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A PROJECT REPORT ON

GSM Based e-notice board

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By

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CERTIFICATE

Certified that the project work entitled " **GSM BASED E-NOTICE BOARD** " is an original work carried out by **Venkatesh Agnihotri, Arjun M Nayak** and **Aditya Bharadwaj** in partial fulfillment for the award of degree of **Bachelor of Engineering in Computer Science and Engineering of SDM College Of Engineering and Technology , under the Visvesvaraya Technological University ,Belgaum** during the year 2012 to 2013 .The Project report has been approved as it satisfies the academic requirements in respect of Project work prescribed for the Bachelor of Engineering Degree.

Signature of Guide *Signature of HOD* *Signature of Principal*

Name and Signature of the examiners with date:

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2. *Name:* *Signature:* *Date:*

Acknowledgement

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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.

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Chapter – 1

INTRODUCTION

1.1. Project Overview

The GSM based e-notice board also called Campus Display System (CDS) 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 CDS 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 CDS is easy to expand and allows the user to add more display units at any time and at any location in the campus depending on the requirement of the institute.

1.2. Information Transfer

A coordinated sequence of user and telecommunication 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**.

1.2.1. Broadcast

A term to describe communication where a piece of information is sent or transmitted from one point to all other points. There is just one sender, but the information is simultaneously sent to all connected receivers.

In networking, a distinction is made between **broadcasting** and **multicasting**. Broadcasting sends a message to everyone on the network whereas multicasting sends a message to a select list of recipients.

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.

1.3. Components Overview

This system uses the following components.

Microcontroller

CDS is based on **AT89S52 microcontroller** which is a variant of 8052. It is an 8-bit microcontroller with 8KB on-chip Flash memory, 256 bytes RAM, three timer / counters, one serial and four 8-bit parallel ports. It can also address up to 64KB of external data memory RAM and program memory.

LCD

The GSM based CDS uses **HD44780** LCD for displaying the text data. It is **20 character x 2 line display module**. But in practice, it should be replaced by the large multiline, multicolor commercial display units

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.

In this project, we must take into account the fact that the modem requires a wired connection at one end and wireless at the other. **Matrix Simado GDT11** is a **Fixed Cellular Terminal (FCT)** for data applications. It is a compact and portable terminal that can satisfy various data communication needs over GSM. It can be connected to a computer with the help of a standard **RS232C serial port**. Simado GDT11 offers features like Short Message Services (SMS), Data Services (sending and receiving data files), Fax Services and Web Browsing. The Simado GDT11 is easy to set up.

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 dialup 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.

Computer Interface

Finally, this project uses RS232 serial interface for interfacing the GSM modem with a PC. This interface is used to setup the GSM modem. A hyper terminal application is used to issue AT commands to the GSM modem.

MAX-232

The MAX232 is a dual driver/receiver that includes a capacitive voltage generator to supply EIA-232 voltage levels from a single 5-V supply. Each receiver converts EIA 232 inputs to 5-V TTL/CMOS levels. These receivers have a typical threshold of 1.3 V and a typical hysteresis of 0.5 V, and can accept ±30-V inputs.

1.4. System operation

The operation of the system is very simple. Sending message from any of the remote area to the distant located e-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

LITERATURE SURVEY

The word GSM Refers to Global System for Mobile Communications. Nowadays many people are showing lot of interest to know more about GSM related concepts. So, here we have surveyed a list of various GSM based projects ideas which are having more demand and very interesting to learn. The following projects based on GSM technology we surveyed would give better idea about the GSM technology practically.

4.1. GSM BASED DISPLAY TOOLKIT

Presently, the wireless communication has announced its arrival on big stage and the world is going mobile. We want to control everything and without moving an inch. This remote of appliances is possible through Embedded Systems. The main aim of this project will be to design a SMS driven automatic display toolkit which can replace the currently used programmable electronic display. It is proposed to design receive cum display toolkit which can be programmed from an authorized mobile phone. The message to be displayed is sent through an SMS from an authorized transmitter. The toolkit receives the SMS, Validates the sending Mobile Identification Number (MIN) and displays the desired information after necessary code conversions.

4.2. GSM BASED DATA ACQUISITION SYSTEM

GSM based data acquisition is a process control system that enables a site operator to monitor and control processes that are distributed among various remote sites. This project is designed to monitor various parameters like humidity, rainfall, wind direction, temperature, light intensity, etc. This system saves time and money by eliminating the need for service personnel to visit each site for inspection and data collection. They are used in all types of industries, from electrical distribution systems, to food processing, to facility security alarms.

4.3. DEVELOPMENT OF SMS BASED TEACHING AND LEARNING SYSTEM

The Short Message Service (SMS) technology is one the most stable mobile technologies around. Most of our tertiary students carry mobile phones with SMS facilities and can be used for teaching and learning. There are many projects using SMS technologies in education as outlined in the literature survey, but many publications do not provide the possible underlying technologies to implement such as the teaching and learning systems. The system is capable of supporting administrative teaching and learning activities via the SMS technology.

4.4. DESIGN AND DEVELOPMENT OF GSM BASED ENERY METER

Traditional metering method for retrieving the energy data is not convenient and the cost of the data logging systems is high. Automatic Meter Reading (AMR) system is boom for remote monitoring and control domestic energy meter. AMR system gives the information of meter reading, power cut, total load used, power disconnect and tempering on request or regularly in particular interval through SMS. The information is being sent and received by concerned energy Provider Company with the help of GSM network. Energy provider receives the meter reading within a second without visiting person AMR minimize the number of traditional visits required by employs of energy Provider Company. This system not only reduces the labor cost but also increase meter reading accuracy and save huge amount of time.

4.5. GSM BASED AUTOMATIC METER READING SYSTEM USING ARM

Nowadays the automation in every field is becoming necessary. The service provider for energy still uses conventional methods for getting the energy consumed by

individual costumer. The proposed system automatically reads the energy consumed and sends it to the service provider using the existing SMS.

4.6. MULTIPLE UNIT GSM CONTROLLED DEVICES

The human mind always needs information of interest to control systems of his/her choice. In the age of electronic systems it is important to be able to control and acquire information from everywhere. Remote management of several home and office appliances is a subject of growing interest and in recent years we have seen many systems providing such controls. In this study we have developed an interface which is a phone based home/office remote controller equipped with power to turn ON/OFF and receive STATUS of electrical appliances remotely located**.**

Chapter – 3

PROBLEM DEFINITION

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.

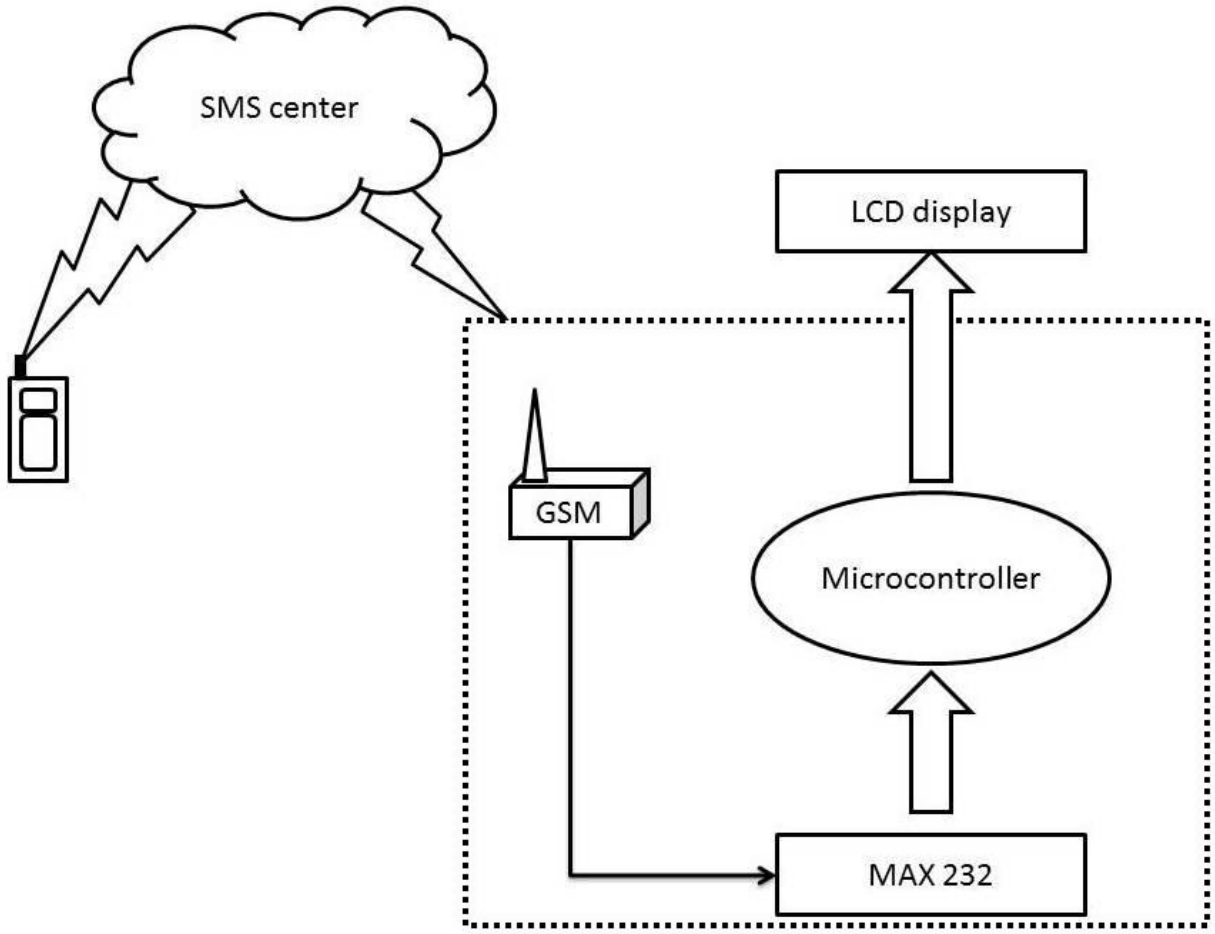

Fig 3.1 overview of system

As we see in the above figure, 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 memories.

Fig 3.2 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.

Chapter – 4

SYSTEM REQUIREMENT SPECIFICATION

4.1. HARDWARE REQUIREMENTS

4.1.1. 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.

