MICROCONTROLLER BASED CONTROL OF ELECTRONIC APPLIANCES THROUGH GSM

Project Report submitted in partial fulfillment of the requirement for the degree of

Bachelor of Technology
in
Electronics and Communication Engineering

By

SUCHIT NEGI **071113**

ASHUTOSH YADAV **071095**

Under the Supervision of
Ms. Pragya Gupta

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY

Jaypee University of Information Technology
Waknaghat, Solan – 173 234, Himachal Pradesh

Certificate

This is to certify that project report entitled "**MICROCONTROLLER BASED CONTROL OF ELECTRONIC APPLIANCES THROUGH GSM**", submitted by **Suchit Negi** and **Ashutosh Yadav** in partial fulfillment for the award of degree of Bachelor of Technology in Electronics and Communication Engineering to Jaypee University of Information Technology, Waknaghat, Solan has been carried out under my supervision.

Date : **Ms. Pragya Gupta**

(Lecturer)

Certified that this work has not been submitted partially or fully to any other University or Institute for the award of this or any other degree or diploma.

1. **Suchit Negi**
   (071113)

2. **Ashutosh Yadav**
   (071095)

Acknowledgment

It has been a wonderful and intellectually stimulating experience working on the **Microcontroller based control of electronic appliances through GSM** which is useful in the area of communication and control system.

We gratefully acknowledge the Management and Administration of Jaypee University of Information Technology for providing us the opportunity and hence the environment to initiate and complete our project.

For providing with the finest details of the subject, we are greatly thankful to our project guide **Ms. Pragya Gupta.** She provided us the way to get our job done, not providing the exact way to do it, but the concept behind the complexities so that we can make better use of the existing knowledge and build up higher skills to meet the industry needs. Her methodology of making the system strong from inside taught us that output is not the end of project.

Date:

Suchit Negi

Ashutosh Yadav

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Abstract

Today's busy world is an assemblage of many communication networks, some are yet to have their entries. The amazing thing is that, these all are being used for various communication purposes only, it is possible to extend their impacts in a variety of manner by the manifestation of interesting systems where we can directly have an aid from these. We are coming up with one of such interesting system by which we can access even our bedroom electronic devices even from the most far off places in the world, provided the network under use has good range everywhere.

The objective of this project is to enable users to remotely control their home appliances and systems using a cell phone-based interface. To access the control unit, the user should send an authentication code along with the required/desired function/action to his/her home control system via GSM. Upon being properly authenticated, the cell phone-based interface at home (control unit) would relay the commands to a microcontroller that would perform the required function/action.

CHAPTER 1
INTRODUCTION

Wireless communication is, by any measure, the fastest growing segment of the communication industry. As such, it has captured the attention of the media and the imagination of the public. Cellular systems have experienced exponential growth over the last decade and there are currently around two billion users worldwide. Indeed, cellular phones have become a critical business tool and part of everyday life in most developed countries, and are rapidly supplanting antiquated wireline systems in many developing countries. In addition, wireless local area netwroks currently supplement or replace wired networks in many homes, businesses, and campuses. Many new applications, including wireless sensor networks, automated highways and factories, smart homes and appliances, and remote telemedicine, are emerging from research ideas to concrete systems. The explosive growth of wireless systems coupled with the proliferation of laptop and palmtop computers indicate a bright future for wireless networks, both as stand-alone systems and as part of the larger networking infrastructure. However, many technical challenges remain in designing robust wireless networks that deliver the performance necessary to support emerging applications.

1.1 Common examples of wireless equipment in use today

- Cellular phones and pagers provide connectivity for portable and mobile applications, both personal and business
- Global Positioning System (GPS): allows drivers of cars and trucks, captains of boats and ships, and pilots of aircraft to ascertain their location anywhere on earth
- Cordless computer peripherals: the cordless mouse is a common example; keyboards and printers can also be linked to a computer via wireless

- Cordless telephone sets: these are limited-range devices, not to be confused with cell phones
- Home-entertainment-system control boxes: the VCR control and the TV channel control are the most common examples; some hi-fi sound systems and FM broadcast receivers also use this technology
- Remote garage-door openers: one of the oldest wireless devices in common use by consumers; usually operates at radio frequencies
- Two-way radios: this includes Amateur and Citizens Radio Service, as well as business, marine, and military communications
- Satellite television: allows viewers in almost any location to select from hundreds of channels
- Wireless LANs or local area networks: provide flexibility and reliability for business computer users

Wireless technology is rapidly evolving, and is playing an increasing role in the lives of people throughout the world. In addition, ever-larger numbers of people are relying on the technology directly or indirectly. More specialized and exotic examples of wireless communications and control include:

- **Global System for Mobile Communication (GSM):** a digital mobile telephone system used in Europe and other parts of the world.
- **General Packet Radio Service (GPRS):** a packet-based wireless communication service that provides continuous connection to the Internet for mobile phone and computer users.
- **Enhanced Data GSM Environment (EDGE):** a faster version of the Global System for Mobile (GSM) wireless service.
- **Universal Mobile Telecommunications System (UMTS):** a broadband, packet-based system offering a consistent set of services to mobile computer and phone users no matter where they are located in the world.

1.2 Global Systems for Mobile Communication (GSM)

During the period of Evolution of mobile communication technologies various systems were introduced and deployed to achieve standardization in mobile industry but all the efforts were failed. Multiple issues were sustained like incompatibility of systems, development of digital radio frequency. That is when GSM (Global System for Mobile Communication) Technology was introduced and problems like standardization, incompatibility etc were overcame. TDMA solution was chosen in 1987, it is narrowband system and TDMA standards for Time Division Multiple access.

GSM systems were in market for testing purposes in 1980's but first commercial lunch of GSM technology was made in 1991 in Finland. GSM based mobile phones are operated on TDMA Systems, in TDMA single radio frequency is offered to users with any interference. After all these years, GSM is now the largest mobile communication technology worldwide, all manufacturers of Mobile phones develop their products based on GSM, and all mobile companies provide their subscribers GSM networks. GSM standards for Global System for Mobile Communication, it is widely used mobile technology worldwide and it adopted by more than 214 countries around the world.

1.2.1 GSM Requirements

- The quality of Voice in the GSM system must be better than that achieved by the 900MHz analogue systems over all the operating conditions.
- The system must offer encryption of user information
- The system must operate in the entire frequency band 890-915MHz and 935-960MHz.

- An international standardised signaling system must be used to allow the interconnection of mobile switching centers and location registers.
- Minimise modifications to the existing fixed public networks.
- Design the system so handset costs are minimized.
- Handsets must be able to be used in all participating countries.
- Maximum flexibility for other services like ISDN.
- System should maximise the functions and services available to cater for the special nature of mobile communications.

1.3 Features of GSM Technology

There are many features associated with GSM technology due to which it is by far the most leading mobile communication technology in the world today. GSM technology facilitates with high speed integrated data, voice data, fax, mail, voice mail and mostly used SMS feature. GSM also make sure that all the communication made between networks are secured and protected from intruders and frauds.

One of the major advantages of GSM technology which changed the way we looked mobile phones at the beginning. GSM actually brought the concept of being Mobile way beyond the limits. It enabled us to communicate across the continents. GSM supports multiple frequency levels like 900MHz, 1800MHz, 1900MHz. 1900MHz frequency is used in North America where as 1800MHz is used in other parts of the world. Different frequency bands are used by different mobile phone operators. If you are using Mobile phone which supports 1800MHz and operators are available on this band, phone can be used in this network, where as if phone is out of the range of the frequency band on mobile operator frequency than you need to have phone that supports the frequency. To avoid such cases one should always adopt to have mobile phones that support multiple frequency bands.

There are over 700 GMS networks available in the world operating in their respective countries and providing international roaming services courtesy GSM technology. There are over 2 billion GSM subscribers in the world. Countries which are using GSM networks on larger scales are Russia, China, Pakistan, United States, India. GSM phone deliver very good voice quality, support useful services and standards, it is very likely that GSM will remain the only mobile communication network technology to be adopted by each and every country of the world.

1.3.1 Different Frequency Bands

There are three different frequency bands on which mobile phones usually operate and these are:

- **Dual Band**
- **Tri-Band**
- **Quad Band**

1.4 GSM Applications

The GSM's versatility lends itself to a wide range of GSM remote control applications including

1. **Remote control switching of vehicle engine pre-heaters**

The GSM Device can be connected to the engine pre-heater timer control or if a new installation it may be possible to connect directly to the pre-heater thereby saving the cost of a timer unit. When the GSM Device is called it will switch on the engine pre-heater for a preset length of time between 1 second and 18 hours, alternatively the heater can be switched on or off by sending the Device an sms text message

2. **Control of aviation engine pre-heater**

Switch on your aircraft engine and cabin heaters using your cell phone

3. **Remote control switching of irrigation systems, water well pumps and pumping stations**

Control irrigation systems, water well pumps and pumping stations, switch on for a pre-set length of time or on and off as required by sending an sms text message from anywhere in the world.

4. **Central heating remote control**

If you have a holiday home switch on the heating and hot water before you arrive, periodically switch on the central heating to prevent damp, if freezing weather conditions are forecast at your second home location switch on the heating to prevent water freezing and pipes bursting.

5. **Automated gate remote control**

Open automatic gates using a cell phone, control user access by programming authorized users telephone numbers into the GSM-AUTO, open the gates from anywhere in the world to allow access for deliveries

6. **Remote control lighting**

Retro fit to existing street or security lighting enabling remote control without having to install expensive cabling.

7. **Resetting of remote servers and routers, control and communications systems**

Reset remote servers, routers and control systems without travelling to the site.

