

DESIGN AND CONSTRUCTION OF A GSM HOME BASED SECURITY SYSTEM

BY

ONIFADE OLABISI

2005/22081EE

A PROJECT SUBMITTED TO THE DEPARTMENT
OF ELECTRICAL AND COMPUTER
ENGINEERING, SCHOOL OF ENGINEERING AND
ENGINEERING TECHNOLOGY, IN PARTIAL
FULFILMENT OF THE REQUIREMENTS FOR THE
AWARD OF BARCHELOR OF ENGINEERING
(B.ENG) DEGREE OF THE FEDERAL UNIVERSITY
OF TECHNOLOGY MINNA.

OCTOBER 2010.

Dedication

This project work is dedicated to God Almighty for is infinity mercies, protection and guidance.
Also to my parents professor and Mrs. Onifade for their unending love, prayers and support all
through my studies

Acknowledgement

I would like to express my gratitude and appreciation in the first place to God Almighty for his love, protection and guidance throughout my project and my entire studies.

My profound gratitude also goes to Mr. Micheal David who is my project supervisor for his patient and sound advice leading to the successful completion of this work and also to my H.O.D Engr. Raji and all the lecturers in the department of electrical and computer engineering.

My sincere gratitude also goes to my parents Professor and Mrs. Onifade for their encouragement, advice and support.

I extend my special thank to my brothers, Ayokola, Bolaji and Dapo for their support and assistance. Also to my friends Shola, Daniel and Abdul, and my other colleagues in the department.

Abstract

This project is about design and construction of GSM HOME SECURITY SYSTEM. This project was design due to high rate of crime and domestic hazards in our society. The project will be able to detect the presence of an intruder, senses fire and other security system in the house. With this system, our society will be able to be computerized, in order to protect us from sudden danger. Four different sensors are used and each of the sensors will be able to respond to different message. The system will be able to alert the owner irrespective of the distance and irrespective of the GSM network the owner is using. Motorola C168 will be use for interfacing the microcontroller system with each of the sensor. The Motorola C168 is chosen because it is having GSM instructions that are being used to programme in embedded

C.

Table of Contents

Dedication	ii
Declaration	iii
Acknowledgement	iv
Abstract	v
Table of Contents	vi
List of Figures	x
List of Tables	xi
CHAPTER ONE:	
1.0 Introduction	1
1.1 Background to the study	1
1.2 What makes SMS messaging so successful worldwide	2
1.3 Methodology	4
1.4 Scope of the work	5
1.5 Aims.....	6
1.6 Objectives.....	6
CHAPTER TWO:	
2.0 Literature Review.....	7
2.1 GSM	7

2.2 GSM Architecture	7
2.3 Technical Details	7
2.4 GSM Frequencies	9
2.5 Network Structure	9
2.6 Subscriber Identity Module (sim)	10
2.7 GSM Security	10
2.8 Basic Model of the System	11
2.9 Parts of the System	11
2.9.1 Microcontroller	11
2.9.2 GSM modem	12
CHAPTER THREE:	
3.0 Hardware Description	14
3.1 Microcontrollers - AT89C52	14
3.1.1 Functions of the 89C52 pin	15
3.2 MAX 232	16
3.3 RS 232	17
3.4 GSM Modem	18
3.5 LCD.....	19
3.6 LCD Pin Descriptions.....	20
3.7 Introduction To At Commands.....	27
3.8 General Syntax.....	27
3.9 Tasks Performed	27

3.10 Types.....	29
3.11 Reading and Sending SMS Using AT Commands.....	29
3.11.1 Reading Messages.....	29
3.11.2 Illustrating the Difference Between +Cmgr and +Cmgl.....	30
3.11.3 Sending Messages.....	31
3.12 Flowchart.....	33
CHAPTER FOUR:	
4.0 Tests, Results and Discussion.....	35
4.1 Software.....	35
4.2 Introduction to Keil	35
4.3 Programmer.....	40
CHAPTER FIVE	
5.1 Conclusion.....	41
5.2 Recommendation	41
5.3 Possible Improvement.....	42
References	43
Appendix A: User's Manual.....	45
Appendix B: Flowchart	46
Appendix C: Source Code	48
Appendix D: Pictorial Views of the Design.....	55

List of Figures

2.1 Network structure of a GSM system	9
2.2 Block Diagram of the System	11
3.1 Pin Diagram of AT89C52.....	15
3.2: Internal Architecture of AT89C52	16
3.3: Pin diagram of MAX232	17
3.4 DB-9 Connector	18
3.5 LCD pin Description	20
3.6. The complete circuit diagram	26
3.7a Flow Chart	34
3.7b Flow Chart	35
4.1 Window for Choosing target Device.....	36
4.2 Project Options Dialog.....	37
4.3: Project Workspace Pane	38
4.4 “Save All” and “Build All Target Files” Buttons	38
4.5 Vision3 Debugger window	39

List of Table

3.1. Pin description for LCD	22
3.2. Moving the LCD's cursor.....	25
3.3. AT Command Instruction.....	32

CHAPTER ONE

1.0 INTRODUCTION

1.1 BACKGROUND TO THE STUDY

Mobile Phones and related technologies are becoming more ubiquitous. Various technical areas in the field of Telecommunication and Embedded systems have been brought to the door steps of the common man, even in the third world countries. The number of people with cell phones is on the rise. Improvements in the Networking technologies have fostered growth of very dense networks. Land line telephones are becoming less popular and people now prefer communicating while on the move (mobile).

A Remote Control is perhaps the most popular gadget today. Right from the intense creativity of remotely controlling laser chip markers to the highly destructive remotely ignitable bombs, from the pins to the planes, remote control is but is enhancing its scope and domains.

When people have a good connectivity at their disposal, with tremendous power of mobile computing to supplement the same, we can think of a way to keep our homes safe with the help of mobile technology. Different types of sensors for different purposes can be sited at different locations within the home, so that in any event, people would be able to be informed and be aware about the security and safety of their homes, and necessary actions and measures can be taken to take control of the situation even from a distant place. A very good example of these is getting a text message alert on your phone, when you are not at home, immediately somebody enters your home that is an intrusion, without the intruder knowing. If not close by, the nearest police station can be contacted to take control of the situation. The usefulness of this

long range technology to the home or office has no limits. A setup facilitating such a thing would be to connect the sensors to a microcontroller interfaced to a GSM modem that receives the controls from the user, the means of sending signals to the appliances being a mobile phone.

This project presents one of the emerging applications of the GSM technology. We present the design of a stand-alone embedded system that can to some extent efficiently and effectively secure the home mostly in the event of the home owner's absence. Remotely, the system allows the homeowner to monitor activities in his house he/she is away. The system has two parts, namely; hardware and software. The hardware architecture consists of a stand-alone embedded system that is based on 8-bit microcontroller, an interface and a Driver circuit to connect the devices to the microcontroller, an LCD display, and a GSM modem. The GSM modem provides the communication media between the home owner and the system by means of SMS messages. The system software driver is developed using an interactive C programming language platform.

This project is an implementation to the idea of the wireless communication between a mobile phone and a microcontroller.

1.2 WHAT MAKES SMS MESSAGING SO SUCCESSFUL WORLDWIDE?

SMS is a success all over the world. The number of SMS messages exchanged every day is enormous. SMS messaging is now one of the most important revenue sources of wireless carriers. What is so special about SMS that makes it so popular worldwide? Some of the reasons are discussed below.

SMS Messages can be Sent and Read at Any Time: Nowadays, almost everybody has a mobile phone and carries it most of the time. With a mobile phone, you can send and read SMS messages at any time, no matter whether in the office, on a bus or at home.

SMS Messages can be sent to an Offline Mobile Phone: Unlike a phone call, you can send an SMS message to your friend even when he/she has not switched on the mobile phone or when he/she is in a place where the wireless signal is temporarily unavailable. The SMS system of the mobile network operator will store the SMS message and later forward it to your friend when his/her mobile phone is switched on.

SMS Messaging is Less Disturbing While You can Still Stay in Touch: Unlike a phone call, you do not need to read or reply an SMS message immediately. Besides, writing and reading SMS messages do not make any noise. While you have to run out of a theater or library to answer a phone call, you do not need to do so if SMS messaging is used.

SMS Messages are Supported by 100% GSM Mobile Phones and they can be exchanged between different wireless carriers: SMS messaging is a very mature technology. All GSM mobile phones support it. Not only that you can exchange SMS messages with mobile users of the same wireless carrier, but you can also exchange SMS messages with mobile users of many other wireless carriers worldwide.

SMS is a Suitable Technology for Wireless Applications to Build on: Here are some of the reasons that make SMS a suitable technology for wireless applications to build on:

- Firstly, SMS messaging is supported by 100% GSM mobile phones. Building wireless applications on top of the SMS technology can maximize the potential user base.
- Secondly, SMS messages are capable of carrying binary data besides text. They can be used to transfer ringtones, pictures, operator logos, wallpapers, animations, VCards, VCals (calendar entries), etc.

- Thirdly, SMS supports reverse billing, which enables payment to be made conveniently. For example, suppose you want to develop a commercial ringtone download application that charges a fee from the user for each ringtone downloaded. One way to accept payment is to use a reverse billing phone number obtained from a wireless carrier. To buy a ringtone, the user will write an ordinary SMS text message that contains the ID of the ringtone he/she wants to buy and send it to your SMS application's reverse billing phone number. Your SMS application will then send back one or more reverse billing SMS messages that carry the ringtone. The user will be charged a fee for the reverse billing SMS messages he/she received. The fee will be included in the user's monthly mobile phone bill or be deducted from his/her prepaid card credits. Depending on the agreement between you and the wireless carrier, all or part of the money received will be given to you.

1.3 METHODOLOGY

To implement this, a GSM modem is connected to a programmed microcontroller (**Programmed In Embedded C**) which would receive the SMS from a reference cell phone. The control signal part of the received SMS is extracted and is changed to microcontroller-preferred format. We have selected **GSM PHONES (MOTOROLA C168)** because the ubiquity of its standard makes international roaming very common between mobile phone operators, enabling subscribers to use their phones in many parts of the world. A PC which is connected to the micro-controller using a serial communication through RS232 can be used for monitoring and transmission of the control signals to the modem. The monitoring is also done by interfacing an LCD to the microcontroller. AT commands were used for controlling the functionality of modem.

In this project, the home appliances are controlled with the help of a cell phone. The system uses SMS facility to give the commands and receive the status from the receiver. The mobile user sends a secret code with control data. In the receiver section, GSM modem receives the command and sends the signal to the microcontroller; the microcontrollers verify the secret code and perform the command functions. The controller also triggers the relay circuit through the relay drivers. The relay drivers in turn control the load. The status is send back to the mobile user as well as sends to pc. The personal computer send to another pc's through LAN or wireless network using TEL NET PROTOCOL.

1.4 SCOPE OF THE WORK

In recent times, there is a lot of burglary happening across the city, the reason behind this is that police cannot make out the exact location of burglary, for example, if burglary is happening inside any area in the city, police will get information after the incident had happened, and then they can't find out the direction in which the thieves had escaped. Now a days, so many alarms and security system are emerging in our markets and using high-tech techniques, but in this design, we are implementing security systems using GSM. GSM is one of the latest mobile technologies using smart MODEM which can easily be interfaced to embedded microcontrollers. Everything is going to be automated using this technology, using this technology we can access the devices remotely. Using GSM and GPS, we can now identify people, vehicles etc, anywhere around the world. In this project, there will be sensors inside the home, if anybody enters the house forcefully, the sensors output will give information to the system that somebody has come in, then it will send an SMS to the owners mobile or alternatively make a call to the police.

