PICO Electronics patented the X10 technology. This technology can be considered the first “home network” as, differently to other networks available at the time, it enabled the existing electrical wiring in anyone’s home to also be used as the media for the communication network. By doing so, X10 made home automation a reality for the majority of the household at an affordable price. Nowadays, an increasing number of houses have home computers, game consoles and always-on Internet connections that extend the availability of services and resources to the household beyond the physical boundaries of the home.

2.5 SMART HOME TODAY

The Oxford Dictionary defines “smart” as both “stylish and fresh in appearance, having a quick intelligence”, and “being fashionable and up market”. Sony was among the first companies to attach the “smart” buzzword to a computer when, in 1982, it marketed the “Smart Sony” computer: no longer advertised simply as a

“home” computer, but tried to cash in on the smart concept by selling it as a device which could “help you make smarter business decisions” (Heckman, 2008). The “smart” concept has become since a marketing catchword, still employed today, to sell a wide range of products, hence: “smart phones”, “smart cameras”, “smart design”, “smart bombs” and “smart homes”. Usually, the word define devices that are reportedly based on cutting-edge design that unite innovation with practical simplicity, However, as this would soon be demonstrated, sometimes marketing buzzwords alone cannot guarantee the sell. Xanadu was the first example of a mass-produced Smart Home. Built throughout the 1980s in the US around the original EPCOT idea, these houses were commercially built dwellings that made extensive use of Smart Home technologies. To look even more futuristic, the actual house was made entirely of polyurethane foam. The Xanadu home had a computer that monitored and controlled all its systems: the kitchen, living room, bathrooms, and bedrooms all had their own electrical and electronic devices to control the appliances present in the house. For example, the shower could be set to be turned on at a specific time and a set temperature. The ad campaign eloquently described the house as “Xanadu: the Computerized House of Tomorrow” and its peculiar appeal was set by the advertisement campaign: a “house with a brain – a house you can talk to, a house where every room adjusts automatically to match your changing moods” (Heckman, 2008). As the time moved on, and most of the houses

were still unsold, the technology contained soon became obsolete. One by one, these Xanadu houses started to get demolished to make space for more “commercially viable” projects and, by October 2005, they were all gone. In spite of the commercial setback provided by the Xanadu homes, the concept was sound and a combination of elements such as computers, robotics and Artificial Intelligence (AI) were to push the Smart Home concept further, even if sometimes only in research laboratories. Throughout the 1980s, several innovative ideas provided a clear indication that the technology might have been finally mature enough to deliver commercially viable solutions. As an example, a device named Waldo, which interfaced with an Apple computer, could use voice recognition and speech synthesis technology to control appliances.

2.6 ASPECTS OF AUTOMATIC SPEECH RECOGNITION (ASR) DEVICE

Automatic speech recognition (ASR) is the process by which a computer maps an acoustic speech signal to some form of abstract meaning of the speech. Automatic speech recognition (ASR) applications focus on public services such as operator automatic operator assistance voice activated information retrieval, voice doing and many other similar tasks. Speech recognition should not be confused with a dial tone (DTMF) application where the user must select from numbered options or

spell out and account number using the telephone keypad. A speech recognition application allows the user to answer questions and provide information using a normal speaking voice many companies have already invested easily in human powered call centers or DTMF (touch- tone) interactive voice response (IVR) systems. They are changing or adapting to ASR applications, because of cost savings and improvement in customer satisfaction and experience. It has been shown that automatic speech recognition application are far more popular with callers than DTMF menu systems. In general, ASR system consist of

- (i) A signal processing front-end
- (ii) Acoustic modeling
- (iii) Language modeling

2.7 TECHNICAL DETAILS OF GSM

GSM is a cellular network, which means that mobile phone can be connected to it by searching for cells in the immediate vicinity. GSM network operate in four different frequency ranges. Most GSM network operates in the 900Mh2 or 1800 MHz bands. In 900 MHz band, the uplink frequency band is between 890-915 MHz and the downlink frequency band is 935-960 MHz. In the 1800mz band, the uplink frequency is between 1710-1785 MHz and the downlink is between 1805-