8. **Air conditioner**

Switch on your air conditioner before arriving home.

9. **Security systems**

Arm and disarm security systems from anywhere in the world.

1.4.1 Example of wiring connections

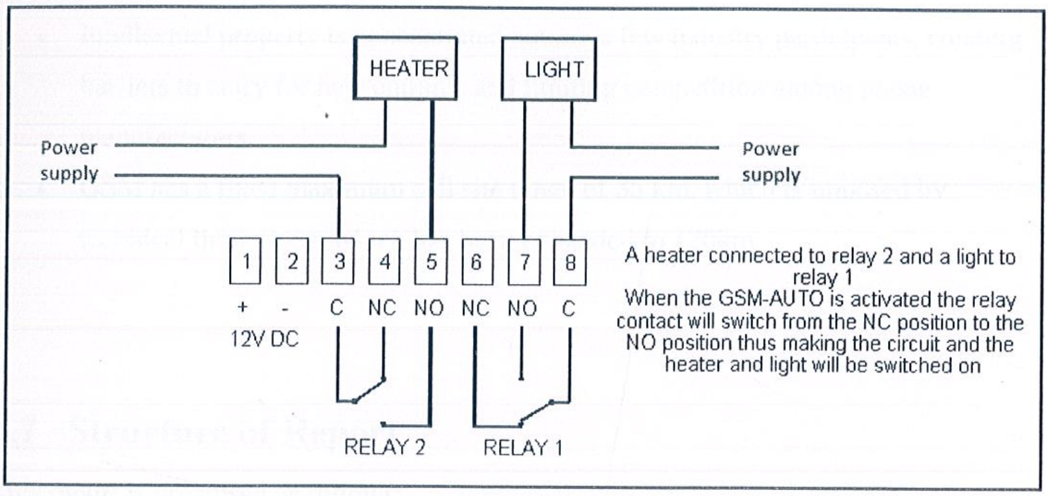


Figure 1.1: Wiring Connections

1.5 Advantages of GSM

- GSM is mature, this maturity means a more stable network with robust features.
- Less signal deterioration inside buildings.
- Ability to use **repeaters.**
- Talktime is generally higher in GSM phones due to the pulse nature of transmission.
- The availability of Subscriber Identity Module allows users to switch networks and handsets at will.
- GSM **covers virtually all parts of the world** so international roaming is not a problem.

- The much bigger number of **subscribers globally** creates a better network effect for GSM handset makers, carriers and end users.

1.6 Disadvantages of GSM

- Interferes with some electronics, especially certain audio amplifiers.
- Intellectual property is concentrated among a few industry participants, creating barriers to entry for new entrants and limiting competition among phone manufacturers.
- GSM has a fixed maximum cell site range of 35 km, which is imposed by technical limitations, which has been expanded to 120km.

1.7 Structure of Report

This report is organised as follows:

Chapter 2 describes the designing of PCB and Power supply. Chapter 3 includes the description of Decoder, Demultiplexer and Microcontroller. LCD and Relay circuitry are described in Chapter 4. Finally results, conclusion and future work are included in Chapter 5 & 6.

CHAPTER 2

DESIGNING OF PRINTED CIRCUIT BOARD AND POWER SUPPLY

2.1 Objective

The objective of this project is to develop a device that allows a user to remotely control and monitor multiple home appliances using a cellular phone. This system will be 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 systems, security systems, and lights; anything with an electrical interface.

2.2 Printed Circuit Board

A **printed circuit board**, or **PCB**, is used to mechanically support and electrically connect electronic components using conductive pathways, tracks or signal traces etched from copper sheets laminated onto a non-conductive **substrate.** It is also referred to as **printed wiring board (PWB)** or **etched wiring board**. A PCB populated with electronic components is a **printed circuit assembly (PCA)**, also known as a **printed circuit board assembly (PCBA)**. Printed circuit boards are used in virtually all but the simplest commercially-produced electronic devices.

PCBs are inexpensive, and can be highly reliable. They require much more layout effort and higher initial cost than either wire wrap or point-to-point construction, but are much cheaper and faster for high-volume production, the production and soldering of PCBs can be done by totally automated equipment.

2.2.1 PCB Design Process & Workflow

Step 1: Finalize your Circuit Design – Everything starts with the circuit design. Without a circuit there is no need for a PCB. In the old days most circuits were hand drawn and later captured electronically. In today's world of modern computing, the circuit design is captured directly into a schematic. For the sake of clarity we've added this as step 1 in the PCB design guide.

Step 2: Choose PCB Design Software – It is important to choose a package that is first and foremost easy to use, but also capable of completing the PCB design as some packages won't be able to handle the complexity.

Step 3: Capture Your Schematic – As mentioned earlier it's likely that the circuit design is being captured electronically from the start. In general "capturing the schematic" is the process by which each component is drawn electronically and are interconnected with each other.

Step 4: Design Component Footprints – Once the schematic is complete its time to draw the physical outline of each of the components. These outlines are what are placed on the PCB in copper to allow the components to be soldered to the printed wiring board.

Step 5: Establish PCB Outline – Each project will have restrictions related to the board outline. This should be determined in this step since an idea of component count and area should be known.

Step 6: Setup Design Rules – With the PCB outline and PCB footprints complete it's just about time to start the placement. Before placement thought you should setup the design rules to ensure that components or traces aren't too close together.

Step 7: Place Components – Now it's time to move each component onto the PCB and begin the tedious work of making all those components fit together. This is where you'll find that PCB design is really a jigsaw puzzle.

Step 8: Manual Route Traces – It's necessary to manually route critical traces. Clocks, Power, Sensitive analog traces. Once that's complete you can turn it over to Step 9.

Step 9: Using the Auto Router – There are a handful of rules that will need to be applied for using an auto-router, but doing so will save you hours if not days of routing traces.

Step 10: Run Design Rule Checker – Most PCB design software packages have a very good setup of design rule checkers. It's easy to violate PCB spacing rules and this will pinpoint the error saving you from having to re pin the PCB.

Step 11: Output Gerber Files – Once the board is error free it's time to output the gerber files. These files are universal and are needed by the PCB fabrication houses to manufacture your printed circuit board.

2.3 Softwares Used

1. Diptrace

Diptrace 1.50 proved to be a very handy and easy to use tool for the PCB layout process. Many of its features were utilized leading to an accurate and efficient design. It has design error check and electrical rule check tools which proved to be helpful in the design. It is loaded with a huge component list that is categorized in various libraries for giving simplicity. Placement of components is also very easy and they can be rotated at 360^0 to customize the design.

2. µVision Keil

It provides IDE for 8051 programming and is very easy to use. When starting a new project simply select the microcontroller being used from the device database and the µVision IDE sets all Compiler, Assembler, Linker and memory options. Its device database is large which supports many IC's of the 8051 family. A hex file can be created with the help of Keil which is required for burning onto chip. It has a powerful debugging tool which detects most of the errors in the program.

3. Flash Magic

It's a PC tool for programming flash based microcontrollers. It has some excellent features like changeable baud rate, erase all flash before programming, setting security bits etc. The hex file created with the help of Keil was selected through it for programming the microcontroller.

2.4 Power Supply

2.4.1 Types of Power Supply

There are many types of power supply. Most are designed to convert high voltage AC mains electricity to a suitable low voltage supply for electronic circuits and other devices. A power supply can by broken down into a series of blocks, each of which performs a particular function.

For example a 5V regulated supply:

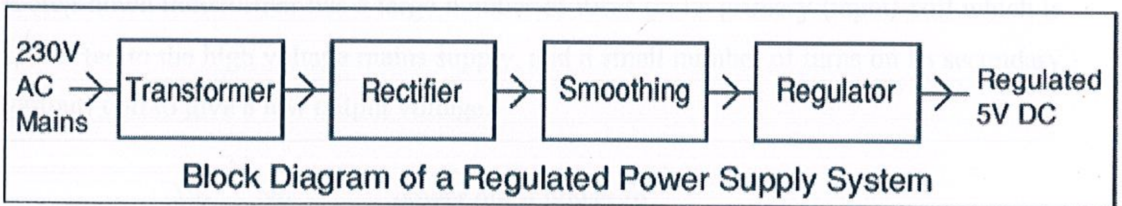


Figure 2.1: Power supply

Each of the blocks is described in more detail below:

- Transformer - steps down high voltage AC mains to low voltage AC.
- Rectifier - converts AC to DC, but the DC output is varying.

- Smoothing - smoothens the DC from varying greatly to a small ripple.
- Regulator - eliminates ripple by setting DC output to a fixed voltage.