GSM sim 300 Modem can accept any GSM network operator SIM card and act just like a mobile phone with its own unique phone number. Advantage of using this modem will be that you can use its RS232 port to communicate and develop embedded applications. Applications like SMS Control, data transfer, remote control and logging can be developed easily. The modem can either be connected to PC serial port directly or to any microcontroller. It can be used to send and receive SMS or make/receive voice calls. It can also be used in GPRS mode to connect to internet and do many applications for data logging and control. In GPRS mode you can also connect to any remote FTP server and upload files for data logging. This GSM modem is a highly flexible plug and play quad band GSM modem for direct and easy integration to RS232 applications. Supports features like Voice, SMS, Data/Fax, GPRS and integrated TCP/IP stack.

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 standards. With the extended AT commands, various things can be done:

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

- Reading, writing and deleting SMS messages.

The number of SMS messages that can be processed by a GSM modem per minute is very low -- only about six to ten SMS messages per minute.

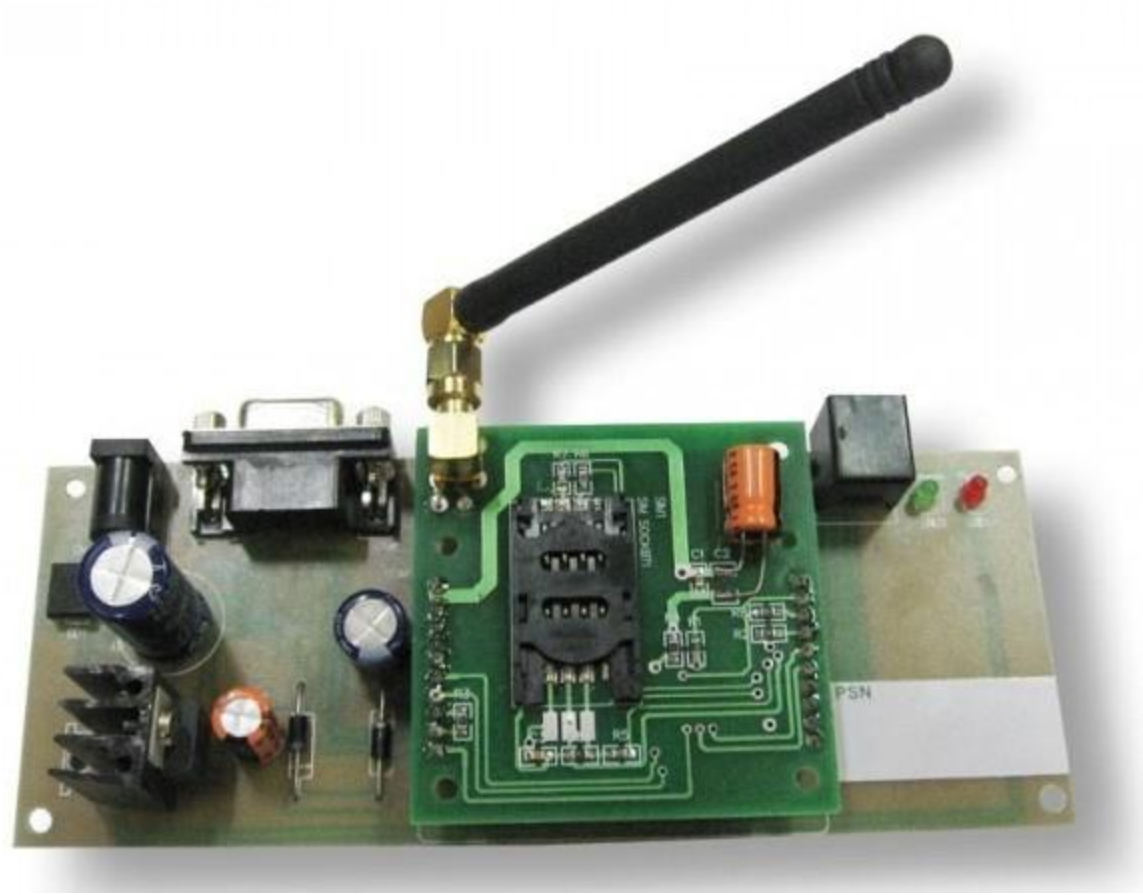

Fig 4.1 GSM modem

4.1.2. LCD display

One of the most common devices attached to an 8051 is an LCD display. Some of the most common LCDs connected to the 8051 are 16x2 and 20x2 displays. This means 16 characters per line by 2 lines and 20 characters per line by 2 lines, respectively. In recent years the LCD is finding widespread use replacing LED's.

This is due to the following reasons:

1. Declining prices
2. Ability to display numbers, characters and graphics.
3. Incorporation of a refreshing controller into the LCD.

4. Ease of programming.

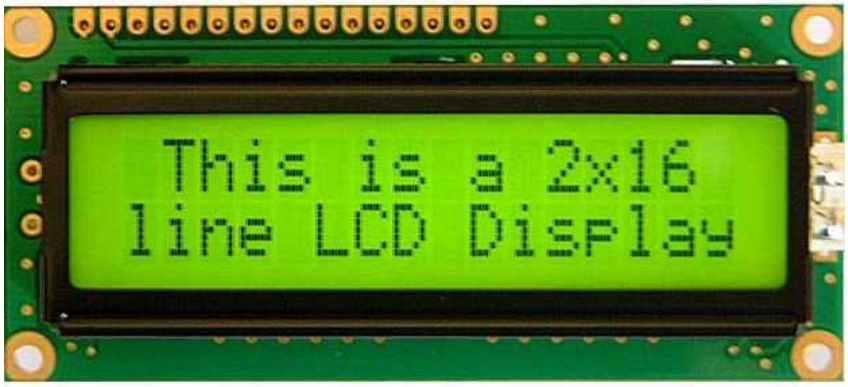

Fig 4.2 LCD display

Fortunately, a very popular standard exists which allows us to communicate with the vast majority of LCDs regardless of their manufacturer. The standard is referred to as **HD44780U**, which refers to the controller chip which receives data from an external source (in this case, the 8051) and communicates directly with the LCD. The 44780 standard requires 3 control lines as well as either 4 or 8 I/O lines for the data bus. The user may select whether the LCD is to operate with a 4-bit data bus or an 8-bit data bus. If a 4-bit data bus is used the LCD will require a total of 7 data lines (3 control lines plus the 4 lines for the data bus). If an 8-bit data bus is used the LCD will require a total of 11 data lines (3 control lines plus the 8 lines for the data bus).

Pin Symbol I/O Description

PIN NO	Symbol	Fuction
1	VSS	GND
2	VDD	+5V
3	V0	Contrast adjustment
4	RS	H/L Register select signal
5	R/W	H/L Read/Write signal
6	E	H/L Enable signal
7	DB0	H/L Data bus line
8	DB1	H/L Data bus line
9	DB2	H/L Data bus line
10	DB3	H/L Data bus line
11	DB4	H/L Data bus line
12	DB5	H/L Data bus line
13	DB6	H/L Data bus line
14	DB7	H/L Data bus line
15	A	+4.2V for LED
16	K	Power supply for BKL(0V)

Table 4.1 LCD pin symbol I/O description

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 RW 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 is 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. You can use a bench power supply

set to 5v or use a onboard +5 regulator. Remember a few de-coupling capacitors, especially if you have trouble with the circuit working properly.

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 right
7	Shift display left
8	Display off, cursor off
A	Display on, cursor off
C	Display on, cursor off
E	Display on, 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 of 1st line
0C0	Force cursor to beginning of 2nd line
38	2 lines and 5x7 Matrix

Table 4.2 LCD command set

4.1.3. Microcontroller AT89S52

Features:

- Compatible with MCS-51® Products
- 8K Bytes of In-System Programmable (ISP) Flash Memory
- Endurance: 1000 Write/Erase Cycles
- 4.0V to 5.5V Operating Range
- Fully Static Operation: 0 Hz to 33 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
- Full Duplex UART Serial Channel
- Low-power Idle and Power-down Modes
- Interrupt Recovery from Power-down Mode
- Watchdog Timer
- Dual Data Pointer
- Power-off Flag

Fig 4.3 Microcontroller AT89S52

Description:

The AT89S52 is a low-power, high-performance CMOS 8-bit microcontroller with 8K bytes of in-system programmable Flash memory. The device is manufactured using Atmel's high-density nonvolatile memory technology and is compatible with the industry standard 8051 instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. By combining a versatile 8-bit CPU with in-system programmable flash on a monolithic chip, the Atmel AT89S52 is a powerful microcontroller which provides a

Highly-flexible and cost-effective solution to many embedded control applications. The AT89S52 provides the following standard features: 8K bytes of flash, 256 bytes of RAM, 32 I/O lines, Watchdog timer, two data pointers, three 16-bit timer/counters, six-vector two-level interrupt architecture, a full duplex serial port, on-chip oscillator, and clock circuitry. In addition, the AT89S52 is designed with static logic for operation down to zero frequency and supports two software selectable power saving modes. The Idle Mode stops the CPU while allowing the RAM, timer/counters, serial port, and interrupt system to continue functioning. The Power-down mode saves the RAM contents but freezes the oscillator, disabling all other chip functions until the next interrupt or hardware reset.

4.1.4. MAX 232

The **MAX232** is an IC that converts signals from an RS-232 serial port to signals suitable for use in TTL compatible digital logic circuits. The MAX232 is a dual driver/receiver and typically converts the RX, TX, CTS and RTS signals. The drivers provide RS-232 voltage level outputs (approx. ± 7.5 V) from a single + 5 V supply via on-chip charge pumps and external capacitors. This makes it useful for implementing RS-232 in devices that otherwise do not need any voltages outside the 0 V to + 5 V range, as power supply design does not need to be made more complicated just for driving the RS-232 in this case.

