CHAPTER ONE

INTRODUCTION

1.1 Background of study

Has technology transformed humankind into omniscient being? Years back, communication was done through difficult means like travelling to the destination of the second party, posting letters est. Today people can communicate easily through various means like e-mailing, face booking, GSM etc. 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 application of mobile phones cannot be restricted to sending SMS or starting conversation. New innovation and ideas can be generated from it that can further enhance its capabilities. Technologies such as infra-red, Bluetooth etc which has developed in recent years goes to show the very fact that improvement are infact possible and those improvement have eased our life and the way we live. Remote management of several home and offices appliances is a subject of growing interest and in recent years we have seen many systems providing such controls.

These days, apart from supporting voice calls, a mobile phone can be used to send text message as well as multimedia message (that may contain pictures, graphics, animation, etc). Sending written text messages is very popular among mobile phone users. Instant messaging as it is known, allows an individual to share ideas, opinions and other relevant information. I have used this to design a system that allows a platform to receive calls which infact are commands sent to control different appliances and device connected to the platform. The design of this control system system is based on the GSM technology that effectively allows control from a remote area to the desired location. 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 equipments. The need to be physically presenting order to control appliances of a certain location eliminated with the use of this system.

The research is borne out of the need for man to control electrical devices that are remotely located to him. Anything from home devices such as alarms, heaters, air conditioner and so on, IT equipment such as routers and servers can be controlled.

The desire for man to control an object that is remotely located to him has been for many ages. However, the technology that meets the perfect desire in

this respect has not been obtained, though there is increasing improvement in technology that struggles to meet this need in terms of accuracy, speed, ease of operation and limitless operation point. The introduction of the global system for mobile communication (GSM) and particularly the use of hand-held mobile phones brought the innovation of distance communication at remote location. Based on this, research utilizes this facility for remote control of systems and appliances, take for instance, a man on a journey inside his car suddenly remembers that he left the air conditioner (AC) ON when it was supposed to be OFF. The normal condition is to drive back and switch OFF. But with the GSM mobile phone in the hand, one looks on how the same could be used to effect control at any point and time.

1.2 Statement of problem

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 (i.e. important) as it saves a lot of time and effort. Therefore there arises a need to do so in a systematic manner which will be implemented in the proposed system. The system is an extended approach to automating a control system. With the advancement and breakthrough in technology over the years, the lives of people have become busier than before. With the adoption of this system, we can gain control over certain things that require constant

attention. The application of this system comes in handy when people who forget to do simple things such as turn ON or OFF devices at their homes or at their offices. They can now d so without their presence by the transmission of a simple call from their mobile phone. This development , I believe will ultimately save a lot of time especially when people do not have to come back for simple things such as to turn ON or OFF at their homes or at their office once they set out for their respective work or appointment.

1.3 Project Aims and objectives

The project “GSM control system” 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 :

a. To co-ordinate appliances and other devices through calls.
b. To effectively receive and transmit data via calls.
c. To eliminate the need of being physically present in any location for tasks involving the operation of appliances with household/office.
d. Minimize power and time wastage.
e. It allows a great degree of freedom to an individual.

1.4 Justification of study

- The proposed project can be used as a reference or as a base of realizing a scheme to be implemented in other project of greater level such as device synchronization, temperature updates, weather forecasting 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.
- It can be used by companies for management purpose example is switching ON/OFF the server in other to manage the bandwidth.

1.5Scope of the study

The project covers the aspect of just being able to switch ON/OFF any electrical appliance connected to the circuit.

1.6 Project Report Organization

The project is designed to have five chapters, which will explain in details the various aspects of system. The first chapter gives an introduction to GSM control system along with the project aims and objectives, with emphasis to the scope in order to achieve the desired goal and limitations to the study.

Chapter two is on literature review which contains a review of previously implemented systems.

Chapter three contains the details of the entire major component that were used in the actualization of the hardware part of the project.

Chapter four deals with the implementation and the testing, the chapter contains the major work of the project.

Chapter five summarizes and concludes the project work on GSM – Based Remote switching system. Recommendations are also stated.

CHAPTER TWO

LITERATURE REVIEW

2.1 Brief History of tone Recognition Device

Despite the fact that the largest stride in the development of tone recognition device has occurred in the past two decades. This aspect of technology really began with Alexander Graham Bells invention at about 1870. In this discovery, conversion of sound waves into electrical signals started the process of exploring scientific and mathematical basis for understanding tones.

Bell laboratories in the 50s 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 80s distinct types of products were available, they offered speaker-independent recognition useful for telephones transfer processing, development of large vocabulary voice recognition systems such that documents could be created by voice dictation (Kurzweil, Dragon IBM).

The last two decades has invariably experienced a developed of voice recognition to the point of real-time continuous speech systems with exceptional high accuracy.

2.2 Automatic Speech Recognition (ASR)

Automated speech recognition is the process by which a computer maps an acoustic speech signal to some form of abstract meaning of the speech.ASR applications focus on public services such as operator automation,operator assistance, voice- activated information retrieval, and voice dailing and many other similar tasks. Speech recognition should not be confused with dial-tone (DTMF) applications where the user must select from numbered options or spell out an account number using the telephone keypad. A speech application allows the user to answer questions and provide information using a normal speaking voice.

Many companies have already invested heavily in human-powered call centers or DTMF (touch-time) 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 some parts of the world 80% of callers encountering a touch-tone menu system will quit or elect to transfer to the operator, with automatic speech recognition this situation can be eliminated.

No uniform single indigenous language is spoken throughout South Africa. Most people who are not so literate only speak their “mother’s language”

due to lack of schooling opportunities and very little reading and writing skills.

As a result it is highly desirable that more ASR applications based on indigenous languages be developed and implemented.

In general ASR systems consist of three major modules namely, a signal processing front-end, acoustic modelling and language modelling.

2.3 Related works

During the course of research, some related works were found which are explained below

Dial2open GSM remote control and GSM alarm: the Dial2open GSM is a remote control switch that connects to the GSM mobile phone network. It enables one to open automated gate, barriers and garage doors using a mobile phone. Simply "speed-dial" the dial2open which identifies you as an authorized user and the automatic gate, barrier or door open. There is no call costs incurred when calling without answering easily programmed by SMS text message, authorized telephone numbers can be added or deleted as required.

GSM based device ON-OFF control especially designed for agricultural needs: the device consist of GSM modem, microcontroller, motor stater, relays, memory and display. If the user wants to control some devices in his house he/she have to send the SMS message indicating the operation of the

device and then the system password, while the MODEM embedded with the system microcontroller receives SMS. The microcontroller will read SMS and check for the password the user had sent with the SMS. If the password is correct then it will check whether the massage is for switch ON or OFF the motor. According to the received message, the controller will switch on/off the relays. The device is password controlled; therefore only people who know thw device password are capable of controlling the device. The relay or buzzer are controlled by the microcontroller using single pins i.e. giving high means device will be switch on and vise versa. Sometimes it can be interchanged according to the transistors used to drive the devices.

GSM-Auto Remote control switch: the GSM-auto is a remote control switch, it connects to the cell phone and like a cell phone has its own cell phone number. The GSM-auto is activated by calling its cell phone number, it will recognize an authorized telephone number calling it, rejects the call without answering and switches on/off the device connected to it because it rejects the call without answering there is no call cost incurred. It has two independent relays switches with normally open or normally closed switch contacts, these can be programmed to switch on for a pre-determined length of time whenever the GSM-auto is called, alternatively the switches can be permanently switched ON or OFF by sending the GSM-auto a short message service (SMS). Applications include the remote control of Hein

holiday homes, lighting, engine pre-heaters, aviation engine heaters, irrigation systems, water well pumps and reboots of remote servers and routers, arming and disarming security systems etc.

In the above related work, since the short message system (SMS) are used there is a disadvantage of late delivery of SMS because of traffic on the networks. Users might not be able to track what appliances is ON at a particular time. In subsequent study of this project, the GSM control system will take advantage of the keypad tone hence ensuring that users track each equipment just by the press of a button.