2.4.2 Transformer

Transformers convert AC electricity from one voltage to another with little loss of power. 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 a step-down transformer to reduce the dangerously high mains voltage (220V in India, 230V in UK) 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.

$$\text{turns ratio} = \frac{Vp}{Vs} = \frac{Np}{Ns} \quad \text{and} \quad \begin{array}{l}\text{power out} = \text{power in} \\ Vs \times Is = Vp \times Ip\end{array}$$

Vp = primary (input) voltage Vs = secondary (output) voltage

Np = number of turns on primary coil Ns = number of turns on secondary coil

Ip = primary (input) current Is = secondary (output) current

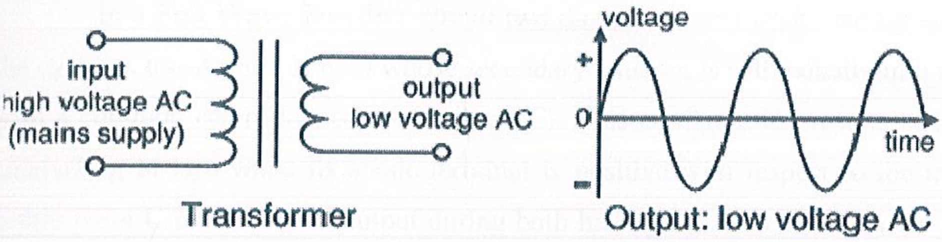


Figure 2.2: Transformer circuit symbol & output waveform

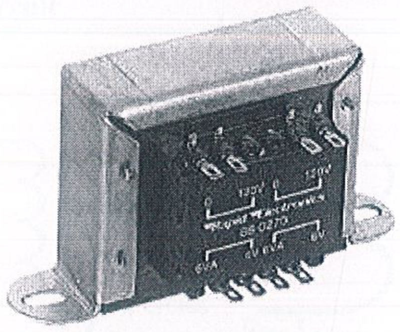


Figure 2.3: Transformer

2.4.3 Full Wave Rectifier

This method is suitable for applications which need a "steady and smooth" DC supply voltage. One method to improve on this is to use every half-cycle of the input voltage instead of every other half-cycle. The circuit which allows us to do this is called a **Full Wave Rectifier.**

Like the half wave circuit, a full wave rectifier circuit produces an output voltage or current which is purely DC or has some specified DC component. Full wave rectifiers have some fundamental advantages over their half wave rectifier counterparts. The average (DC) output voltage is higher than for half wave, the output of the full wave rectifier has much less ripple than that of the half wave rectifier producing a smoother output waveform.

In a **Full Wave Rectifier** circuit two diodes are now used, one for each half of the cycle. A transformer is used whose secondary winding is split equally into two halves with a common centre tapped connection, (C). This configuration results in each diode conducting in turn when its anode terminal is positive with respect to the transformer centre point C producing an output during both half-cycles, twice that for the half wave rectifier so it is 100% efficient as shown below.

Full Wave Rectifier Circuit

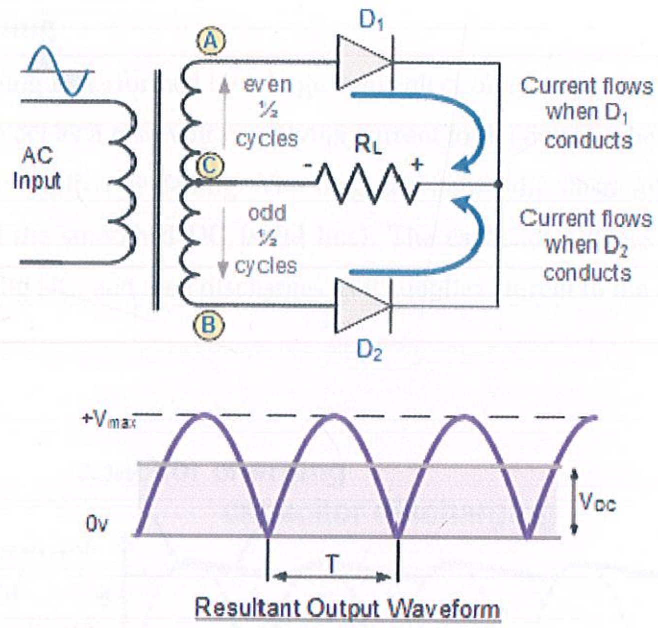


Figure 2.4: Center Tap Rectifier

The full wave rectifier circuit consists of two diodes connected to a single load resistance (R_L) with each diode taking it in turn to supply current to the load. When point A of the transformer is positive with respect to point C, diode D_1 conducts in the forward direction as indicated by the arrows. When point B is positive (in the negative half of the cycle) with respect to point C, diode D_2 conducts in the forward direction and the current flowing through resistor R is in the same direction for both half-cycles. As the output voltage across the resistor R is the phasor sum of the two waveforms combined, this type of full wave rectifier circuit is also known as a "bi-phase" circuit.

As the spaces between each half-wave developed by each diode is now being filled in by the other diode the average DC output voltage across the load resistor is now double that of the single half-wave rectifier circuit.

2.4.4 Smoothing

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.

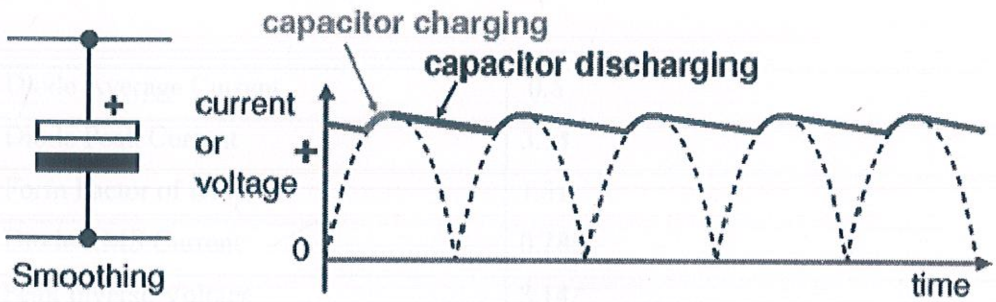
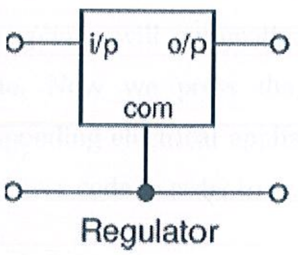


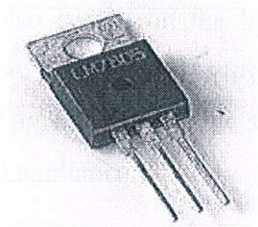
Figure 2.5: DC after smoothing

2.4.5 Regulator

Voltage regulator ICs are available with fixed (typically 5, 12 and 15V) or variable output voltages. They are also rated by the maximum current they can pass. Negative voltage regulators are available, mainly for use in dual supplies. Most regulators include some automatic protection from excessive current ('overload protection') and overheating ('thermal protection').

Many of the fixed voltage regulator ICs have 3 leads and look like power transistors, such as the 7805 +5V 1A regulator shown below. They include a hole for attaching a heatsink if necessary.





Voltage regulator

Figure 2.6: Circuit symbol & actual Voltage Regulator

Diode Average Current	0.5
Diode Peak Current	3.14
Form Factor of Diode	1.57
Diode RMS Current	0.785
Peak Inverse Voltage	3.14
Ripple Factor	0.482
Lowest Ripple Frequency	2
Rectification Ratio	81.2%

Table 2.1: Characteristics of Center Tap Full Wave Rectifier

CHAPTER 3

DECODER, DEMULTIPLEXER AND MICROCONTROLLER

3.1 Overview

Through this project we can control any electrical appliance through a mobile or a landline from any part of the country. One base unit is connected to the Circuit as a receiver. When we want to control any electrical appliance through outer phone we first dial the number of the connected mobile phone at the receiver end, after few bells the mobile phone will automatically switch on and will also switch on the base unit to operate. Now we press the single digit access code, which will switch on the corresponding electrical appliance connected to it. Now again we press the same single digit access code in order to switch off the same electrical appliance.

The proposed approach for designing this system is to implement a microcontroller-based control module that receives its instructions and commands from a cellular phone over the GSM network. The microcontroller then will carry out the issued commands. The control system will include two separate units: the cellular phone, and the control unit. There will therefore be two operating environments. The cellular phone will operate indoors and outdoors whereas the control unit will operate indoors.

Complete circuit is divided into three parts.