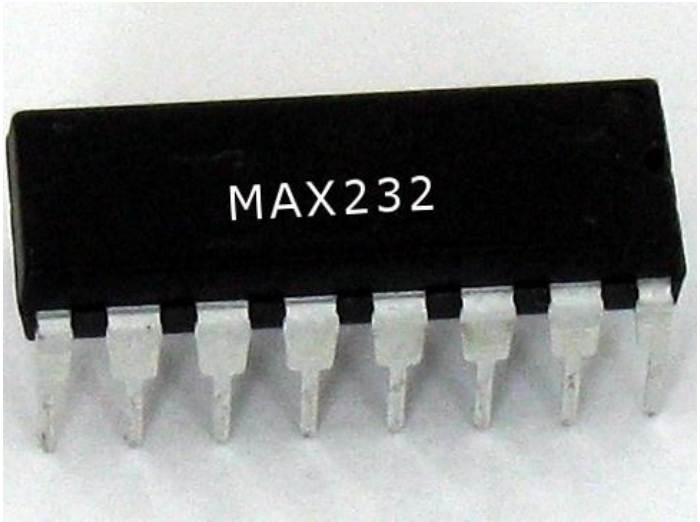

Fig 4.4 MAX232

The receivers reduce RS-232 inputs (which may be as high as ± 25 V), to standard 5 V TTL levels. These receivers have a typical threshold of 1.3 V, and a typical hysteresis of 0.5 V. It is helpful to understand what occurs to the voltage levels. When a MAX232 IC receives a TTL level to convert, it changes TTL logic 0 to between +3 and +15 V, and changes TTL logic 1 to between -3 to -15 V, and vice versa for converting from RS232 to TTL. This can be confusing when you realize that the RS232 data transmission voltages at a certain logic state are opposite from the RS232 control line voltages at the same logic state. The MAX232 (A) has two receivers (converts from RS-232 to TTL voltage levels), and two drivers (converts from TTL logic to RS-232 voltage levels). This means only two of the RS-232 signals can be converted in each direction. Typically, a pair of a driver/receiver of the MAX232 is used for TX and RX signals, and the second one for CTS and RTS signals.

RS232 line type and logic level	RS232 voltage	TTL voltage to/from MAX232
Data transmission (Rx/Tx) logic 0	+3 V to +15 V	0 V
Data transmission (Rx/Tx) logic 1	-3 V to -15 V	5 V
Control signals (RTS/CTS/DTR/DSR) logic 0	-3 V to -15 V	5 V
Control signals (RTS/CTS/DTR/DSR) logic 1	+3 V to +15 V	0 V

Table 4.3 RS232 signal description

There are not enough drivers/receivers in the MAX232 to also connect the DTR, DSR, and DCD signals. Usually these signals can be omitted when e.g. communicating with a PC's serial interface. If the DTE really requires these signals, either a second MAX232 is needed, or some other IC from the MAX232 family can be used. Also, it is possible to directly wire DTR (DB9 pin #4) to DSR (DB9 pin #6) without going through

any circuitry. This gives automatic (brain dead) DSR acknowledgment of an incoming DTR signal.

4.2. SOFTWARE REQUIREMENTS

4.2.1. Embedded C

Embedded C is a set of language extensions for the C Programming language by the C Standards committee to address commonality issues that exist between C extensions for different embedded systems. Historically, embedded C programming requires nonstandard extensions to the C language in order to support exotic features such as fixed-point arithmetic, multiple distinct memory banks, and basic I/O operations.

Difference between C and Embedded C

Though C and embedded C appear different and are used in different contexts, they have more similarities than the differences. Most of the constructs are same; the difference lies in their applications.

- C is used for desktop computers, while embedded C is for microcontroller based applications.
- C takes more resources of a desktop PC like memory, OS, etc. while programming on desktop systems what embedded C cannot. Embedded C has to use the limited resources (RAM, ROM, I/Os) on an embedded processor. Thus, program code must fit into the available program memory. If code exceeds the limit, the system is likely to crash.
- Compilers for C (ANSI C) typically generate OS dependent executable files. Embedded C requires compilers to create files to be downloaded to the microcontrollers/microprocessors where it needs to run. Embedded compilers give access to all resources which is not provided in compilers for desktop computer applications.

- Embedded systems often have the real-time constraints, which is usually not there with desktop computer applications.
- Embedded systems often do not have a console, which is available in case of desktop applications.

The C programming language is perhaps the most popular programming language for programming embedded systems. C continues to be a very popular language for micro-controller developers/programmers due to the code efficiency and reduced overhead and development time. C offers low-level control and is considered more readable than assembly language which is a little difficult to understand. Assembly language requires more code writing, whereas C is easy to understand and requires less coding. Plus, using C increases portability, since C code can be compiled for different types of processors. We can program microcontrollers using 8051, AVR or PIC.

We can develop our programs as per our electronic hardware using 8051 micro controller. For example we can blink led, increment decrement counters, token displays etc.

Most C programmers are spoiled because they program in environments where not only there is a standard library implementation, but there are frequently a number of other libraries available for use. The cold fact is, that in embedded systems, there rarely are many of the libraries that programmers have grown used to, but occasionally an embedded system might not have a complete standard library, if there is a standard library at all. Few embedded systems have capability for dynamic linking, so if standard library functions are to be available at all, they often need to be directly linked into the executable. Oftentimes, because of space concerns, it is not possible to link in an entire library file, and programmers are often forced to "brew their own" standard c library implementations if they want to use them at all. While some libraries are bulky and not well suited for use on microcontrollers, many development systems still include the standard libraries which are the most common for C programmers.

C remains a very popular language for micro-controller developers due to the code efficiency and reduced overhead and development time. C offers low-level control and is considered more readable than assembly. Many free C compilers are available for a wide variety of development platforms. The compilers are part of an IDEs with ICD support, breakpoints, single-stepping and an assembly window. The performance of C compilers has improved considerably in recent years, and they are claimed to be more or less as good as assembly, depending on who you ask. Most tools now offer options for customizing the compiler optimization. Additionally, using C increases portability, since C code can be compiled for different types of processors.

4.2.2. Keil software

Keil development tools for the 8051 Microcontroller Architecture support every level of software developer from the professional applications engineer to the student just learning about embedded software development.

The Keil 8051 Development Tools are designed to solve the complex problems facing embedded software developers.

- When starting a new project, simply select the microcontroller you use from the Device Database and the µVision IDE sets all compiler, assembler, linker, and memory options for you.
- Numerous example programs are included to help you get started with the most popular embedded 8051 devices.
- The Keil µVision Debugger accurately simulates on-chip peripherals (I^2C, CAN, UART, SPI, Interrupts, I/O Ports, A/D Converter, D/A Converter, and PWM Modules) of your 8051 device. Simulation helps you understand hardware configurations and avoids time wasted on setup problems. Additionally, with simulation, you can write and test applications before target hardware is available.
- When you are ready to begin testing your software application with target hardware, use the MON51, MON390, MONADI, or FlashMON51 Target Monitors, the ISD51 In-

System Debugger, or the ULINK USB-JTAG Adapter to download and test program code on your target system.

The Atmel AT89S52 is an 8051 based Full Static CMOS controller with Three-Level Program Memory Lock, 32 I/O lines, 3 Timers/Counters, 8 Interrupts Sources, Watchdog Timer, 2 DPTRs, 8K Flash Memory, 256 Bytes On-chip RAM

If not simpler, the version of the C programming language used for the microcontroller environment is not very different than standard C when working on mathematical operations, or organizing your code. The main difference is all about the limitations of the processor of the 89S52 microcontroller as compared to modern computers.

Even if you're not very familiar with the C language, this tutorial will introduce all the basic programming techniques that will be used along this tutorial. It will also show you how to use the KEIL IDE.

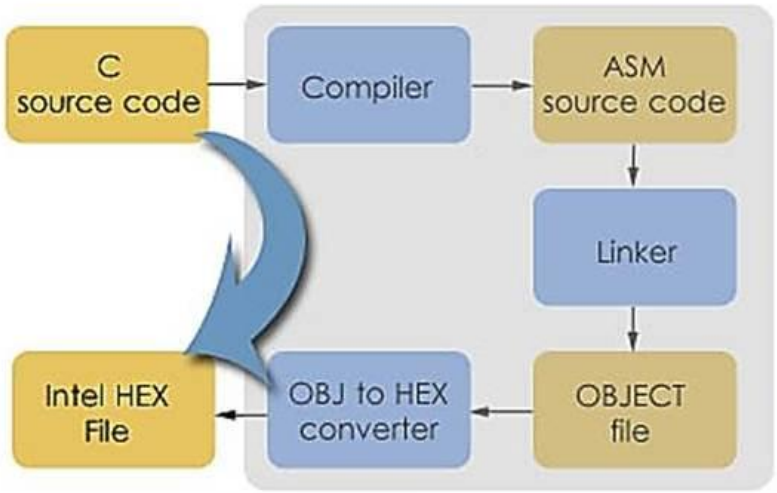

Fig 4.5 converting C code to HEX

From the C program to the machine language

The C source code is very high level language, meaning that it is far from being at the base level of the machine language that can be executed by a processor. This machine language is basically just zero's and one's and is written in Hexadecimal format, that why they are called HEX files. There are several types of HEX files; we are going to produce machine code in the INTEL HEX-80 format, since this is the output of the KEIL IDE that we are going to use. *Figure* shows that to convert a C program to machine language, it takes several steps depending on the tool you are using, however, the main idea is to produce a HEX file at the end. This HEX file will be then used by the 'burner' to write every byte of data at the appropriate place in the EEPROM of the 89S52.

4.2.3. 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:

1. Information and configuration pertaining to mobile device or MODEM and SIM card.
2. SMS services.
3. MMS services.
4. Fax services.
5. 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.

Types of AT Commands:

There are four types of AT commands:

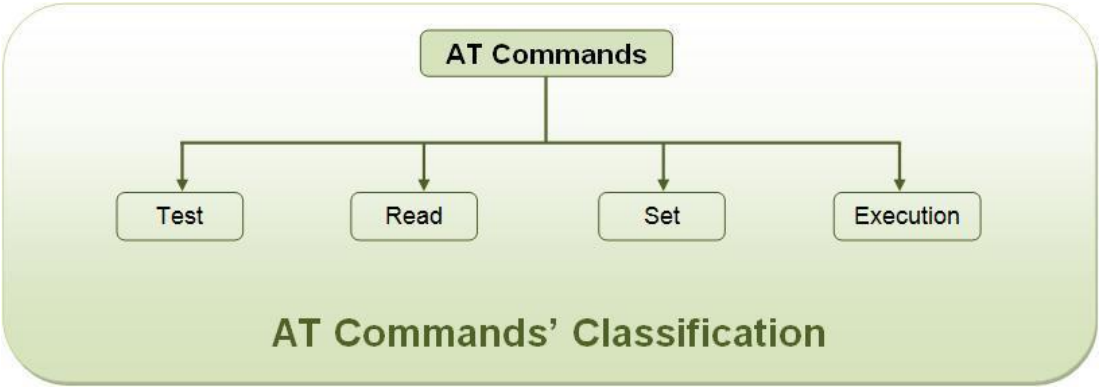

Fig 4.6 AT commands classification

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 are 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)

List of AT commands:

The AT commands for both, GSM module and the mobile phone, are listed below. Some of these commands may not be supported by all the GSM modules available. Also there might be some commands which won't be supported by some mobile handsets.