2.4 DTMF Decoder

DTMF stands for Dual ton multi-frequency. That is, a DTMF signal is one that consists of only the sum of two pure sinusoids at valid frequencies. The keypad of the handset is a common but an interesting feature on every phone. The keypad has tones, each with unique frequency (and hence sounds). Once a call is acknowledge by the receiving phone, the speakers of the two phones (the transmitter and the receiver) are automatically activated to receive keypad tones when the button of any of the phones is depressed. Every phone irrespective of their manufacturers has twelve (12) keypads. The twelve keypads are key 0 to 9, asterisk (*) and the harsh (#). These tones are automatically transmitted and received as the keypad tones with independent frequency and twelve in number, each button could be used to

transmit command to the control equipment. Thus several independent commands could be generated using the approach. With the trend in technology where microcontroller has gained wide appreciation, the controls are not limited to twelve (12). The keypad tone is a frequency array in matrix table as shown below. The address of any number is given by two frequencies, the row and the column frequencies. Phones only uses twelve of the possible sixteen tones. If you look at a phone, there are only 4 rows (R1, R2, R3 and R4) and three columns (C1, C2 and C3). The rows and columns select frequencies from the low and high frequency group respectively. By so doing, every number of the keypad can be located on the matrix table. The keypad tone is used to generate the necessary command that will activate electromagnetic or solid state relays for switching ON or OFF and the accessing of the status of several appliances. If you are familiar with how telephones work, the basic circuit might also help you to build devices that respond to calls. For example, you can build upon the decoder and add relays to control household devices that respond when you call your home. The bottom line is that DTMF was designed for optimal performance with each tone being very distinct. This makes decoding the tone very easy even in noisy surrounding. It is this performance that makes DTMF ideal for clear transmission and reception in remote control (wireless or through phone line) applications.

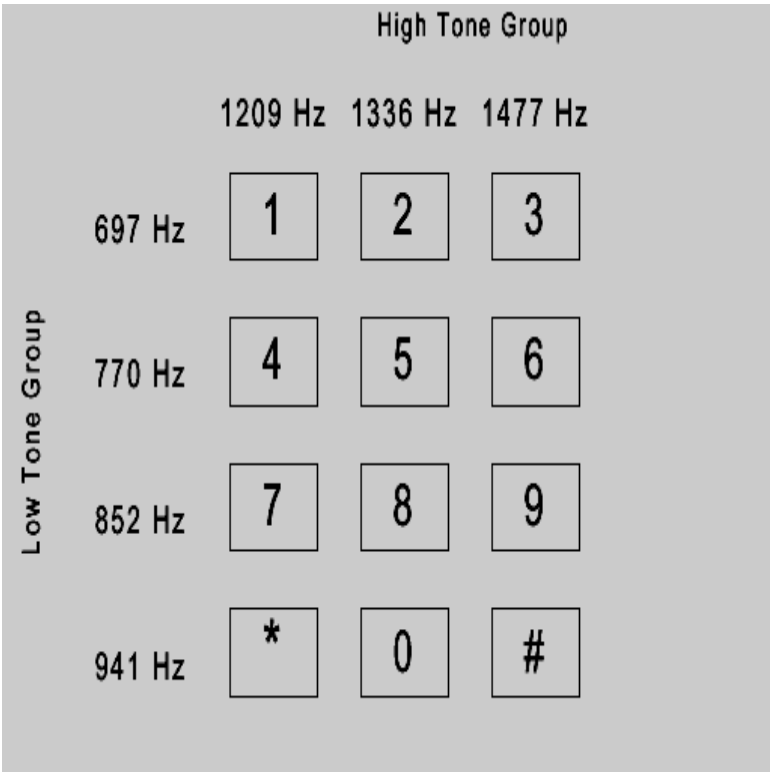


figure 1.1 keypad dual tone multi-frequencies

To determine what tone frequency is associated with a particular key, look at your phone again. Each key is specified by its row and column locations. For example, the "2"key is row 1 (R1) and column2 (C2). Thus using the above figure, "2"has frequency of 697+1336=2106HZ. The "9"is row 3 (R3) and column 3 (C3) and has frequency of 852+1477=2329HZ.

2.5 MICROPROCESSORS EVOLUTION: HISTORY AND OVERVIEW

The central processing unit (CPU) in a microcomputer is called a microprocessor. Microprocessors are of different types, but before we proceed, we shall look at the historical evolution and general overview of the different types of microprocessors.

In categorizing microprocessor, we must do that according to the number of bits their ALU can work with at a time. This implies that a microprocessor built with an 8-bit ALU is referred to as 8-bit microprocessor irrespective of the number of data and addresses lines it possesses.

It was in 1971 when the first commercially available microprocessor was introduced by INTEL 4004. This has 2300PMOS transistor and a 4-bit device meant to be used together with some other devices in making a calculator. The idea behind this led to some logic designers conclude that it could replace PC boards that is filled with combinational and sequential logic devices. Another important feature that makes it attractive was its ability to be reprogrammed, thereby making it possible to change the function of a system, by changing the programming rather than redesigning the hardware.

Intel came out with the 8-bit 8008 which requires 20 or more additional devices to form a functional CPU. The year 1974 saw the introduction of 8080 which has a much larger instruction set than the 8008 and required on two additional devices to form a functional CPU. It uses a NMOS transistor, thus it operates

Faster than the 8008. It is often referred to as a second generation microprocessor.

After the introduction of 8080, Motorola introduced the MC6800, which has an 8-bit general purpose CPU. It has the advantage of using only +5v rather than the +5v,-5v and +12v required by the 8080. The 8-bit 8080 and 6800 remained the top selling microprocessors for several years. They completed with the MOS technology 6502, which was used as the CPU in the Apple II microcomputer and the Zilog Z80, used as the CPU in Radio Shack TRS-80 microcomputer.

As the need for microprocessor with more applications increased, the designers pressured manufacturers to produce microprocessor with optimized features for performing functions. In response, microprocessor has evolved into three major directions in the last two decades.

2.6 TYPES OF MICROPROCESSORS

2.6.1 Dedicated or embedded controllers

These are specialized kinds of microprocessor used for the control of “smart” machines such as microwave ovens, clothes washers, sewing machines, auto ignition system, metal latches and a host of other industrial and domestic machines.

A microcontroller is a microprocessor characterized by several I/O ports and on-board ROM and RAM. The total memory size including external space is usually smaller than that of a normal microprocessor. Examples of commercially available microcontrollers are Texas Instruments TMS-1000, Zilog Z8 and the INTEL 8051 family; which includes the 8951. We shall separately treat the 8951 microcontroller. A more recently introduced single chip microcontroller, the INTEL 8096 contains a 16-bit CPU, ROM, RAM, UART ports, timers, and a 10bit ADC.

2.6.2 BIT SLICE PROCESSORS

In some applications, general purpose CPUs such as the 8080 and 6800 are not fast enough or do not posses suitable instruction sets. In order to meet up with the demand for a microprocessor that will perform the required applications, manufacturers produced devices that can be used to build custom CPUs. An

example of these is the Advanced Micro Devices 2900 family. This family includes 4-bit ALUs multiplexers, sequences, and other parts needed for custom building a CPU.

The term “slice” comes from the fact that these parts can be connected in parallel to work with 8-bit words, 16-bit words, or even 32-bit words. This implies that a designer can add many slices as needed for a particular application. The designer not only custom-design the hardware of the CPU, but also customizes the instruction set to use “microcode”.

2.6.3 GENERAL PURPOSE CPUs

This includes general purpose CPUs which gives a microcomputer most or all of the computing power of earlier minicomputers. The major competitors in category are the INTEL 8080 and Motorola 68000 which can work directly with 16-bit instead of 8-bit words, they can address a million or more bytes of memory instead of the 64kbytes addressable by the 8-bit processors.

They also have single instruction for function such as multiplication and division which require lengthy sequence of instructions on the 8-bit processor. The evolution along this last path has continued on to 32-bit processors that work with GB (10^9bytes) or TB (10^{12}bytes) of memory. Examples of these devices are the Motorola MC 68020, the Intel 80386 and the National

CHAPTER THREE

SYSTEM ANALYSIS AND DESIGN

3.1 METHODOLOGY

Initial approach to project designing and execution is to gather enough information in order to help speed up the operation once the actual work commences. Methodology is the study of how to perform scientific research. It is the part of any analysis or research that is used to find out what type of data is maintained, what fact to find and look for, how to find them and how to record them for usage. In order to achieve these, Structured System Analysis and Design Methodology (SSADM) were used. This is because; SSADM is an internationally accepted software engineering model mainly used in most result oriented analysis.