1.5 AIMS

The aim of the propose system is to investigate a cost effective solution that will provide a means of making sure properties and valuables are safe in the absence of home owner.

1.6 OBJECTIVES

1. This system will provide ideal solution to the problems of theft faced by home owners in daily life.
2. The system is wireless therefore more adaptable and cost-effective.
3. This system will detect motion, fire and gas leakage using sensors.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 GSM

GSM (Global System for Mobile communications: originally from Groupe Spécial Mobile) is the most popular standard for mobile phones in the world. Its promoter, the GSM Association, estimates that 80% of the global mobile market uses the standard. GSM is used by over 3 billion people across more than 212 countries and territories. It makes international roaming very common between mobile phone operators, enabling subscribers to use their phones in many parts of the world. GSM differs from its predecessors in that both signaling and speech channels are digital, and thus is considered a second generation (2G) mobile phone system. This has also meant that data communication was easy to build into the system. .

2.2 GSM ARCHITECTURE

GSM is a complex system and difficult to understand. The GSM network can be divided into three parts. The Mobile Station (MS) refers to the mobile equipment. The Base Station Subsystem controls the radio link with the Mobile Station. The Network Subsystem performs main functions such as switching of calls between mobile users, mobility management operations, and proper operation and setup of a network. These functions are controlled by the Mobile Services Switching Center (MSC).

2.3 TECHNICAL DETAILS

GSM is a cellular network, which means that mobile phones connect to it by searching for cells in the immediate vicinity. There are five different cell sizes in a GSM network—macro, micro,

pico, femto and umbrella cells. The coverage area of each cell varies according to the implementation environment. Macro cells can be regarded as cells where the base station antenna is installed on a mast or a building above average roof top level. Micro cells are cells whose antenna height is under average roof top level; they are typically used in urban areas. Picocells are small cells whose coverage diameter is a few dozen meters; they are mainly used indoors. Femtocells are cells designed for use in residential or small business environments and connect to the service provider's network via a broadband internet connection. Umbrella cells are used to cover shadowed regions of smaller cells and fill in gaps in coverage between those cells.

Cell horizontal radius varies depending on antenna height, antenna gain and propagation conditions from a couple of hundred meters to several tens of kilometers. The longest distance the GSM specification supports in practical use is 35 kilometers (22 miles). There are also several implementations of the concept of an extended cell, where the cell radius could be double or even more, depending on the antenna system, the type of terrain and the timing advance.

Indoor coverage is also supported by GSM and may be achieved by using an indoor picocell base station, or an indoor repeater with distributed indoor antennas fed through power splitters, to deliver the radio signals from an antenna outdoors to the separate indoor distributed antenna system. These are typically deployed when a lot of call capacity is needed indoors, for example in shopping centers or airports. However, this is not a prerequisite, since indoor coverage is also provided by in-building penetration of the radio signals from nearby cell

The modulation used in GSM is Gaussian minimum-shift keying (GMSK), a kind of continuous-phase frequency shift keying. In GMSK, the signal to be modulated onto the carrier is first smoothed with a Gaussian low-pass filter prior to being fed to a frequency modulator, which greatly reduces the interference to neighboring channels (adjacent channel interference

2.4 GSM FREQUENCIES

GSM networks operate in a number of different frequency ranges (separated into GSM frequency ranges for 2G and UMTS frequency bands for 3G). Most 2G GSM networks operate in the 900 MHz or 1800 MHz bands. Some countries in the Americas (including Canada and the United States) use the 850 MHz and 1900 MHz bands because the 900 and 1800 MHz frequency bands were already allocated. Most 3G GSM networks in Europe operate in the 2100 MHz frequency band.

2.5 NETWORK STRUCTURE

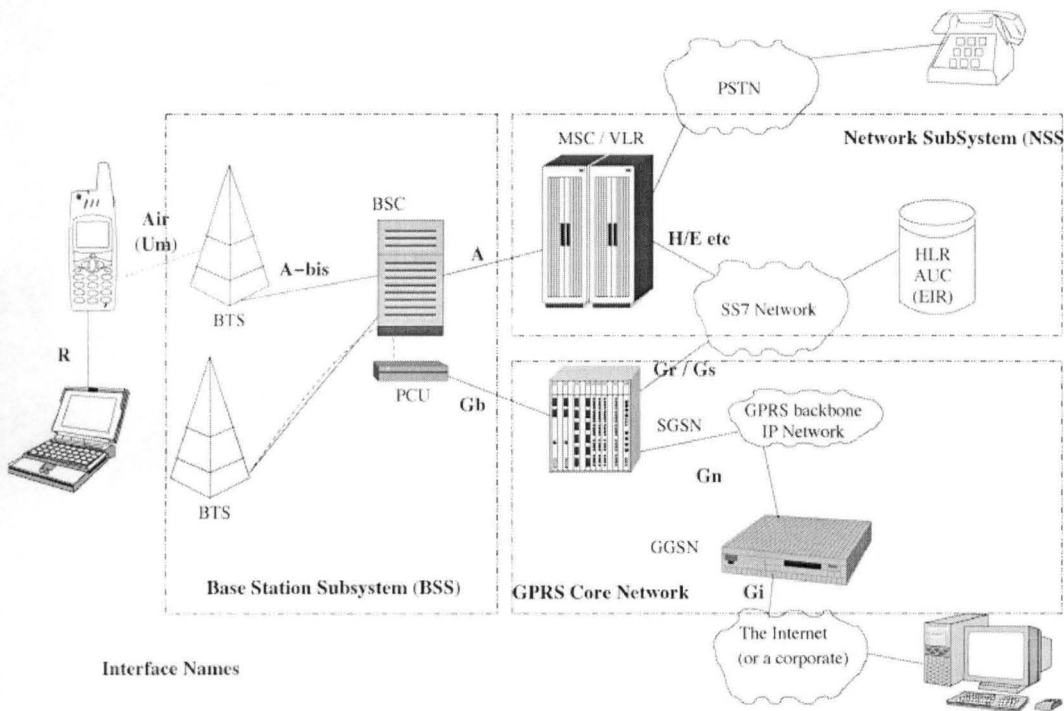


Fig 2.1 Network structure of a GSM system

The network behind the GSM seen by the customer is large and complicated in order to provide all of the services which are required. It is divided into a number of sections and these are each covered in separate articles.

- The Base Station Subsystem (the base stations and their controllers).

- The Network and Switching Subsystem (the part of the network most similar to a fixed network). This is sometimes also just called the core network.
- The GPRS Core Network (the optional part which allows packet based Internet connections).
- All of the elements in the system combine to produce many GSM services such as voice calls and SMS.

2.6 SUBSCRIBER IDENTITY MODULE (SIM)

One of the key features of GSM is the Subscriber Identity Module, commonly known as a **SIM card**. The SIM is a detachable smart card containing the user's subscription information and phone book. This allows the user to retain his or her information after switching handsets. Alternatively, the user can also change operators while retaining the handset simply by changing the SIM. Some operators will block this by allowing the phone to use only a single SIM, or only a SIM issued by them; this practice is known as SIM locking, and is illegal in some countries

2.7 GSM SECURITY

GSM was designed with a moderate level of security. The system was designed to authenticate the subscriber using a pre-shared key and challenge-response. Communications between the subscriber and the base station can be encrypted. The development of UMTS introduces an optional USIM, that uses a longer authentication key to give greater security, as well as mutually authenticating the network and the user - whereas GSM only authenticates the user to the network (and not vice versa). The security model therefore offers confidentiality and authentication, but limited authorization capabilities, and no non-repudiation. GSM uses several cryptographic algorithms for security. The A5/1 and A5/2 stream ciphers are used for ensuring

over-the-air voice privacy. A5/1 was developed first and is a stronger algorithm used within Europe and the United States; A5/2 is weaker and used in other countries.

2.8 BASIC MODEL OF THE SYSTEM

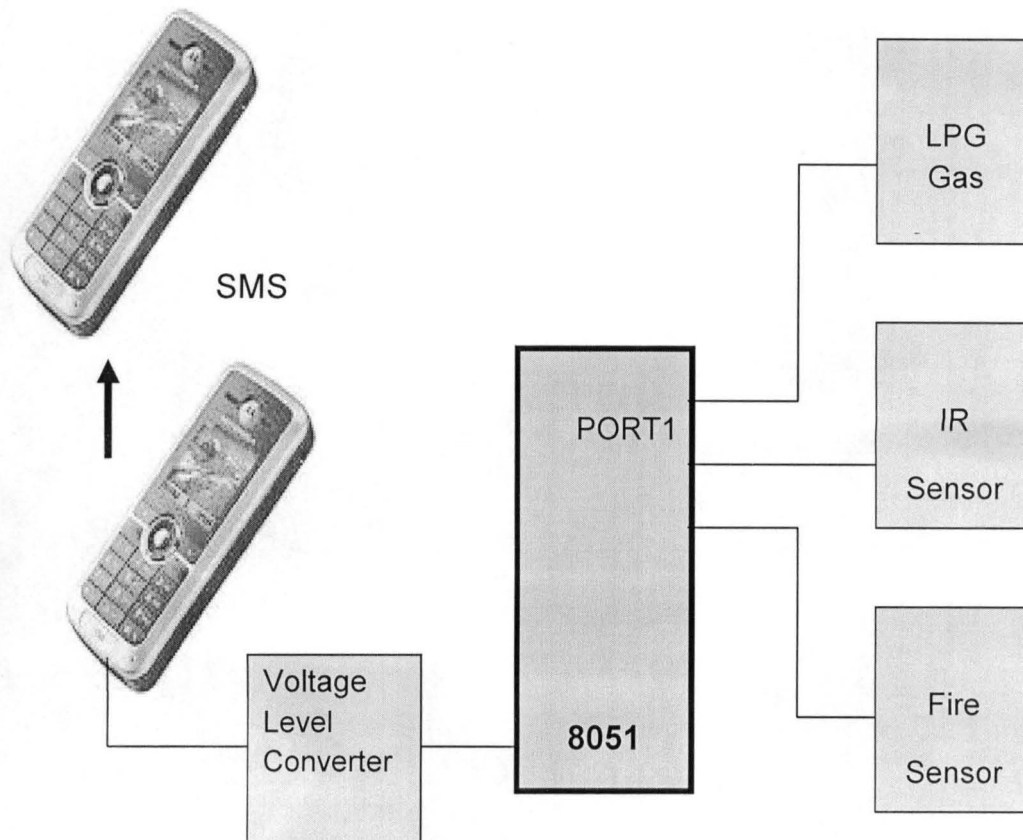


Fig 2.2 Block Diagram of the System

2.9 PARTS OF THE SYSTEM

2.9.1 MICROCONTROLLER: The microcontroller forms the heart of the system. Its responsibilities include reading the message from the GSM modem and displaying it on LCD. Reading of message from the SIM card inserted into the modem is done by sending the

appropriate AT command to the modem. Here we use the 8051 based AT89C52 manufactured by Atmel.

2.9.2 GSM MODEM: A GSM modem is a wireless modem that works with a GSM wireless network. A wireless modem behaves like a dial-up modem. The main difference between them is that a dial-up modem sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves. Like a GSM mobile phone, a GSM modem requires a SIM card from a wireless carrier in order to operate.

