GSM BASED LCD NOTICE BOARD DISPLAY

Dissertation submitted in fulfillment of the requirements for the Degree of

BACHELOR OF TECHNOLOGY

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

By

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June 2016

DECLARATION BY THE SCHOLAR

We hereby declare that the work reported in the B-Tech thesis entitled **"GSM based Wireless Notice Board Display"** submitted at **Jaypee University of Information Technology, Waknaghat, India** is an authentic record of our work carried out under the supervision of **Mr. Pardeep Garg**.

We have not submitted this work elsewhere for any other degree or diploma.

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Date – 24/05/16

SUPERVISOR'S CERTIFICATE

This is to certify that the work reported in the B-Tech. thesis entitled "**GSM based Wireless Notice Board Display**", submitted by **Ayush Jamalta (121094), Abhishek Gupta (121103), Kritika Sood (121107)** at **Jaypee University of Information Technology, Waknaghat**, **India** is a bonafide record of their original work carried out under my supervision.

This work has not been submitted elsewhere for any other degree or diploma.

Signature of Supervisor

Mr. Pardeep Garg

Assistant Professor

Date – 24/05/16

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Date – 24/05/16

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS & ABBREVIATIONS

CD	Carrier Detect
CMGF	Command name in text: Message Format
CMGS	Command name in SMS text Mode
CMGW	Command name in text: Write Message to Memory
CTS	Clear To Send
DCE	Data Circuit-terminating Equipment
DCS	Digital Cellular System
DSR	Data Set Ready
DTE	Data Terminal Equipment
EEPROM	Electrically Erasable Programmable Read Only Memory
EGSM	Extended Global System for Mobile Communication
EN	Enable
ETSI	European Telecommunications Standards Institute
GSM	Global System for Mobile Communication
LCD	Liquid Crystal Display
MIN	Mobile Identification Number
PAS	Public Addressing System
PCS	Personal Communication Service
PDU	Protocol Data Unit
PEROM	Programmable and Erasable Read Only Memory
RI	Ring Indicator
RS	Register Select

RTS	Request To Send
R/W	Read/Write
TDMA	Time Division Multiple Access
TTL	Transistor–to–Transistor Logic
UART	Universal Asynchronous Receiver/Transmitter

ABSTRACT

In the last couple of decades, communication technology has developed by leaps and bounds. It has already established its importance in sharing the information right from household matters to worldwide phenomena. Apart from sharing information, it is also used for remote control of machines and electronic appliances. In our day-to-day life, we use many such appliances at home, office and public places for our comfort and convenience. Every device requires one or the other kind of operation control for which it has a HMI (human-machine interface).

Communication technology not only helps us to exchange information with human beings but also allows us to carry out monitoring and controlling of machines from remote locations. This remote control of appliances is possible with wired or wireless communication interfaces embedded in the machines. The use of "Embedded System in Communication" has given rise to many interesting applications. One of such applications is public addressing system (PAS). Many companies are manufacturing audio / video systems like public announcement system, CCTV, programmable sign boards etc. But all these systems are generally hard-wired, complex in nature and difficult to expand. So, by adding wireless communication interface such as GSM to these systems, we can overcome their limitations.

CHAPTER 1

INTRODUCTION

1.1 Project Overview

Now-a-days advertisement is going digital. The big shops and the shopping centers use digital displays now. Also, in trains and buses the information like platform number, ticket information is displayed in digital boards. People are now adapted to the idea of the world at its finger-tips. The use of mobile phones have increased drastically over years. Control and communication has become important in all the parts of the world. This gave us the idea to use mobile phones to receive message and then display it on a LCD display board.

We know the importance of notice boards in public places. But changing notices day-to-day is a difficult task. Being GSM-based system, it offers flexibility to display flash news or announcements faster than the programmable system. This thesis explains how to design a LCD notice board using GSM technology.

As engineer's main aim is to make life simple with help of technology, this is one step to simplify real time noticing.

GSM based LCD notice board display is aimed at the colleges and universities for displaying day-to-day information continuously or at regular intervals during the working hours. Being GSM-based system, it offers flexibility to display flash news or announcements faster than the programmable system. GSM based campus display system can also be used at other public places like schools, hospitals, railway stations, gardens etc. without affecting the surrounding environment.

The GSM based LCD notice board mainly consists of a GSM receiver and a display toolkit which can be programmed from an authorized mobile phone. It receives the SMS, validates the sending **Mobile Identification Number** (MIN) and displays the desired

information after necessary code conversion. It can serve as an electronic notice board and display the important notices instantaneously thus avoiding the latency. Being wireless, the GSM based LCD notice board is easy to expand and allows the user to add more display units at anytime and at any location in the campus depending on the requirement of the institute.