1880MHz. also in 1900 MHz band, the uplink frequency band is 1850MHz- 1950 MHz. In GSM 900 MHz, the band allocation is 25 MHz band width which is subdivided into 24 carrier frequency channels, each spaced 200 kHz apart. Time division multiplexing is used to allow eight-half rate to sixteen half-rate speech channels per radio frequency channel. There are eight-radio time slots (giving eight burst periods) grouped into what is called TDMA frame. Half rate channels use alternate frames in the same time slot. The channels data rate is 270 833kbit/s and the frame duration is 4.615ms. The transmission power in the handset is limited to a maximum of 2 watts in GSM 900 and 1 watt in GSM 1800/1900. GSM has used a variety of voice codes.

2.8 SUBSCRIBER IDENTITY MODULE (SIM) AS A GSM FEATURE

One of the key features of GSM is the subscriber identity module (SIM). It is usually known as Sim card. The Sim is detachable smart in appearance and is used for the subscription of information and phonebook. This allows the retrieval of information after switching handset on. The Sim card also enables users to link each other irrespective of different network operation. For the purpose of this project work to be achieved a Sim card on any network is required to establish a

link between a user and its household equipments to squeeze 3.1Kh2 audio
between 5.6 and 13kb/s.

CHAPTER THREE

SYSTEM DESIGN METHODOLOGY AND ANALYSIS

3.1 HARDWARE SUBSYSTEMS

The project was designed and implemented using top to bottom design method just as shown in the block diagram in figure 3.1. The system starts form the following units:-

- GSM module unit
- Peripheral interface control (P.I.C) unit
- Driver unit.
- Power surge monitoring and control unit , (AVR)

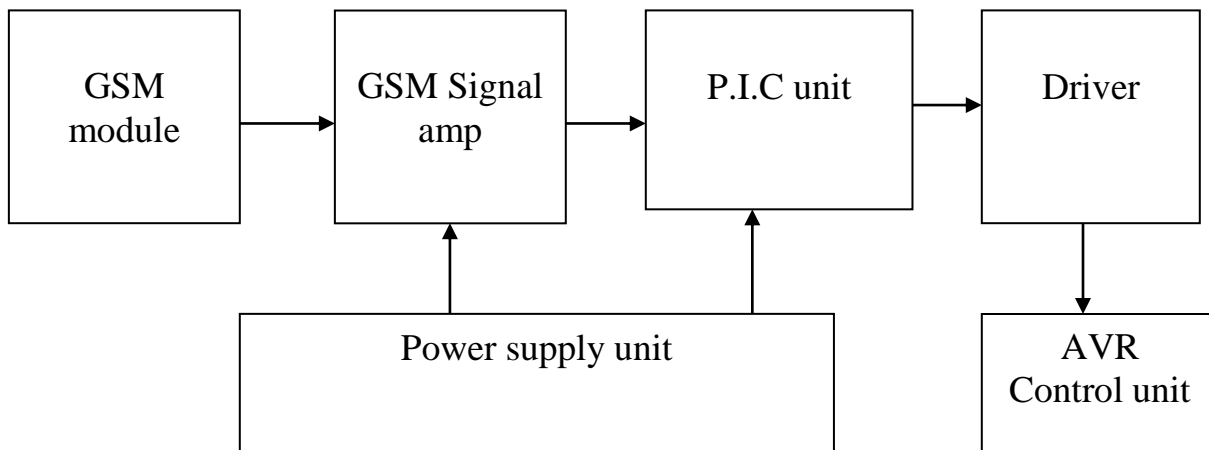


Fig 3.1 Block diagram of the project

In the methodology, the over all system design is in two parts: hardware design and software design. The hardware design is the physical parts of the system while the

software design treats the programs that were written to control the microcontroller at the processing center of the system. The hardware design is the heart of the project. This is the physical implementation where the various components used for the design were incorporated together on a vero board through soldering. It consists of many units which includes a GSM module, a PIC unit and other units listed above.