A GSM modem can be an external unit or a PCMCIA card (also called PC Card). An external GSM modem is connected to a PC through a serial cable, a USB cable, Bluetooth or Infrared. Like a GSM mobile phone, a GSM modem requires a SIM card from a wireless carrier in order to operate.

PC's use AT commands to control a modem. GSM modems and normal Hayes modems support a common set of AT commands. You can use a GSM modem just like a Motorola phone compatible modem. GSM modems support an extended set of AT commands. These extended AT commands are defined in the GSM standards. With these we can:

- Send SMS messages.
- Monitor the signal strength.
- Monitor the charging status and charge level of the battery.
- Read, write and search phone book entries.

The number of SMS messages that can be processed by a GSM modem is pretty low, approximately six messages per minute.

RS-232 INTERFACE: For GSM modem which works on the RS-232 voltage levels, logic 1 varies from -3 to -15 volts and logic 0 from +3 to +15 volts. The microcontroller which works on TTL logic levels, logic 1 is +5 volts and logic 0 is 0 volts. Therefore to interface the two we use a MAX 232 driver IC manufactured by Maxim.

2.9.3 DISPLAY UNIT: To display messages received we are using a 20*4 alphanumeric LCD. If any new message arrives the current one is erased and new one is displayed.

CHAPTER 3

HARDWARE DESCRIPTION

3.1 MICROCONTROLLER - AT89C52

The AT89C52 is a low-power, high-performance CMOS 8-bit microcomputer with 4 Kbytes of Flash Programmable and Erasable Read Only Memory (PEROM). The device is manufactured using Atmel's high density nonvolatile memory technology and is compatible with the industry standard MCS-51 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 Flash on a monolithic chip, the Atmel AT89C52 is a powerful microcomputer which provides a highly flexible and cost effective solution to many embedded control applications.

The AT89C52 provides the following standard features:

- 8 Kbytes of In-System Reprogrammable Flash Memory
- Endurance: 1,000 Write/Erase Cycles
- Fully Static Operation: 0 Hz to 24 MHz
- Three-Level Program Memory Lock
- 256 x 8-Bit Internal RAM
- 32 Programmable I/O Lines
- Three 16-Bit Timer/Counters
- Eight Interrupt Sources
- Programmable Serial Channel

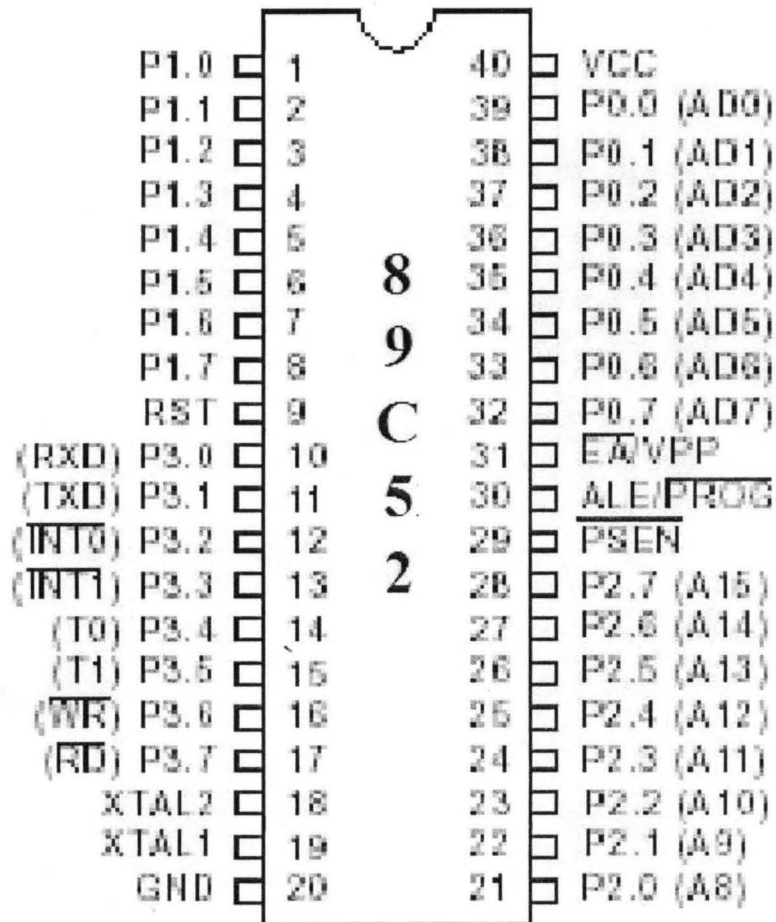


Fig 3.1 Pin Diagram of 89C52

3.1.1 FUNCTIONS OF THE 89C52 PIN

Pin 1 to 8: This consist of Port 1 of the microcontroller.

Pin 9: This is the reset button.

Pin 10 to 17: This consist of Port 3 of the microcontroller.

Pin 18 and 19: They are connected to the crystal Oscillators.

Pin 20: It is connected to ground.

Pin 21 to 28: This consist of Port 2 of the microcontroller.

Pin 29 and 30: They are used for external memory.

Pin 31 and 40: they are connected to Vcc.

Pin 32 to 39: This consist of port 0 of the microcontroller.

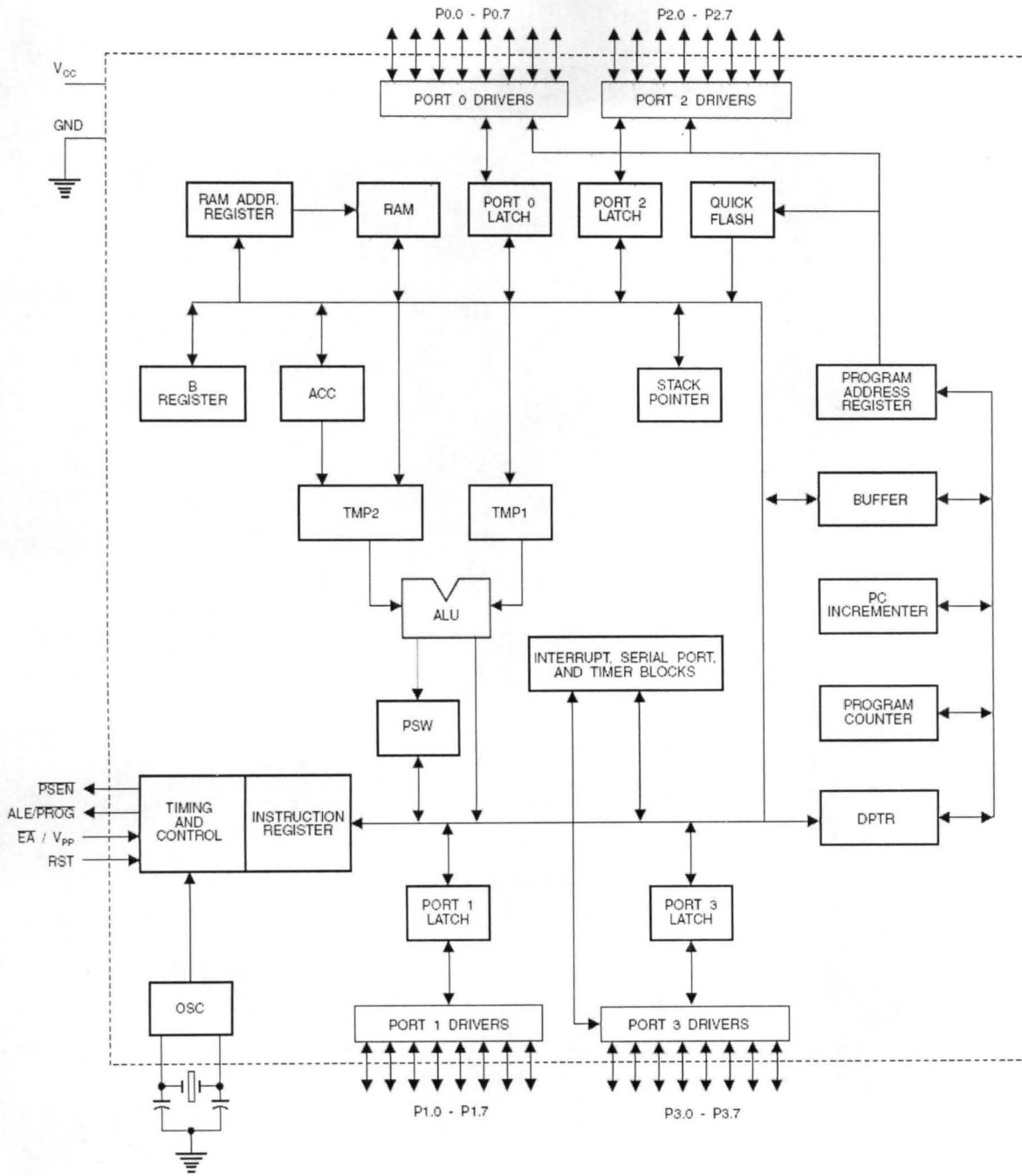


Fig3.2: Internal Architecture of AT89C52

3.2 MAX 232

The MAX220–MAX249 family of line drivers/receivers is intended for all EIA/TIA-232E and V.28/V.24 communications interfaces, particularly applications where $\pm 12V$ is not

available. These parts are especially useful in battery-powered systems, since their low-power shutdown mode reduces power dissipation to less than $5\mu\text{W}$

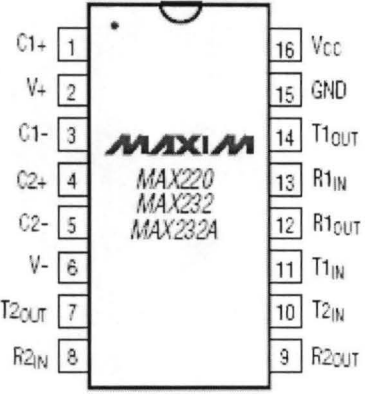


Fig3.3: Pin diagram of MAX232

3.3 RS 232

Due to its relative simplicity and low hardware overhead (as compared to parallel interfacing), serial communications is used extensively within the electronics industry. Today, the most popular serial communications standard in use is certainly the EIA/TIA-232-E specification. This standard, which has been developed by the Electronic Industry Association and the Telecommunications Industry Association (EIA/TIA), is more popularly referred to simply as "RS-232" where "RS" stands for "recommended standard". In recent years, this suffix has been replaced with "EIA/TIA" to help identify the source of the standard. We use the common notation "RS-232".

9-PIN CONNECTOR

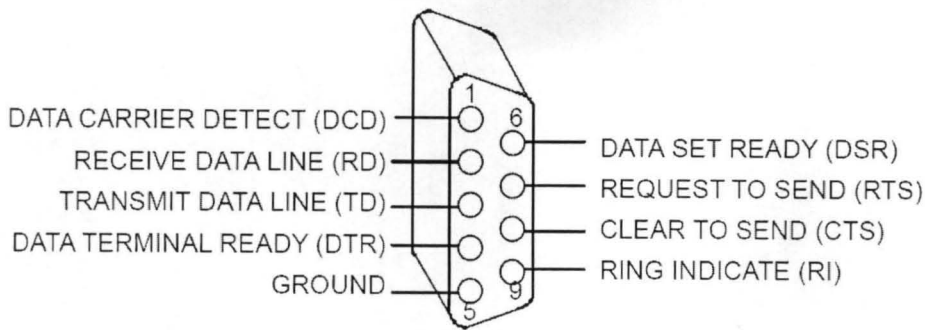


Fig 3.4 DB-9 Connector

3.4 GSM MODEM

The GSM/GPRS Modem comes with a serial interface through which the modem can be controlled using AT command interface. An antenna and a power adapter are provided.