3.1.1 System Analysis

Analysis involves a detailed study of the current system, leading to specifications of a new system. Analysis is a detailed study of various operations performed by a system and their relationships within and outside the system. This is the total analysis given to all the data obtained during the cause of this project design. The reason for this analysis is to have the best possible design or the close adaptive designed principle for achieving my own project.

These analyses have been done to ascertain correct and best design. This system analysis was employed in selecting the best design module and in calculating the component for the system. Because of the nature of country we are in, system analysis will help in order to engage the available component in our design.

3.2 DATA COLLECTION

Some of the information used was obtained from the sources below, which are all secondary form of data collection.

3.2.1 The Internet: when gathering information on GSM control system, the internet played a very important role. This is because one can get the latest and up to date information on almost anything at all on the network. I was able to get almost all the relevant information needed on the internet. Surfing the internet for this topic gave me data on things like the origin of microprocessor, microcontrollers and how they have improved our technology and our lives over the years.

3.2.2 Libraries: information on this topic was also gotten in different kinds of books on different topics. Some of the kinds of books which I used in my research were books on electronics, magazines on the latest kind of technologies. Etc.

3.2.3 My supervisor: on several meetings with my supervisor on this project, she also provided some relevant information on how GSM control system should operate and also modifications on the information gotten from the internet to fit to the actual project on hand.

3.3 ANALYSIS OF THE EXISTING SYSTEM.

The existing system is a system that has been carried out in terms of SMS operation. It is a system in which all the electrical appliances in an office or home can be controlled through the use of SMS which over the years has been had some basis of unreliability. Critical analysis of this system reveals that it is a system prone to errors. Careful analysis also shows that because of the complexities of delivered or undelivered information, it may really take time before the expected action will be carried out. Over the years, the mode of operation have been done using SMS, the system is prone to error because their may be a lot of delay in the arrival of the message in which some damages may have already been caused before the action is been performed.

3.4 LIMITATIONS OF THE EXISTING SYSTEM

Some of the problems identified in the present system include:

a. The processing speed of data is slow and prone to errors.
b. There are no guarantee that the information sent via SMS will get to its destination on time

3.5 SYSTEM DESIGN

This is the phase of system designing. It is a most crucial phase in the development of a system. The approach to a design is highly considered; else failure and incomplete project will be its outcome.

3.5.1 Transformer

The transformer is a device used for reducing or increasing the voltage of an electric power supply, usually to apply a particular piece of equipment to be used. Transformers work only with AC and this is one of the reasons why mains electricity is AC. Step-up transformers increase voltage, step-down transformers reduce voltage. Most power supplies use step-down transformers to reduce the dangerously high mains voltage (220V in Nigeria) to a safer low voltage. The input coil is called the primary and the output coil is called the secondary. There is no electrical connection between the two coils; instead they are linked by an alternating magnetic field created in the soft-iron core of the transformer. The two lines in the middle of the circuit symbol represent the core. Transformers waste very little power so the power out is (almost) equal to the power in. Note that as voltage is stepped down current is stepped up.

The ratio of the number of turns on each coil, called the turn ratio determines the ratio of the voltages. A step-down transformer has a large number of turns on its primary (input) coil which is connected to the high voltage mains supply,

and a small number of turns on its secondary (output) coil to give a low output voltage. Turn ratio=Vp/Vs=Np/Ns and power in=power in Vs*Is=Vp*Is, Vp = primary(input) voltage

Np = number of turns on primary, coil Ip = primary (input) current, Vs = secondary (output) voltage, Ns = number of turns on secondary coils =) secondary (output) current.

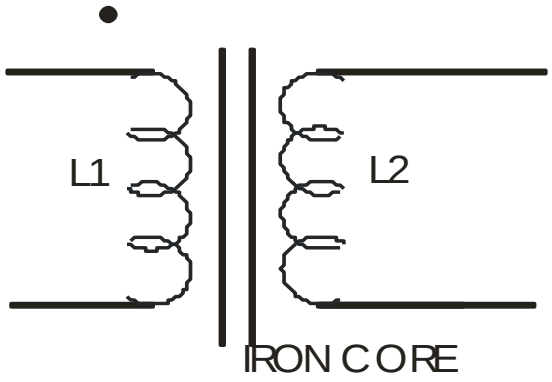


Figure 3.1: Symbol of a Transformer

3.5.2 RELAY

Relay is an electromechanical device with solenoid and mechanical switch. The solenoid is an electromagnetic device when voltage is applied to its inductor it become an electromagnet (temporal magnet), when the applied voltage is remove it loses its magnetic properties (Induction will occur). To prevent this inductive kick back, a diode is connected across the inductive load if it is operating in a dc power system. The switch used in this project has a normally-

open and a normally-close contact switches which is called a single pole double throw switch, which is the mechanical part. Below is circuit symbol of a relay.

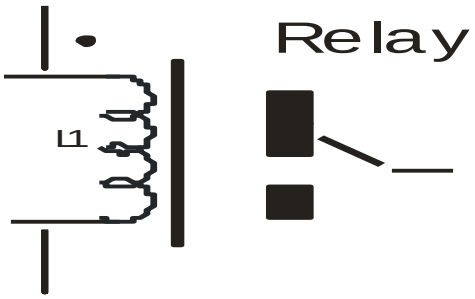


Figure 3.2: circuit symbol of a relay

3.5.3 RESISTORS

A resistor is a two terminal electronic component which produces a voltage across its terminals that is proportional to the electric current through it in accordance with Ohm's law:

$$V = IR$$

Resistors are elements of electrical network and electronic circuits and are ubiquitous in most electronic equipment. Practical resistors can be made with various compounds and films as well as resistance wires (wire made of high resistivity alloy, such as nickel-chrome).

The primary characteristics of a resistor are the resistance, the tolerance, the maximum working voltage and the power rating. The ohm (symbol: Ω) is the SI

unit of electrical resistance, named after George Smith Ohm. Commonly used multiples and submultiples in electrical and electronic usage are the Milliohm (1 x 10^{-3}), Kilo-ohm (1 x 10^{3}) and Mega-ohm (1 x 10^{6}).

Theory of Operation

Ohm's Law:

The behaviour of an ideal resistor is dictated by the relationship specified in Ohm's law:

V = I. R

Ohm's law states that the voltage (V) across a resistor is proportional to the current (I) where the constant of proportionality is the resistance (R).

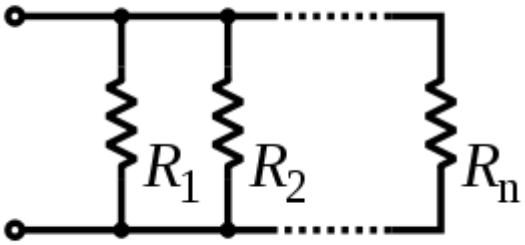
Equivalently, from Ohm's law we get:

V/R = I

This formulation of Ohm's law states that when a voltage (V) is maintained across a resistance (R), a current (I) will flow through the resistance.

Series and Parallel Resistors

Resistors in parallel connection each have the same potential difference (voltage). To find their total equivalent resistance (R_{eq}):

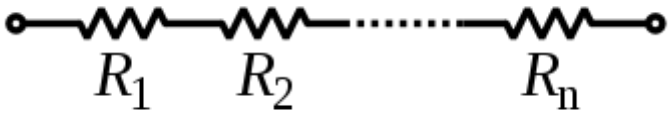


$1/R_{eq} = 1/R_1 + 1/R_2 + ….. + 1/R_n$

The parallel property can be represented in equations by two vertical lines "II" to simplify equations. For two resistors,

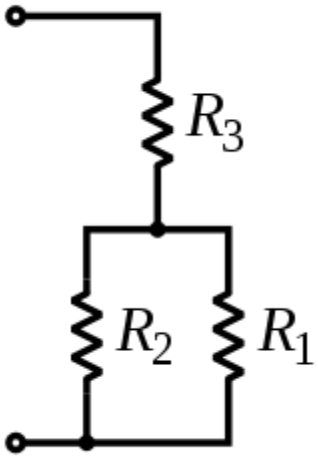
$\mathbf{R_{eq} = R_1R_2 = R_1R_2/ R_1 + R_2}$

The current through resistors in series stays the same, but the voltage across each resistor can be different. The sum of the potential differences (voltage) is equal to the total voltage. To find their resistance:



$R_{eq} = R_1 + R_2 + \ldots + R_n$

A resistor network that is a combination of parallel and series can be broken up into smaller parts that are either one or the other. For instance:



$R_{eq} = (R1\ R2) + R_3 = (R1R2/\ R1 + R2) + R_3$

The practical application to resistors is that the resistance of any non standard value can be obtained by connecting standard values in series or in parallel.