3.2 SYSTEM ANALYSIS AND DESIG

The system uses GSM signal system which allows its users to effectively control their house/office appliances simply by calling the device.

The call receive by the device is processed by a microcontroller to perform an OFF operations. The type of the operation performed is based on the nature of the GSM signal sent. An encoded GSM signal is generated and sent from the GSM base station to the device.

In this project two GSM module are involved:

- The GSM transmitter module which is the users cell phone
- The GSM receiver module which is the cell phone connected to the project.

There are lots of remote controls methodology like infrared, RF, SMS and more but in this project I prefer the calling system using GSM network. SMS control

system uses the GSM network as well but the problem with it is that SMS sometimes does not arrive on time. In the design methodology, GSM network was used because of its wider coverage.

The relay driver is used to drive the relay circuits which switches the different appliances connected to the output of the project.

The figure shown above is the schematic diagram of our project. It is a simple illustration of how we have implemented our project and the various parts involved in it. From the above representation, the first Mobile station is used as a transmitting section from which the subscriber makes a call which is the command or instruction for the second mobile station. A SIM card is inserted in the receiver cell phone.

supply and steps it down to 12v. The transformer primary is shown connected only to the line cord and plug in which the first block diagram represents. This power supply is double-insulated. There is no electrical connection between the primary and secondary sides of the transformer so most jurisdictions do not require a grounding plug. Figure 3.2 shows the picture of transformer used in the project.

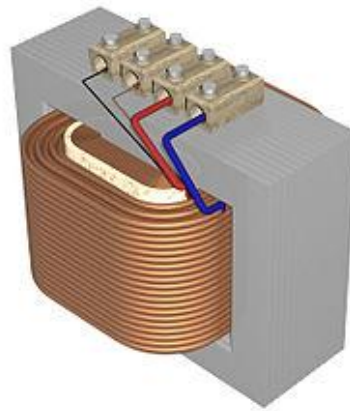


Fig 3.3 a Transformer

The voltage induced across the secondary coil may be calculated from Faraday's law of induction, which states that:

$$V_s = N_s \frac{d\Phi}{dt}$$

Where V_s is the instantaneous voltage, N_s is the number of turns in the secondary coil and Φ is the magnetic flux through one turn of the coil. If the turns of the coil are oriented perpendicularly to the magnetic field lines, the flux is the product of

the magnetic flux density B and the area A , through which it cuts. The area is constant, being equal to the cross-sectional area of the transformer core, whereas the magnetic field varies with time according to the excitation of the primary. Since the same magnetic flux passes through both the primary and secondary coils in an ideal transformer, the instantaneous voltage across the primary winding equals

$$V_p = N_p \frac{d\Phi}{dt}$$

Taking the ratio of the two equations for V_s and V_p gives the basic equation for stepping up or stepping down the voltage

$$\frac{V_s}{V_p} = \frac{N_s}{N_p}$$

N_p / N_s is known as the turn ratio, and is the primary functional characteristic of any transformer. In the case of step-up transformers, this may sometimes be stated as the reciprocal, N_p / N_s . Turns ratio is commonly expressed as an irreducible fraction or ratio: for example, a transformer with primary and secondary windings of, respectively, 100 and 150 turns is said to have a turns ratio of 2:3 rather than 0.667 or 100:150.

3.3 REGULATION UNIT

Regulation is a measure of the difference in voltage provided by the transformer's secondary winding when it is on load and off load. It is expressed as a percentage relative to the full load voltage and, basically, the lower the value, the less the voltage difference. Strictly speaking, the transformer's datasheet (or supplier) should state the output voltage when the transformer is under its full rated load.