1.2 Architecture of the system

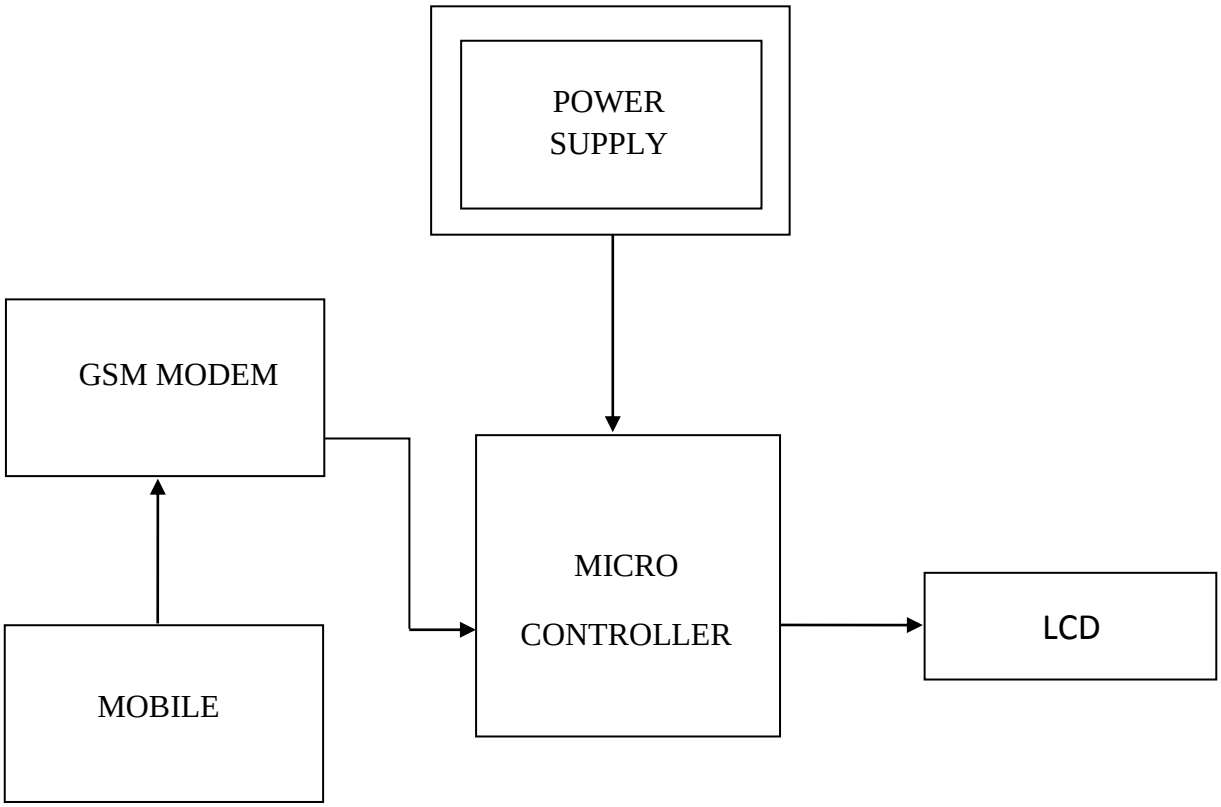

Figure 1.1: Architecture of the system

Architecture of the system consists of Microcontroller which involves in the operation and validation. Regulated supply is to power up the whole circuit components. GSM modem stores any message received by the user, any operation performed by the GSM is due to the AT commands initiated by the microcontroller. Microcontroller forwards the message to the LCD. LCD receives the message and can display only 16*2 characters at a time. Mobile is the end user that starts the interaction with GSM by sending a message.

1.3 Information Transfer

1.3.1 Information Transfer

A coordinated sequence of user and telecommunications system actions that causes information present at a source user to become present at a destination user. An information transfer transaction usually consists of three consecutive phases called the **access phase**, the **information transfer phase**, and **the disengagement phase.**

1.3.2 Broadcast

One of the most common examples is broadcast through a cellular network service. This serves multiple end users at different locations in a simulcast fashion. Practically every cellular system has some kind of broadcast mechanism. This can be used directly for distributing information to multiple mobiles, commonly, for example in a mobile telephony system, the most important use of broadcast information is to set up channels for one to one communication between the mobile trans-receiver and the base station. This is called **paging**. The details of the process of paging vary somewhat from network to network, but normally we know a limited number of cells where the phone is located (this group of cells is called a location area in the GSM system). Paging takes place by sending the broadcast message on all of those cells.

This project aims at integrating the expansiveness of a wireless cellular network and the ease of information transfer through the SMS with the coverage of campus display boards. It can also be a modest effort to realize the complete potential of public display boards in instantaneous information broadcast in swift response to events of interests.

1.4 Components Overview

This GSM based LCD display system uses the following components:

1.4.1 Microcontroller

AT89S52 is an 8-bit microcontroller and belongs to Atmel's 8051 family. **ATMEL 89S52** has 4KB of Flash Programmable and Erasable Read Only Memory (PEROM) and 128 bytes of RAM. It can be erased and program to a maximum of 1000 times.

1.4.2 LCD

LCD (**Liquid Crystal Display**) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs.

1.4.3 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 in order to operate. Computers use AT commands to control modems. Both GSM modems and dial-up modems support a common set of standard AT commands. GSM modem can be used just like a dial- up modem. In addition to the standard AT commands, GSM modems support an extended set of AT commands. These extended AT commands are defined in the GSM.

1.4.4 MAX232

MAX232 is a dual driver/receiver that includes a capacitive voltage generator to supply voltage levels from a single 5-V supply. Each receiver converts RS232 inputs to 5V TTL/CMOS levels. These receivers (R_1 & R_2) can accept ±30V inputs. The drivers (T_1 & T_2), also called transmitters, convert the TTL/CMOS input level into RS232 level.

1.5 System operation

The operation of the system is very simple. Sending message from any of the remote area to the distant located LCD notice board using GSM mobile. For sending the text message from remote area we need to interface the mobile phone with GSM Modem. For developing some of GSM based applications we need to have some commons peripherals including GSM MODEM, SIM, microcontroller, LCD (Liquid crystal display), power supply and also some connecting wires. Moreover GSM based applications could be easily developed and enhanced due to easily accessibility of components in local markets at very pocket friendly prices

CHAPTER 2

DESIGN OVERVIEW

Presently almost all electronic notice boards are designed using wired system.One of the drawbacks of the design is the system is inflexible in term of placement. The common notice board cannot be placed anywhere because of the messy wire. The aim of this project is to develop a wireless notice board that will be used at the faculty in order to display latest information.

This wireless notice board project mainly focuses on transmission of textual data through air interface by the use of GSM through asynchronous serial communication. The data will be processed by the microcontroller.

When we send the message from the mobile, GSM modem which is arranged at the display unit receives the message. Now the controller reads the message from the GSM modem and displays in on LCD.

The block diagram of the project is divided into two parts

1. GSM Module
2. Controller Module

GSM Module consists of GSM transmitter and receiver.
Controller Module consists of MAX 232 and Microcontroller.

As explained in the introduction chapter, the realization of complete potential of the display boards and the wireless medium in information transfer is the major issue that the following thesis of the following project deals with.

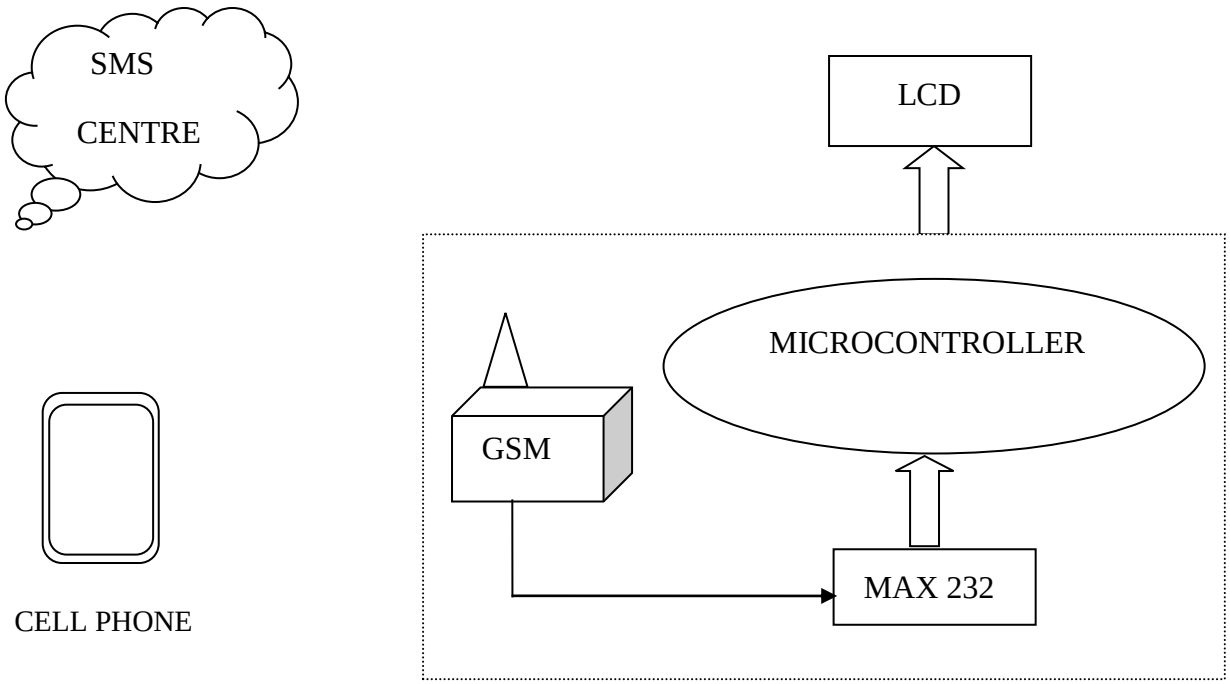

Figure 2.1: Design Overview

As we see in figure 2.1, there are at least three interfacing circuits, MAX-232 with Microcontroller, LCD display with microcontroller, and MAX-232 with GSM MODEM. It is not a hidden fact that interfacing a MODEM with a normal PC is quite easy with the help of the AT commands sent to it from the Hyper Terminal window. But we must take into account the fact that the MODEM requires a wired connection at one end and wireless at the other. Dedicating a general purpose computer at each and every site of the display boards, although makes the task a lot easier but is too expensive to be a possibility. Hence we employ Atmel 89S52 microcontroller with 64 KB EEROM storage memory.