1. **DTMF DECODER**
2. **MICROCONTROLLER**
3. **RELAY CONTROL CIRCUIT**

3.2 Circuit Diagram

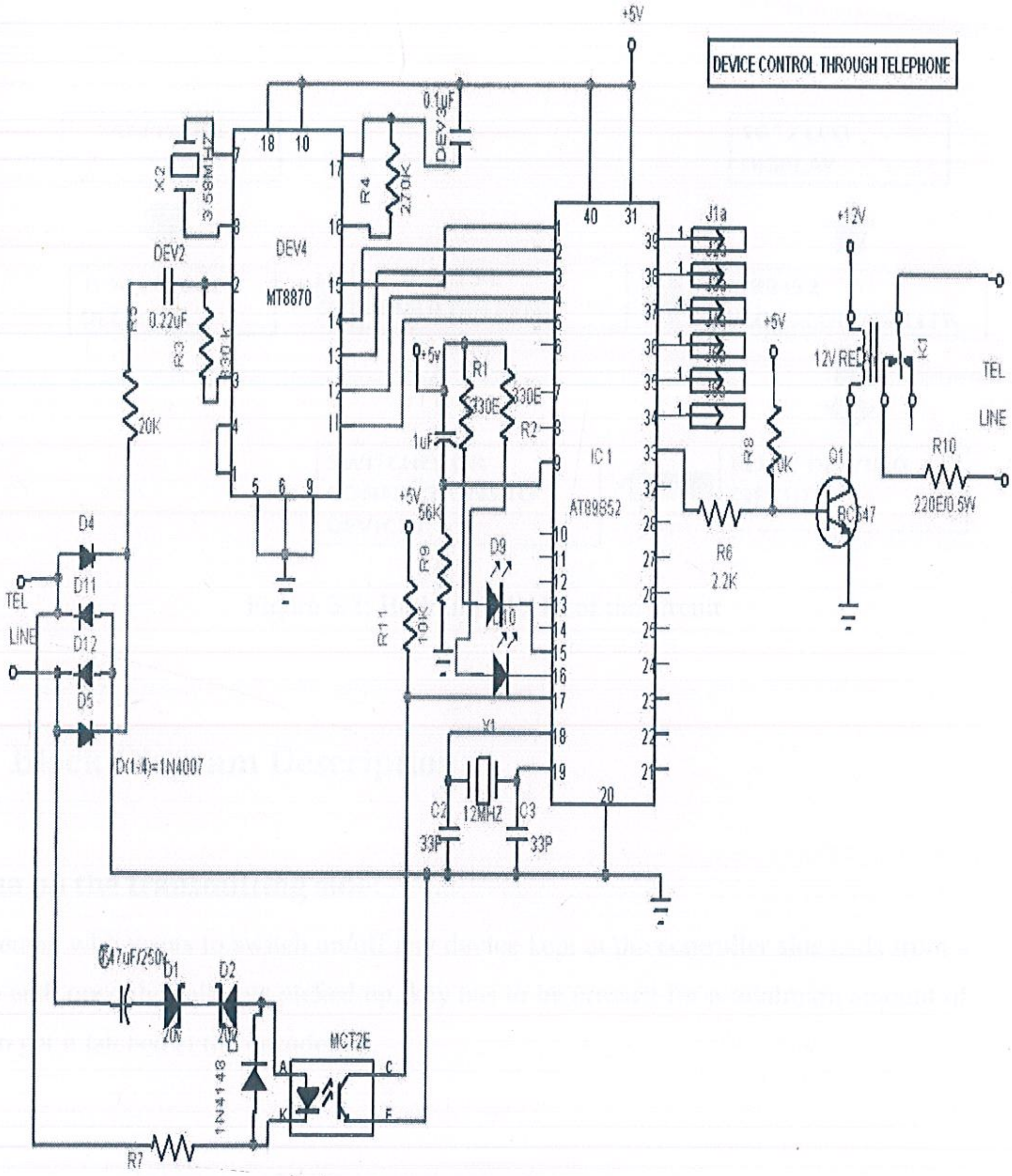


Figure 3.1: Circuit Diagram of Device Control through Mobile phone

3.3 Block Diagram

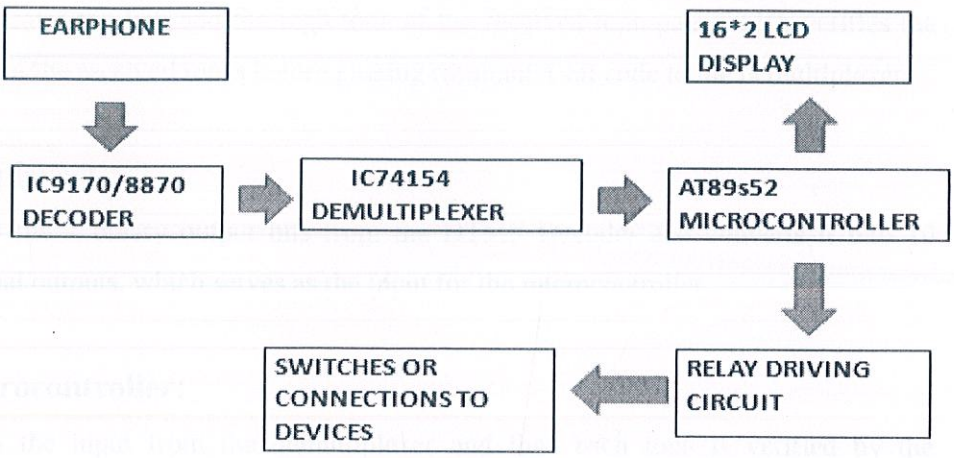


Figure 3.2: Building Blocks of the circuit

3.4 Block Diagram Description:

Phone on the transmitting side:

The person who wants to switch on/off any device kept at the controller side calls from a phone and, once the call gets picked up, key has to be pressed for a minimum amount of time to get it latched at the decoder IC.

Mobile phone on the receiving side:

The mobile phone on the receiver side picks up the phone automatically after 5seconds, and then makes the tones available to the DTMF tone decoder IC through the headphone jack of the phone.

DTMF Tone Decoder IC:

The DTMF tone decoder IC converts the received tones to their respective binary values and then gives them as an input to the demultiplexer.

The DTMF tone decoder IC's internal architecture consists of a band split filter section which separates the low and the high tone of the received tone pair, which verifies the frequency of the received tones before passing resultant 4-bit code to the demultiplexer.

Demultiplexer:

It receives the 4 binary output bits from the DTMF Decoder and converts it into 10 hexadecimal outputs, which serves as the input for the microcontroller.

The Microcontroller:

It receives the input from the demultiplexer and then each tone is verified by the programmed microcontroller and once a correct sequence of code is received, output corresponding to the tones sent by the user is made available at the output port, which is connected to relay.

Relay Circuitry:

The output from the port of the microcontroller is given to the relay, to which the home appliances are connected. Same number of relays are connected to the circuit as the number of appliances to be controlled.

Home Appliances:

One terminal of each appliance is connected to relay and the other terminal is connected to 220V AC. As soon as the relay gets driven by the microcontroller the device gets switched on/off.

3.5 DTMF Decoder

In DTMF decoder circuit we use IC9170 which is a DTMF decoder. IC9170 converts the dual tones to corresponding binary outputs.

3.5.1 DTMF signaling

Register signaling is used in DTMF telephones, here tones rather than make/break pulse are used for dialing, each dialed digit is uniquely represented by a pair of sine waves tones. These tones (one from low group for row and another from high group for column) are sent to the exchange when a digit is dialed by pushing the key, these tone lies within the speech band of 300-3400Hz, and are chosen so as to minimize the possibility of any valid frequency pair existing in normal speech simultaneously. Actually, this is made possible by forming pairs with one tone from the higher group and the other from the lower group of frequencies. A valid DTMF signal is the sum of two tones, one from a lower group (697-940 Hz) and the other from a higher group (1209 -1663 Hz).

Each group contains four individual tones. This scheme allows 10 unique combinations. Ten of these codes represent digits 1 through 9 and 0. Tones in DTMF dialing are so chosen that none of the tones is harmonic of the other tone. Therefore there is no chance of distortion caused by harmonics. Each tone is sent as long as the key remains pressed. The DTMF signal contains only one component from each of the high and low group. This significantly simplifies decoding because the composite DTMF signal may be separated with band pass filters into single frequency components, each of which may be handled individually.

IC9170 OUTPUT TRUTH TABLE

F low	F high	KEY	BCD
697	1209	1	0001
697	1336	2	0010
697	1477	3	0011
770	1209	4	0100
770	1336	5	0101
770	1477	6	0110
852	1209	7	0111
852	1336	8	1000
852	1477	9	1001
941	1209	0	1010

Table 3.1: Outputs of IC9170

3.6 Pin diagram of IC9170

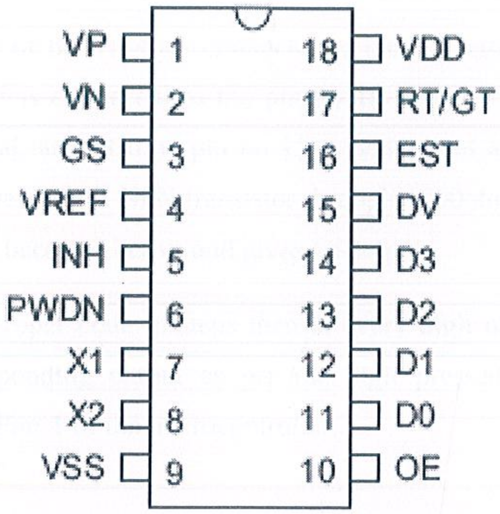


Figure 3.3: 18-Pin IC9170

3.6.1 Pin description of IC9170

First section of this project comprises of DTMF decoder. DTMF IC9170 receives the DTMF pulse and then converts it into binary coded decimal. Pin no 18 of the IC is connected to the positive supply. In this circuit we use 5V regulated power supply for the smooth working of the circuit.

DTMF signal is applied to the pin no 2 and 3 of the IC through resistor and capacitor network. Capacitor of 0.1 microfarad works as a dc blocking capacitor. Pin no 5, 6, 9 are connected to the ground pin.

Pin no.7 and 8 are connected to the 3.57945 MHz crystal oscillator.

Pin no 16 and 17 are connected to the RC network which works as an automatic reset, whenever we switch on the power supply. BCD output is available on the pin no 11,12,13,1,4, and this output is connected to the IC 74154.

3.7 IC74154

IC74154 is a BCD to decimal decoder/4 to 16 Demultiplexer. Pin no 20, 21, 22, 23 are connected to the DTMF decoder IC.

Pin no 18 and 19 of IC74154 are connected to the collector of an npn transistor Base of the npn transistor is connected to the pin no 15 of the IC9170. When DTMF decoder decodes the signal, at that time pin no 15 is active and acknowledges the signal. This signal is fed to the base of NPN transistor through 1000ohm resistor. When this signal is fed to IC74154 it becomes active and gives an output.

If we press the proper code in steps then at every digit of code IC74154 is active and gives the corresponding output as per the digit pressed. Output of the IC74154 is connected to the Port 1 of the microcontroller.