For example, a transformer rated at 12v, 50VA should provide 12v to a load which takes 4 amps.

$$50VA \text{ at } 12\text{volts} = 50/12 = 4.1 \text{ Amps}$$

Our transformer provides 12.5 volts off load so, unless the regulation is exceptionally good, the "nominal" 12 volts hasn't been specified as the on-load voltage at all.

$$\% \text{ regulation} = \frac{\text{off load voltage} - \text{on load voltage}}{\text{on load voltage}} \times 100$$

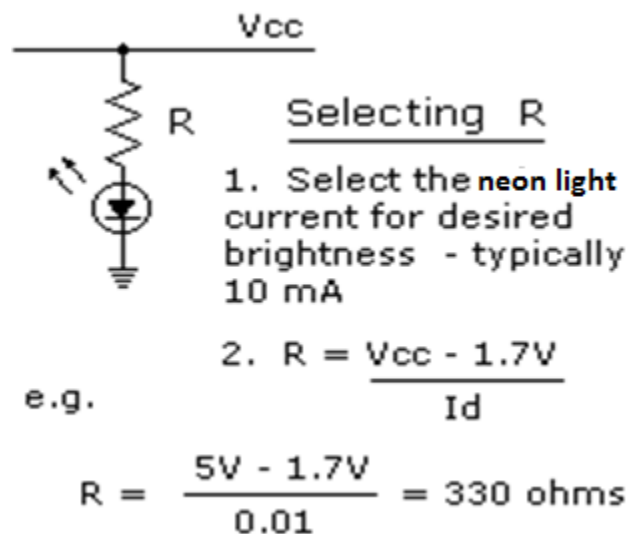
$$= \frac{12.5 - 12}{12} \times 100$$

$$= 4\%$$

Later tests proved that the output voltage dropped to less than 11.4 volts when presented with a load of just 2 Amps. At best, this is a regulation of around 14%

even at just 2 Amps. The disadvantage of using a transformer with too high an output voltage is that the regulator will need to work harder and dissipate even more surplus energy and, as the maximum off load voltage will be higher, the voltage monitoring circuit will need to take the higher voltage into account.

NEON LIGHT: A red neon light indicator and voltage meter is used in this project to indicate when there is voltage supply in the system and when the system shutdown the house appliances. A neon light is a solid-state lamp that emits light just as a light-emitting diode.



The resistance of the neon light is 330 ohms while the voltage is 3v.

3.4 THE POWER SUPPLY

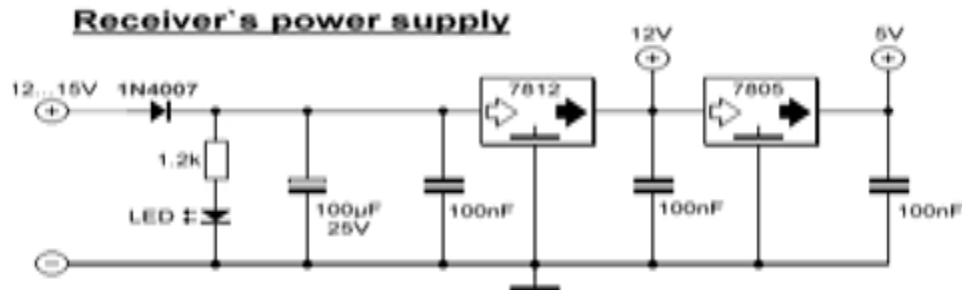


Fig: 3.4The power supply of receiver

The power supply of this project is constituted by 2 voltage regulator; LM7812 and LM7805. The first 12V is only to power the relay and the second 5V is to power the microcontroller.

3.5 THE MICROCONTROLLER

The microcontroller used in this project is the PIC12F629. Its pins are shown below.