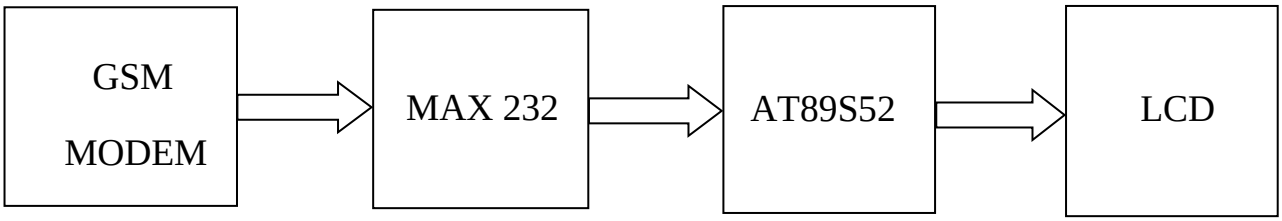

Figure 2.2: Block diagram of the system

The complexity of coding substantially increases, but once programmed the module works at its robust best since it is a dedicated embedded system and not a general purpose computer. The design procedure involves identifying and assembling all the required hardware and ensuring fail safe interfacing between all the components. Then we have the coding process which has to take care of the delays between two successive transmissions and most importantly the validation of the sender's number. The number of valid mobile numbers can be more than one. The limiting constraint is the RAM of the microcontroller rather than the coding-complexities.

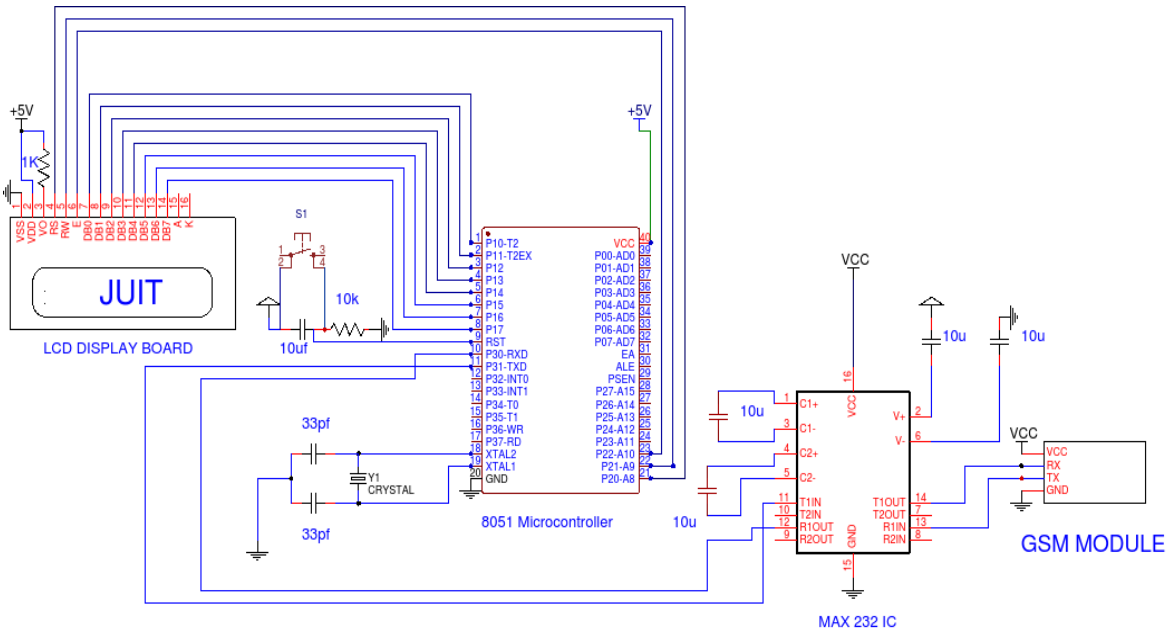

Figure 2.3: Circuit diagram of the system [1]

Circuit Components

- AT89S52 microcontroller
- 16*2 LCD
- MAX232 level converter
- GSM sim 900 module
- Programming cable
- DC battery or 12V,1A adaptor
- 5V power supply circuit
- Ceramic capacitors
- Capacitors
- Electrolytic capacitor
- 12MHz crystal
- Resistors

Software Requirements

- Keil Compiler
- Flash Magic

The circuit diagram in Figure 2.3 consists of 8051 microcontroller, GSM module, level converter and **16*2 LCD**. LCD is connected to **P1.0** and it is used to display message. GSM module is connected to controller through the MAX232 IC. Here it is used for level conversion.

Here LCD is used in 8 bit mode. Means 8data lines are required to display the data. These data lines are connected to **P1.1** to **P1.7** respectively. The controller logic levels and GSM module logic levels are different. Hence we use max232 level converter as a mediator between Controller and GSM to transfer the data.

In order to communicate with GSM we need to send some AT commands using serial communication (UART protocol). Here **GSM sim 900** module is used. This module requires 9600 baud rate.

Algorithm

- Initialize the LCD and UART protocol.
- Check for the command **+CMTI: "SM", 3 (Location number)** to know whether the new message is received or not.
- If you receive the command then store message location number.
- Now read that particular location and extract the body of the message.
- Display the message on LCD.

How to operate?

- Write the program to the wireless electronic notice board using Keil software.
- Now burn the program to the microcontroller with the help of Flash Magic.
- Give the connections as per the circuit diagram.
- Use power supply circuit to provide 5V DC to the microcontroller.
- Insert the SIM (Subscriber Identity Module) to the GSM module.
- Now switch on the supply.
- Send SMS to the GSM module using other mobile.
- Now you can see the same message on LCD.

Figure 2.4: Commercially used display boards [2]

The display boards are usually huge in size and can't be used for simulation purpose. So LCD displays are used for testing. It is not a hidden fact that interfacing a MODEM with a normal PC is quite easy with the help of the AT commands sent to it from the Hyper Terminal window. But we must take into account the fact that the MODEM requires a wired connection at one end and wireless at the other. Dedicating a general purpose computer at each and every site of the LCD display boards, although makes the task a lot easier but is too expensive to be a possibility. Hence we employ AT89S52 microcontroller with 64 KB EEPROM storage memory.