Power Dissipation – the power dissipated by a resistor (or equivalent resistance of resistor network) is calculated using the following:

$$\mathbf{P = I^2R = IV = V^2/R}$$

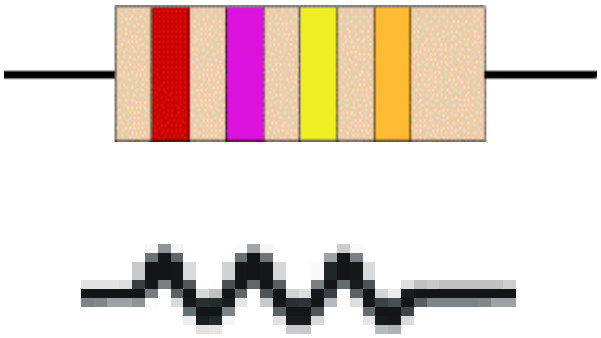


Figure 3.3: Resistor and its circuit symbol

Resistors restrict the flow of electric current, for example a resistor is placed in series with a light-emitting diode (LED) to limit the current passing through the LED. Resistors may be connected either way round. They are not damaged by heat when soldering. Resistance is measured in ohms; the symbol for ohm is an omega.

1 is quite small so resistor values are often given in k and M.

1 k = 1000 1 M = 1000000.

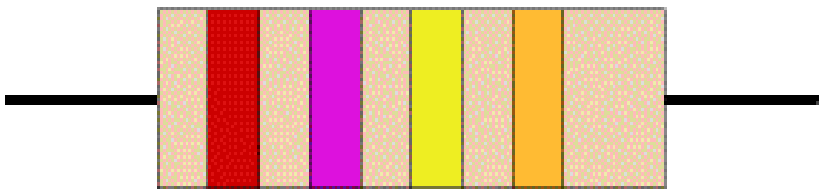
Each colour represents a number as shown in the table.

	Black	Brown	Red	orange	Yellow	Green	Blue	violet	Grey	white
	0	1	2	3	4	5	6	7	8	9
Tolerance		Brown	red	Gold		Silver		no colour		
Percentage		± 1	± 2	±5		±10		±20		

Table3. 1: Color codes and tolerance

Most resistors have 4 bands:

- The first band gives the first digit.
- The second band gives the second digit.
- The third band indicates the number of zeros.
- The fourth band is used to shows the tolerance (precision) of the resistor, this may be ignored for almost all circuits.



1st band 2nd band 3rd band 4th band

Figure 3.4: Resistor with colored bands.

This resistor has red (2), violet (7), yellow (4 zeros) and gold bands. So its value is 270000 = 270 k. On circuit diagrams this is usually omitted and the value is written 70K. Small value resistors (less than 10 ohm)

The standard colour code cannot show values of less than 10. To show these small values two special colours are used for the third band: gold which means × 0.1 and silver which means × 0.01. The first and second bands represent the digits as normal. For example: red, violet, gold bands represent 27 × 0.1 = 2.7 green, blue, silver bands represent 56 × 0.01 = 0.56

The tolerance of a resistor is shown by the fourth band of the colour code. Tolerance is the precision of the resistor and it is given as a percentage. For example a 390 resistor with a tolerance of ±10% will have a value within 10% of 390, between 390 - 39 = 351 and 390 + 39 = 429 (39 is 10% of 390). A special colour code is used for the fourth band tolerance: silver ±10%, gold ±5%, red ±2%, brown ±1%. If no fourth band is shown the tolerance is ±20%.

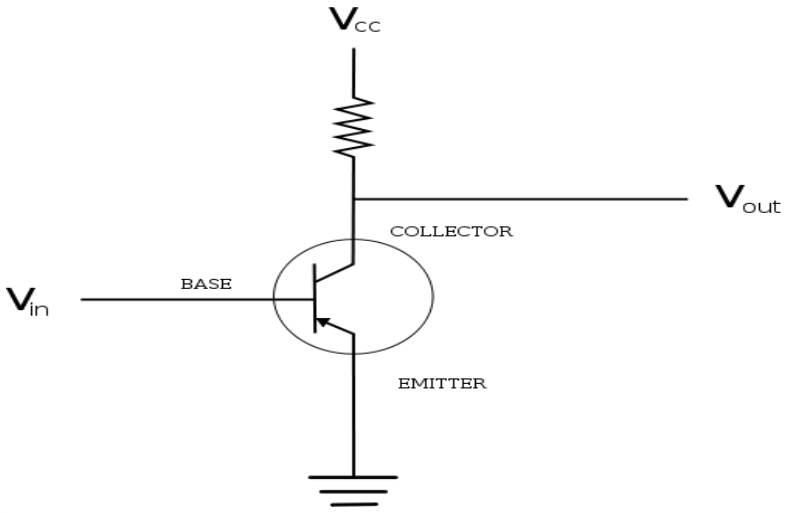
Tolerance may be ignored for almost all circuits because precise resistor values are rarely required.

3.5.4 Transistors:

The transistor is one of the fundamental building blocks of modern electronic devices, and is ubiquitous in modern electronic systems. Following its release in

the early 1950s the transistor revolutionized the field of electronics and paved way for smaller and cheaper radios, calculators and computers amongst other things.

A transistor is a semiconductor device used to amplify and switch electronic signals. It is made of a solid piece of semiconductor material with at least three terminals for connection to an external circuit. A voltage or current applied to one pair of the transistor's terminals, changes the current flowing through another pair of terminals. Since the controlled (output) power can be much more than the controlling (input) power, the transistor provides amplification of a signal. Today, some transistors are packaged individually but many more are found embedded in integrated circuits.



E

Fig. 3.5 Simple Circuit Showing the Labels of a Bi-polar Transistor.

Physical Description of Transistors:

The two types of transistors have slight differences in how they are used in a circuit. A bi-polar transistor has terminals labelled **base, collector and emitter.** A small current at the base terminal (i.e. flowing from the base to the emitter) can control or switch a much larger current between the collector and emitter terminals. For a field effect transistor (FET), the terminals are labeled **gate, source and drain**; a voltage at the gate can control current between source and drain.

Principle of Operation

Transistors are commonly used as electronic switches for both high power applications including switched mode power supplies and low power applications such as logic gates. In grounded emitter transistor circuit, as the voltage rises, the base and collector current rises exponentially and the collector voltage drops because of the collector load resistor. For the transistor to act as a switch, the values of the input voltage can be chosen such that the output is completely on (at saturation) or completely off. This type of operation is common in digital circuits where only “on” and “off” values are relevant.

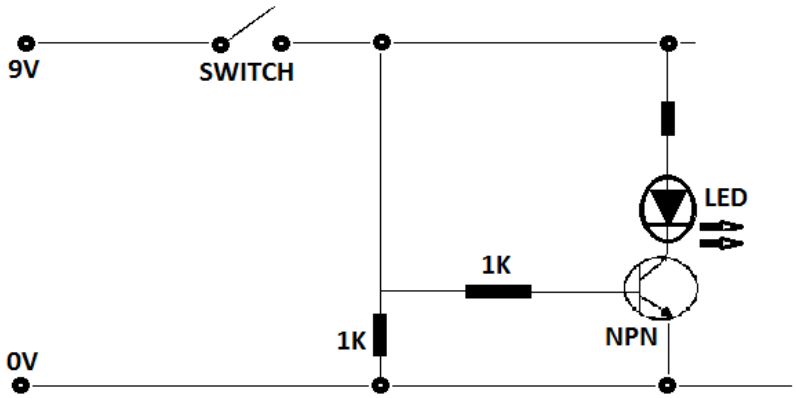


FIG 3.6 An NPN Transistor acting as static a switch.