The basic segregation of working of the modem is as numerated below;

1. Voice calls: Voice calls are not application areas to be targeted. In future if interfaces like a microphone and speaker are provided for some applications then this can be considered.
2. SMS: SMS is an area where the modem can be used to provide features like:
 - Pre-stored SMS transmission.
 - These SMS can be transmitted on certain trigger events in an automation system.
 - SMS can also be used in areas where small text information has to be sent. The transmitter can be an automation system for machines like vending machines, collection machines or applications like positioning systems where the navigator keeps on sending SMS at particular time intervals.

- SMS can be a solution where GSM data call or GPRS services are not available.

3. GSM Data Calls: Data calls can be made using this modem. Data calls can be made to a normal PSTN modem/phone line also (even received). Data calls are basically made to send/receive data streams between two units either PC's or embedded devices. The advantage of Data calls over SMS is that both parties are capable of sending/receiving data through their terminals.

3.5 LCD

- The liquid - crystal display (LCD) consist of a liquid crystal material (normally organic for LCD's) that will flow like a liquid but whose molecular structure has some properties normally associated with solids.
- The LCD does not generate its own light but depends on an external or internal source.
- Under dark conditions, it would be necessary for the unit to have its own internal light source either behind or to the side of the LCD.
- During the day, or in the lighted areas, a reflector can be put behind the LCD to reflect the light back through the display for maximum intensity.

The LCD has the distinct advantage of having the lower power requirement than the LED. It is typical in the order of microwatts for the display, as compared to the same order of mill watts for LEDs. LCD is limited to a temperature range of about 0° to 60° C. Lifetime is an area of concern because LCDs can chemically degrade.

LCDs can add a lot to our applications in terms of providing a useful interface for the user, debugging an application or just giving it a "professional" look. The most common type of LCD controller is the Hitachi 44780 which provides a relatively simple interface between a processor and an LCD. Besides this there are several other reasons for LCDs replacing LEDs (seven segment LEDs or other multisegment LEDs). This is due to the following reasons:-

- The declining prices of LCDs.
- The ability to display numbers, characters and graphics. This is in contrast to LEDs, which are limited to numbers and a few characters.
- In corporation of a refreshing controller into the LCD, thereby relieving the CPU of the task of refreshing the LCD in contrast, the LED must be refreshed by the CPU (or in some other way) to keep displaying the data.
- Ease of programming for characters and graphics.

3.6 LCD PIN DESCRIPTIONS

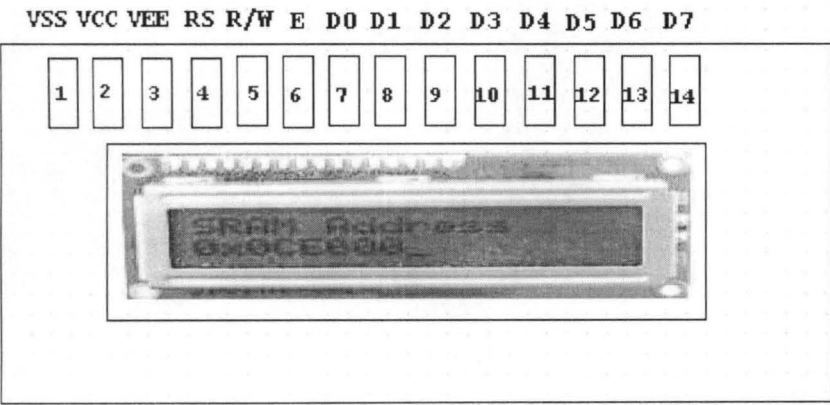


Fig 3.5 LCD pin Description

The LCD used here has 14 pins. The functions of each pin are given below:

Vcc, Vss, And V_{EE} : While Vcc and Vss provide +5V and ground, respectively, VEE is used for controlling LCD contrast.

Rs, Register Select: There are two very important registers inside the LCD. The RS pin is used for their selection as follows .If RS = 0 , then instruction command code register is selected , allowing the user to send the command such as clear display, cursor at home, etc. If RS = 1 the data register is selected, allowing the user to send data to be displayed on the LCD.

R/W, read/write: R/W input allows the user to write information to the LCD or read information from it. R/W =1 when reading; R/W = 0 when writing.

E, enable: The enable pin is used by the LCD to latch information presented to its data pins. When data is supplied to data pins, a high – to – low pulse must be applied to this pin in order for the LCD to latch in the data present at the data pins. This pulse must be a minimum of 450 ns wide.

D0 – D7: The 8 – bit data pins , D0 – D7, are used to send information to the LCD or read the contents of the LCD's internal registers.

To display letters and numbers, we send ASCII codes for the letters A- Z, a-z, and 0-9 to these pins while making RS = 1.

There are also instruction commands codes that can be send to the LCD to clear the display or force to cursor to the home position or blink the cursor.

We also use RS=0 to check the busy flag bit to see if the LCD is ready to receive information.

The busy flag is D7 and can be read when R/W=1.RS=0, as follows: if R/W=1 and RS=0. When

D7=1 (busy flag=1), the LCD is busy taking care of internal operations and will not accept any new information. When D7 = 0, the LCD is ready to receive new information.

Table 3.1a: Pin description for LCD

Pin	Symb ol	I/O	Description
1	Vss	--	Ground
2	Vcc	--	+5V power supply
3	VEE	--	Power supply to control contrast
4	RS	I	RS=0 for command register, RS=1 for data register
5	R/W	I	R/W+0 for write, R/W+1 for read
6	E	I/O	Enable
7	DB0	I/O	The 8-bit data bus
8	DB1	I/O	The 8-bit data bus
9	DB2	I/O	The 8-bit data bus
10	DB3	I/O	The 8-bit data bus
11	DB4	I/O	The 8-bit data bus
12	DB5	I/O	The 8-bit data bus
13	DB6	I/O	The 8-bit data bus
14	DB7	I/O	The 8-bit data bus

Table 3.1b: LCD command codes.

LCD Command Codes

Code (Hex)	Command to LCD Instruction Register
------------	-------------------------------------

1	Clear display screen
2	Return home
4	Decrement cursor(shift cursor to left)
6	Increment cursor(shift cursor to right)
5	Shift display left
7	Shift display left
8	Display off, cursor off
A	Display off, cursor on
C	Display on, cursor off
E	Display on
F	Display on, cursor blinking
10	Shift cursor position to left
14	Shift cursor position to right
18	Shift the entire display to the left
1C	Shift the entire display to the right
80	Force cursor to beginning of first line
C0	Force cursor to beginning of second line
38	2 lines and 5x7 matrix

WORKING: The interface used by LCD is a parallel bus, allowing simple and fast reading/writing of data to and from the LCD.

LCD Data Write Waveform

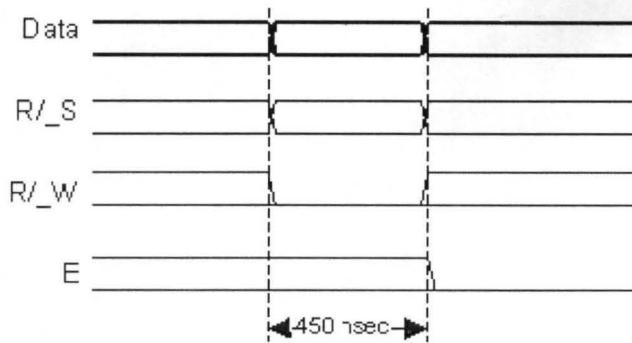


Fig. 3.7 LCD data write waveform.

This waveform will write an ASCII Byte out to the LCD's screen. The ASCII code to be displayed is eight bits long and is sent to the LCD either four or eight bits at a time. If four bit mode is used, two "nibbles" of data (Sent high four bits and then low four bits with an "Enable" Clock pulse with each nibble) are sent to make up a full eight bit transfer. The "Enable" Clock is used to initiate the data transfer within the LCD.

Sending parallel data as either four or eight bits are the two primary modes of operation. While there are secondary considerations and modes, deciding how to send the data to the LCD is most critical decision to be made for an LCD interface application.

Eight bit mode is best used when speed is required in an application and at least ten I/O pins are available. Four bit mode requires a minimum of six bits. To wire a microcontroller to an LCD in four bit mode, just the top four bits (DB4-7) are written to.

The "RS" bit is used to select whether data or an instruction is being transferred between the microcontroller and the LCD. If the Bit is set, then the byte at the current LCD "Cursor" Position can be read or written. When the Bit is reset, either an instruction is being sent to the LCD or the execution status of the last instruction is read back (whether or not it has completed).

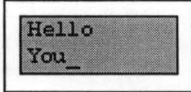
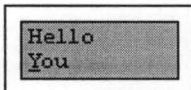
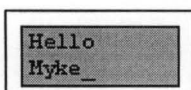
Reading Data back is best use in applications which required data to be moved back and forth on the LCD (such as in applications which scroll data between lines). In our Project we have permanently grounded R/W pin which means we are not retrieving any data from LCD.

The LCD can be thought of as a "Teletype" display because in normal operation, after a character has been sent to the LCD, the internal "Cursor" is moved one character to the right. The "Clear Display" and "Return Cursor and LCD to Home Position" instructions are used to reset the Cursor's position to the top right character on the display.

To move the Cursor, the "Move Cursor to Display" instruction is used. For this instruction, bit 7 of the instruction byte is set with the remaining seven bits used as the address of the character on the LCD the cursor is to move to. These seven bits provide 128 addresses, which matches the maximum number of LCD character addresses available.

Table.3.2. Moving the LCD's cursor.