CHAPTER 3

HARDWARE DESCRIPTION

3.1 AT89S52 MICROCONTROLLER

In 40 pin AT89S52, there are four ports designated as P_1, P_2, P_3 and P_0. All these ports are 8-bit bi-directional ports, *i.e.*, they can be used as both input and output ports. Except P_0 which needs external pull-ups, rest of the ports have internal pull-ups. When 1s are written to these port pins, they are pulled high by the internal pull-ups and can be used as inputs. These ports are also bit addressable and so their bits can also be accessed individually.

Port P_0 and P_2 are also used to provide low byte and high byte addresses, respectively, when connected to an external memory. Port 3 has multiplexed pins for special functions like serial communication, hardware interrupts, timer inputs and read/write operation from external memory. AT89S52 has an inbuilt UART for serial communication. It can be programmed to operate at different baud rates. Including two timers & hardware interrupts, it has a total of six interrupts.

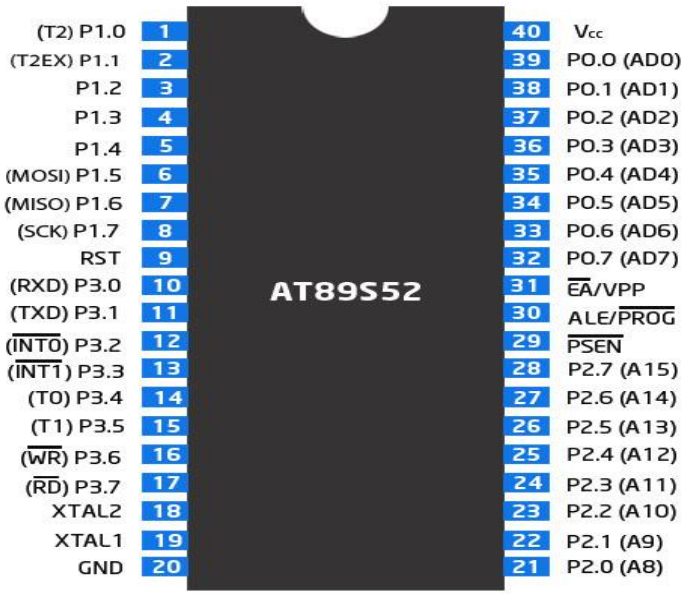

Figure 3.1: Pin diagram of AT89S52 Microcontroller [3]

Table 3.1: Pin description of AT89S52 [4]

Pin No.	Function			Name
1	8 bit input/output port (P_1) pins			$P_1.0$
2				$P_1.1$
3				$P_1.2$
4				$P_1.3$
5				$P_1.4$
6				$P_1.5$
7				$P_1.6$
8				$P_1.7$
9	Reset pin; Active high			Reset
10	Input (receiver) for serial communication	RxD	8 bit input/output port (P_3) pins	$P_3.0$
11	Output (transmitter) for serial communication	TxD		$P_3.1$
12	External interrupt 1	Int0		$P_3.2$
13	External interrupt 2	Int1		$P_3.3$
14	Timer1 external input	T_0		$P_3.4$
15	Timer2 external input	T_1		$P_3.5$
16	Write to external data memory	Write		$P_3.6$
17	Read from external data memory	Read		$P_3.7$
18	Quartz crystal oscillator (up to 24 MHz)			Crystal 2
19				Crystal 1
20	Ground (0V)			Ground
21	8 bit input/output port (P_2) pins / High-order address bits when interfacing with external memory			$P_2.0$/ A_8
22				$P_2.1$/ A_9
23				$P_2.2$/ A_{10}

24	8 bit input/output port (P_2) pins / High-order address bits when interfacing with external memory	$P_2.3/ A_{11}$
25		$P_2.4/ A_{12}$
26		$P_2.5/ A_{13}$
27		$P_2.6/ A_{14}$
28		$P_2.7/ A_{15}$
29	Program store enable; Read from external program memory	PSEN
30	Address Latch Enable	ALE
	Program pulse input during Flash programming	Prog
31	External Access Enable; Vcc for internal program executions	EA
	Programming enable voltage; 12V (during Flash programming)	Vpp
32	8 bit input/output port (P_0) pins / Low-order address bits when interfacing with external memory	$P_0.7/ AD_7$
33		$P_0.6/ AD_6$
34		$P_0.5/ AD_5$
35		$P_0.4/ AD_4$
36		$P_0.3/ AD_3$
37		$P_0.2/ AD_2$
38		$P_0.1/ AD_1$
39		$P_0.0/ AD_0$
40	Supply voltage; 5V (up to 6.6V)	Vcc

3.2 GSM MODEM

GSM stands for Global System for Mobile Communications. It is a standard set developed by the **European Telecommunications Standards Institute** (ETSI) to describe protocols for second generation (2G) digital cellular networks used by mobile phones.

A Modem is a device which modulates and demodulates signals as required to meet the communication requirements. It modulates an analog carrier signal to encode digital information, and also demodulates such a carrier signal to decode the transmitted information.

A GSM Modem is a device that modulates and demodulates the GSM signals and in this particular case 2G signals. The modem we are using is SIMCOM SIM900. It is a Tri-band GSM/GPRS Modem as it can detect and operate at three frequencies (**EGSM 900** MHz, **DCS 1800** MHz and **PCS 1900** MHz). Default operating frequencies are EGSM 900MHz and DCS 1800MHz.

Sim900 is a widely used in many projects and hence many variants of development boards for this have been developed. These development boards are equipped with various features to make it easy to communicate with the SIM900 module. Some boards provide only TTL interface while some boards include an RS232 interface and some others include an USB interface. If your PC has a serial port (DB9) you can buy a GSM Modem that has both TTL and RS232 interfacings in economy.

Sim900 GSM module used here consists of a TTL interface and an RS232 interface. The TTL interface allows us to directly interface with a microcontroller while the RS232 interface includes a MAX232 IC to enable communication with the PC. It also consists of a buzzer, antenna and SIM slot. Sim900 in this application is used as a **DCE** (Data Circuit-terminating Equipment) and PC as a **DTE** (Data Terminal Equipment).

Why to use A GSM Modem?

GSM Technology has grown so much, that literally there isn't a place on earth where there is no GSM signal. In such a scenario GSM provides us a wide scope in controlling things remotely from any place just with our finger tips. GSM also provides ease to easily communicate in a more robust way.