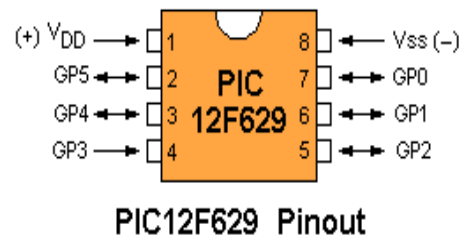


Fig 3.5 PIC 12F629

3.6 SYSTEM FLOW CHART

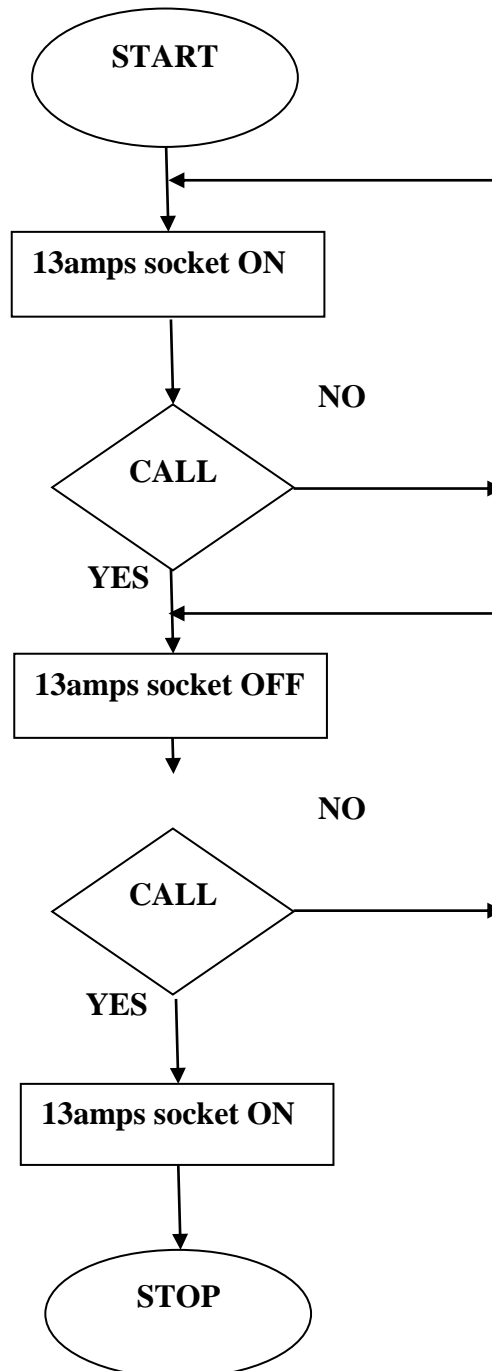
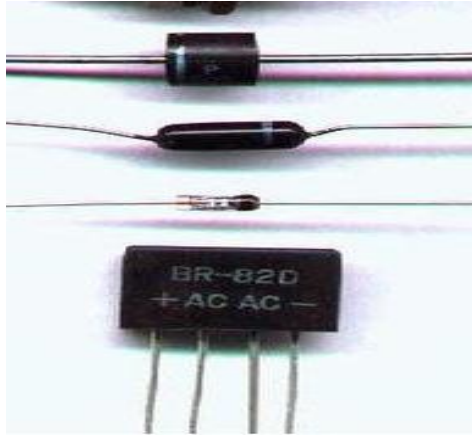


Fig 3.6 Flow Chart of the

The process to operate this project is first make a mobile to mobile connection wirelessly or with a single mobile onboard wired. But here we are using two mobiles to make a wireless application. Start with making a connection with the onboard mobile from a remote distance, then when connection is established lets control the project with the data as follows:

To control appliances, make a “CALL”, to switch ON, and also, to switch OFF again, make another “CALL”. This ON/OFF condition of the device is through the Relay, where switching is very fast and accurate.

DIODES: A diode plays an important role in the project. It allows the battery voltage to flow into the circuit only in one direction (called the diode's forward bias direction) and also block any back electromotive force that may damage the driver transistors. The diode is a two-terminal electronic component with a nonlinear current–voltage characteristic. This unidirectional behavior of diode is called rectification and it is used in the project to convert alternating current from the GSM Module to direct current which is used to bias the switch transistor used in the project.



Picture of four types of diodes

CAPACITOR: Capacitors are used in the project to blocking direct current from the GSM Module and allow alternating signal to pass into the system. It is also used for filtration and smoothing of unwanted A.C ripples in the power supply unit. A capacitor is a passive component consists of a pair of conductors separated by a dielectric (insulator). When there is a potential difference (voltage) across the conductors, a static electric field develops across the dielectric, causing positive charge to collect on one plate and negative charge on the other plate.