When the switch is closed, current flows through the resistor to the base of the transistor. The transistor then allows current to flow from the +9v to the 0v and the lamp comes on. The transistor has to receive a voltage at its base for the lamp to light up. The presence of the resistor is to protect the transistor as they can be damaged easily by very high voltage/current.

3.5.5 Resonance in Crystal Oscillator

A quartz crystal provides both series and parallel resonance. The series resonance is a few kilohertz lower than the parallel one. Crystals below 30 MHz are generally operated between series and parallel resonance, which means that the crystal appears as an inductive reactance in operation. Any additional circuit capacitance will thus pull the frequency down. For parallel resonance crystal to

operate at its specified frequency, the electronic circuit has to provide a total parallel capacitance as specified by the crystal manufacturer.

Crystals above 30 MHz (up to > 200 MHz) are generally operated at series resonance where the impedance appears as minimum and equal to the series resistance. For these crystals, the series resistance is specified (< 100 Ω) instead of the parallel capacitance. To reach higher frequencies, a crystal can be made to vibrate at one of its overtone modes, which occur at multiples of the fundamental resonant frequency. Only odd numbered overtones are used. Such a crystal is referred to as a 3rd, 5th or even 7th overtone crystal. To accomplish this, the oscillator circuit usually includes additional LC circuits to select the desired overtone.

3.5.6 DIODES

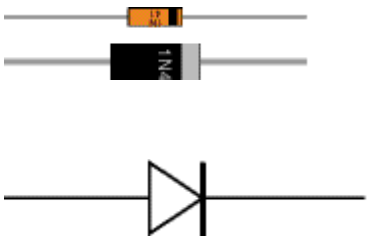


Figure 3.7: Diode and its circuit symbol

Diodes allow electricity to flow in only one direction. The arrow of the circuit symbol shows the direction in which the current can flow. Diodes are the electrical version of a valve and early diodes were actually called valves.

Electricity uses up a little energy pushing its way through the diode, rather like a person pushing through a door with a spring. This means that there is a small voltage across a conducting diode, it is called the **forward voltage drop** and is about 0.7V for all normal diodes which are made from silicon. The forward voltage drop of a diode is almost constant whatever the current passing through the diode so they have a very steep characteristic (current-voltage graph).

Ordinary diodes can be split into two types: Signal diodes which pass small currents of 100mA or less and Rectifier diodes which can pass large currents. In addition there are LEDs (which have their own page) and Zener diodes .

Diodes must be connected the correct way round, the diagram may be labelled a, or (+) for anode and k or (-) for cathode (yes, it really is k, not c, for cathode!). The cathode is marked by a line painted on the body. Diodes are labelled with their code in small print; you may need a magnifying glass to read this on small signal diodes! Small signal diodes can be damaged by heat when soldering, but the risk is small unless you are using a germanium diode (codes beginning OA...) in which case you should use a heat sink clipped to the lead between the joint and the diode body. A standard crocodile clip can be used as a

heat sink. Rectifier diodes are quite robust and no special precautions are needed for soldering them.

3.5.7 RECTIFIERS

There are several ways of connecting diodes to make a rectifier (convert AC to DC). The bridge rectifier is the most important and it produces full-wave varying DC. A full-wave rectifier can also be made from just two diodes if a centre-tap transformer is used, but this method is rarely used now that diodes are cheaper. A single diode can be used as a rectifier but it only uses the positive (+) parts of the AC wave to produce half-wave varying DC. A bridge rectifier can be made using four individual diodes, but it is also available in special packages containing the four diodes required. It is called a full-wave rectifier because it uses the entire AC wave (both positive and negative sections). 1.4V is used up in the bridge rectifier because each diode uses 0.7V when conducting and there are always two diodes conducting, as shown in the diagram below. Bridge rectifiers are rated by the maximum current they can pass and the maximum reverse voltage they can withstand.

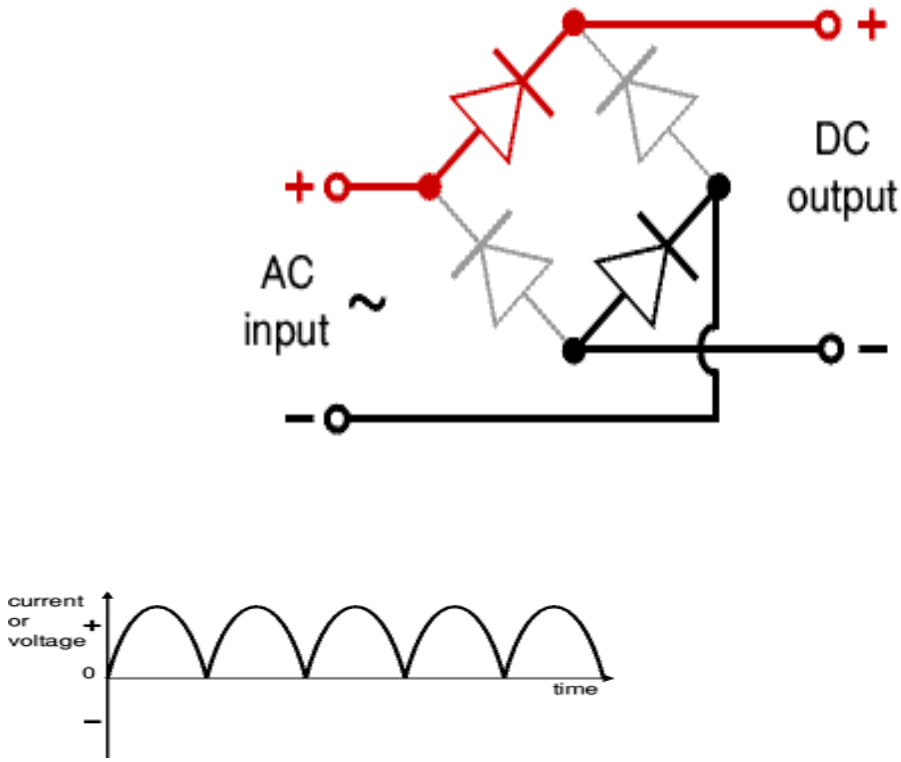


Figure 3.8: Full Wave Rectifier (Bridge Rectifier) And Wave Form.

3.5.8 CAPACITORS (SMOOTHING)

A capacitor is a component used to store electrical charges temporarily, which consists of two conducting surfaces separated by a non-conductor dielectric. Smoothing is performed by a large value electrolytic capacitor connected across the DC supply to act as a reservoir, supplying current to the output when the varying DC voltage from the rectifier is falling. The diagram shows the unsmoothed varying DC (dotted line) and the smoothed DC (solid line). The capacitor charges quickly near the peak of the varying DC, and then discharges as it supplies current to the output.

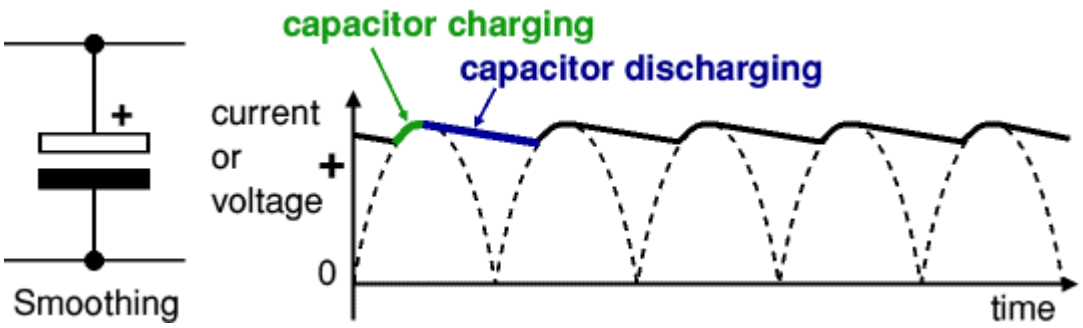


Figure 3.9: Capacitor charging and discharging.