3.2.1 Interfacing GSM

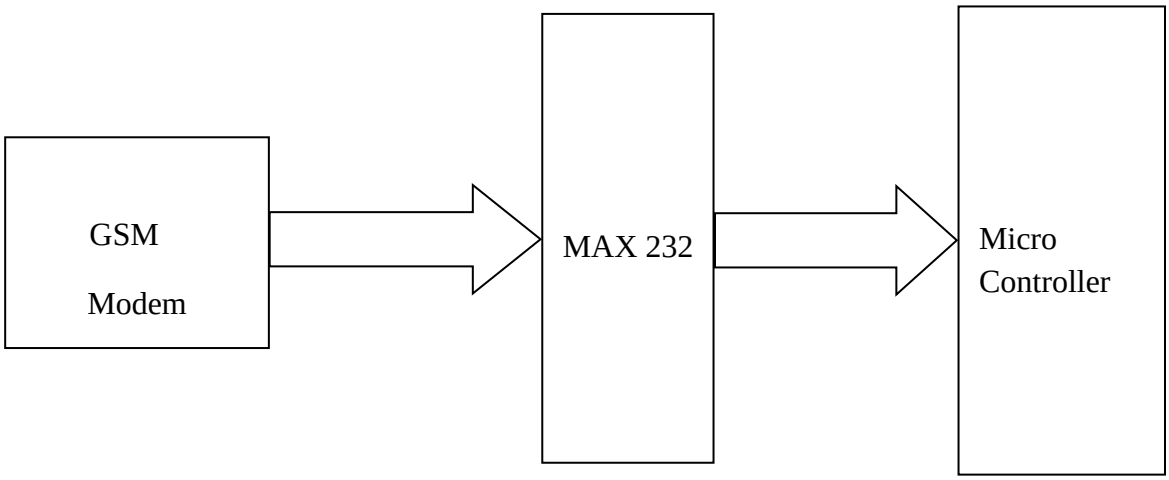

Figure 3.2: Interfacing GSM with Microcontroller

Figure 3.2 shows how to interface the GSM with microcontroller. The GSM module communicates with the microcontroller with mobile phones through UART. To scommunicate over UART or USART, we just need three basic signals which are namely, **RxD** (receive), **TxD** (transmit), **GND** (common ground).

The sending SMS through GSM modem when interfaced with microcontroller or PC is much simpler as compared with sending SMS through UART. Text message may be sent through the modem by interfacing only three signals of the serial interface of modem with microcontroller i.e., TxD, RxD and GND. In this scheme RTS and CTS signals of serial port interface of GSM Modem are connected with each other.

The transmit signal of serial port of microcontroller is connected with transmit signal (TxD) of the serial interface of GSM Modem while receive signal of microcontroller serial port is connected with receive signal (RxD) of serial interface of GSM Modem.

The SMS message in text mode can contain only 140 characters at the most. It depends upon the amount of information collected from GPS Engine that you need at the base station for tracking vehicle or person.

We now want to display a text in mobile from 8051 Primer Board by using GSM module through UART. In 8051 Primer Board contains two serial interfaces that are UART0 & UART1. Here we are using UART0. The GSM modem is being interfaced with the microcontroller 8051 Primer Board for SMS communication. The SMS can be sending and receiving for the data sharing and situation information and control.

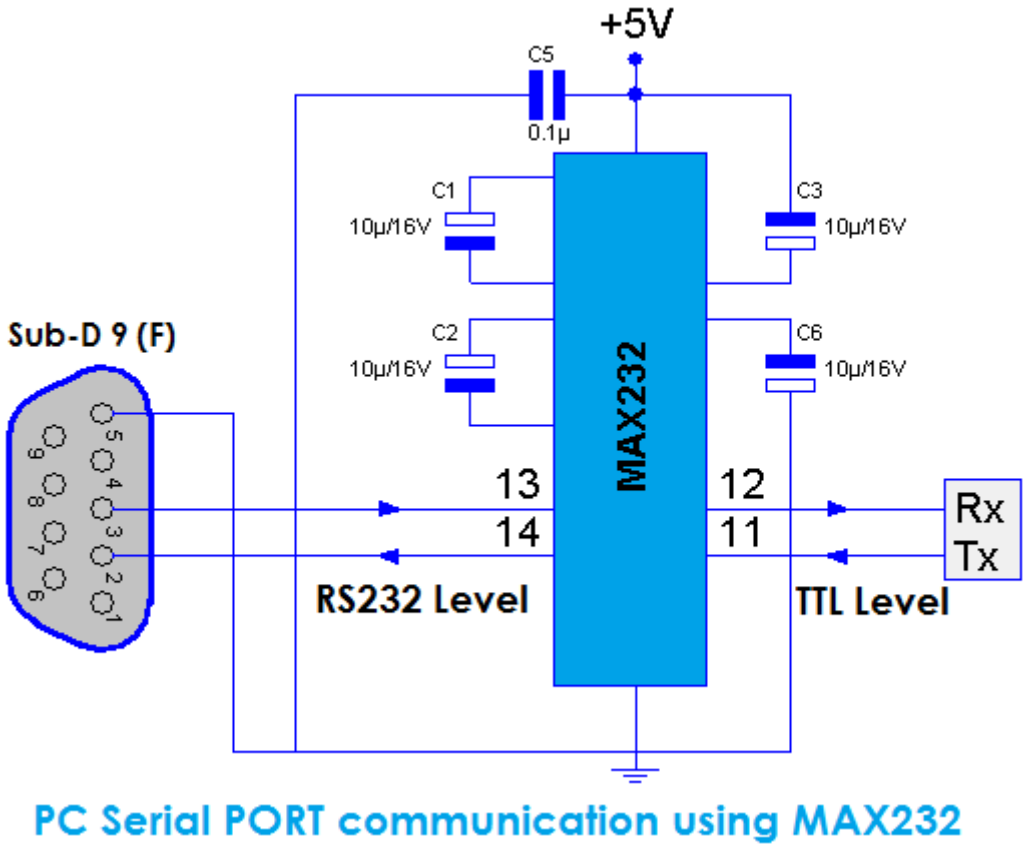

Figure 3.3: PC Serial port communication using MAX232 [5]

3.2.2 ACCESSING GSM MODEM

Both GSM modems and dial-up modems support a common set of standard AT commands. GSM modem can be used just like a dial- up modem. In addition to the standard AT commands, GSM modems support an extended set of AT commands. These

extended AT commands are defined in the GSM standards. With the extended AT commands, various things can be done:

- Reading, writing and deleting SMS messages.
- Sending SMS messages.
- Monitoring the signal strength.
- Monitoring the charging status and charge level of the battery.
- Reading, writing and searching phone book entries.

3.2.2.1 List of important AT commands

AT commands are used to control MODEMs. AT is the abbreviation for Attention. These commands come from Hayes commands that were used by the Hayes smart modems. The Hayes commands started with AT to indicate the attention from the MODEM. The dial up and wireless MODEMs (devices that involve machine to machine communication) need AT commands to interact with a computer. These include the Hayes command set as a subset, along with other extended AT commands.

AT commands with a GSM/GPRS MODEM or mobile phone can be used to access following information and services:

- Information and configuration pertaining to mobile device or MODEM and SIM card.
- SMS services.
- MMS services.
- Fax services.
- Data and Voice link over mobile network.

The Hayes subset commands are called the basic commands and the commands specific to a GSM network are called extended **AT commands**.

Explanation of commonly used AT commands:

1. AT - This command is used to check communication between the module and the computer.

For example, AT OK The command returns a result code OK if the computer (serial port) and module are connected properly. If any of module or SIM is not working, it would return a result code ERROR.

2. +CMGF - This command is used to set the SMS mode. Either text or PDU mode can be selected by assigning 1 or 0 in the command.

SYNTAX:

AT+CMGF=<mode> 0: for PDU mode 1: for text mode.

The text mode of SMS is easier to operate but it allows limited features of SMS. The **PDU** (protocol data unit) allows more access to SMS services but the operator requires bit level knowledge of TPDUs. The headers and body of SMS are accessed in hex format in PDU mode so it allows availing more features.

For example, AT+CMGF=1 OK

3. +CMGW - This command is used to store message in the SIM.