Command	Description
AT	Checking communication between the module and computer.

Call control:

Command	Description
ATA	Answer command
ATD	Dial command
ATH	Hang up call
ATL	Monitor speaker loudness
ATM	Monitor speaker mode
ATO	Go on-line
ATP	Set pulse dial as default
ATT	Set tone dial as default
AT+CSTA	Select type of address
AT+CRC	Cellular result codes

Data card Control :

Command	Description
ATI	Identification
ATS	Select an S-register
ATZ	Recall stored profile
AT&F	Restore factory settings
AT&V	View active configuration
AT&W	Store parameters in given profile
AT&Y	Select Set as power up option
AT+CLCK	Facility lock command
AT+COLP	Connected line identification presentation
AT+GCAP	Request complete capabilities list
AT+GMI	Request manufacturer identification
AT+GMM	Request model identification
AT+GMR	Request revision identification
AT+GSN	Request product serial number identification (IMEI)

Phone control :

Command	Description
AT+CBC	Battery charge
AT+CGMI	Request manufacturer identification
AT+CGMM	Request model identification
AT+CGMR	Request revision identification
AT+CGSN	Request product serial number identification
AT+CMEE	Report mobile equipment error
AT+CPAS	Phone activity status
AT+CPBF	Find phone book entries
AT+CPBR	Read phone book entry
AT+CPBS	Select phone book memory storage
AT+CPBW	Write phone book entry
AT+CSCS	Select TE character set
AT+CSQ	Signal quality

Computer data interface :

Command	Description
ATE	Command Echo
ATQ	Result code suppression
ATV	Define response format
ATX	Response range selection
AT&C	Define DCD usage
AT&D	Define DTR usage
AT&K	Select flow control
AT&Q	Define communications mode option
AT&S	Define DSR option
AT+ICF	DTE-DCE character framing
AT+IFC	DTE-DCE Local flow control
AT+IPR	Fixed DTE rate

Service :

Command	Description
AT+CLIP	Calling line identification presentation
AT+CR	Service reporting control
AT+DR	Data compression reporting
AT+ILRR	DTE-DCE local rate reporting

Network Communication parameter :

Command	Description
ATB	Communications standard option
AT+CBST	Select bearer service type
AT+CEER	Extended error report
AT+CRLP	Radio link protocol
AT+DS	Data compression

Miscellaneous :

Command	Description
A/	Re-execute command line
AT?	Command help
AT*C	Start SMS interpreter
AT*T	Enter SMS block mode protocol
AT*V	Activate V.25bis mode
AT*NOKIATEST	Test command
AT+CESP	Enter SMS block mode protocol

SMS Text mode :

Command	Description
AT+CSMS	Select message service
AT+CPMS	Preferred message storage
AT+CMGF	Message format
AT+CSCA	Service centre address
AT+CSMP	Set text mode parameters
AT+CSDH	Show text mode parameters
AT+CSCB	Select cell broadcast message types
AT+CSAS	Save settings
AT+CRES	Restore settings
AT+CNMI	New message indications to TE
AT+CMGL	List messages
AT+CMGR	Read message
AT+CMGS	Send message
AT+CMSS	Send message from storage
AT+CMGW	Write message to memory
AT+CMGD	Delete message

SMS PDU mode

Command	Description
AT+CMGL	List Messages
AT+CMGR	Read message
AT+CMGS	Send message
AT+CMGW	Write message to memory

Table 4.4 AT commands

Chapter – 5

SYSTEM MODELLING AND DESIGN

5.1. THE ENGINEERING MODEL

An embedded system is a combination of hardware and software and perhaps other mechanical parts designed to perform a specific function. Theoretically an SMS sent form a mobile phone to GSM modem is received by the GSM and stores it through AT commands. Using microcontroller it is possible to retrieve the stored message in GSM and display it on a LCD display using embedded programming languages. Short information can be sent from a mobile phone as SMS and made display until the next one.

5.2. SYSTEM MODELS

5.2.1. Use case diagram

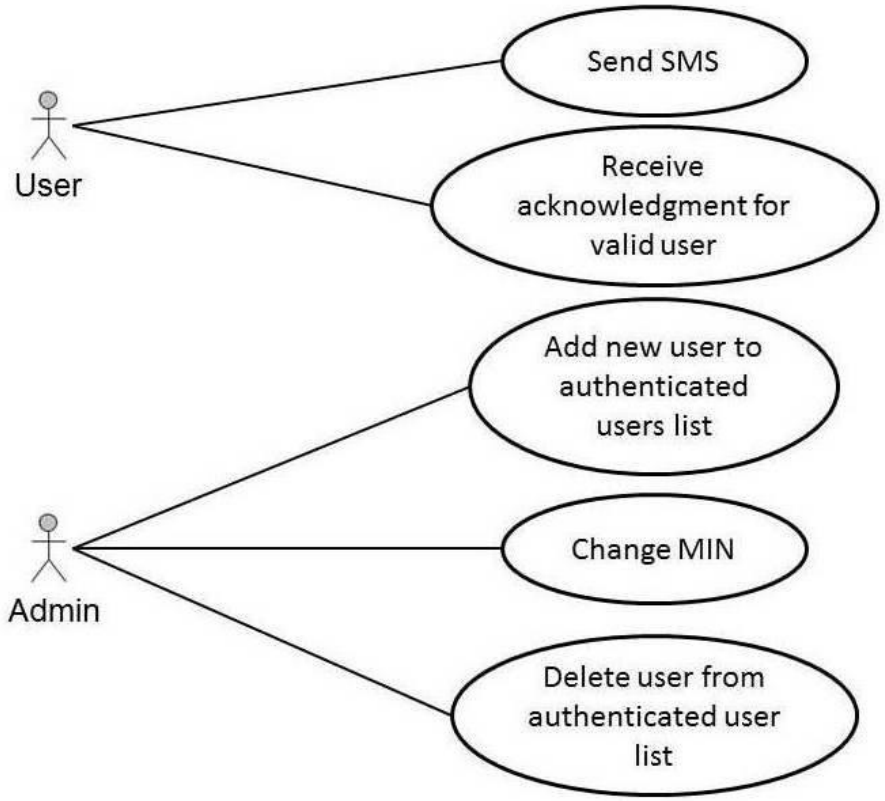

Fig 5.1 use case diagram (contd...)

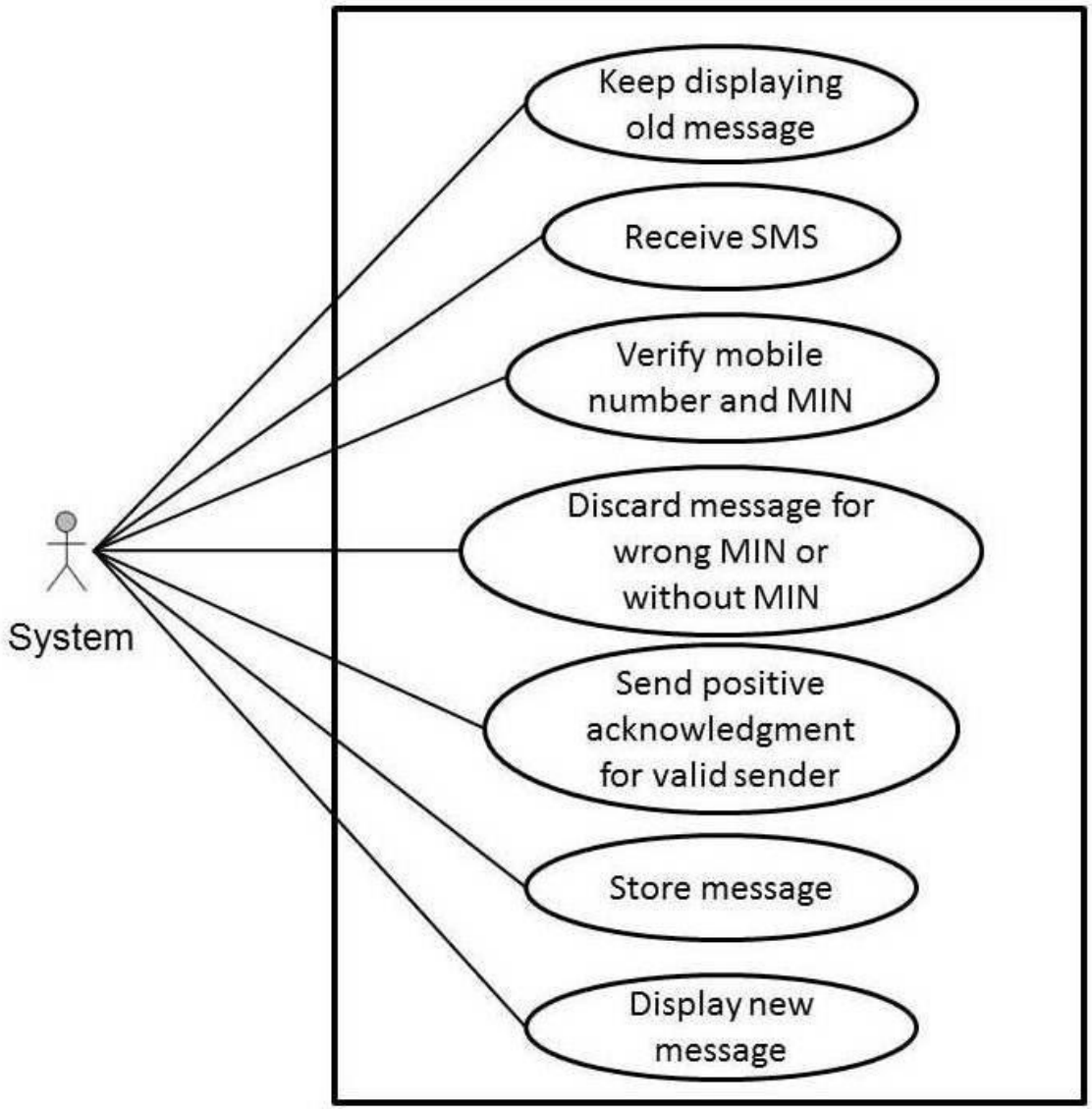

Fig 5.2 use case diagram

The User interacts with the system by sending a message to the system for it to display. Once the system receives the message it verifies the user identification (MIN) with his number. If the validation proves to be authentic the message is stored and proceeds to display the message. Denial of authentication (wrong MIN) results in discarding the message. Admin is granted with the responsibility of addition to the authenticated list, deletion of users from the list and also has the ability to change the access code (MIN).