3.5.9 THE LIGHT EMITTING DIODE (LED)

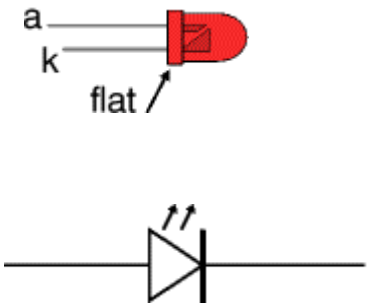


Figure 3.10: LED and its circuit symbol

LEDs emit light when an electric current passes through them.LEDs must be connected the correct way round, the diagram may be labelled a or + for anode and k or - for cathode (yes, it really is k, not c, for cathode!). The cathode is the short lead and there may be a slight flat on the body of round LEDs. If you can see inside the LED the cathode is the larger electrode (but this is not an official identification method). LEDs can be damaged by heat when soldering, but the risk is small unless you are very slow. No special precautions are needed for soldering most LEDs.

An LED must have a resistor connected in series to limit the current through the LED; otherwise it will burn out almost instantly.

The resistor value, R is given By: $R = (V_S - V_L) / I$), V_s = supply voltage V_L = LED voltage (usually 2V, but 4V for blue and white LEDs) I = LED current (e.g. 20mA), this must be less than the maximum permitted current.

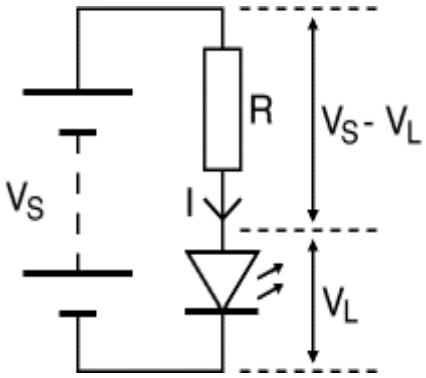


Figure 3.11: choosing Led Resistor value

If the calculated value is not available choose the nearest standard resistor value which is greater, so that the current will be a little less than you chose. In fact you may wish to choose a greater resistor value to reduce the current (to increase battery life for example) but this will make the LED less bright.

3.6 POWERS SUPPLY UNIT

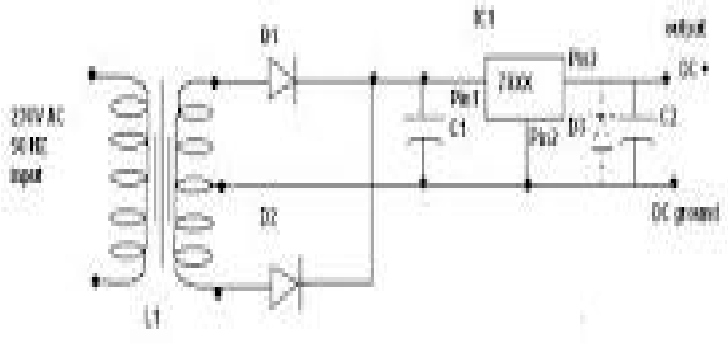


Figure 3.12: power supply unit

The system power supply consists of few components such as:

- The transformer which steps down the main voltage as well as isolates the system from risk of electric shock.
- The input (primary) winding of the transformer use to connect to supply source.
- The output Power (secondary) is tied up to the rectifier.
- A diode rectifying circuit is connected directly on the transformer secondary to rectify the AC voltage to a pulsating DC voltage.
- The filter circuit that smoothens the pulsating DC to a normal DC. It makes use of an electrolytic capacitor and finally,
- A voltage regulator (78x05) used to convert the DC output to a regulated +5vDC.

- **AC to DC Conversion**: This is achieved by the use of suitable voltage and power rating. The transformer also provides electrical isolation between the AC Linear and the rest of the supply.

Basically, the conversion of AC power supply voltage to DC is done in four primary steps:

- The incoming voltage level is adjustable to provide a level of compatibility with the demands of the designed circuitry e.g. a 220V AC Level must be adjusted to 9V of DC.

- The incoming AC voltage level will be converted to a pulsed DC Level which has varying amplitude, but is one polarity /current direction. In this case, appropriate diodes are used.

- The pulsed DC voltage would be smoothened but to a constant level using a cow pass filter or with appropriate capacitors.

- This DC level would be fixed using a linear voltage regulator. This makes for a stable DC Level.

The designing of the project was done as complying with the basic rules in electronic designing and construction. The major components used had been described in the previous chapter. Other components would be discussed in this

chapter. The construction is made in modules; starting from the power supply, the DTMF Decoder unit, the microcontroller unit and the switching unit

.This chapter also talks about installing and testing the individual components before packaging them.

3.7 DTMF Decoder using MT8870DE

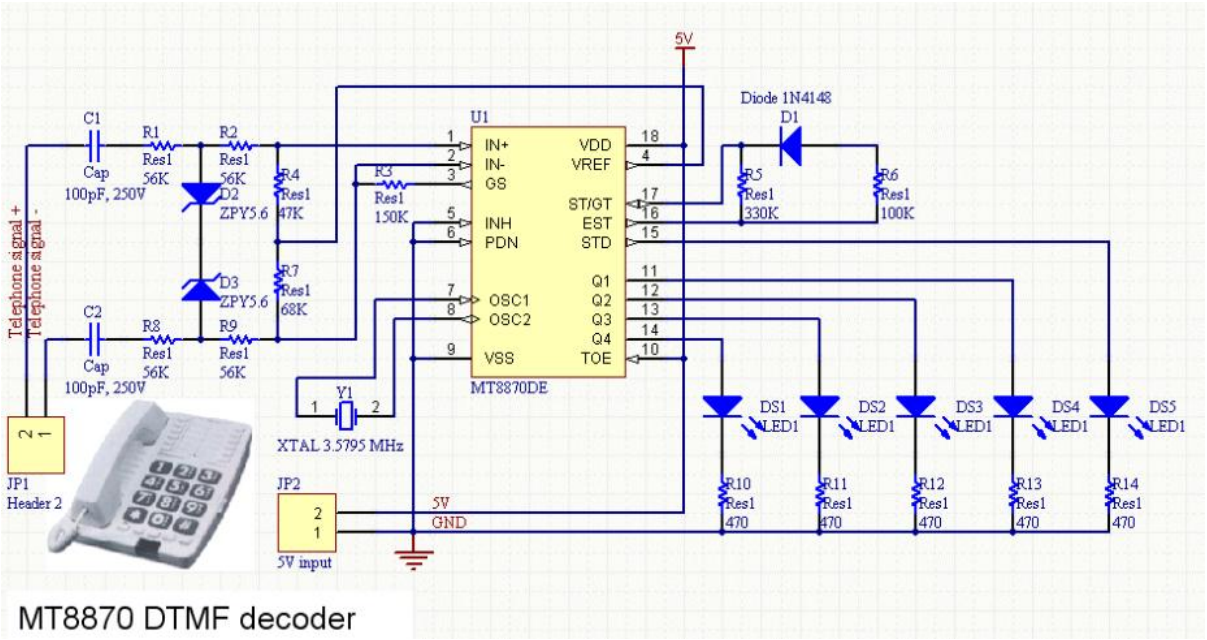


Figure 3.13 MT8870DTMF Decoder

The MT8870D/MT8870D-1 is a complete DTMF receiver integrating both the band split filter and digital decoder functions. The filter section uses switched capacitor techniques for high and low group filters; the decoder uses digital counting techniques to detect and decode all 16 DTMF tone pairs into a 4-bit code. External component count is minimized by on chip provision of a differential input amplifier, clock oscillator and latched three-state bus

Interface. This circuit detects the dial tone from a telephone line and decodes the keypad pressed on the remote telephone. The dial tone we heard when we pick up the phone set is call Dual Tone Multi-Frequency, DTMF in short. The name was given because the tone that we heard over the phone is actually make up of two distinct frequency tone, hence the name dual tone. The DTMF tone is a form of one way communication between the dialler and the telephone exchange.

A complete communication consists of the tone generator and the tone decoder. In this article, we are use the IC MT8870DE, the main component to decode the input dial tone to 5 digital outputs. These digital bits can be interface to a computer or microcontroller for further application (eg. remote control, phone line transfer operation, etc...).