SYNTAX:

AT+CMGW=" Phone number"> Message to be stored **Ctrl+Z**

As one types AT+CMGW and phone number, '>' sign appears on next line where one can type the message. Multiple line messages can be typed in this case. This is why the message is terminated by providing a '**Ctrl+Z**' combination. As **Ctrl+Z** is pressed, the following information response is displayed on the screen.

+CMGW: Number on which message has been stored.

4. +CMGS - This command is used to send a SMS message to a phone number.

SYNTAX: AT+CMGS= serial number of message to be send.

As the command AT+CMGS and serial number of message are entered, SMS is sent to the particular SIM.

For example, AT+CMGS=1 OK

5. ATD - This command is used to dial or call a number.

SYNTAX: ATD<Phone number>(Enter) For example, ATD123456789

6. ATA - This command is used to answer a call. An incoming call is indicated by a message 'RING' which is repeated for every ring of the call. When the call ends 'NO CARRIER' is displayed on the screen.

SYNTAX: ATA (Enter).

As ATA followed by enter key is pressed, incoming call is answered.

For example, RING RING ATA

7. ATH - This command is used to disconnect remote user link with the GSM module.

SYNTAX: ATH (Enter)

3.3 MAX232 IC

The MAX232 IC is used to convert the **TTL/CMOS** logic levels to **RS232** logic levels during serial communication of microcontrollers with PC. The controller operates at TTL logic level (0-5V) whereas the serial communication in PC works on RS232 standards (-25 V to + 25V). This makes it difficult to establish a direct link between them to communicate with each other.

The intermediate link is provided through MAX232. It is a dual driver/receiver that includes a capacitive voltage generator to supply RS232 voltage levels from a single 5V supply. Each receiver converts RS232 inputs to 5V TTL/CMOS levels. These receivers (R_1 & R_2) can accept ±30V inputs. The drivers (T_1 & T_2), also called transmitters, convert the TTL/CMOS input level into RS232 level.

The transmitters take input from controller's serial transmission pin and send the output to RS232's receiver. The receivers, on the other hand, take input from transmission pin of RS232 serial port and give serial output to microcontroller's receiver pin. MAX232 needs four external capacitors whose value ranges from 1µF to 22µF.

Table 3.2: Interfacing pins of MAX232 and Modem

Microcontroller	**MAX232**		**RS232**
Tx	$T_{1/2}$ In	$T_{1/2}$ Out	Rx
Rx	$R_{1/2}$ Out	$R_{1/2}$ In	Tx

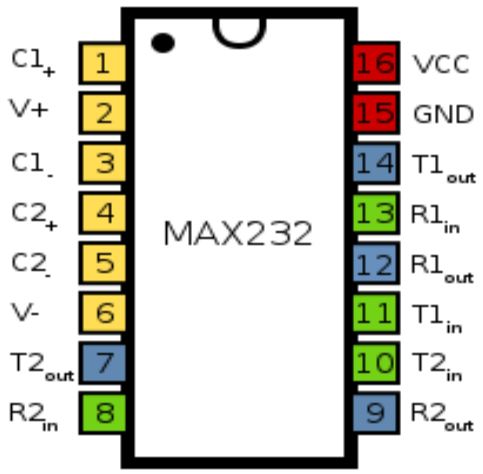

Figure 3.4: Pin Diagram of MAX 232 IC [6]

Table 3.3: Pin description of MAX232 [7]

Pin No.	Function	Name
1	Capacitor connection pins	Capacitor 1 +
2		Capacitor 3 +
3		Capacitor 1 -
4		Capacitor 2 +
5		Capacitor 2 -
6		Capacitor 4 -
7	Output pin; outputs the serially transmitted data at RS232 logic level; connected to receiver pin of PC serial port	T_2 Out
8	Input pin; receives serially transmitted data at RS 232 logic level; connected to transmitter pin of PC serial port	R_2 In
9	Output pin; outputs the serially transmitted data at TTL logic level; connected to receiver pin of controller.	R_2 Out
10	Input pins; receive the serial data at TTL logic level; connected to serial transmitter pin of controller.	T_2 In
11		T_1 In
12	Output pin; outputs the serially transmitted data at TTL logic level; connected to receiver pin of controller.	R_1 Out
13	Input pin; receives serially transmitted data at RS 232 logic level; connected to transmitter pin of PC serial port	R_1 In
14	Output pin; outputs the serially transmitted data at	T_1 Out

	RS232 logic level; connected to receiver pin of PC serial port	
15	Ground (0V)	Ground
16	Supply voltage; 5V (4.5V – 5.5V)	Vcc

3.4 LCD (LIQUID CRYSTAL DISPLAY)

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

A **16x2 LCD** means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD.

In recent years the LCD is finding widespread use replacing LED's. This is due to the following reasons:

- Declining Prices.
- Ability to display numbers, characters and graphics.
- Incorporation of a refreshing controller into the LCD.
- Ease of programming.

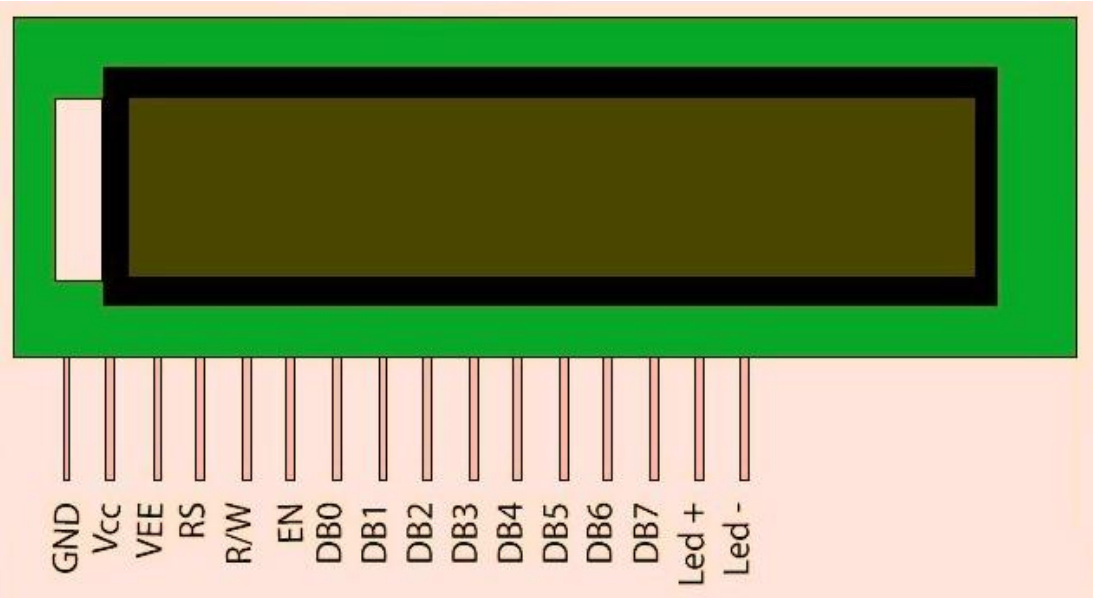

Figure 3.5: Pin Diagram of LCD [1]

Table 3.4: Pin description of LCD [8]

Pin No.	Function	Name
1	Ground (0V)	Ground
2	Supply voltage; 5V (4.7V – 5.3V)	Vcc
3	Contrast adjustment; through a variable resistor	V_{EE}
4	Selects command register when low; and data register when high	Register Select
5	Low to write to the register; High to read from the register	Read/write
6	Sends data to data pins when a high to low pulse is given	Enable
7	8-bit data pins	DB0
8		DB1

9		DB2
10		DB3
11		DB4
12		DB5
13		DB6
14		DB7
15	Backlight V_{CC} (5V)	Led+
16	Backlight Ground (0V)	Led-

3.4.1 Important Signals

The following pins are important to LCD's while programming:

Enable (EN): The EN line is called "Enable." This control line is used to tell the LCD that you are sending it data. To send data to the LCD, your program should make sure this line is low (0) and then set the other two control lines and/or put data on the data bus. When the other lines are completely ready, bring EN high (1) and wait for the minimum amount of time required by the LCD datasheet (this varies from LCD to LCD), and end by bringing it low (0) again.