5.2.2. Functional decomposition

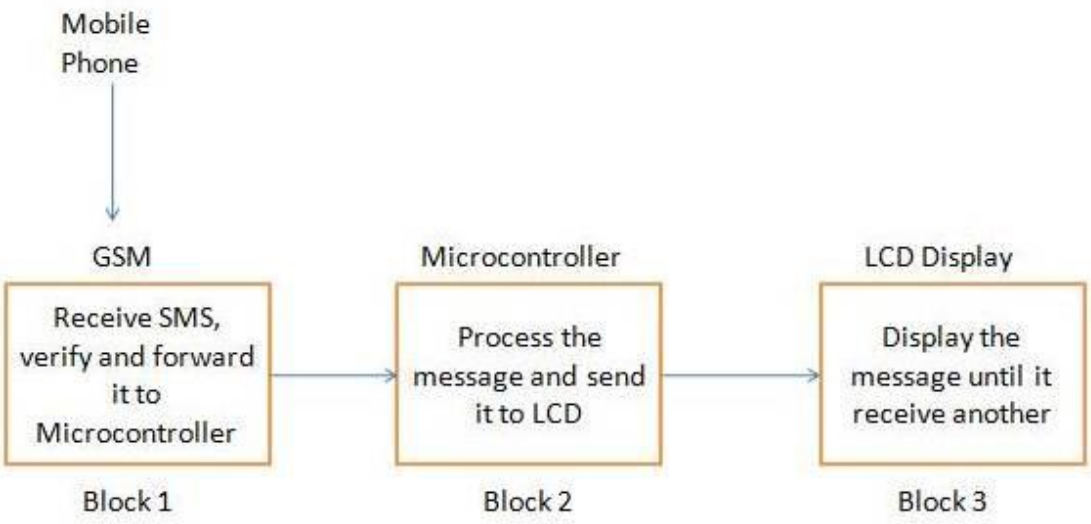

Fig 5.3 functional decomposition diagram

The constituent parts involved in the process are

- Mobile phone
- GSM (global system for mobile)
- Microcontroller
- LCD display

First block portrays to be gsm which receives, verifies and forwards the message to the Microcontroller. Micro is the second block. Micro processes the message and sends to the LCD. LCD behaving as the third constituent part displays the message until it is invoked by micro to display a new message.

5.2.3. Data flow diagram

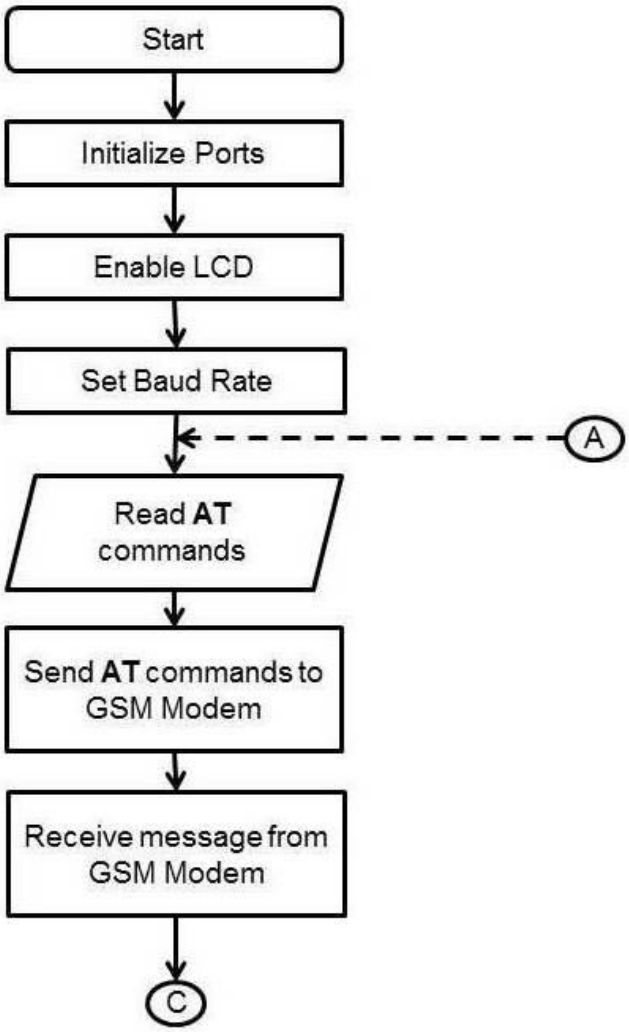

Fig 5.4 flow chart (contd…)

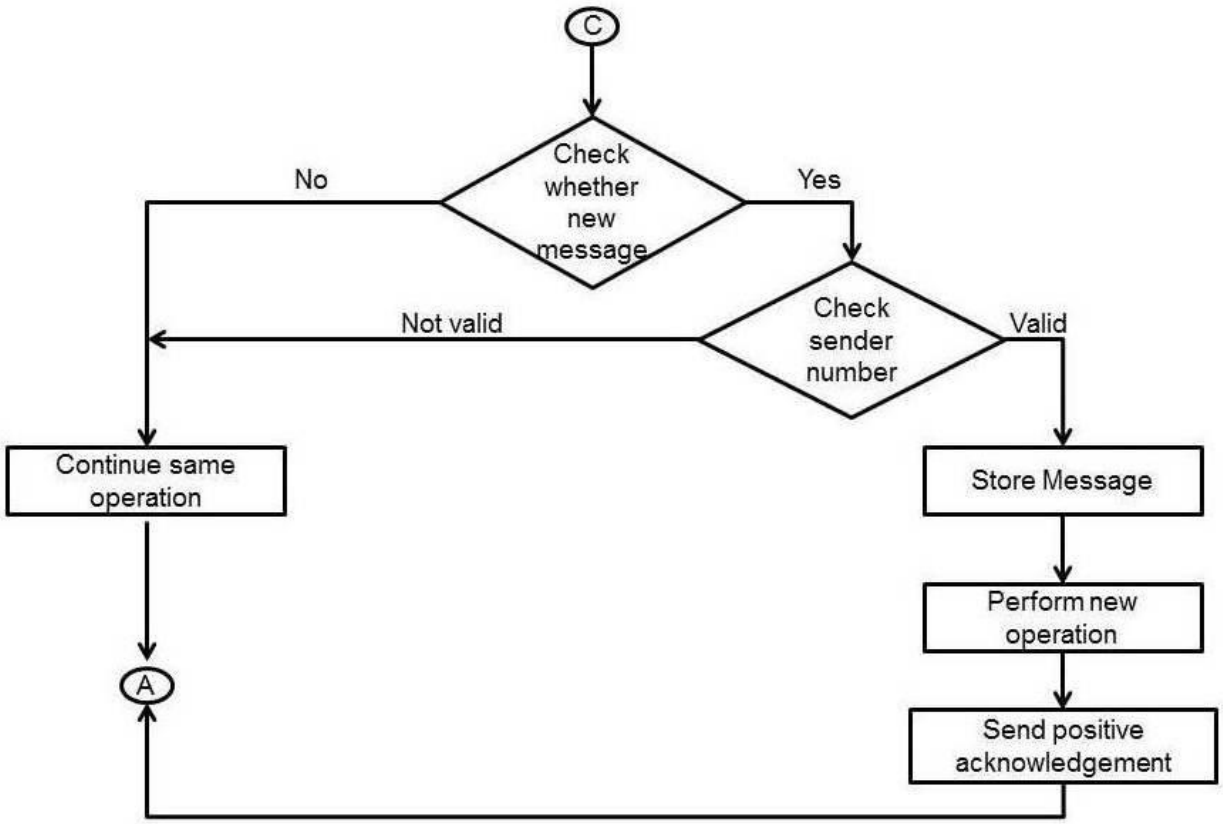

Fig 5.5 flow chart

The flow starts by initializing the ports of components. LCD is enabled and the baud rate is set. The program module points out the AT commands that has to be executed by the GSM. When micro reads these AT commands, it is sent to the GSM module where the commands are processed. At this instance the messages are sent to the micro so it can be displayed. The updating of messages is checked and if the sender is valid the messages are stored. Any operation pertaining to the present result is performed. Once the operations are performed the acknowledgement is sent. In the worst case scenario if there are no new messages the loop of checking for new messages continues until the new one arrives.