3.7.1 Pin Diagram

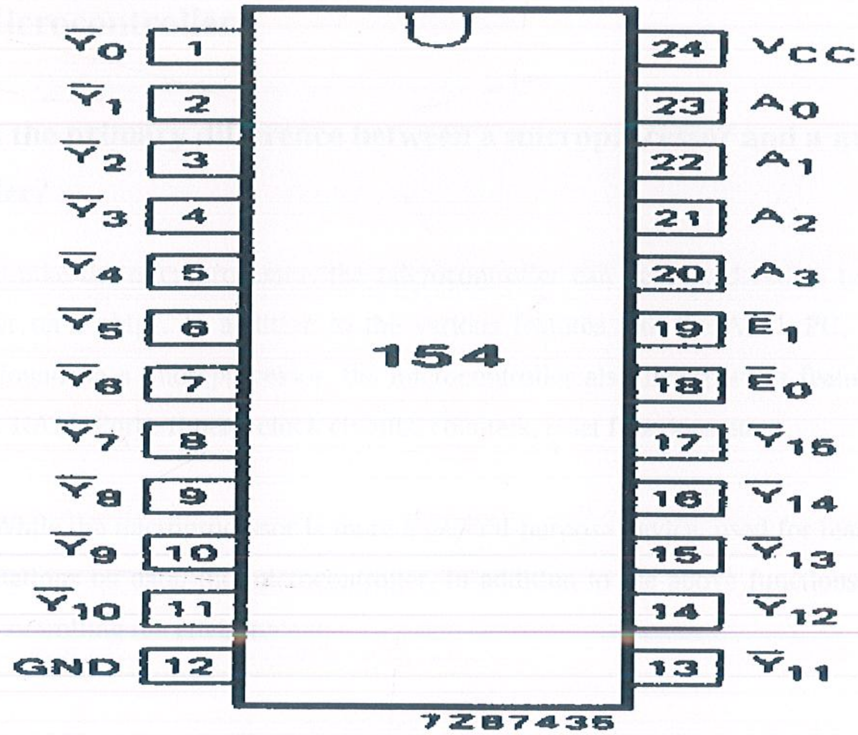


Figure 3.4: 24-Pin IC74154

3.7.2 Pin Description

- IC74154 is a Demultiplexer which is a 24 pin IC. Pin no.20, 21, 22, 23 are the BCD input pins of this IC.
- Pin no. 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, are the output pins, pin no.24 is connected to the positive 5 volt supply and pin no.12 is the negative supply pin.
- Pin no. 18 and pin no. 19 of this IC is enable pin. If the data available on the pin no. 19 is negative then output is negative for a time. The negative pulse is given by the NPN transistor collector point. Decodes 4 binary-coded inputs into one of 16 mutually exclusive outputs

3.8 Microcontroller

What is the primary difference between a microprocessor and a micro controller?

Unlike the microprocessor, the microcontroller can be considered to be a true "Computer on a chip". In addition to the various features like the ALU, PC, SP and registers found on a microprocessor, the microcontroller also incorporates features like the ROM, RAM, Ports, timers, clock circuits, counters, reset functions etc.

While the microprocessor is more a general-purpose device, used for read, write and calculations on data, the microcontroller, in addition to the above functions is also useful in controlling the environment.

3.9 8051 microcontroller

The 8051 developed and launched in the early 80`s, is one of the most popular micro controller in use today. It has a reasonably large amount of built in ROM and RAM. In addition it has the ability to access external memory.

The generic term '8x51' is used to define the device. The value of 'x' defining the kind of ROM, i.e. x=0, indicates none, x=3, indicates mask ROM, x=7, indicates EPROM and x=9 indicates EEPROM or Flash.

A note on ROM

- The early 8051, namely the 8031 was designed without any ROM. This device could run only with external memory connected to it. Subsequent developments lead to the development of the PROM or the programmable ROM. This type had the disadvantage of being highly unreliable.

- The next in line, was the EPROM or Erasable Programmable ROM. These devices used ultraviolet light erasable memory cells. Thus a program could be loaded, tested and erased using ultra violet rays. A new program could then be loaded again.

- An improved EPROM was the EEPROM or the electrically erasable PROM. This does not require ultra violet rays, and memory can be cleared using circuits within the chip itself.

- Finally there is the FLASH, which is an improvement over the EEPROM. While the terms EEPROM and flash are sometimes used interchangeably, the difference lies in the fact that flash erases the complete memory at one stroke, and not act on the individual cells. This results in reducing the time for erasure.

3.9.1 Different microcontrollers available in the market

- **PIC**

  One of the famous microcontrollers used in the industries. It is based on RISC Architecture which makes the microcontroller process faster than other microcontroller.

- **INTEL**

  These are the first to manufacture microcontrollers. These are not as sophisticated other microcontrollers but still the easiest one to learn.

- **ATMEL**

  Atmel's AVR microcontrollers are one of the most powerful in the embedded industry. This is the only microcontroller having 1kb of ram even at the entry stage.

3.9.2 Companies manufacturing 8051 microcontroller

- **PHILIPS**

The Philips 8051 derivatives have more number of features than in any microcontroller. The cost of the Philips's microcontroller is higher than the Atmel's which makes us to choose Atmel more often than Philips.

- **DALLAS**

Dallas has made many revolutions in the semiconductor market. Dallas's 8051 derivative is the fastest one in the market. It works 3 times as fast as any 8051 can process. But it is not easily available in India

- **ATMEL**

  Atmel was the one to master the flash devices. These are the cheapest microcontrollers available in the market. Atmel even introduced a 20pin variant of 8051 named 2051. The Atmel's 8051 derivatives are available in India for less than 70 rupees. There are a lot of cheap programmers available in India for Atmel. So it is always good for students to stick with Atmel's 8051 while learning a new microcontroller.

3.10 AT89S52 Microcontroller

3.10.1 Description

The AT89S52 is a low power, high performance CMOS 8bit microcontroller with 8K bytes of in-system programmable Flash memory. The device is manufactured using Atmel's high density non-volatile memory technology and is compatible with the industry-standard 80C51 instruction set and pin out. The on-chip flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. By combining a versatile 8-Bit CPU with in-system programmable flash on a monolithic chip, the Atmel AT89S52 is a powerful microcontroller which provides a highly-flexible and cost-effective solution to many embedded control applications.

3.10.2 Features

- 256 bytes of RAM (Random Access Memory) internally.
- Four-port I / O, which each consist of eight bits.
- The internal oscillator and timing circuits.
- A CPU (Central Processing Unit) 8Bit.
- Two timer / counters 16 bits.

- Five interrupt lines (two fruits and three external interrupt internal interruptions).
- A serial port with full duplex UART (Universal Asynchronous Receiver Transmitter).
- Able to conduct the process of multiplication, division, and Boolean.
- The size of 8 kilobyte EPROM for program memory.
- Maximum speed execution of instructions per cycle is 0.5s at 24 MHz clock frequency. If the microcontroller clock frequency used is 12 MHz, the speed is 1 s instruction execution.

3.10.3 Pin Configuration

AT89S52 microcontroller has 40 pins with a single 5 Volt power supply. The pin 40 is illustrated as follows:

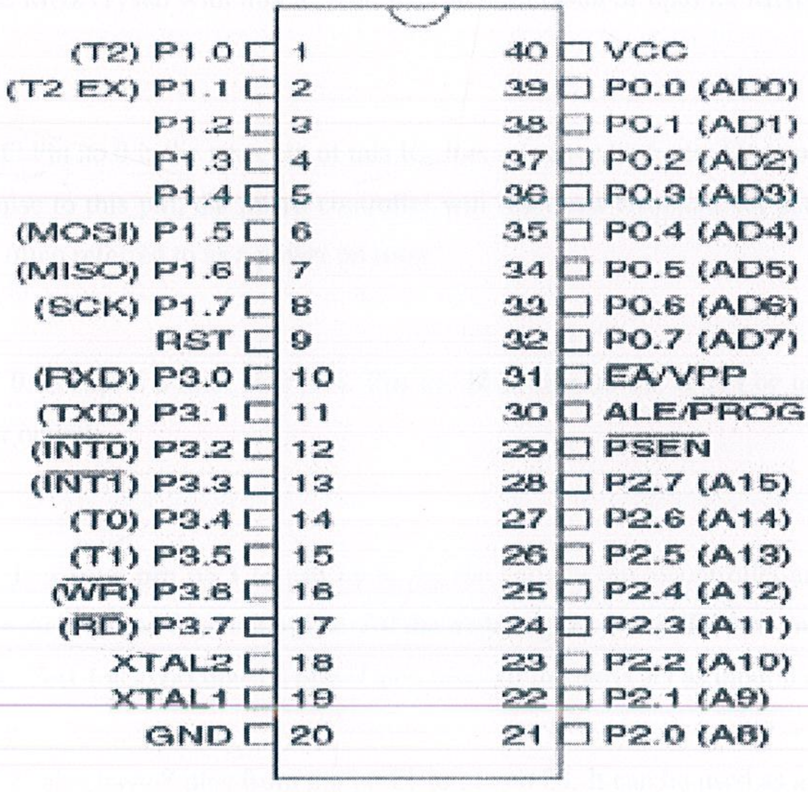


Figure 3.5: 40-Pin IC AT89S52

3.10.4 Pin Functions of AT89S52

- **Supply** pin of this IC is pin no 40. Normally we apply a 5V regulated DC power supply to this pin. For this purpose either we use step down transformer power supply or we use 9 volt battery with 7805 regulator.

- **Ground** pin of this IC is pin no 20. Pin no 20 is normally connected to the ground pin (normally negative point of the power supply).

- **XTAL** is connected to the pin no 18 and pin no 19 of this IC. The quartz crystal oscillator connected to XTAL1 and XTAL2 pin. These pins also need two capacitors of 30pf value. One side of each capacitor is connected to the crystal and the other side is connected to the ground. Normally we connect a 12 MHz or 11.0592 MHz crystal with this IC. But we can use crystal of upto 20 MHz to this pin.