Register Select (RS): The RS line is the "Register Select" line. When RS is low (0), the data is to be treated as a command or special instruction (such as clear screen, position cursor, etc.). When RS is high (1), the data being sent is text data which should be displayed on the screen. For example, to display the letter "T" on the screen you would set RS high.

Read/Write (R/W): The R/W line is the "Read/Write" control line. When RW is low (0), the information on the data bus is being written to the LCD. When RW is high (1), the program is effectively querying (or reading) the LCD. Only one instruction ("Get LCD status") is a read command. All others are write commands. So RW will almost always be low.

Finally, the data bus consists of 4 or 8 lines (depending on the mode of operation selected by the user). In the case of an 8-bit data bus, the lines are referred to as DB0, DB1, DB2, DB3, DB4, DB5, DB6, and DB7.

Above is the quite simple schematic. The LCD panel's Enable and Register Select is connected to the Control Port. The Control Port is an open collector/open drain output. While most Parallel Ports have internal pull-up resistors, there are a few which don't. Therefore by incorporating the two 10K external pull up resistors, the circuit is more 18 portable for a wider range of computers, some of which may have no internal pull up resistors. We make no effort to place the Data bus into reverse direction. Therefore we hard wire the R/W line of the LCD panel, into write mode. This will cause no bus conflicts on the data lines. As a result we cannot read back the LCD's internal Busy Flag which tells us if the LCD has accepted and finished processing the last instruction. This problem is overcome by inserting known delays into our program.

The 10k Potentiometer controls the contrast of the LCD panel. Nothing fancy here. As with all the examples, I've left the power supply out. We can use a bench power supply set to 5v or use an onboard +5V regulator. Remember a few de-coupling capacitors, especially if we have trouble with the circuit working properly.

CHAPTER 4

INTERFACING

4.1 Microcontroller–MODEM Interfacing

4.1.1 DTE and DCE

The terms DTE and DCE are very common in the data communications market. DTE is short for Data Terminal Equipment and DCE stands for Data Communications Equipment.

But what do they really mean?

As the full DTE name indicates this is a piece of device that ends a communication line, whereas the DCE provides a path for communication.

Let's say we have a computer on which wants to communicate with the Internet through a modem and a dialup connection. To get to the Internet you tell your modem to dial the number of your provider. After your modems has dialed the number, the modem of the provider will answer your call and your will hear a lot of noise. Then it becomes quiet and you see your login prompt or your dialing program tells you the connection is established. Now you have a connection with the server from your provider and you can wander the Internet. In this example you PC is a Data Terminal (DTE). The two modems (yours and that one of your provider) are DCEs, they make the communication between you and your provider possible. But now we have to look at the server of your provider.

Is that a DTE or DCE?

The answer is a DTE. It ends the communication line between
you and the server. When you want to go from your provided server to another place it uses another interface. So DTE and DCE are interfacing dependent. It is e.g. possible that for your connection to the server, the server is a DTE, but that that same server is a DCE for the equipment that it is attached to on the rest of the Net.

4.1.2 RS232

In telecommunications, RS232 is a standard for serial binary data signals connecting between a DTE (Data terminal equipment) and a DCE (Data Circuit terminating Equipment). It is commonly used in computer serial ports. In RS232, data is sent as a time series of bits. Both synchronous and asynchronous transmissions are supported by the standard. In addition to the data circuits, the standard defines a number of control circuits used to manage the connection between the DTE and DCE. Each data or control circuit only operates in one direction that is, signaling from a DTE to the attached DCE or the reverse. Since transmit data and receive data are separate circuits, the interface can operate in a full duplex manner, supporting concurrent data flow in both directions. The standard does not define character framing within the data stream, or character encoding.

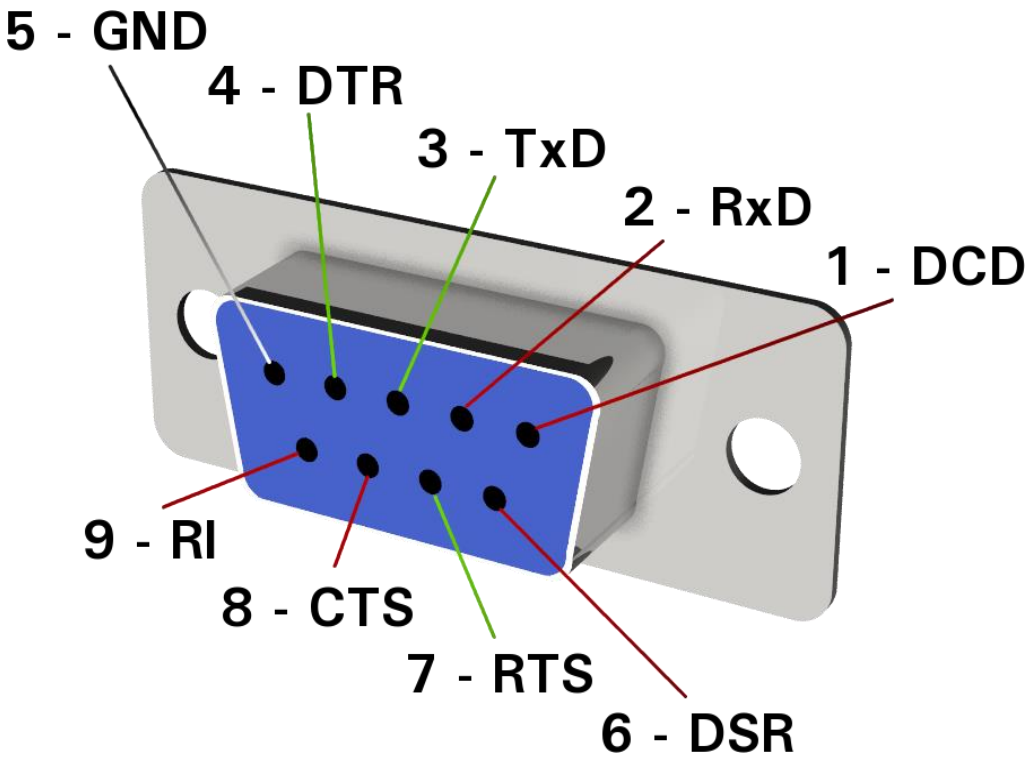

Figure 4.1: Pin diagram of RS232 [9]

Table 4.1: Various RS232 Signals [10]

Function	Signal	PIN	DTE	DCE
Data	TxD	3	Output	Input
Data	RxD	2	Input	Output
Handshake	RTS	7	Input	Output
Handshake	CTS	8	Input	Output
Handshake	DSR	6	Input	Output
Handshake	DCD	1	Output	Output
Handshake	STR	4	Output	Input
Common	Com	5	.....	.....
Other	RI	9	Output	Input

4.1.2.1 RS232 Signals

- **Transmitted Data (TxD)**

Data sent from DTE to DCE.