Moving the LCD's Cursor

LCD Initial Condition		After String is written, LCD Cursor after "u"
Moving LCD Cursor		LCD Instruction "0x0C0" moves Cursor to start of second line
Final - "You" overwritten		String sent, to overwrite "You"

Eight programmable characters are available and use codes 0x000 to 0x007. They are programmed by pointing the LCD's "Cursor" to the Character Generator RAM

The last aspect of the LCD to discuss is how to specify a contrast voltage to the Display. I typically use a potentiometer wired as a voltage divider. This will provide an easily variable voltage between Ground and Vcc, which will be used to specify the contrast (or "darkness") of the characters on the LCD screen. You may find that different LCDs work differently with lower voltages providing darker characters in some and higher voltages do the same thing in others

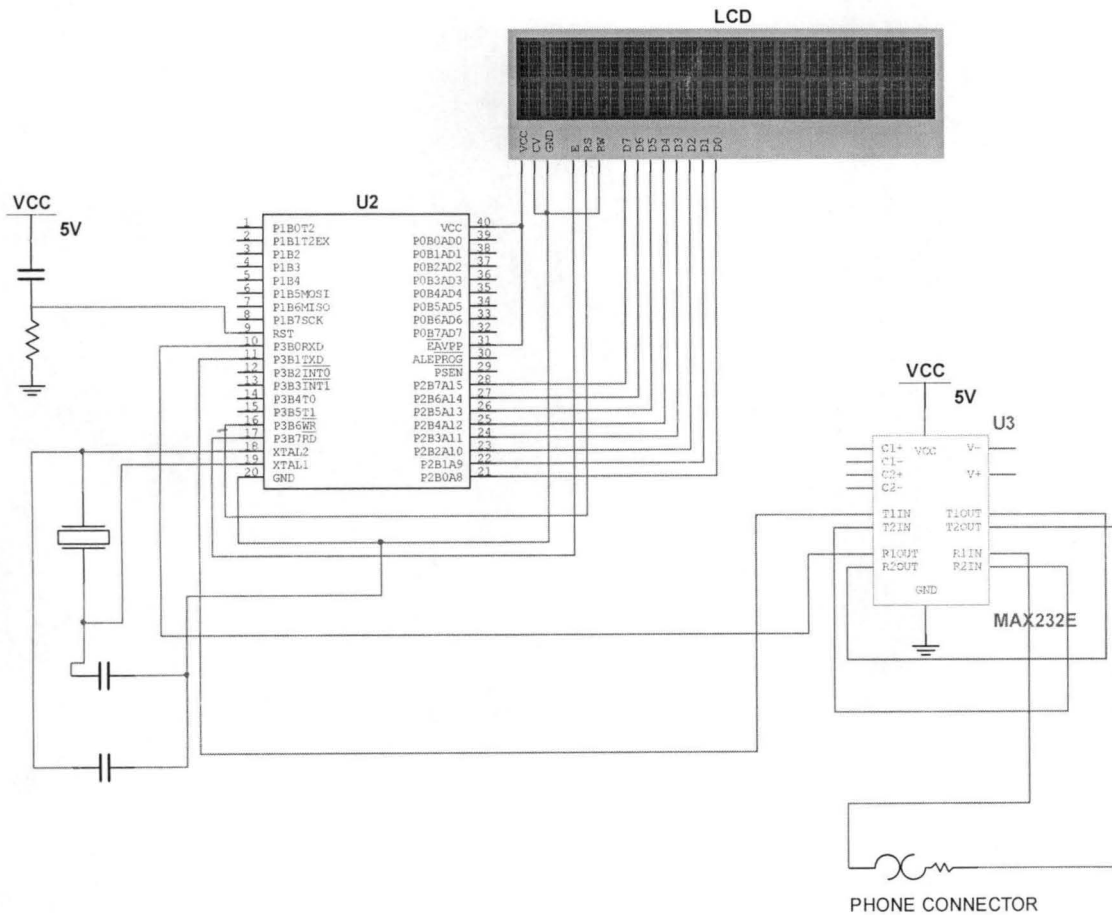


Fig. 3.6. The complete circuit diagram

3.7 INTRODUCTION TO AT COMMANDS

AT commands are instructions used to control a modem. AT is the abbreviation of **ATTENTION**. Every command line starts with "AT" or "at". That's why modem commands are called AT commands. Many of the commands that are used to control wired dial-up modems, such as ATD (Dial), ATA (Answer), ATH (Hook control) and ATO (Return to online data state), are also supported by GSM/GPRS modems and mobile phones. Besides this common AT command set, GSM/GPRS modems and mobile phones support an AT command set that is specific to the GSM technology, which includes SMS-related commands like AT+CMGS (Send SMS message), AT+CMSS (Send SMS message from storage), AT+CMGL (List SMS messages) and AT+CMGR (Read SMS messages).

3.8 GENERAL SYNTAX

The starting "AT" is the prefix that informs the modem about the start of a command line. It is not part of the AT command name. For example, D is the actual AT command name in ATD and +CMGS is the actual AT command name in AT+CMGS. However, some books and web sites use them interchangeably as the name of an AT command.

3.9 TASKS PERFORMED

Here are some of the tasks that can be done using AT commands with a GSM/GPRS modem or mobile phone:

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

- Get basic information about the subscriber. For example, MSISDN (AT+CNUM) and IMSI number (International Mobile Subscriber Identity) (AT+CIMI).
- Get the current status of the mobile phone or GSM/GPRS modem. For example, mobile phone activity status (AT+CPAS), mobile network registration status (AT+CREG), radio signal strength (AT+CSQ), battery charge level and battery charging status (AT+CBC).
- Establish a data connection or voice connection to a remote modem (ATD, ATA, etc).
- Send and receive fax (ATD, ATA, AT+F*).
- Send (AT+CMGS, AT+CMSS), read (AT+CMGR, AT+CMGL), write (AT+CMGW) or delete (AT+CMGD) SMS messages and obtain notifications of newly received SMS messages (AT+CNMI).
- Read (AT+CPBR), write (AT+CPBW) or search (AT+CPBF) phonebook entries.
- Perform security-related tasks, such as opening or closing facility locks (AT+CLCK), checking whether a facility is locked (AT+CLCK) and changing passwords (AT+CPWD). (Facility lock examples: SIM lock [a password must be given to the SIM card every time the mobile phone is switched on] and PH-SIM lock [a certain SIM card is associated with the mobile phone. To use other SIM cards with the mobile phone, a password must be entered.])
- Control the presentation of result codes / error messages of AT commands. For example, you can control whether to enable certain error messages (AT+CMEE) and whether error messages should be displayed in numeric format or verbose format (AT+CMEE=1 or AT+CMEE=2).

- Get or change the configurations of the mobile phone or GSM/GPRS modem. For example, change the GSM network (AT+COPS), bearer service type (AT+CBST), radio link protocol parameters (AT+CRLP), SMS center address (AT+CSCA) and storage of SMS messages (AT+CPMS).
- Save and restore configurations of the mobile phone or GSM/GPRS modem. For example, save (AT+CSAS) and restore (AT+CRES) settings related to SMS messaging such as the SMS center address.

3.10 TYPES

There are two types of AT commands: basic commands and extended commands.

- Basic commands are AT commands that do not start with "+". For example, D (Dial), A (Answer)
- Extended commands are AT commands that start with "+". All GSM AT commands are Extended commands. For example, +CMGS (Send SMS message), +CMGL (List SMS Messages) and +CMGD (DELETE SMS messages) are extended commands.

3.11 READING AND SENDING SMS USING AT COMMANDS

3.11.1 Reading Messages: To enable a computer / PC to read SMS messages from a message storage area, the GSM/GPRS modem or mobile phone has to support either of the AT commands +CMGR (command name in text: Read Messages) and +CMGL (command name in text: List Messages). The +CMGR AT command is used to read an SMS message at a certain location of the message storage area, while the +CMGL AT command is used to read SMS messages that have a certain status from the message storage area. The status can be "received unread",

"received read", "stored unsent", "stored sent", etc. The +CMGL AT command also allows you to retrieve all SMS messages stored in the message storage area.

3.11.2 Illustrating the difference between +CMGR and +CMGL; Suppose you want to use your computer / PC to read a text message from the message storage area and you know the index at which the SMS text message is located. In this case, you should use the +CMGR AT command. Here is the command line to be typed (assume the SMS text message is stored at index 3)

```
AT+CMGR=3
```

The GSM/GPRS modem or mobile phone should return something like this:

```
+CMGR: "REC READ","+85291234567",,"07/02/18,00:12:05+32"
```

Hello, welcome to our SMS tutorial.

OK

(b) Suppose you are now in another situation. You want to use your computer / PC to retrieve all inbound SMS messages that have not been read before. In this case, you should use the +CMGL AT command. In SMS text mode, the command line to be used should be:

```
AT+CMGL="REC UNREAD"
```

The GSM/GPRS modem or mobile phone should return something like this:

```
+CMGL: 1,"REC UNREAD","+85291234567",,"07/02/18, 00:05:10+32"
```

Reading text messages is easy.

```
+CMGL: 2,"REC UNREAD","+85291234567",,"07/02/18, 00:07:22+32"
```

A simple demo of SMS text messaging.

OK

(c) The +CMGL AT command can also be used to read all SMS messages stored in the message storage area. To do so in SMS text mode, the command line should be: AT+CMGL="ALL". This time the response of the GSM/GPRS modem or mobile phone should be something like this:

```
+CMGL: 1,"REC READ","+85291234567",,"07/02/18,00:05:10+32"
```

Reading text messages is easy.

```
+CMGL: 2,"REC READ","+85291234567",,"07/02/18,00:07:22+32"
```

A simple demo of SMS text messaging.

```
+CMGL: 3,"REC READ","+85291234567",,"07/02/18,00:12:05+32"
```

Hello, welcome to our SMS tutorial.

OK

As you can see above, the +CMGR AT command can only be used to read one SMS message at a time, while the +CMGL AT command can be used to read multiple SMS messages at a time.

.11.3 Sending Messages: To send SMS messages, first place a valid SIM card from a wireless carrier into a mobile phone or GSM/GPRS modem, which is then connected to a computer. There are several ways to connect a mobile phone or GSM/GPRS modem to a computer. For example, they can be connected through a serial cable, a USB cable, a Bluetooth link or an infrared link. The actual way to use depends on the capability of the mobile phone or GSM/GPRS modem. For example, if a mobile phone does not support Bluetooth, it cannot connect to the computer through a Bluetooth link.

After connecting a mobile phone or GSM/GPRS modem to, you can control the mobile phone or GSM/GPRS modem by sending instructions to it. The instructions used for controlling mobile phone or GSM/GPRS modem are called AT commands. (AT commands are also used

to control dial-up modems for wired telephone system.) Dial-up modems, mobile phones and GSM/GPRS modems support a common set of standard AT commands. In addition to this common set of standard AT commands, mobile phones and GSM/GPRS modems support an extended set of AT commands. One use of the extended AT commands is to control the sending and receiving of SMS messages.

The following table lists the AT commands that are related to the writing and sending of SMS messages:

Table 3.3 AT Command Instructions

AT command	Meaning
+CMGS	Send message
+CMSS	Send message from storage
+CMGW	Write message to memory
+CMGD	Delete message
+CMGC	Send command
+CMMS	More messages to send