- **RESET**: Pin no 9 is the reset pin of this IC. It is an active high pin. On applying a high pulse to this pin, the micro controller will reset and terminate all activities. This is often referred to as a power on reset.

- **PORT 0**: occupies a total of 8 pins. **Pin no 32 to pin no 39.** It can be used for input or output.

- **PORT 1**: is from **pin no 1 to pin no 8.** All the ports in microcontroller are 8 bit wide because it is an 8 bit controller. All the main registers and SFRs are mainly 8 bit wide. Port 1 also occupies 8 pins. Upon reset all the ports act as input ports.

- **PORT 2:** also have 8 pins from pin no 21 to pin no 28. It can be used as an input or as an output port

- **PORT 3**: also occupies a total of 8 pins from pin no 10 to pin no 17. Port 3 is a bi-directional port. Port 3 does not require any pull up resistor. The same as port 1 and port2. Port 3 is configured as an output port on reset. Port 3 has the additional function of providing some important signals such as interrupts. Port 3 is also used for serial communication.

- **ALE**: is an output pin and is active high. In normal operation, ALE is emitted at a constant rate of 1/6 the oscillator frequency and may be used for external timing or clocking purposes. The ALE pin is used for demultiplexing the address and data by connecting to the IC 74154 chip.

- **PSEN:** stands for program store enable. When the AT89S52 is executing code from external program memory PSEN is activated twice each machine cycle.

- **EA:** stands for external access enable. In AT89S52 or any other family member of the Atmel series, all come with an on-chip ROM to store programs, in such cases the EA pin is connected to the Vcc.

How is the execution time of a Microcontroller calculated?

The speed with which a microcontroller executes instructions is determined by what is known as the crystal speed. A crystal is a component connected externally to the microcontroller. The crystal has different values, and some of the used values are 6MHZ, 10MHZ, and 11.059 MHz etc.
Thus a 10MHZ crystal would pulse at the rate of 10,000,000 times per second.

The time is calculated using the formula

No of cycles per second = Crystal frequency in Hz / 12.

For a 10MHZ crystal the number of cycles would be,

10,000,000/12=833333.33333 cycles.

This means that in one second, the microcontroller would execute 833333.33333 cycles.

3.11 Pin connections of AT89S52 on PCB

- Output from IC74154 is connected at Port1 of the microcontroller.
- Port0 of the microcontroller is connected to the LCD for display purpose.
- Port2 is connected to the LEDs to show whether the electronic appliance is ON or OFF.
    - When the LED is glowing the Device is ON and vice-versa.

CHAPTER 4
LCD AND RELAY CIRCUITRY

4.1 General description of LCD

The 2*16 Parallel LCD is an 8 bit or 4 bit parallel interfaced LCD. This unit allows the user to display text, numerical data and custom created characters. LCDs have become a cheap and easy way to get text display for an embedded system. Common displays are set up as 16 to 20 characters by 1 to 4 lines.

4.2 Pin Diagram

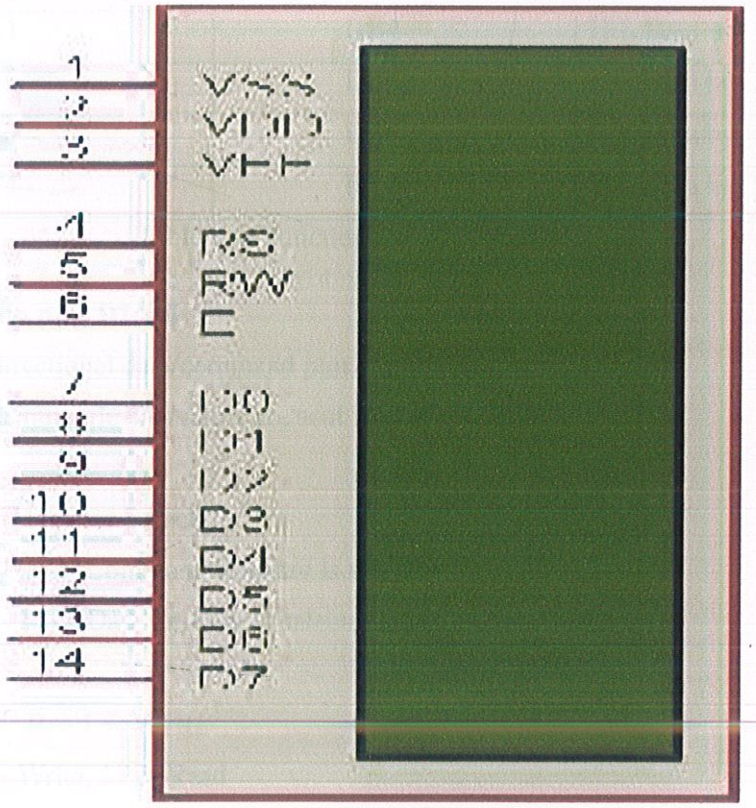


Figure 4.1: 14-pin 2*16 LCD

4.2.1 Pin Description

PIN NO.	SYMBOL	FUNCTION
1	Vss	Ground
2	Vdd	+5V
3	Vo	Contrast Adjustment
4	RS	H/L Register select signal
5	R/W	H/L Read/Write signal
6	E	H→L Enable signal
7	DB0	H/L Data bus line
8	DB1	H/L Data bus line
9	DB2	H/L Data bus line
10	DB3	H/L Data bus line
11	DB4	H/L Data bus line
12	DB5	H/L Data bus line
13	DB6	H/L Data bus line
14	DB7	H/L Data bus line

Table 4.1: Functions of 14 pins of an LCD

- **8 data pins D7:D0**

  Bi-directional data/command pins.

  Alphanumeric characters are sent in ASCII format.

- **RS: Register Select**

  RS = 0 --> Command Register is selected

  RS = 1 --> Data Register is selected

- **R/W: Read or Write**

  0 --> Write, 1 --> Read

- **E: Enable (Latch data)**

  Used to latch the data present on the data pins

  High-to-low edge is needed to latch the data

- **Vo** : contrast control

- **Display Data RAM (DDRAM)**

  Display data RAM (DDRAM) is where you send the characters (ASCII code) you want to see on the LCD screen. It stores display data represented in 8-bit character codes. Its capacity is 80 characters (bytes).

- **Character Generator RAM (CGRAM)-User defined character RAM**

  In the character generator RAM, we can define our own character patterns by program. CGRAM is 64 bytes, allowing for eight 5*8 pixel, character patterns to be defined.

- **Registers**

  The HD44780 has two 8-bit registers, an instruction register (IR) and a data register (DR). The IR stores instruction codes. The DR temporarily stores data to be written into DDRAM or CGRAM and temporarily stores data to be read from DDRAM or CGRAM. Data written into the DR is automatically written into DDRAM or CGRAM by an internal operation. These two registers can be selected by the register selector (RS) signal. See the table:

RS	R/W	OPERATION
0	0	IR write as an internal operation (display clear, etc.)
0	1	Read busy flag (DB7) and address counter (DB0 to DB6)
1	0	DR write as an internal operation (DR to DDRAM or CGRAM)
1	1	DR read as an internal operation (DDRAM or CGRAM to DR)

Table 4.2: Register Selection Table

- **Busy Flag (BF)**

  When the busy flag is 1, the LCD is in the internal operation mode, and the next instruction will not be accepted. When RS = 0 and R/W = 1 (see the table above), the busy flag is output to DB7 (MSB of LCD data bus). The next instruction must be written after ensuring that the busy flag is 0.

4.3 Control and Display Instructions

- **Clear display:** It clears the entire display and sets Display Data RAM Address 0 in Address Counter.

	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	0	0	0	0	0	0	1

- **Return home:** The cursor or blink goes to the most-left side of the display (to the 1st line if 2 lines are displayed). The contents of the Display Data RAM do not change.

	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	0	0	0	0	0	1	X

- **Entry mode set :**

During writing and reading data, it defines cursor moving direction and shifts the display.

I/D = 1: Increment, I/D = 0: Decrement.

S = 1: The display shift, S = 0: The display does not shift.

S = 1; I / D = 1 It shifts the display to the left

S = 1; I / D = 0 It shifts the display to the right

	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	0	0	0	0	1	I / D	S

- **Display ON/OFF control :**

D = 1: Display on, D = 0: Display off

C = 1: Cursor on, C = 0: Cursor off

B = 1: Blinks on, B= 0: Blinks off

	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	0	0	0	1	D	C	B

- **Cursor or display shift:**

Without changing DD RAM data, it moves cursor and shifts display.

	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	0	0	1	S/C	R/L	X	X

S/C	R/L	Description	Address Counter
0	0	Shift cursor to the left	AC = AC - 1
0	1	Shift cursor to the right	AC = AC + 1
1	0	Shift display to the left. Cursor follows the display shift	AC = AC
1	1	Shift display to the right. Cursor follows the display shift	AC = AC

Table 4.3: Instruction set for cursor/display shift

- **Function set :**

X: Do not care (0 or 1)

DL: It sets interface data length.

DL = 1: Data transferred with 8-bit length (DB7 - 0).

DL = 0: Data transferred with 4-bit length (DB7 - 4).

It requires two times to accomplish data transferring.

N: It sets the number of the display line.

N = 0: One-line display.

N = 1: Two-line display.

F: It sets the character font.

	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	0	1	DL	N	F	X	X

N	F	No. of Display Lines	Character Font	Duty Factor
0	0	1	5 x 8 dots	1 / 8
0	1	1	5 x 10 dots	1 / 11
1	X	2	5 x 8 dots	1 / 16

Table 4.4: Instructions for Function Set

- **Set character generator RAM address :**

It sets Character Generator RAM Address $(aaaaaa)_2$ to the Address Counter. Character Generator RAM data can be read or written after this setting.