Picture of the electrolytic capacitor

RESISTORS: A resistor is used to bias the switching transistor that energizes the relay. It also used to limit the amount of current flowing into the project. A linear resistor is a linear component that implements electrical resistance as a circuit element. The current through a resistor is in direct proportion to the voltage across the resistor's terminals. Thus, the ratio of the voltage applied across a resistor's terminals to the intensity of current through the resistor is called resistance. This relation is represented by Ohm's law:

$$I = \frac{V}{R}$$



Picture of a resistor used in the project

RELAY: Relay is the main control switch that shutdown the house appliances when a call is made. A relay is an electromagnetic operated switch. Current flowing through the coil of the relay creates a magnetic field, which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and they are double throw switches. To prevent damage to the

relay a diode must be connected across the relay coil. The relay's switch connections are usually labeled **COM, NC and NO**:

PIN CONFIGURATION	MEANING
COM	Common, always connect to this; it is the moving part of the switch
NC	Normally closed, COM is connected to this when the relay coil is off.
NO	Normally open, COM is connected to this when the relay coil is on.

The pin configuration of a relay

RELAYS AND TRANSISTORS COMPARED

Like relays, transistors can be used as an electrically operated switch. For switching small DC currents ($< 1\text{A}$) at low voltage they are usually a better choice than a relay. However, transistors cannot switch AC (such as mains electricity) and in simple circuits they are not usually a good choice for switching large currents ($> 5\text{A}$). In these cases a relay will be needed, but note that a low power transistor may

still be needed to switch the current for the relay's coil! The main advantages and disadvantages of relays are listed below:

ADVANTGES OF RELAYS:

- Relays can switch AC and DC, transistors can only switch DC.
- Relays can switch higher voltages than standard transistors.
- Relays are often a better choice for switching large currents (>5A).
- Relays can switch many contacts at once.

DISADVANTAGES OF RELAYS:

- Relays are bulkier than transistors for switching small currents.
- Relays cannot switch rapidly (except reed relays), transistors can switch many times per second.
- Relays use more power due to the current flowing through their coil.

Relays require more current than many ICs can provide, so a low power transistor may be needed to switch the current for the relay's coil.

CHAPTER FOUR

SYSTEM IMPLEMENTATION AND PROJECT COSTING

CONSTRUCTION AND COMPONENTS LIST

4.1 CONSTRUCTION

The term stage is associated to a group of components, which is aimed at achieving a specific purpose. This has been broken down in the previous chapter. Each of the stage will now be treated more elaborately.

4.2 CONSTRUCTIONAL METHOD

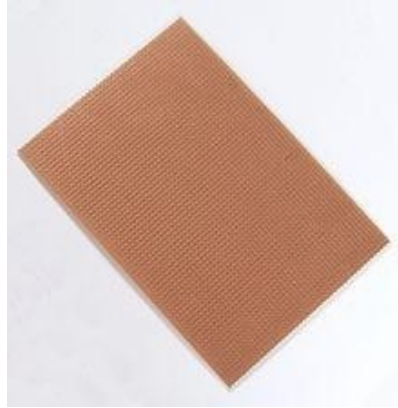
The construction of this project was done on a vero board. Vero board is called strip board. It is a widely-used type of electronics prototyping board characterized by a 0.1 inch (2.54 mm) regular (rectangular) grid of holes, with wide parallel strips of copper cladding running in one direction all the way across one side of the board. In using the board, breaks are made in the tracks, usually around holes, to divide the strips into multiple electrical nodes. With care, it is possible to break between holes to allow for components that have two pin rows only one position apart such as twin row headers for ICs.

4.3 POWER SUPPLY UNIT (PSU)

The transformer is connected to mains of 220v/50Hz through a power cord of R ohm resistance. The transformer's (12v/500mA) secondary output is connected to the bridge rectifier source inputs. An output is taken from the negative and positive terminals of the rectifier and connected to the corresponding pins in the 1000uF/35v capacitor. This bridge rectifier the supply while the capacitor filters the A.C voltage lefts and equally smoothens the signal into a pure D.C voltage of 12vDC. The positive terminal of the capacitor is connected to pin 1 of the 7805 voltage regulator, while the negative terminal connects to pin 2 of the regulator. This regulator produces an output of +5v between pin 3 and pin 2(Ground).