3.12 FLOWCHART

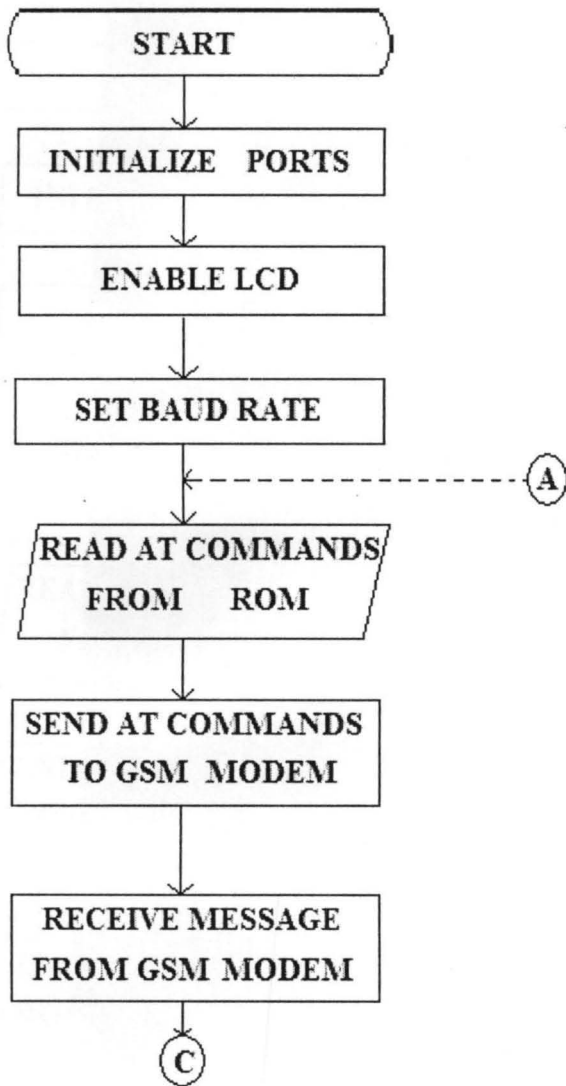


Fig 3.9a Flow Chart

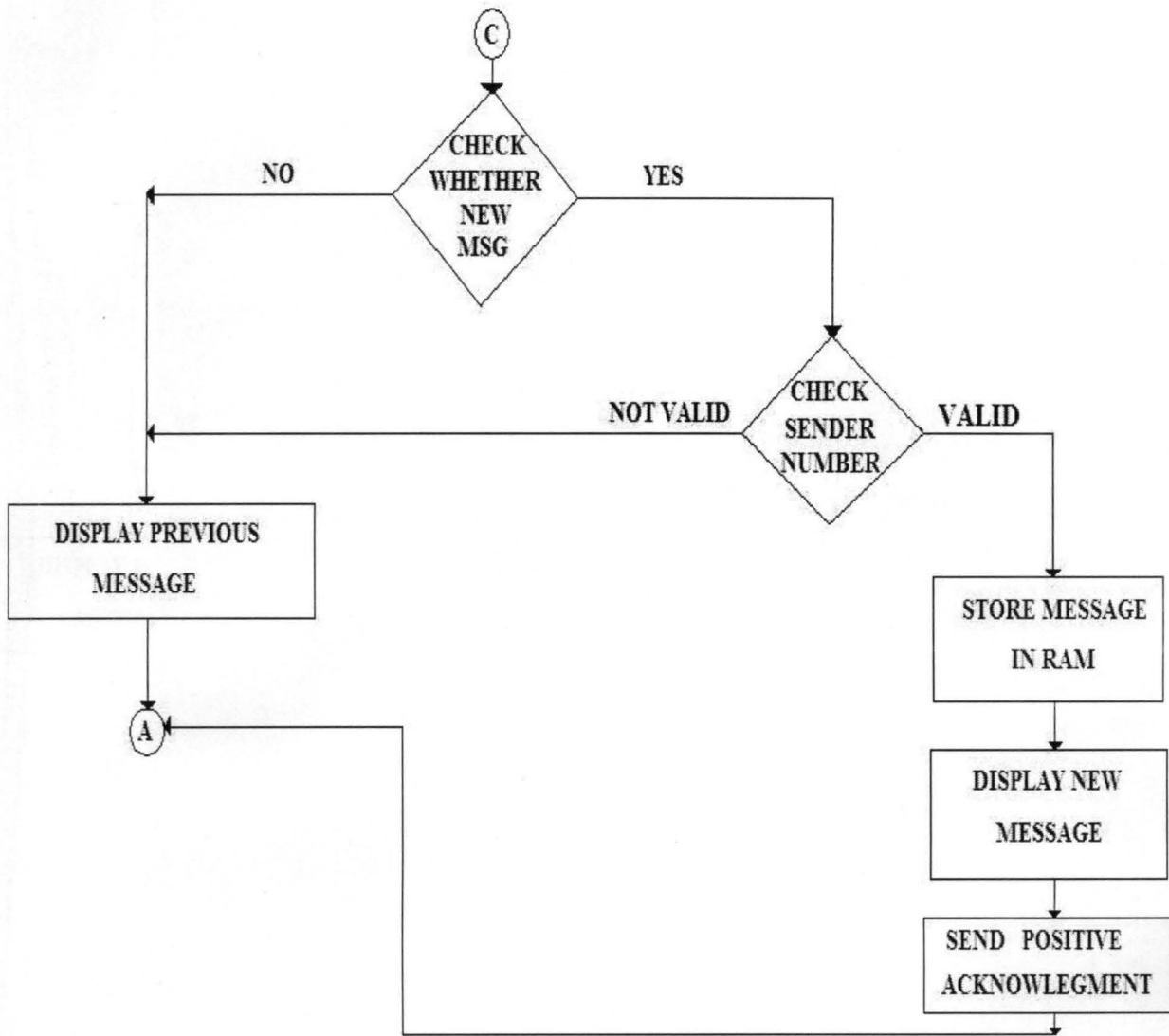


Fig.3.9b Flow Chart

CHAPTER FOUR

TESTS, RESULTS AND DISCUSSION

4.1 SOFTWARE

4.2 INTRODUCTION TO KEIL

Keil u Micro Version is an integrated development environment used to create software to be run on embedded systems (like a microcontroller). It allows for such software to be written either in assembly or C programming languages and for that software to be simulated on a computer before being loaded onto the microcontroller.

Keil uVersion3 is an IDE (Integrated Development Environment) that helps write, compile, and debug embedded programs. It encapsulates the following components:

- A project manager.
- A make facility.
- Tool configuration.
- Editor.
- A powerful debugger.

To create a new project in Vision3:

1. Select Project - New Project.
2. Select a directory and enter the name of the project file.
3. Select Project –Select Device and select a device from Device Database.
4. Create source files to add to the project

5. Select Project - Targets, Groups, and Files. Add/Files, select Source Group1, and add the Source files to the project.
6. Select Project - Options and set the tool options. Note that when the target device is selected from the Device Database all-special options are set automatically. Default memory model settings are optimal for most applications.
7. Select Project - Rebuild all target files or Build target.

To create a new project, simply start Micro Vision and select “Project”=>”New Project” from the pull-down menus. In the file dialog that appears, choose a name and directory for the project. It is recommended that a new directory be created for each project, as several files will be generated. Once the project has been named, the dialog shown in the figure below will appear, prompting the user to select a target device. In this lab, the chip being used is the “AT89C52,” which is listed under the heading “Atmel”.

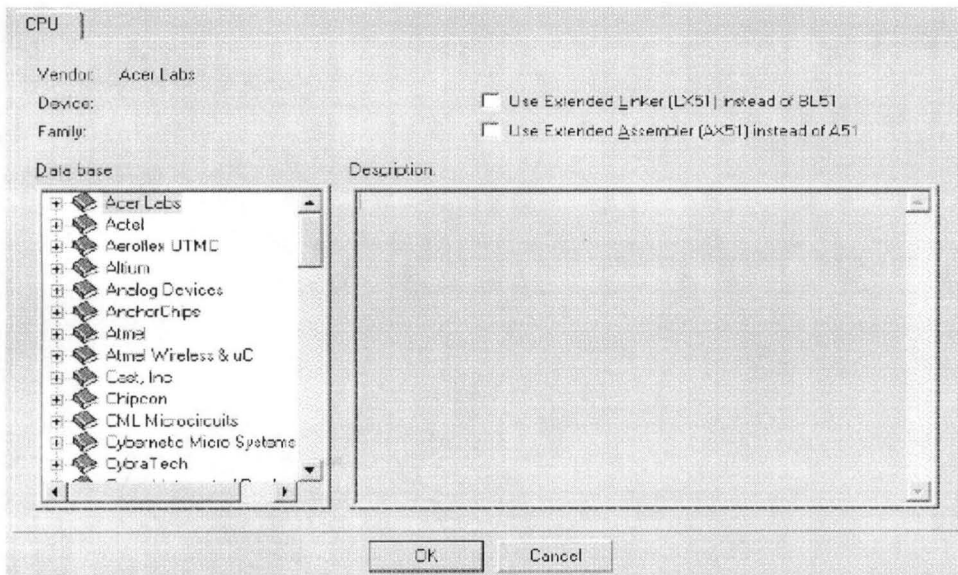


Fig 4.1: Window for choosing target device.

Next, Micro Vision must be instructed to generate a HEX file upon program compilation. A HEX file is a standard file format for storing executable code that is to be loaded onto the microcontroller. In the “Project Workspace” pane at the left, right-click on “Target 1” and select “Options for ‘Target 1’ ”. Under the “Output” tab of the resulting options dialog, ensure that both the “Create Executable” and “Create HEX File” options are checked. Then click “OK”.

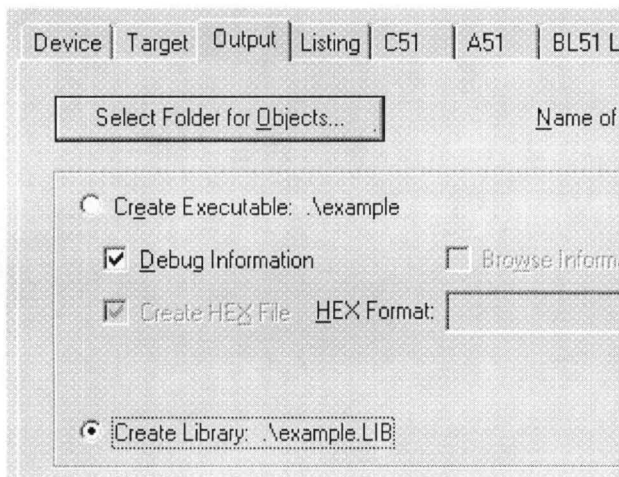


Fig 4.2: Project Options Dialog

Next, a file must be added to the project that will contain the project code. To do this, expand the “Target 1” heading, right-click on the “Source Group 1” folder, and select “Add files...” Create a new blank file (the file name should end in “.asm”), select it, and click “Add.” The new file should now appear in the “Project Workspace” pane under the “Source Group 1” folder. Double-click on the newly created file to open it in the editor. All code for this lab will go in this file. To compile the program, first save all source files by clicking on the “Save All” button, and then click on the “Rebuild All Target Files” to compile the program as shown in the figure below. If any errors or warnings occur during compilation, they will be displayed in the output window at the bottom of the screen. All errors and warnings will reference the line and

column number in which they occur along with a description of the problem so that they can be easily located. Note that only errors indicate that the compilation failed, warnings do not (though it is generally a good idea to look into them anyway).

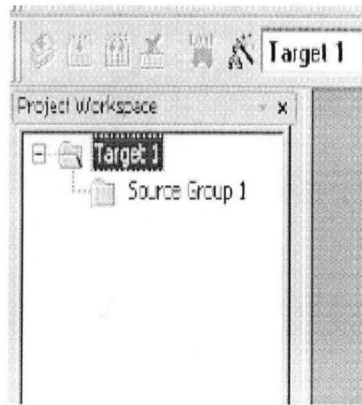


Fig 4.3: Project Workspace Pane



Fig 4.4: “Save All” and “Build All Target Files” Buttons

When the program has been successfully compiled, it can be simulated using the integrated debugger in Keil MicroVision. To start the debugger, select “Debug”=>”Start/Stop Debug Session” from the pull-down menus.

At the left side of the debugger window, a table is displayed containing several key parameters about the simulated microcontroller, most notably the elapsed time (circled in the

figure below). Just above that, there are several buttons that control code execution. The “Run” button will cause the program to run continuously until a breakpoint is reached, whereas the “Step Into” button will execute the next line of code and then pause (the current position in the program is indicated by a yellow arrow to the left of the code)[15].