3.8 SWITCHING UNIT

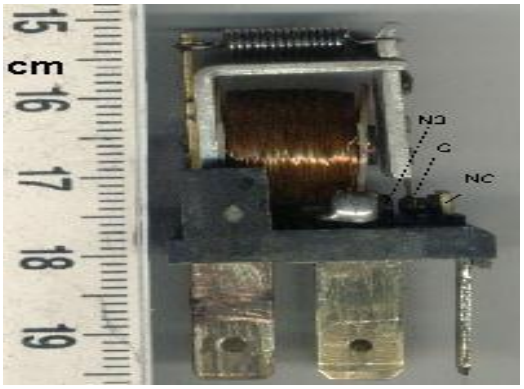


Figure 3.14: Diagram of a switching unit

A relay is an electrically operated switch. Many relays use an electromagnet to operate a switching mechanism mechanically, but other operating principles

are also used. Relays are used where it is necessary to control a circuit by a low-power signal (with complete electrical isolation between control and controlled circuits), or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits, repeating the signal coming in from one circuit and re-transmitting it to another. Relays were used extensively in telephone exchanges and early computers to perform logical operations.

A type of relay that can handle the high power required to directly control an electric motor or other loads is called a contractor. Solid-state relays control power circuits with no moving parts, instead using a semiconductor device to perform switching. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults; in modern electric power systems these functions are performed by digital instruments still called "protective relays”.

3.8 MICROCONTROLLER UNIT

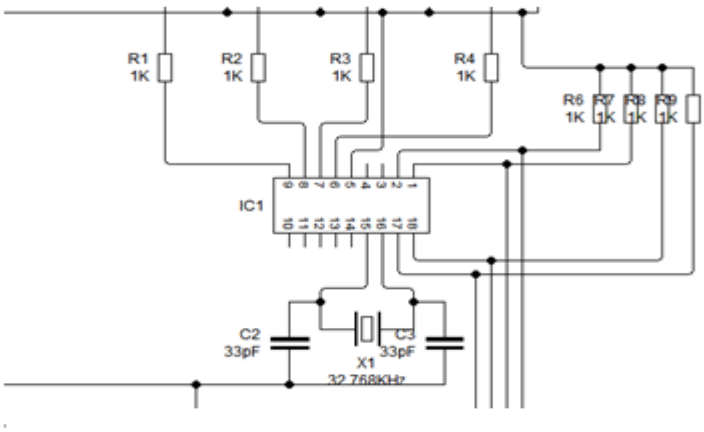


figure 3.15 The microcontroller unit

The PICI6F84A Microcontroller has 18 pins. Only 11 pins were used during the design of the project. Pin 5,6,7,8,9 were connected to the transistor, while other pins namely; 1,3,5,15,16,17.18 were connected to resistors, bridge rectifier and the DTMF decoder. The PICI6F84A was programmed with assembly language to be able to switch ON/OF any electrical equipment connected to the circuit.

3.10 TOP DOWN DESIGN

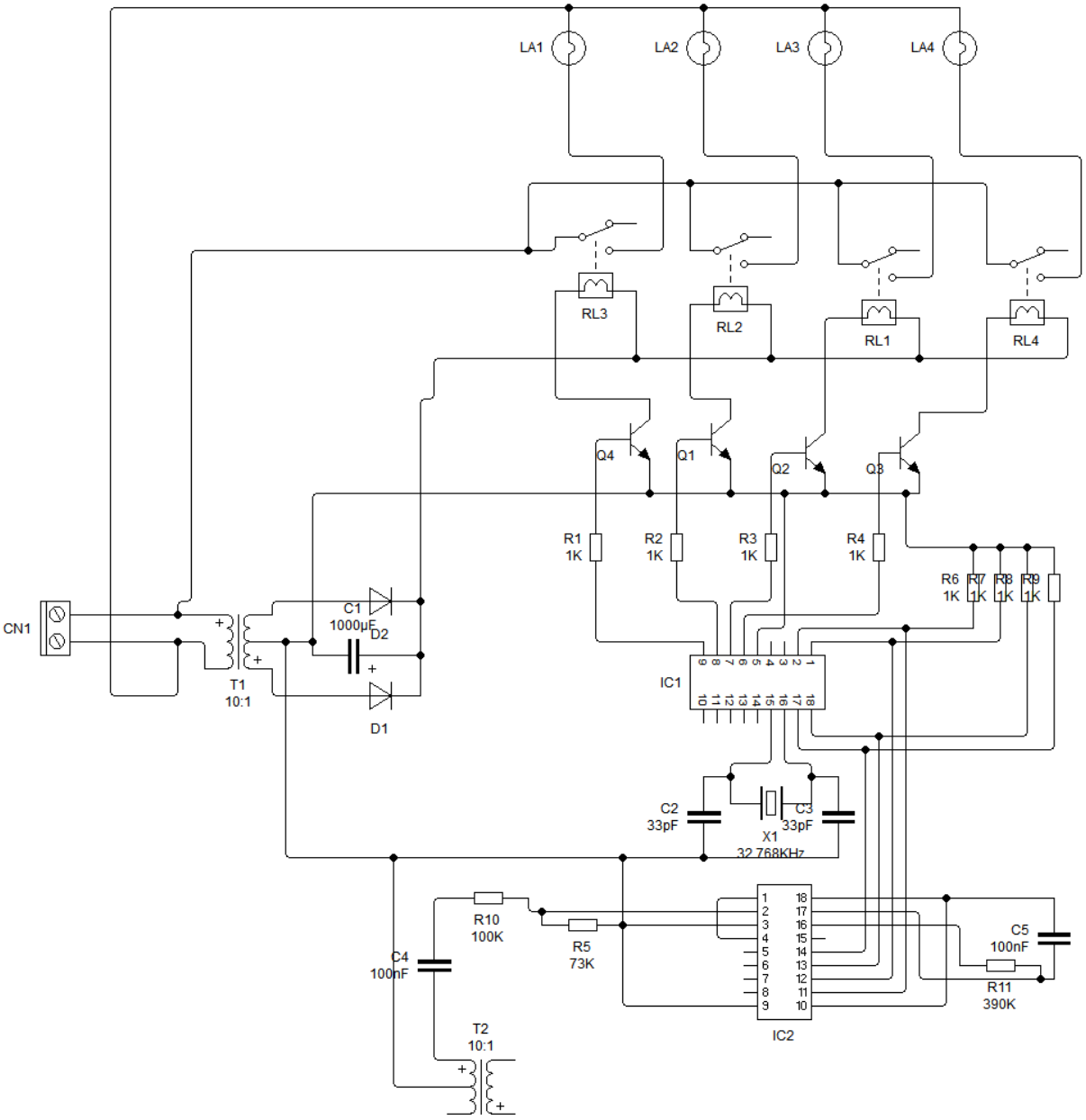


FIG 3.16 SYSTEM CIRCUIT DIAGRAM

The above diagram represents or shows how the design of the project was carried out to come out with a reliable result. The basic component that is used are bulb, socket, transistors acting as switch, resistor that will reduce excess current, the microcontroller chip, the DTMF. All this and many others were used as shown above.

CHAPTER FOUR

IMPLEMENTATION, TESTING AND INTEGRATION

4.1 CHOICE OF DEVELOPEMENT TOOLS

To ensure a standardised object oriented program i used assembly language as the programming language that will run the circuit.

4.2 SYSTEM REQUIREMENT

In other to achieve this project, the following hardware and software requirement were needed

4.2.1 Software requirement

- Windows 98/2000/xp or any version of windows
- Assembly language

4.2.2 System hardware requirement

The microcontroller based GSM control system is an electronic device that is made up of different kinds of component which are put together to perform a particular task. These components are

- Transformer
- Relay
- Transistor
- Inductor
- Capacitor

- Resistors
- Ear phone
- Connecting wires
- Bridge rectifier
- Vero board etc.

4.3 IMPLEMENTATION

In the implementation, the four loads to be controlled is connected to the relays (4) which in turn were connected to the different individual transistors, This is to help in the switching unit of the circuit. The transistors are connected to different resistors which are connected to the pin 6,7,8,9 of the microcontroller. A transformer is connected to A.C to step the current down to 5v. The transformer will be connected to a bridge rectifier to convert the A.C to D.C that will be used by the circuit. The bridge rectifier and some other resistors will in turn be connected to the microcontroller chip pin 1,2,15,16,17,18. The Microcontroller will be connected to the pin legs 1,2,3,4,9,10,11,12,13,14,16,17,18 of the DTMF decoder. The DTMF decoder is then connected to a step-up transformer to increase the frequency of the DTMP. This step-up transformer would have been connected the previous transformer.