	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	1	a	a	a	a	a	a

- **Set display data RAM address :**

It sets Display Data RAM Address $(aaaaaaa)_2$ to the Address Counter.

	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	1	a	a	a	a	a	a	a

- **Read busy flag and address :**

When BF = 1, it indicates the system is busy now and it will not accept any instruction until not busy (BF = 0).

	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	1	BF	a	a	a	a	a	a	a

- **Write data to character generator RAM or display data RAM :**

It writes data $(dddddddd)_2$ to character generator RAM or display data RAM.

	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	1	0	d	d	d	d	d	d	d	d

- **Read data from character generator RAM or display data RAM :**

It reads data $(dddddddd)_2$ from character generator RAM or display data RAM.

To read data correctly, we need the following:

1) The address of the Character Generator RAM or Display Data RAM or shift the cursor instruction.

2) The "Read" instruction

	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	1	1	d	d	d	d	d	d	d	d

4.4 Interfacing of AT89s52 with 16*2 LCD

The 44780 standard requires 3 control lines as well as either 4 or 8 I/O lines for the data bus. The user may select whether the LCD is to operate with a 4-bit data bus or an 8-bit data bus.

If a 4-bit data bus is used, the LCD will require a total of 7 data lines.
If an 8-bit data bus is used, the LCD will require a total of 11 data lines.

The three control lines are **EN**, **RS**, and **RW**.

Note that the EN line must be raised/lowered before/after each instruction sent to the LCD regardless of whether that instruction is read or write, text or instruction. In short, you must always manipulate EN when communicating with the LCD. EN is the LCD's way of knowing that you are talking to it. If you don't raise/lower EN, the LCD doesn't know you're talking to it on the other lines.

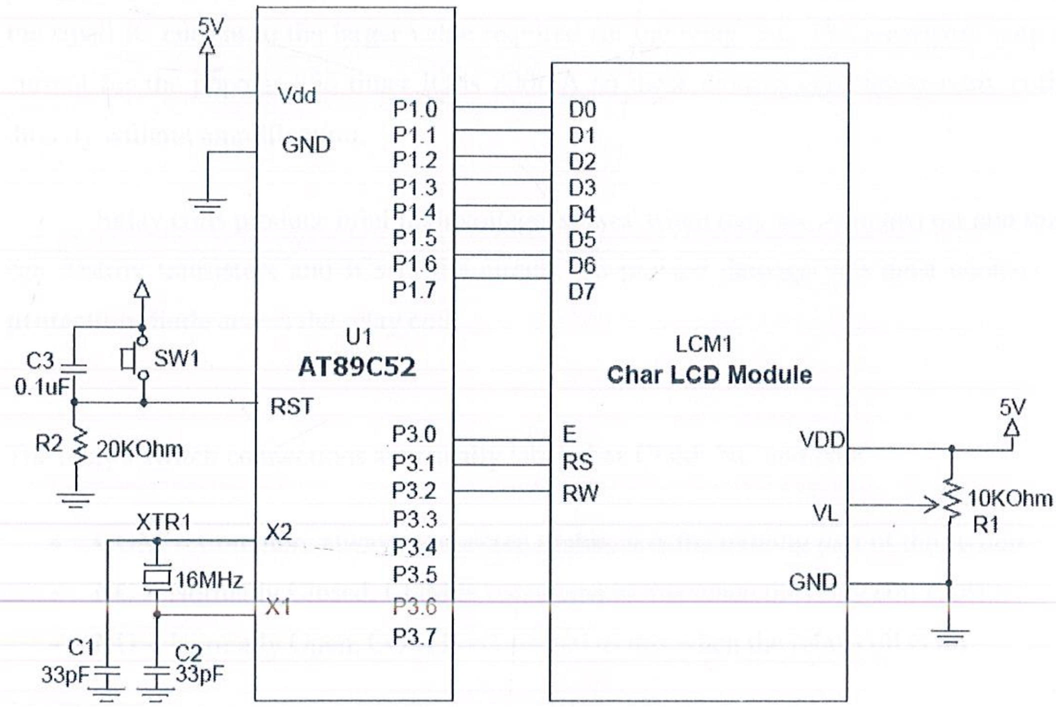


Figure 4.2: Microcontroller and LCD Interfacing

4.5 Relay

4.5.1 Introduction

A relay is an **electrically 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 most have double throw (changeover) switch contacts.

Relays allow one circuit to switch a second circuit which can be completely separate from the first. For example a low voltage battery circuit can use a relay to switch a 220V AC mains circuit. There is no electrical connection inside the relay between the two circuits, the link is magnetic and mechanical.

The coil of a relay passes a relatively large current, typically 30mA for a 12V relay, but it can be as much as 100mA for relays designed to operate from lower voltages. Most ICs (chips) cannot provide this current and a transistor is usually used to amplify the small IC current to the larger value required for the relay coil. The maximum output current for the popular 555 timer IC is 200mA so these devices can supply relay coils directly without amplification.

Relay coils produce brief high voltage 'spikes' when they are switched off and this can destroy transistors and ICs in the circuit. To prevent damage you must connect a **protection diode** across the relay coil.

The relay's switch connections are usually labeled as COM, NC and NO:

- **COM** = Common, always connected 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**.

4.5.2 Protection diodes for relays

Transistors and ICs must be protected from the brief high voltage produced when a relay coil is switched off. The diagram shows how a signal diode is connected 'backwards' across the relay coil to provide this protection.

Current flowing through a relay coil creates a magnetic field which collapses suddenly when the current is switched off. The sudden collapse of the magnetic field induces a brief high voltage across the relay coil which is very likely to damage transistors and ICs. The protection diode allows the induced voltage to drive a brief current through the coil (and diode) so the magnetic field dies away quickly rather than instantly. This prevents the induced voltage becoming high enough to cause damage to transistors and ICs.

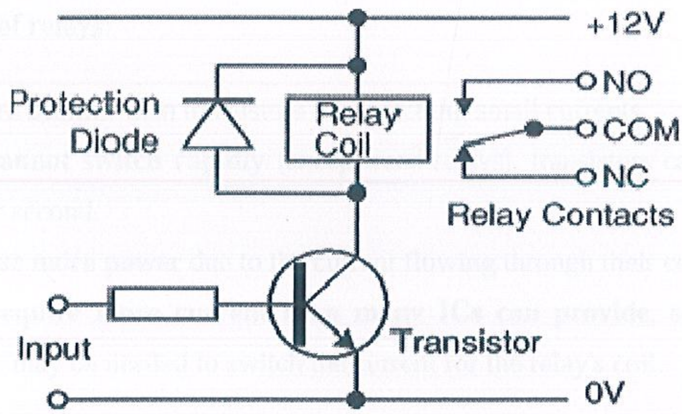


Figure 4.3: Circuitry of relay

4.5.3 Relays and transistors compared

Like relays, transistors can be used as an electrically operated switch. For switching small DC currents (< 1A) 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 (> 5A). 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:

Advantages 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 5

RESULT

5.1 Complexities Involved

Under this heading we are going to mention the problems that we faced while building this project:

- **Building a programmer for the microcontroller:** There are several kinds of microcontroller ICs available in the market. We first bought Intel's 8051 IC, but found that it does not have flash memory, so we were not able to use it. Then we bought Atmel's AT89s52 and tried to build a programmer circuit for the same.

- **PCB printing:** For getting a printed PCB for our circuit we first needed to design a layout. We learnt that through a software named 'DIPTRACE' we can draw a schematic of a circuit and then get its layout. So we learnt this software and printed a layout of correct scale to actual components. Learning the software was a complex task.

- **Programming the microcontroller:** We programmed the microcontroller many a times and tested it, until we got the final result.

5.2 Factors to be considered to implement the system

- The receiver must reside in a location where a signal with sufficient strength can be obtained

- The only person who can communicate with the control module is the person who will be successfully authenticated.

- Only devices with electrical controlling input ports will be possible targets for controlling.

- The receiver must have a power source attached at all times.

- Operation of the controlling unit is only possible through a cell phone with DTMF capabilities and voice message.

5.3 ANALYSIS

- **Successful Authentication with GSM Network**

The GSM receiver has tested for successful communication with network. This test includes automation and consistency of the connection and will be conducted in the following way:

1) The cellular phone dials the GSM receiver's number.
2) Once the connection is established a DTMF will be sent to the GSM receiver.
3) The GSM receiver will be given DTMF to be transferred to the decoder. The DTMF received will be observed henceforth.

Result: The GSM receiver and transmitter both established a successful communication over GSM network.

- **Proper Decoding**

Proper decoding of the remote user's command and issuance of the equivalent command to the controlled device will be performed. A simulated instruction will be fed to the microcontroller communication port. The output command at the input/output interface with the corresponding controlled device will be observed.

Result: Proper decoding of DTMF is completed and microcontroller causes the proper voltage to be observed at the desired devices control interfaces.

5.4 Inference

The Remote Automation using GSM on test performed exceptionally well to its capability and accuracy. All the inherent parts of the circuit performed consistently. It helped us to come out with good judgment. With the features what it inherits, it seems to be advantageous to the present era.

CHAPTER 6

CONCLUSION AND FUTURE WORK

Mobile phones have become an indispensable part of our life. Our system uses a controller and a cellular phone for its operations. The system can be used as a test bed for any application that requires on-off switching based applications. Wireless controlled home appliances in the comforts of any environment will revolutionize our way of living. Controlling appliances remotely by a cell phone will one day become a reality and one would give thanks to the capabilities of Home appliances control system, which might one day become a standard system in the new homes to come.