Vero board: The construction of this project was done on a vero board and the procedure methods used are: -

1. The vero board was inspected of wrong linkages of its line which may be mistake from the producers. The holes of the board were made sure to be through for passing the terminals of the components for soldering.
2. An abrasive paper was used on the soldering section of the board for easy binding of the terminals on the board.

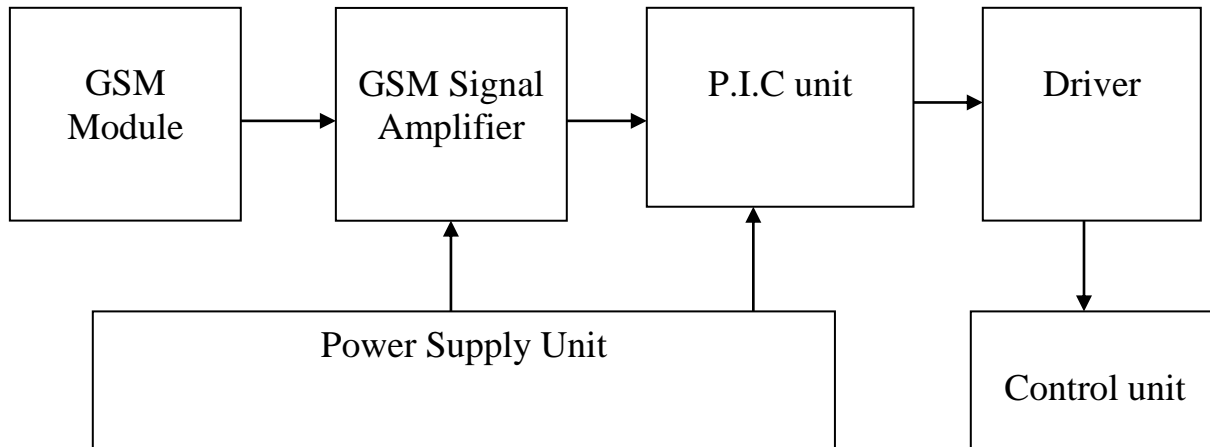


The picture of the Vero board used in the project

Components are usually placed on the plain side of the board, with their leads protruding through the holes. The leads are then soldered to the copper tracks on the other side of the board to make the desired connections, and any excess wire is cut off. The continuous tracks may be easily and neatly cut as desired to form breaks between conductors using a 5mm twist drill, a hand cutter made for the purpose, or a knife. Tracks may be linked up on either side of the board using wire. With practice, very neat and reliable assemblies can be created, though such a method is labour-intensive and therefore unsuitable for production.

4.4 MOUNTING OF THE COMPONENTS

The mounting of the components were placed according to block diagram below.



The soldering process was carried out using a lead and soldering iron. This was done by joining the supposed terminals together before soldering. And after soldering each unit, test was carried out using a meter to ensure good contact. A patrax box was used for the enclosure of the project. Patrax is an electrical installation box used for housing electrical/electronic components. It is made of plastic material, 50×20mm rectangular shape with 10mm thickness. This box houses the control unit.

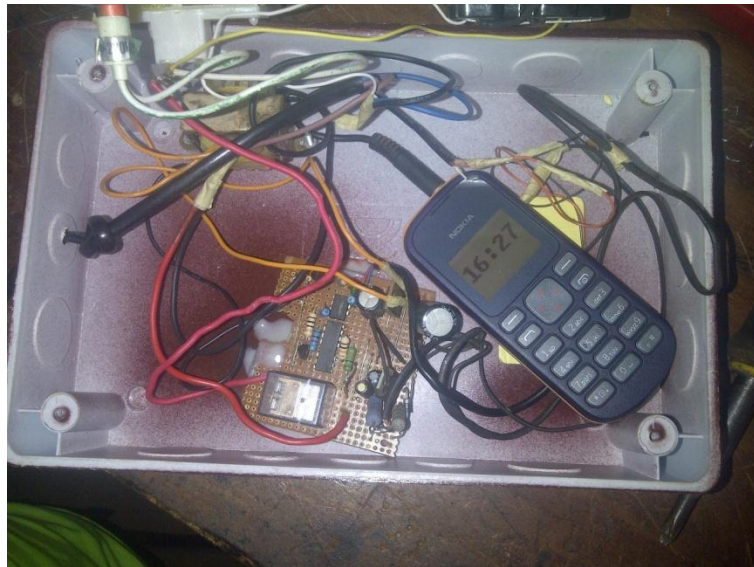
4.5 INTERCONNECTION OF COMPONENTS:

The interconnections of the circuit were done using a PVC connecting wire. This enabled the necessary connections at different sections of the circuit to be

made by extending the terminals or connection made with a wire to a deserved point in the circuit. Connecting wires is a flexible wire made from copper and will be used to connect component or subsystems.



PVC wire



Complete construction of the project

4.6 BILL OF ENGINEERING MATERIALS AND EVALUATION

S/N	COMPONENT	QUANTITY	UNITY PRICE (₱)	AMOUNT (₱)
1	Diode (1N4001)	7	10	70
3	Resistors	12	5	60
4	Transistor BC337	6	20	120
5	78151C Regulator and 7805	1	30	60
6	PIC 12F629	1	200	200
7	12V, 30 AMPS Relay	1	150	150
8	Casing	1	2000	2000
9	Output Socket	1	200	200
10	Copper clad board	1	20	1000
11	Fuse	1	10	20
12	Neon Light	1	50	50
13	Microcontroller	1	2000	2000
14	Transformer (both copper wire and core)	1	2000	2000
15	Nuts and screw	4	5	20

16	Labour	1	5000	5000
			Total	₦12,950

From the summary of the table, it can be seen that the total cost of the project implementation is ₦12,950.

CHAPTER FIVE

RECOMMENDATION, CONCLUSION AND CONSTRAINTS

5.1 CONCLUSION

The GSM based home automation using AVR was designed and constructed to CONTROL 230V \pm 5% ac load. It is rated 2500VA 50Hz.

This project has really exposed me to the use of electronic component. To a large extent I have come to appreciate the theories learned over the years.

5.2 RECOMMENDATION

It is a fact that this is not exhaustive. It can still be improved to get a more sensitive and precise output voltage control.

For this reason I recommend the following.

1. Two layers circuit board can be designed and used in place of single layer circuit board for easier soldering work and neatness.
2. Further research in the field of electronics switching will go a long way in getting better house control system.
3. Engineering students need early exposure to the use of electronic components for practical work; this will enable them to be more innovative.

5.3 MAJOR CONSTRAINTS

Along the course of project completion we encountered various problems and obstacles. Not everything that we had planned went smoothly during the project development span. Also we had a limited amount of time for its completion so we were under a certain amount of pressure as well. We had to start from the research phase at the beginning and needed to gain knowledge on all the devices and components that we had intended to use for our project. Other phases of the project included coding, debugging, testing, documentation and implementation and it needed certain time for completion so we really had to manage the limited time available to us and work accordingly to finish the project within the schedule.

5.4 CONSTRAINTS CONSIDERATIONS

The following is a list of constraint considerations

- The controlled appliances will need an electrical control interface. This system is only capable of controlling electrical devices.
- The control module will need to be shielded against electrostatic discharges. This will increase the reliability of the system.
- Battery backup for controlling unit can be implemented in case of power disruption.

5.5 TECHNOLOGY CONSIDERATIONS

The considerations for this system will include a choice of networks, communication protocols and interfaces.

- ✓ Cellular Networks: The widely available networks are based on GSM. This network provides wide area coverage and can be utilized more cost-effectively for this project.

- ✓ Communication Protocols: The available communication protocol that we have used is phone call. The phone call is the most efficient because this project requires a cellular communication and limited data to be sent.

- ✓ I/O interfaces between microcontroller and devices: Serial I/O is considered as options for connection between the GSM receiver and the microcontroller. Using the microcontroller, a control circuit will be implemented to control the electrical appliances.

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