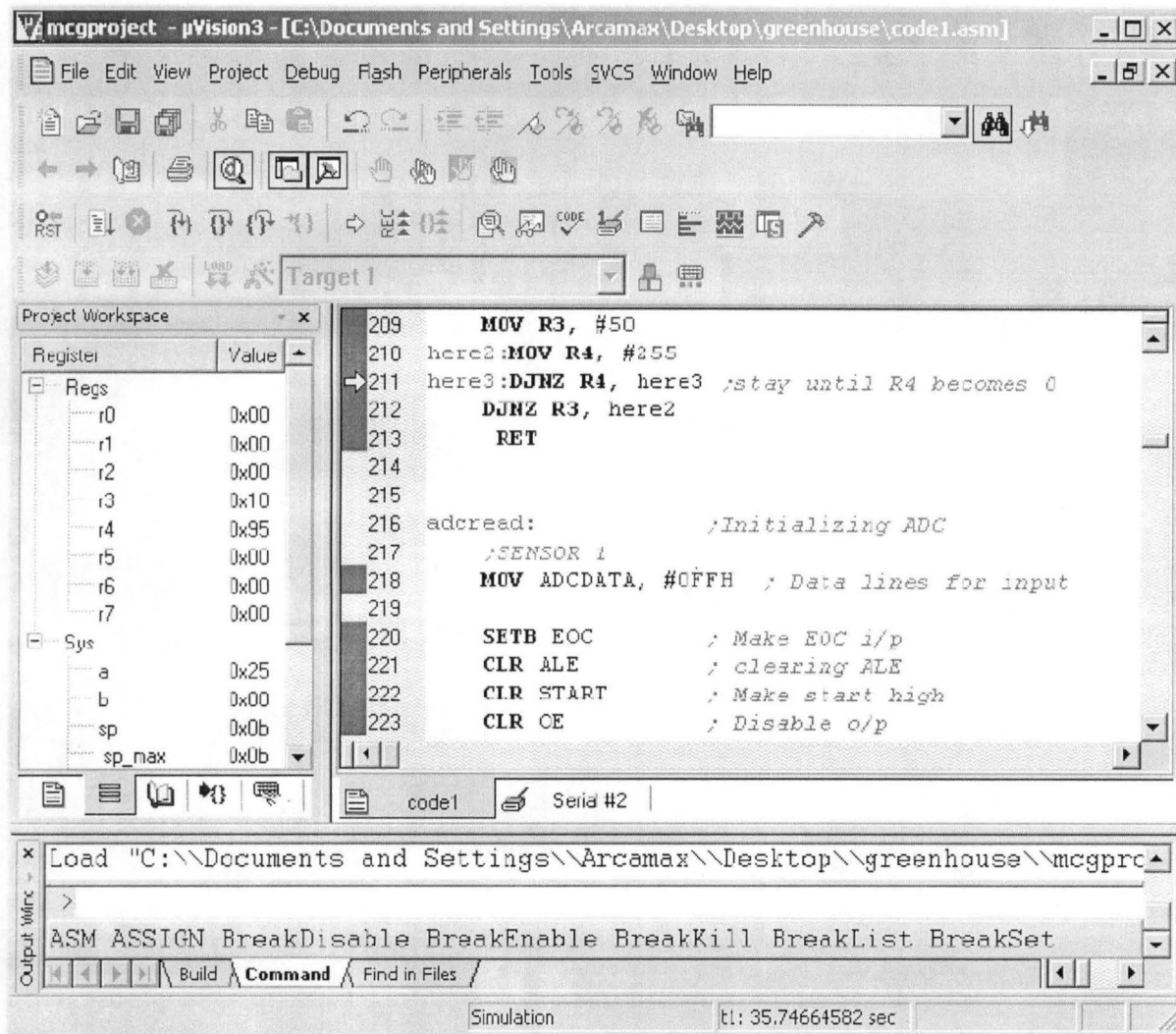


Fig 4.5: Vision3 Debugger window

4.3 PROGRAMMER

The programmer used is a powerful programmer for the Atmel 89 series of microcontrollers that includes 89C51/52/55, 89S51/52/55 and many more.

It is simple to use & low cost, yet powerful flash microcontroller programmer for the Atmel 89 series. It will Program, Read and Verify Code Data, Write Lock Bits, Erase and Blank Check. All fuse and lock bits are programmable. This programmer has intelligent onboard firmware and connects to the serial port. It can be used with any type of computer and requires no special hardware. All that is needed is a serial communication port which all computers have.

All devices also have a number of lock bits to provide various levels of software and programming protection. These lock bits are fully programmable using this programmer. Lock bits are useful to protect the program to be read back from microcontroller only allowing erase to reprogram the microcontroller [16].

Major parts of this programmer are Serial Port, Power Supply and Firmware microcontroller. Serial data is sent and received from 9 pin connector and converted to/from TTL logic/RS232 signal levels by MAX232 chip. A Male to Female serial port cable, connects to the 9 pin connector of hardware and another side connects to back of computer. All the programming 'intelligence' is built into the programmer so you do not need any special hardware to run it. Programmer comes with window based software for easy programming of the devices.

CHAPTER FIVE

CONCLUSIONS

5.1. Conclusion

Home security has been a major issue where crime is increasing and everybody wants to take proper measures to prevent intrusion. In addition there was a need to automate home so that user can take advantage of the technological advancement in such a way that a person getting off the office does not get melted with the hot climate.

The project is aimed at developing the security of Home against Intruders, Gas Leak and Fire. In any of the above three cases any one met while you are out of your home than the device sends SMS to the emergency no provided to it.

The report consists of a background into the area of 8051 microcontroller and mobile communication, how they are interfaced to each other and AT (Attention) commands set used in communication.

5.2 Recommendation

It is recommended that the system be put to better use because of its obvious advantages. Any individual or industry that require the service of this product should connect it to a voltage stabilizer before use, this is to avoid any fluctuation in the supply voltage which can alter the operation of the system, this will make it restart itself there by making the user wait until the system initializes. Finally, individuals, business or cooperate bodies should take advantage the project offers to improve security of valuables and properties. In respect to the features included in this work, the possible improvements that can be included in this project are;

5.3 Possible Improvement

The system can be designed such that it will have an alternative power supply in case of power outage, a rechargeable battery can be included so as to maintain the systems efficiency. Also a portable inverter can be designed along with the prototype, so that in the case of power failure from PHCN, the system can still remain active.

REFERENCES

- [1] The 8051 Microcontroller by Kenneth J. Ayala, 2nd edition, 1996,
- [2] The 8051 Microcontroller and Embedded Systems by Muhammad Ali Mazidi., Jan, 2001.
- [3] Principles and Applications of GSM by Vijay Garg. 3rd edition.
- [4] Artificial Intelligence – Elaine Rich & Kevin Knight, Tata Mc Graw Hill, 2nd Edition.
- [5] Artificial Intelligence – A Modern approach – Stuart Russel and Peter Norving, Pearson Education, 2nd Edition.
- [6] Introduction to Robotics – P.J. Mc Kerrow, Addison Wesley, USA, 1991 Bernard Sklar, *Digital Communications: Fundamentals and Applications*, Prentice Hall, 2001.
- [7] A. Clark and R. Harun, Assessment of Kalman-filter channel estimators for an HF radio link," *IEE Proceedings*, vol. 133, pp. 513-521, Oct 1986.
- [8] ETSI 300 502. European Digital Cellular Telecommunication System (Phase 2); Teleservices Supported by a GSM Public Land Mobile Network (PLMN). *European Telecommunications Standards Institute*. September 1994.
- [9] Matthew C. Valenti and Jian Sun, *Chapter 12: Turbo Codes*, Handbook of RF and Wireless
- [10] *GSM Multiple Access Scheme*, <http://www.eecg.toronto.edu/~nazizi/gsm/ma/> William Stallings *Data and Computer Communications 7th Edition: Chapter 9 Spread Spectrum*, <http://juliet.stfx.ca/~lyang/csci-465/lectures/09-SpreadSpectrum-new.ppt>

- [11] ETS 300 608. Digital Cellular Telecommunication System (Phase 2); Specification of the Subscriber Identity Module-Mobile Equipment (SIM-ME) Interface. *European Telecommunications Standards Institute*. May 1998.
- [12] ETR 100. European Digital Cellular Telecommunication System (Phase 2); Abbreviations and Acronyms. *European Telecommunications Standards Institute*. April 1995.
- [13] Jörg Eberspächer and Hans-Jörg Vögel. *GSM switching, services and Protocols*. John Wiley and Sons, 1999.
- [14] Klaus Vedder GSM: Security, Services, and SIM. State of the art in Applied Cryptography. *Course on Computer Security and Industrial Cryptography*. Leuven, Belgium, June 3-6, 1997.
- [15] J. Wu and A. H. Aghvami, "A new adaptive equalizer with channel estimator for mobile radio communications," *IEEE Transactions on Vehicular Technology*,
- [16] L. J Cimini, "Analysis and simulation of a digital mobile channel using orthogonal frequency division multiplexing," *IEEE Transactions on Communications*, vol. 33, pp. 665-675, July 1985.
- [17] B. Saltzberg, "Performance of an efficient parallel data transmission system," *IEEE Trans. Commun. Techn.*, pp. 805-813, December 1967
- [18] M. Zimmermann and A. Kirsch, "The AN/GSC-10/KATHRYN variable rate data modem for HF radio," *IEEE Trans. Commun. Techn.*, vol CCM-15,16
- [19] Hardware and user manuals of the modem from MOTOROLA C168
- [20] <http://developer.motorola.com/getDocument.do?docId=65054>
- [21] <http://www.mobilegpsonline.com/downloads/GM28-29%20Datasheet%20R1G.pdf>
- [22] <http://www.mobilegpsonline.com/GSMJC01Spec.pdf>
- [23] http://www.visualgsm.com/wire_sms_index.htm