5.2.4. State transition diagram

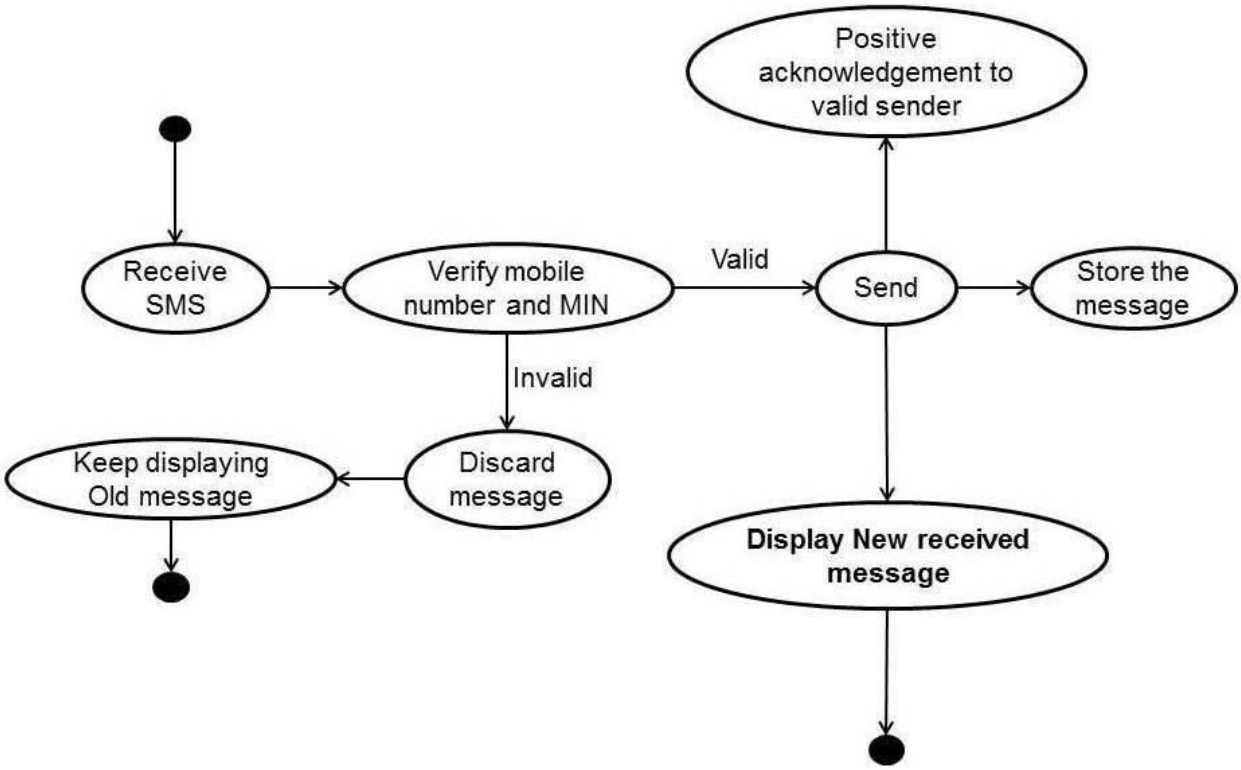

Fig 5.6 state transition diagram

The state transition refers to all the finite states the system enters during the process, pointing out the behavior of the system when the msg is received from the end user. Just as soon as the msg is received from the user the message is validated by comparing with the password characters. The message is stored and sent to display. In the other scenario the invalid user msg is discarded by the microcontroller and later keeps checking for any new recent messages.

5.2.5. Architecture of the system

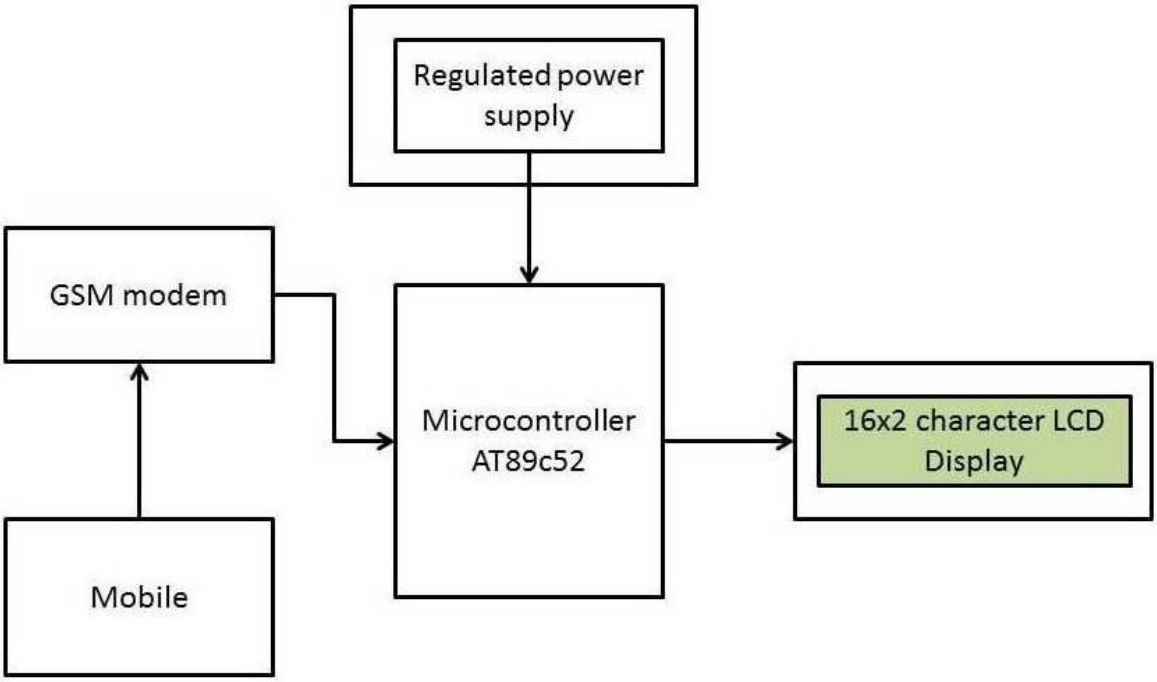

Fig 5.7 architecture of the system

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 msg received by the user, any operation performed by the GSM is due to the AT commands initiated by the microcontroller. Microcontroller forwards the msg to the LCD. LCD receives the msg 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.

Chapter – 6

IMPLEMENTATION

6.1. MICROCONTROLLER - MODEM INTERFACING

6.1.1. 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 dial•]up 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.

6.1.2. RS• 232

In telecommunications, RS• 232 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 RS•] 232, 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 controls 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.

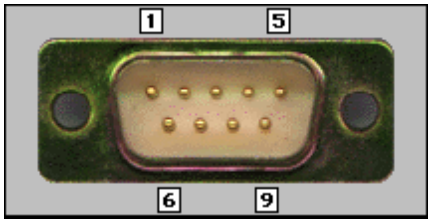

Fig 6.1 RS232

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

Table 6.1 RS232 signals, functions DTE DCE

6.1.2.1. RS-232 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 require 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 Terminal Ready (DTR)**
  Asserted by DTE to indicate that it is ready to be connected. If the DCE is a modem, it should go "off hook" when it receives this signal. If this signal is disserted, the modem should respond by immediately hanging up.

- **Data Set Ready (DSR)**
  Asserted by DCE to indicate an active connection. If DCE is not a modem (e.g. a null-modem cable or other equipment), this signal should be permanently asserted (set to 0), possibly 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.

6.2. MICROCONTROLLER-LCD INTERFACING

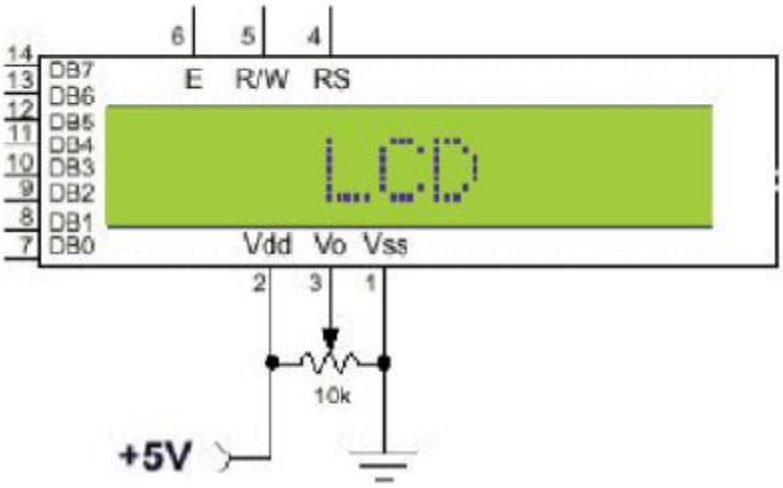

Fig 6.2 Microcontroller – LCD interfacing

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 is 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 10k Potentiometer controls the contrast of the LCD panel. Nothing fancy here. As with all the examples, I've left the power supply out. You can use a bench power supply set to 5v or use a onboard +5 regulator. The user may select whether the LCD is to operate with a 4-bit data bus or an 8- bit data bus. If a 4-bit data bus is used, the LCD will require a total of 7 data lines.

If an 8-bit data bus is used, the LCD will require a total of 11 data lines. The three controls lines are **EN**, **RS**, and **RW**. Note that the EN line must be raised / lowered before/after each instruction sent to the LCD regardless of whether that instruction is read or write text or instruction. In short, you must always manipulate EN when communicating with the LCD. EN is the LCD's way of knowing that you are talking to it. If you don't raise/lower EN, the LCD doesn't know you're talking to it on the other lines.

6.3. IMPLEMENTATION AT INSTITUTE LEVEL

6.3.1. 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.

6.3.2. 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 a 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 – 7

TESTING

7.1. INITIALIZATION

The baud rate of the modem was set to be 4800 bps using the command AT+IPR=4800.The ECHO from the modem was turned off using the command ATE/ATE0 at the hyper terminal. For serial transmission and reception to be possible both the DTE and DCE should have same operational baud rates. Hence to set the microcontroller at a baud rate of 4800bps, we set terminal count of Timer 1 at 0FFh (clock frequency = 1.8432). The TCON and SCON registers were set accordingly.

7.2. SERIAL TRANSFER USING TI AND RI FLAGS

After setting the baud rates of the two devices both the devices are now ready to transmit and receive data in form of characters. Transmission is done when TI flag is set and similarly data is known to be received when the Rx flag is set. The microcontroller then sends an AT command to the modem in form of string of characters serially just when the TI flag is set. After reception of a character in the SBUF register of the microcontroller (response of MODEM with the read message in its default format or ERROR message or OK message), the RI flag is set and the received character is moved into the physical memory of the microcontroller.

7.3. VALIDITY CHECK & DISPLAY

After serially receiving the characters the code then checks for start of the sender's number and then compares the number character by character with the valid number pre stored in the memory. Since we are employing just one valid number, we are able to do the validation process dynamically i.e. without storing the new message in another location in the memory. For more than one valid numbers we would require more memory locations to first store the complete (valid/invalid) message in the memory and then perform the comparison procedure. After validity check the control flow goes into the LCD program module to display the valid message stored in the memory. In case of multiple valid numbers all invalid stored messages are deleted by proper branching in the code to the "delete-message" module.