Almost one fifth of the total population use cell phone. Moreover, the GSM service providers in this country provide their services at cheap rate. Considering this, cell phone can be an effective element so that the home and office appliances may be controlled by wireless device. Devices are directly connected to the power system causes a huge power loss because they are not controlled (turning on/off) properly. Devices connected at homes and offices are controlled manually most of the time. Each device being turned on or off by an individual switch. Therefore, operator will need to control them. This would be time consuming and also not reliable switching because of forgetful mind of human being. Users will be able to use this system to control their home appliances by using their wireless devices (cell phone). Through the user's remote access to the system, proper controlling of devices is ensured, thereby saving power. Moreover, users are comprised of owners, who own the system, administrators, who are responsible for managing and configuring the system and the police/fire department personnel, who are contacted in case of an emergency can utilize this system as an effective method.

6.1 Further Improvement and Future Scope

- **Confirmation system**

  Possibility of confirming the devices initial condition (status) using short messaging system (SMS)

- **Automatic Charging**

  As mobile in the control panel is required to be charged, therefore charging system should be automated which means a timer can be implemented so that the mobile can be charged after a certain period and den gets disconnected from the charger when not required.

- **Password Protection**

  Project can be modified in order to password protect the cell phone so that it can be operated only if correct password is entered. This introduces conditioned access and increases security to a great extent.

- **Alarm phone dialer**

  By replacing DTMF decoder IC9170 by a 'DTMF transceiver IC' CM8880, DTMF tones can be generated from the attached mobile phone. So, a project called 'Alarm phone dialer' can be built which will generate necessary alarms for something that is desired to be monitored (usually by triggering a relay). For example, low temperature alarm, opening of garage door etc. When the system is activated it will call a number of programmed numbers to let the user know the alarm has been activated. This would be great to get alerts of alarm conditions from home when user is at work.

CHAPTER 7

SOURCE CODE

7.1 Programming of LCD

1) Connections

A. Connect P0 of 89S52 (all 8 pins in sequence from 0 to 7) to LCD section's 0 to 7 pins

See the marking near LCD pins for identification

B. Connect P2.0 to RS pin of LCD section

C. Connect P2.1 to RW pin of LCD section

D. Connect P2.2 to EN pin of LCD section

2) Program for programming LCD

```
EN     EQU    P2.2                 ;change as per your connections
RS     EQU    P2.0                 ;change as per your connections
RW     EQU    P2.1                 ;change as per your connections
PDATA  EQU    P0                   ;change as per your connections

START:
    LCALL INIT_LCD                 ; to initialize the LCD
    LCALL CLEAR_LCD                ; to clear the display
    LCALL PRINT_MESSAGE

INIT_LCD:                          ; instructions for initializing LCD
    CLR RS
    MOV PDATA,#00110100b
    SETB EN
```

```
        CLR EN
        LCALL WAIT_LCD

        CLR RS
        MOV PDATA,#00111100b
        SETB EN
        CLR EN
        LCALL WAIT_LCD

        CLR RS
        MOV PDATA,#0Ch
        SETB EN
        CLR EN
        LCALL WAIT_LCD

        CLR RS
        MOV PDATA,#06h
        SETB EN
        CLR EN
        LCALL WAIT_LCD
ret

WRITE_TEXT:                    ; To load the characters in LCD's Accumulator
        SETB RS
        MOV PDATA,A
        SETB EN
        CLR EN
        LCALL WAIT_LCD
RET
CLEAR_LCD:
```

```
        CLR RS
        MOV PDATA,#01h
        SETB EN
        CLR EN
        LCALL WAIT_LCD
RET

WAIT_LCD:                               ; to check the busy status of LCD
        CLR EN
        CLR RS
        SETB RW
        MOV PDATA,#0FFh
        SETB EN
        MOV A,PDATA
        JB ACC.7,WAIT_LCD
        CLR EN
        CLR RW
RET

PRINT_MESSAGE:                          ; to print the text on ROW 1 of LCD
        MOV A,#'G '
        LCALL WRITE_TEXT

        MOV A,#' S'
        LCALL WRITE_TEXT

        MOV A,#'M'
        LCALL WRITE_TEXT

        MOV A,#' '
        LCALL WRITE_TEXT
```

```
MOV A,#'D'
LCALL WRITE_TEXT

MOV A,#'I'
LCALL WRITE_TEXT

MOV A,#'S'
LCALL WRITE_TEXT

MOV A,#'P'
LCALL WRITE_TEXT

MOV A,#'L'
LCALL WRITE_TEXT

MOV A,#'A'
LCALL WRITE_TEXT

MOV A,#'Y'
LCALL WRITE_TEXT


CLR RS                          ; to print characters on ROW 2 of the LCD
MOV DATA,#0C4h
SETB EN
CLR EN
LCALL WAIT_LCD
MOV A,#'2'
LCALL WRITE_TEXT
```

```
        CLR RS
        MOV PDATA,#0C5h
        SETB EN
        CLR EN
        LCALL WAIT_LCD
        MOV A,#'0'
        LCALL WRITE_TEXT

        CLR RS
        MOV PDATA,#0C6h
        SETB EN
        CLR EN
        LCALL WAIT_LCD
        MOV A,#'1'
        LCALL WRITE_TEXT

        CLR RS
        MOV PDATA,#0C7h
        SETB EN
        CLR EN
        LCALL WAIT_LCD
        MOV A,#'1'
        LCALL WRITE_TEXT
RET
END
```

Result: The LCD should display GSM DISPLAY on the first line and 2011 on the second line.

7.2 Programming of Microcontroller

Instructions for AT89S52

```
    sw_1   bit   90h                    ; to assign the base address

    sw_2   bit   91h

    sw_3   bit   92h

    sw_4   bit   93h

    sw_5   bit   94h

    sw_6   bit   95h

    sw_7   bit   96h

    sw_8   bit   97h

    sw_9   bit   0b4h

    sw_10  bit   0b5h

    org 0000h

    jmp main

    org 30h

main:

    mov p3, #0ffh                       ; to set ports p1, p3 High

    mov p1, #0ffh

back:                                   ; to individually complement the values

l1:  mov a, p3
    cjne a, #0001, l1
    cpl sw_1
```

```
s1:   mov a, p3
      cjne a, #0001, l1
      jmp s1

l2:   mov a, p3
      anl a, #0fh
      cjne a, #0010, l2
      mov c, sw_2
s2:   mov a,p3
      cjne a,#0010,l2
      jmp s2

l3:   mov a,p3
      cjne a,#3,l3
      cpl sw_3
s3:   mov a,p3
      cjne a,#0011,l3
      jmp s3

l4:   mov a,p3
      cjne a,#0100,l4
```

```
        cpl sw_4
s4:     mov a,p3
        cjne a,#0100,l4
        jmp s4

l5:     mov a,p3
        cjne a,#0101,l5
s5:     mov a,p3
        cjne a,#0101,l5
        jmp s5

l6:     mov a,p3
        anl a,#0fh
        cjne a,#0110,l6
        cpl sw_6
s6:     mov a,p3
        cjne a,#0110,l6
        jmp s6

l7:     mov a,p3
        cjne a,#0111,l7
```

```
        cpl sw_7
s7:     mov a,p3
        cjne a,#0111,l7
        jmp s7

l8:     mov a,p3
        cjne a,#1000,l8
        cpl sw_8
s8:     mov a,p3
        cjne a,#1000,l8
        jmp s8

l9:     mov a,p3
        anl a,#0fh
        cjne a,#1001,l9
s9:     mov a,p3
        cjne a,#1001,l9
        jmp s9

l10:    mov a,p3
        cjne a,#1010,l10
```

```
s10:  mov a,p3
      cjne a,#1010,l10
      jmp s10

l11:  jmp back

clrlcd:
mov A,#01h                         ; Entry mode, Set increment
acall command
acall delay
ret
init _ LCD:                        ; LCD routines
mov A,#38h                         ; Display clear
acall command
acall delay
 mov A,#38h                        ; Function set
 acall command
acall delay
mov A,#38h                         ; Display on, ;cursor off, cursor blink off
acall command
acall delay
```

```
mov A,#38h          ; Display on, ;cursor off, cursor blink off
acall command
acall delay
 mov A,#01h         ; Entry mode, Set increment
 acall command
acall delay
mov A,#06h          ; Entry mode, Set increment
 acall command
acall delay
mov A,#0Eh          ; Entry mode, Set increment
 acall command
acall delay
display:            ; Write command to LCD
mov lcd,a
setb rs
clr rw
setb en
acall delay
clr en
ret
```

```
fcbsl:
mov a,#0C0h                  ; cursor at beginning of 2nd line
acall delay
acall command
ret
delay:                       ; lcd delay
mov r3,#5
here2:  mov r4,#2
here:
djnz r4,here
djnz r3,here2
ret
command:                     ; instruction command to LCD
mov lcd,a
clr rs
clr rw
setb en
acall delay
clr en
```

```
ret

write:                          ; write from data tables

clr a

inc dptr

jz again

acall display

acall delay

again:

acall delay1

ret

fcbfl:

mov a,#80h                      ; cursor at beginning of 1st line

acall command

acall delay

ret

; DATA TABLE

TABLE1:  DB "GSM DISPLAY",0

TABLE2:  DB 'first',0

TABLE5:  DB "2011",0

TABLE6:  DB " Fourth*",0
```

```
TABLE7:  DB "fifth",0

TABLE3:  DB "second",0

TABLE4:  DB "third",0

TABLE8:  DB "sixth",0

end
```

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