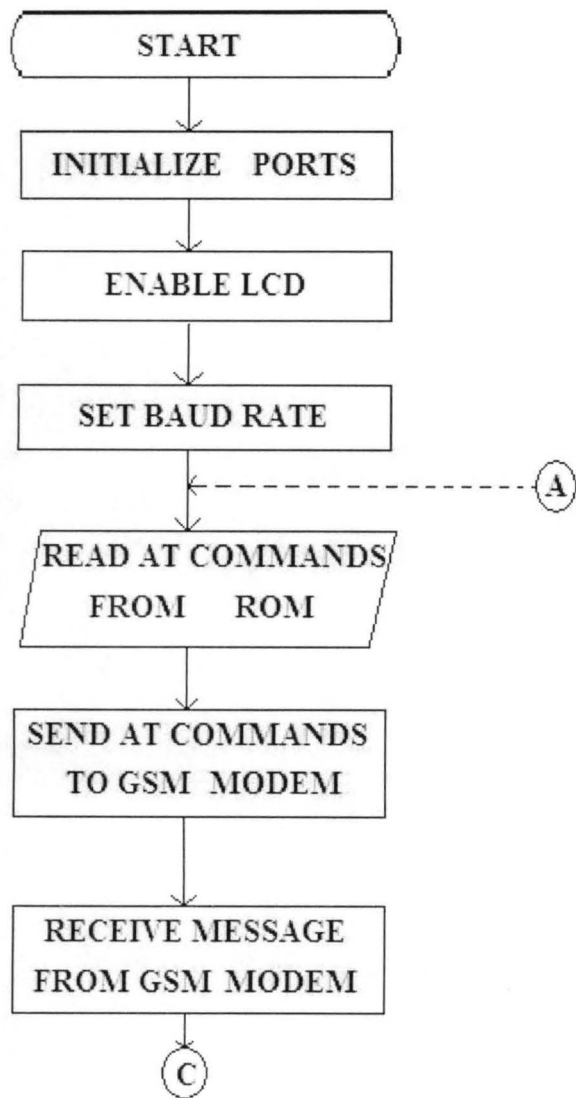
[24] <http://en.wikipedia.org/wiki/Gsm>

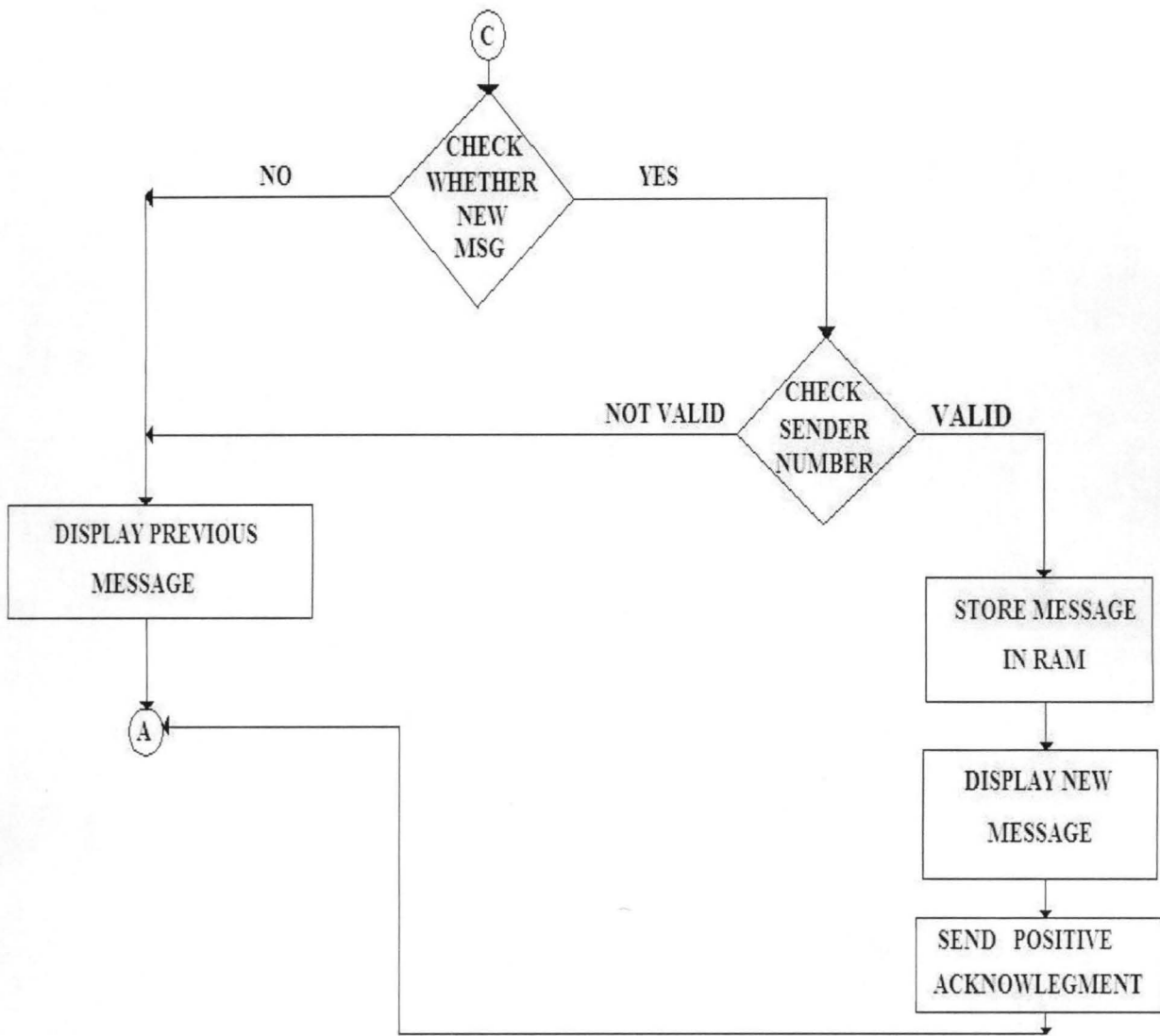
APPENDIX A: USER'S MANUAL

GSM HOME SECURITY SYSTEM

1. Turn on the power switch
2. Make sure the led for the power switch is turn off and glowing
3. Ensure that the message is display on the LCD display. The message that will be display is "GSM HOME SECURITY SYSTEM"
4. Connect the headphone to the mobile phone which is use as the GSM modem
5. Make sure the mobile phone connected to the embedded device send message to the remote phone
6. Activate any sensor, it will then send the corresponding message.

APPENDIX B: FLOWCHART





APPENDIX C: SOURCE CODE

```
#include<reg52.h>

sbit RS=P3^7;
sbit EN=P3^6;

sbit FIRE=P3^2;
sbit MOTION=P3^3;
sbit GAS = P2^0;

#define LCD_PORT P2

//-----
// Forward function declaration
//-----
void Txmsg(unsigned char k);
void lcdinit(void);
void lcdData(unsigned char l);
void lcdcmd(unsigned char k);
void DelayMs(unsigned int count);
void InitModem(void);
void initdisplay(void);

unsigned char count;

//-----
// Main routine
//-----
void main()
{
    TMOD=0x20;           // Configure UART at 9600 baud rate
    TH1=0xFD;
    SCON=0x50;
    TR1=1;

    lcdinit();          // Initialize LCD
    initdisplay();
    DelayMs(5000);
    InitModem();        // Initialize Modem
    lcdinit();          // Initialize LCD

    Txmsg(0);
    while(1)
    {
        if(FIRE==0)
            Txmsg(1);
        if(MOTION==0)
            Txmsg(2);
    }
}
```

```

//-----
// Modem initialization subroutine
//-----
void InitModem(void)
{
unsigned int j=0;
unsigned char i=0,k=0;
unsigned char a[]="at+cmgfm=1";
unsigned char b[]="at+cpms=\"ME\", \"ME\", \"ME\"";
unsigned char c[]="at+cmgd=";
unsigned char d[6];

ReInit:

for(i=0;i<6;i++)
d[i]=0x00;

i=0;
while(a[i]!='\0')
{
SBUF=a[i];
while(TI==0); // ATE0 sending to turn off the echo
TI=0;
lcdData(a[i]);
i++;
}

lcdData(' '); // Enter
SBUF=0x0d;
while(TI==0);
TI=0;

for(i=0;i<4;i++) //command to recv data
{
j=0;
while(RI==0)
{
if(j>=1000)
goto ReInit;
DelayMs(1);
j++;
}
d[i]=SBUF;
RI=0;
lcdData(d[i]);
}

for(i=0;i<4;i++) //command to compare data
{
if((d[i]=='E') || (d[i]=='R'))
goto ReInit;
if((d[i]=='O') || (d[i]=='K'))
goto Inits;
}

```

```

for(i=0;i<5;i++)                //command to recv data
{
j=0;
while(RI==0)
{
if(j>=1000)
goto ReInit;
DelayMs(1);
j++;
}
d[i]=SBUF;
RI=0;
lcdData(d[i]);
}

for(i=0;i<5;i++)                //command to compare data
{
if((d[i]=='E') || (d[i]=='R'))
goto ReInit;
if((d[i]=='+') || (d[i]=='C'))
goto Inits2;
}

Inits2:
for(k=0;k<10;k++)
{
for(i=0;i<6;i++)
d[i]=0x00;

lcdcmd(0x01);
DelayMs(10);
lcdcmd(0x80);
DelayMs(10);

i=0;
while(c[i]!='\0')
{
SBUF=c[i];
while(TI==0);                // sending AT+CMGD to delete message
TI=0;
lcdData(c[i]);
i++;
}

lcdData(k + 0x30);            // Enter
SBUF=k + 0x30;
while(TI==0);
TI=0;

lcdData(' ');                // Enter
SBUF=0x0d;
while(TI==0);
TI=0;

```



```

for(i=0;i<5;i++)
{
j=0;
while(RI==0)
{
if(j>=1000)
goto ReInit;
DelayMs(1);
j++;
}
d[i]=SBUF;
RI=0;
lcdData(d[i]);
}
DelayMs(100);
}
return;
}

//-----
// Transmit message subroutine
//-----
void Txmsg(unsigned char k)
{
unsigned char i=0,rec;
unsigned int j=0;
unsigned char a[]="at+cmgs=\"+2348051874638\"";
unsigned char b[]="Home Security System";
unsigned char d[]="Your home has caught fire";
unsigned char e[]="Some buddy entered your home";
unsigned char c[10];

retryTx:
//Retry();

for(i=0;i<10;i++)
c[i]=0x00;

lcdinit();

i=0;
while(a[i]!='\0')
{
lcdData(a[i]);
SBUF=a[i];
while(TI==0);
TI=0;
i++;
}

lcdData(' ');
SBUF=0x0d;
while(TI==0);

```

```

TI=0;

do
{
j=0;
while(RI==0)
{
if(j>=1000)
goto retryTx;
DelayMs(1);
j++;
}
rec=SBUF;
RI=0;
lcdData(rec);
} while(rec!='>');
DelayMs(1000);

lcdinit();

if(k==0)
{
i=0;
while(b[i]!='\0')
{
SBUF=b[i];
while(TI==0);
TI=0;
lcdData(b[i]);
i++;
}
}

if(k==1 && count<=4)
{
i=0;
while(d[i]!='\0')
{
SBUF=d[i];
while(TI==0);
TI=0;
lcdData(d[i]);
i++;
}
SBUF=count+0x30;
while(TI==0);
TI=0;
}

if(k==1 && count>4)
{
i=0;
while(e[i]!='\0')
{

```

```

SBUF=e[i];
while(TI==0);
TI=0;
lcdData(e[i]);
i++;
}
}

lcdData('Z');
SBUF=26;
while(TI==0);
TI=0;

lcdinit();

for(i=0;i<10;i++)
{
j=0;
while(RI==0)
{
for(i=0;i<10;i++)          //command to recv data
{
if((c[i]=='E') || (c[i]=='R'))
goto retryTx;
}
return;
}

//-----
// Lcd initialization subroutine
//-----
void lcdinit(void)
{
lcmd(0x38);
DelayMs(250);
lcmd(0x0E);
DelayMs(250);
lcmd(0x01);
DelayMs(250);
lcmd(0x06);
DelayMs(250);
lcmd(0x80);
DelayMs(250);
}

//-----
// Lcd data display
//-----
void lcdData(unsigned char l)
{
LCD_PORT=l;
RS=1;
EN=1;
DelayMs(1);
}

```

```

EN=0;
return;
}

//-----
// Lcd command
//-----
void lcdcmd(unsigned char k)
{
LCD_PORT=k;
RS=0;
EN=1;
DelayMs(1);
EN=0;
return;
}

//-----
// Delay mS function
//-----
void DelayMs(unsigned int count)
{
Delay 11.0592 Mhz // mSec
    unsigned int i; // Keil v7.5a
    while(count) {
        i = 115; // 115 exact value
        while(i>0) i--;
        count--;
    }
}

void initdisplay(void)
{
unsigned char d=0,a[]="GSM Home Security System";
lcdcmd(0x01);
lcdcmd(0x80);
while(d!=15)
{
lcdData(a[d]);
d++ ;
}
lcdcmd(0xc0);
while(a[d]!='\0')
{
lcdData(a[d]);
d++ ;
}
}

```

APPENDIX D: PICTORIAL VIEWS OF THE DESIGN