7.4. RESULTS

Snapshots

1. Initializing

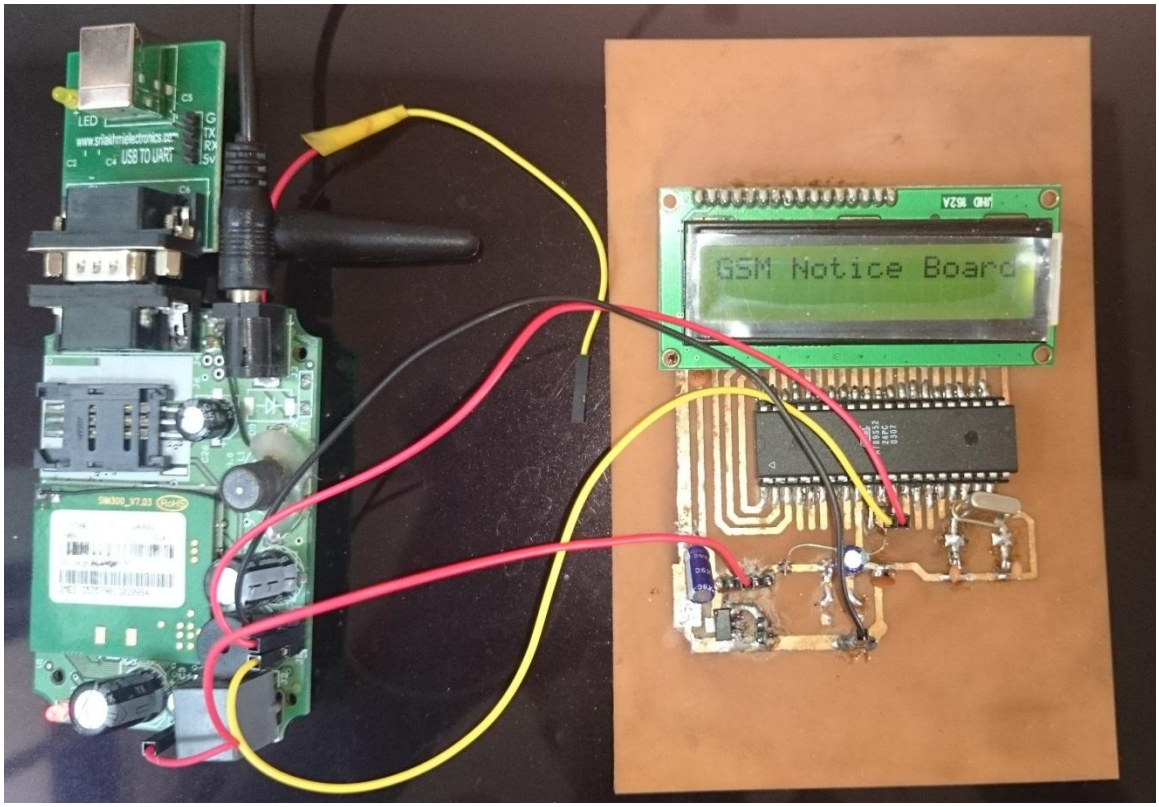

Fig 7.1 initialization

2. Typing the message in the mobile

Fig 7.2 typing the message in the mobile

3. Enter the valid authenticated phone number

Fig 7.3 Enter the valid authenticated phone number

4. Send the message

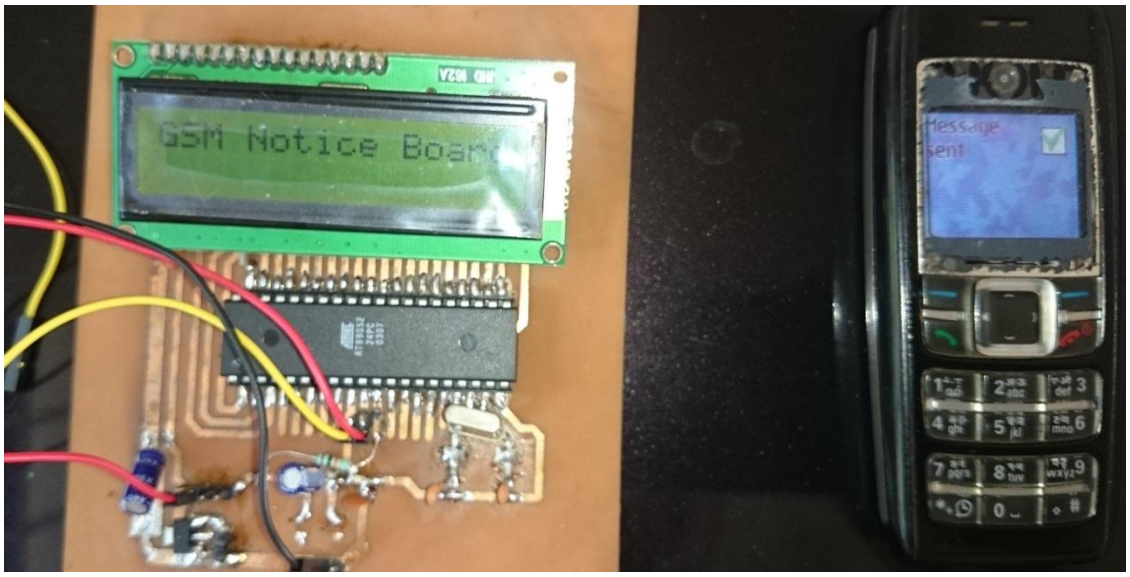

Fig 7.4 Send the message

5. Message is displayed in the notice board

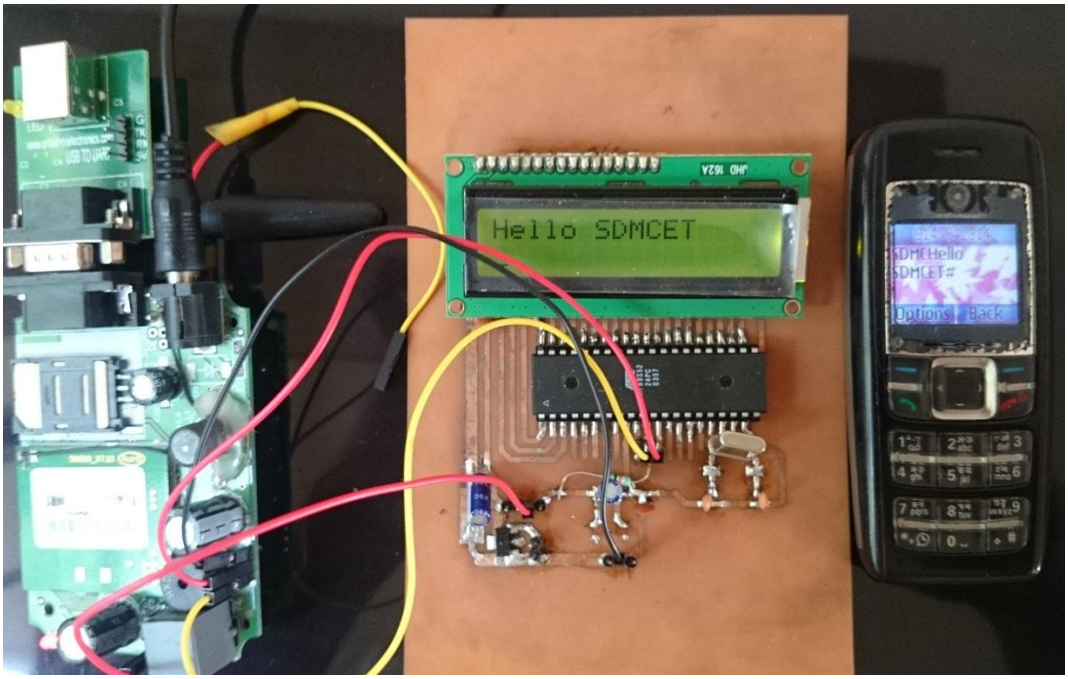

Fig 7.5 Message is displayed in the notice board

6. Change the message

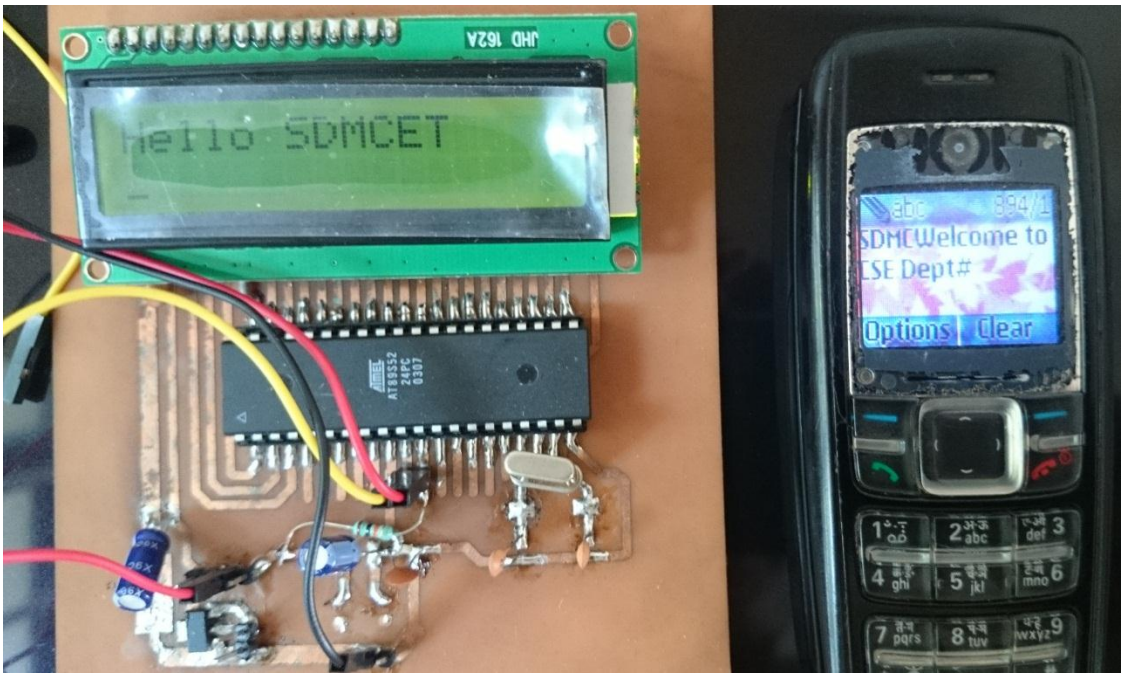

Fig 7.6 Change the message

7. Send the new message

Fig 7.7 Send the new message