The completed circuit works with an algorithm as programmed into the microcontroller chip. In this project, we have designed a particular command codes for turning on and off the four different appliances. Each relay has been

programmed to respond to commands using the *,#,3,5,7 and 9 keys on the keypad.

4.4 TESTING

Test can be defined as a trial run-through of a process to find if it works. With this definition, we can define testing as the series of trial run-throughs of a process to find if it works. Physical examination and testing of component is the first test performed before developing the unit system that makes up the actual one; a project work must undergo series of test before the project will be satisfied okay in production chain, a satisfactory label often written Q.C passed is tagged to a finished product. In small system designs testing process is also applicable. These are the sequence of test needed to undergo for any successful project work.

- Testing of the individual components.
- Unit by unit testing.
- System testing.

4.4.1 TESTING OF THE INDIVIDUAL COMPONENTS.

The components where tested individually before fiddling with it so as to remove the bad ones. The pins of soldered components on the Vero-board were checked for dry joints and a digital multimeter was set to resistance mode to test for short circuiting between the connections. The wires used for the connection of the

various components were also tested for ‘continuity’ to ensure that there was no cut-off during the transfer from the bread-board to the Vero-board. This test will be a satisfied test measures for individual components which are basically done by using of the millimetre (e.g. testing of transistor, diodes, LEDs, LDR and seven-segment display, and every other component that will be used in the project.

4.4.2 UNIT BY UNIT TESTING.

These involve wiring up of circuitry and testing and satisfying its functions before soldering. Examples are bread boarding of power supply stage of the project, testing it and confirming that is functional before soldering.

4.4.3 SYSTEM TESTING.

Involves the testing of the entire circuitry and cross examine it for errors like short circuits, lead flux joining unwanted links ,proper insertion IC pin layout and also checking if ICs of these pin number but different function are slotted in their proper base. After this check cross examine once again before powering the system.

4.5 PACKAGING

Packaging is done after the system testing. Every good product is often determined by its packaging. Credit is awarded to a properly packaged project. After the integrating and final testing of the project, choice of packaging would be considered. Factors to consider include cost, as well durability and elegance. A metallic casing was used to house the project. Before the construction of this package, the size of the project and maintenance factor which need may arise was also considered. There are some other medium for packing the project like plastic package. This would have been a better option, but due to cost of production. Wood was another option. It is relatively cheaper. But the beauty of the project was put into consideration thus, the choice of wood casing.

CHAPTER 5

SUMMARY, RECOMMENDATIONS AND

CONCLUSION

5.1 SUMMARY OF FINDINGS

The design of this remote control system using GSM phone involves researches in different aspects of Electrical/Electronic Engineering. This includes power electronics, differential amplifier, telecommunication, digital electronics and software engineering. Thorough work was done in all these aspects of engineering before the work could be concluded.

the project is a clear indication of a multipurpose control done via the keypad tone reducing the manual efforts and time required while paying individual attention for controlling each device. For people who want to switch ON/OFF

and check status of device when they are not present. This research work saves time and energy of the individual. The system requires less design and implementation cost. For handicapped people, it may be really not entertaining to involve much in work and this system helps them to locate themselves in a place and operate the lights of their room, switch on the fan etc. in every aspect of our daily lives people ranging from scientist to handymen and farmers can make use of this system for controlling electric motor, sprinklers ,tanks and also several other devices making use of electricity.

5.2 LIMITATION OF STUDY

The project has certain limitations and a list of such includes:

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. The controlling unit must be able to receive and decode calls.
d. Operation of the controlling unit is only possible through a cell phone with calls capabilities.

5.3 RECOMMENDATION

A good practicing engineer should be up-to-date in terms of theory and practice. Very good theoretical knowledge should be backed up with a practical design knowledge in order to cement what was taught in the lectures.

In other words, to meet up with the technological demands of the country, Engineering Faculties in Universities and other technological institutes should consider and adopt the following recommendation:

1) Practical designs should be part of any course taught in the education and training.
2) Each department in the engineering faculties should have its own library that is well stocked with old and current books as well as an Internet facility.
3) Project show-rooms should be provided for the exhibition of previous projects as this will in a very great way, act as a source of encouragement and challenge to the junior students.
4) The standard of projects should be reviewed so as to keep up with technological trends.
5) All the probable project topics should be given to the students at the end of their 4^{th} year for early preparation and development. This will also give the student enough time to do thorough research and produce a standard project.

6) Students should be given practicable projects with obtainable system components.
7) Lastly, the design is best implemented using a printed circuit board (PCB) technology for the circuit layout to produce a neat arrangement of components.

5.4 BEME (BILL OF ENGINEERING MEASUREMENT OF ENGINEERING)

PROJECT COSTING

ITEM	QTY	AMOUNT (₦)
transistors	4	100
resistors	4	100
capacitors	4	250
Vero board	1	500
transformers	2	900
ICs	2	2000
CD	1	250
relays	4	550
inductors	4	100
transport		5,000
printing		4,000
binding		1,200
Miscellaneous expenses		9,950
TOTAL		24,900

5.5 CONCLUSION.

This design and construction of a remote system using GSM network was carried out considering some factors, which includes availability of

components, cost effectiveness of design, economic application, research materials, efficiency, portability and finally its durability. The system after completion and normal test met the expected design specification and performance. But misuse of the system by end users may probably lead to lapses in the system performance. The system was designed and constructed in such a way that maintenance and repairs are easily done in the case of faults. Soldering techniques and practical electronic were carefully studied and the experience gain from it was instrumental to the success of this project.

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APPENDIX A

```
;*****************************************************************
***
;   This file is a basic code template for assembly code generation
*
;   on the PIC16F84A. This file contains the basic code
*
;   building blocks to build upon.
*
;
*
;   If interrupts are not used all code presented between the ORG
*
;   0x004 directive and the label main can be removed. In addition
*
;   the variable assignments for 'w_temp' and 'status_temp' can
*
;   be removed.
*
;
*
;   Refer to the MPASM User's Guide for additional information on
*
;   features of the assembler (Document DS33014).
*
;
*
;   Refer to the respective PIC data sheet for additional
*
;   information on the instruction set.
*
;
*
;   Template file built using MPLAB V4.00 with MPASM V2.20 and
*
;   MPLINK 1.20 as the language tools.
*
;
*
;*****************************************************************
***
;
*
;    Filename:       xxx.asm
*
;    Date:
*
;    File Version:
*
;
*
```

```
;    Author:
*
;    Company:
*
;
*
;
*
;*****************************************************************
***
;
*
;    Files required:
*
;
*
;
*
;
*
;*****************************************************************
***
;
*
;    Notes:
*
;
*
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*
;
*
;
*
;*****************************************************************
***


     list      p=16F84A            ; list directive to define
processor
     #include <p16F84A.inc>        ; processor specific variable
definitions

      __CONFIG    _CP_OFF & _WDT_OFF & _PWRTE_ON & _HS_OSC
; '__CONFIG' directive is used to embed configuration data within
.asm file.



;*****************************************************************
***
RESET_VECTOR  CODE    0x000       ; processor reset vector
           goto    start             ; go to beginning of program
```

```
MAIN  CODE

start

           BANKSEL    TRISA
           CLRF  TRISB
           MOVLW 0FFH
           MOVWF TRISA
           BANKSEL    PORTA
           CLRF  06H
           MOVLW 04H
           MOVWF 06H
           CALL  DELAY
           CALL  DELAY
           CALL  DELAY
           CALL  DELAY
           CALL  DELAY
           CALL  DELAY
           CLRF  06H

CHEK
           CLRF  06H
           BTFSS 05H,0
           GOTO  BUZER
           GOTO  CHEK
BUZER
           MOVLW 01H
           MOVWF 06H
           CALL  DELAY
           CALL  DELAY
           CALL  DELAY
           CALL  DELAY
           CALL  DELAY
           CLRF  06H
           CALL  DELAY
           GOTO  CHEK
DELAY
           MOVLW 05H
           MOVWF 0EH
DEL        DECFSZ     0CH,1
           GOTO  DEL
           DECFSZ     0DH,1
           GOTO  DEL
           DECFSZ     0EH,1
           GOTO  DEL
           RETURN



           END
; directive 'end of p
```