- **Received Data (RxD)**

Data sent from DCE to DTE.

- **Request To Send (RTS)**

Asserted (set to 0) by DTE to prepare DCE to receive data. This may reuqire action on the part of the DCE, e.g. transmitting a carrier or reversing the direction of a half-duplex line.

- **Clear To Send (CTS)**

Asserted by DCE to acknowledge RTS and allow DTE to transmit.

- **Data Set Ready (DSR)**

Asserted by DCE to indicate an active connection. If DCE is not a modem (for e.g. a null modem cable or other equipment), this signal should be permanently asserted (set to 0), by a jumper to another signal.

- **Carrier Detect (CD)**

Asserted by DCE when a connection has been established with remote equipment.

- **Ring Indicator (RI)**

Asserted by DCE when it detects a ring signal from the telephone line.

4.2 Microcontroller-LCD Interfacing

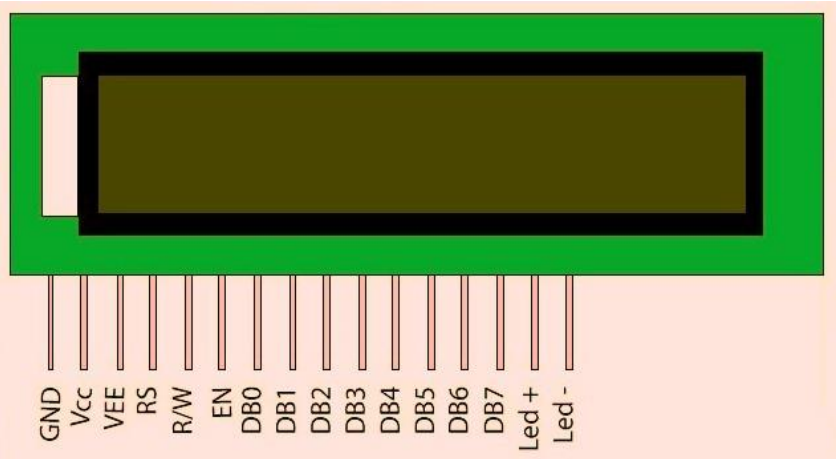

Figure 4.2: Pin Configuration of LCD interfacing [11]

Above is the quite simple schematic. The LCD panel's Enable and Register Select are connected to the Control Port. The Control Port is an open collector / open drain output. While most Parallel Ports have internal pull up resistors, there are a few which don't. Therefore by incorporating the two 10K external pull up resistors, the circuit is more portable for a wider range of computers, some of which may have no internal pull up resistors.

We make no effort to place the Data bus into reverse direction. Therefore we hard wire the R/W line of the LCD panel, into write mode. This will cause no bus conflicts on the data lines. As a result we cannot read back the LCD's internal busy flag which tells us if the LCD has accepted and finished processing the last instruction.
This problem is overcome by inserting known delays into our program.

The user may select whether the LCD 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 we don't raise/lower EN, the LCD doesn't know you're talking to it on the other lines.

Table 4.2: Control codes of LCD

Code (HEX)	**Command to LCD Instruction Register**
1	Clear display screan
2	Return home
4	Decrement Cursor(shift cursor to left)
6	Increment Cursor(shift cursor to right)
5	Shifts display right
7	Shifts display left
8	Display off,cursor off
A	Display on,cursor on
C	Display on,cursor off
E	Display off,cursor blinking
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 to 1st line
C0	Force cursor to beginning to 2nd line
38	2 lines and 5*7 matrix

CHAPTER 5

IMPLEMENTATION AT INSTITUTE LEVEL

5.1 Overview

Information sharing holds an important role in the daily work of our institute LDRP-ITR. The current means of information transfer are notice and circulars. New notice or circular is only checked at the end of the day. This makes the process very time consuming and inefficient. Looking into current trend of information transfer in the campus, it is seen that important notice take time to be displayed in the notice boards. This latency is not expected in most of the cases and must be avoided.

5.2 Proposal

It is proposed to implement this project at the institute level. It is proposed to place display boards at major access points. These include canteens, entrance gate, hostel area etc. but the GSM based display toolkit can be used as an add-on to these display boards and make it truly wireless. The display board programs itself with the help of the incoming SMS with proper validation. The valid senders may include the Director, Deans and Registrars. The centralized system can be placed as the Computer Center for access by any other valid users with authentications. SMS from these users is treated to be valid and is displayed. Other SMS from any other mobile phone is discarded. Thus information from valid sources can be broadcasted easily. Such a system proves to be helpful for immediate information transfer and can be easily implemented at the institute level.

CHAPTER 6

CONCLUSION

6.1 Conclusion

The prototype of the GSM based display toolkit was efficiently designed. This prototype has facilities to be integrated with a display board thus making it truly mobile. The toolkit accepts the SMS, stores it, validates it and then displays it in the LCD module. The SMS is deleted from the SIM each time it is read, thus making room for the next SMS. The major constraints incorporated are the use of "*" as the termination character of the SMS and the display of one SMS as a time. These limitations can be removed by the use of higher end microcontrollers and extended RAM. The prototype can be implemented using commercial display boards. In this case, it can solve the problem of instant information transfer in the campus.

6.2 Future Improvements

The use of microcontroller in place of a general purpose computer allows us to theorize on many further improvements on this project prototype. Temperature display during periods wherein no message buffers are empty is one such theoretical improvement that is very possible. The ideal state of the microcontroller is when the indices or storage space in the SIM memory are empty and no new message is there to display. With proper use of interrupt routines the incoming message acts as an interrupt, the temperature display is halted and the control flow jumps over to the specific interrupt service routine which first validates the sender's number and then displays the information field. Another very interesting and significant improvement would be to accommodate multiple receiver MODEMS at the different positions in a geographical area carrying duplicate SIM cards. With the help of principles of TDMA technique, we can choose to simulcast and /or broadcast important notifications. After a display board receives the valid message through the MODEM and displays it, it withdraws its identification from the network & synchronously another nearby MODEM signs itself into the network and starts to receive

the message. The message is broadcast by the mobile switching centre for a continuous time period during which as many possible display board MODEMS “catch” the message and display it as per the constraint of validation. Multilingual display can be another added variation of the project. The display boards are one of the single most important media for information transfer to the maximum number of end users. This feature can be added by programming the microcontroller to use different encoding decoding schemes in different areas as per the local language. This will ensure the increase in the number of informed users. Graphical display can also be considered as a long term but achievable and target able output. MMS technology along with relatively high end microcontrollers to carry on the tasks of graphics encoding and decoding along with a more expansive bank of usable memory can make this task a walk in the park.

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