8. Message sent

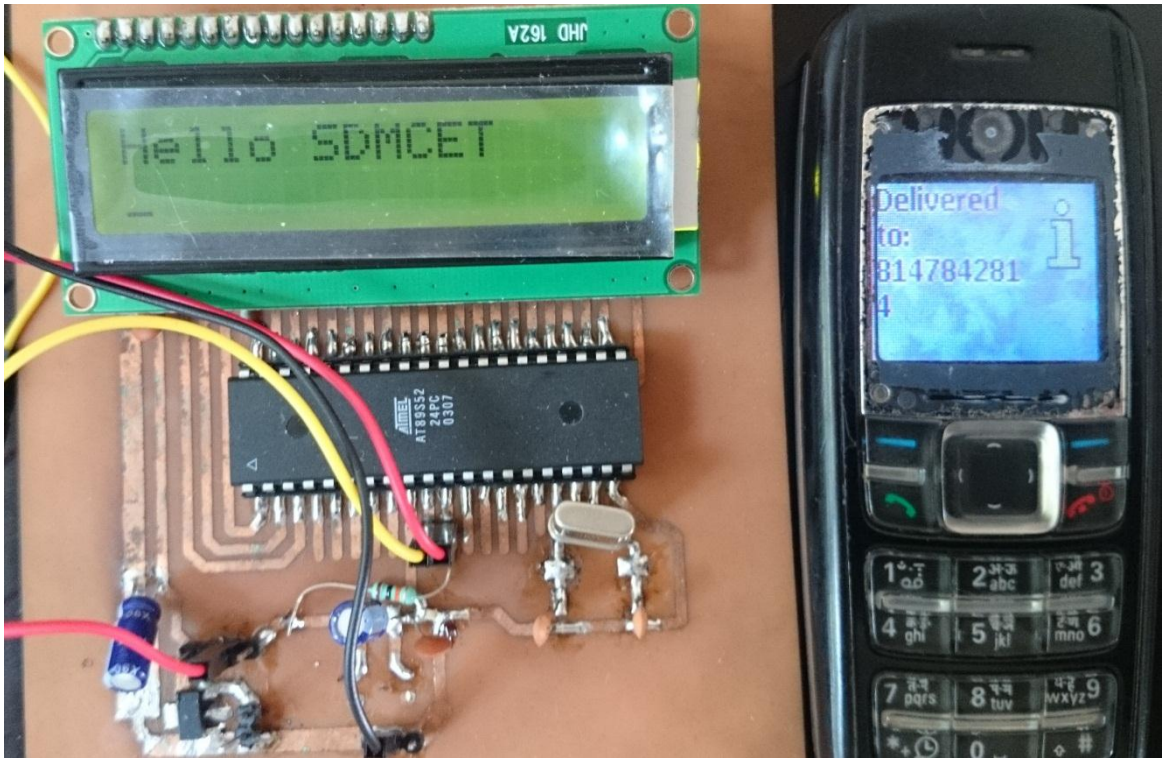

Fig 7.8 message sent

9. Message displayed

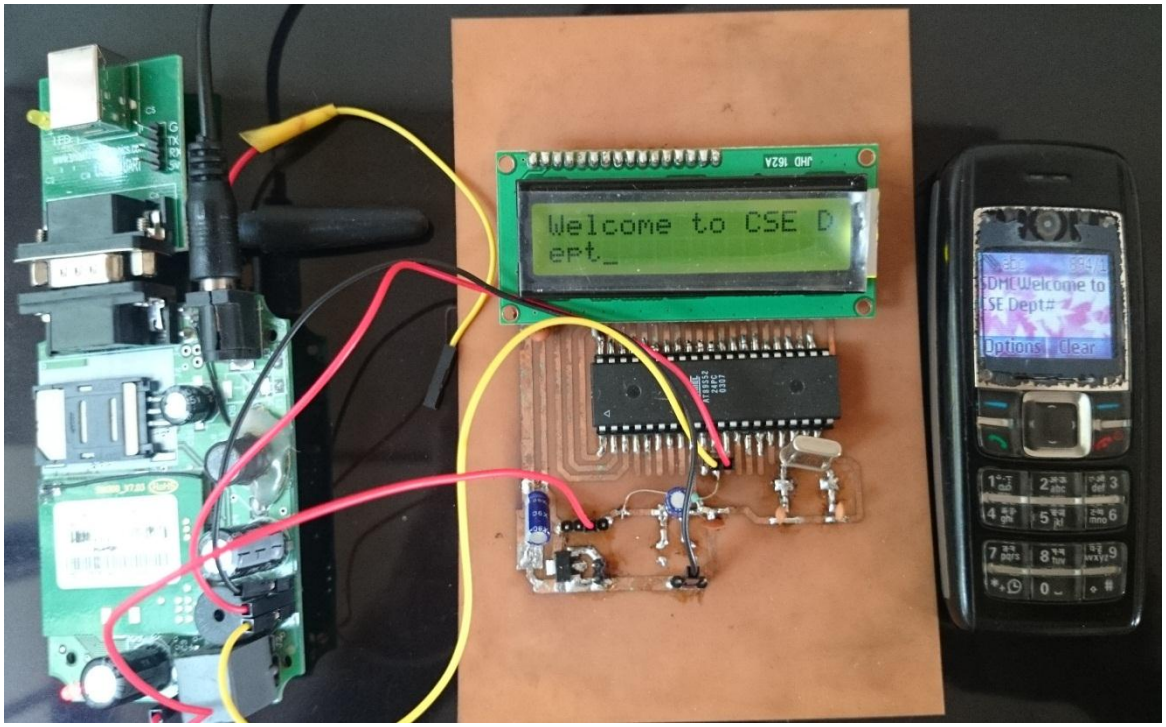

Fig 7.9 message displayed

10. To clear notice board

Fig 7.10 to clear notice board

11. Send sdmc#

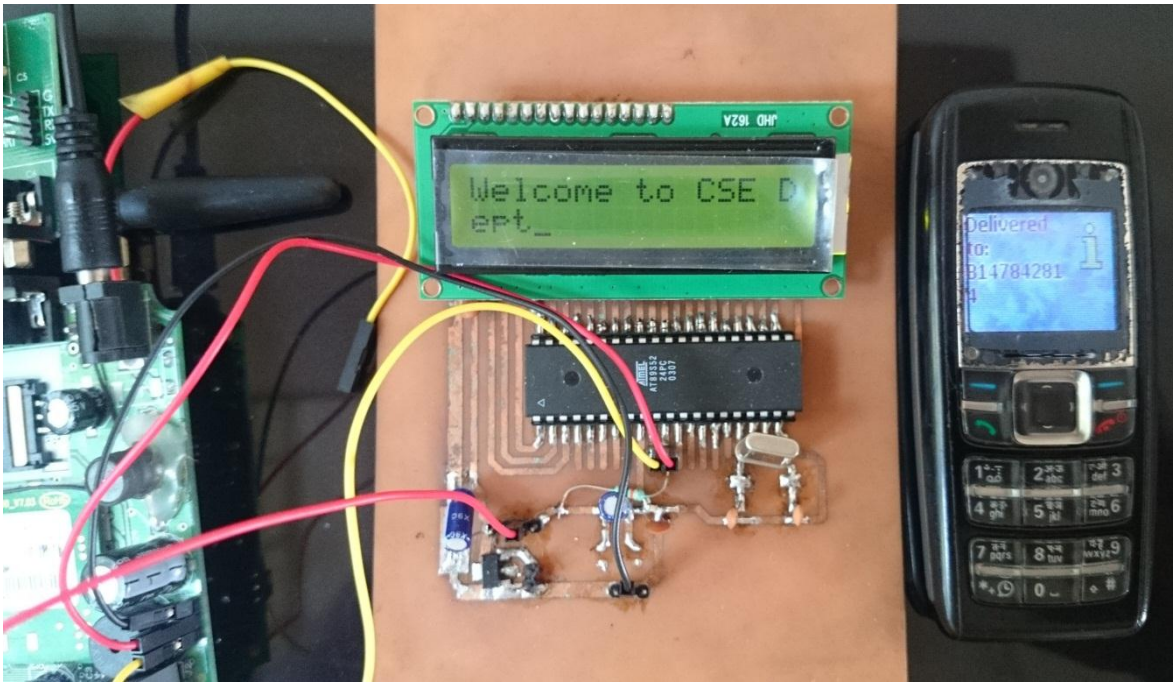

Fig 7.11 send SDMC#

12. Notice board cleared

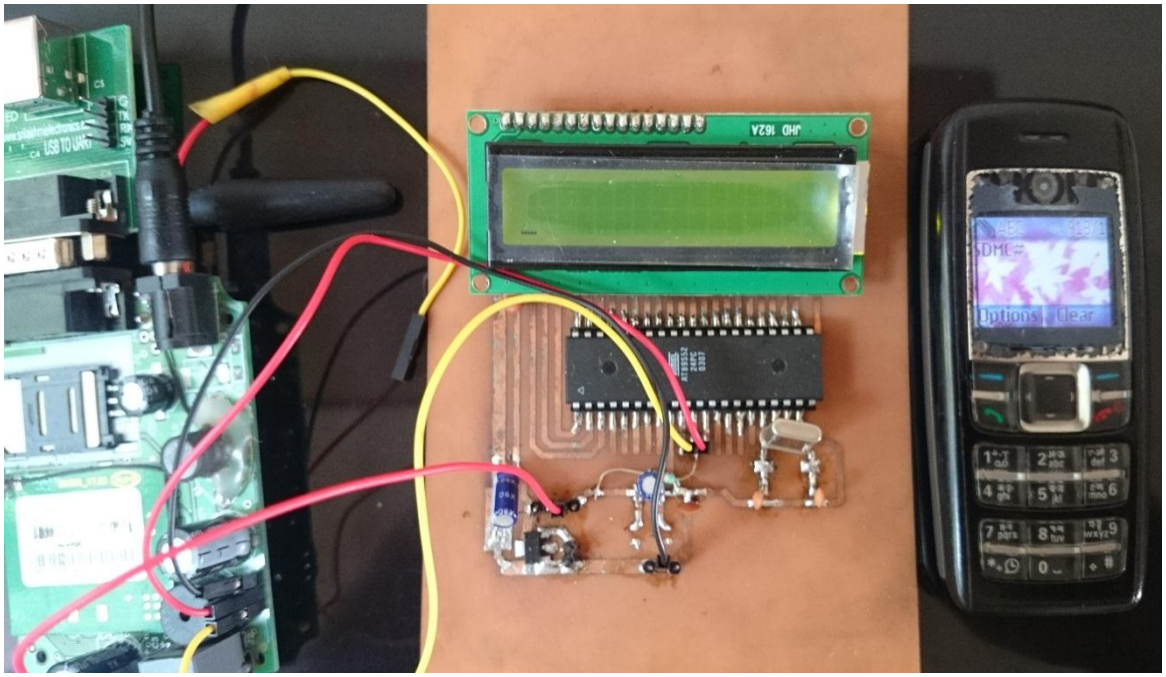

Fig 7.12 notice board cleared

Chapter – 8

CONCLUSION

8.1. 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.

8.2. 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 center 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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