Design and Development of Automatic Intelligent Locking System with Real Time SMS Notifications

Sudip Dogra[1], Subhadeep Sen[2] and Kamalendu Langal[3]

[1] *Department of Electronics and Communications Engineering, Meghnad Saha Institute of Technology, Kolkata, India*

[2] *Department of Electronics and Communications Engineering, Meghnad Saha Institute of Technology, Kolkata, India*

[3] *Department of Electronics and Communications Engineering, Meghnad Saha Institute of Technology, Kolkata, India*

[1]dogra.sudip@gmail.com, [2]subhadeep0977@gmail.com, [3] kamalendulangal@gmail.com

***Abstract*—** In the present era security is a great concern for everybody; starting from individuals to banks to any business or government organizations. A GSM Based Security System can serve to address this issue of security to a large extent. This would ensure that unauthorized access to secured areas or information is prevented. Keeping this thought in mind we embarked upon this project of GSM Based Security System using Microcontroller systems. We have intended to develop a system which will work in every infrastructural condition. It will provide access upon correct password only. In case of any unauthorized person tries to enter by putting wrong password the developed system alerts through SMS to predefined mobile numbers.

***Keywords*—** 89C52 Microcontroller, GSM Module, LCD Display, Matrix Keypad.

I. INTRODUCTION

In our life, security is great concern for each and every one to protect their valuable items. This includes from a common man's valuables to a big industrials items, government, medical, banking etc. Assume that there is a locker in someone's home and that person is currently not at home. If a thief enters and try to break the locker then how could the owner possibly know this? That means, if the thief succeeds to break it then all the valuable items will be gone and the owner will probably know it when the owner will be back to home which will be quiet late. Or let's say someone have a locker facility in a bank. Then how would that person get the information that someone has not accessed the locker. There are so many examples for this purpose. This system will not only help to get notifications of accessing the system, it will also help to protect the items as the system will completely be locked down after back to back three wrong trials and it will only be unlocked by a unique key phrase.

This paper is organized as follows: In section II, the GSM Module is described in brief. Section III describes the design and operation of the system. In section IV, we have described the technical details of the developed prototype system. In section V, the applications of the system.

II. GSM MODEM IN BRIEF

GSM stands for Global System for Mobile Communication which serves a worldwide communication network. The heart of this modem is the SIM900A [1] Chip and it has a built in RS232 interface which allows connecting with PC as well as microcontroller through Rx and Tx pins. It works on frequencies 900/1800 MHz and can be controller via AT Commands provided by the manufacturer. The communication rate, also known as the baud rate, can be configured from 1200 bps to 115200 bps through AT Commands. This Modem is having internal TCP/IP stack that enables to connect with internet via GPRS. It provides us various services like voice calls, sending SMS, FAX and GPRS etc. All the features available to this Modem can be controlled by AT Commands.

A. Brief working of GSM Module

Unlike mobile phones, a GSM Modem does not have a keypad and display to interact with. It just accepts certain commands through a serial interface and acknowledges for those. These commands are called as AT commands. There are a list of AT commands [2] to instruct the modem to perform its functions. Every command starts with "AT". That's why they are called as AT commands. 'AT' stands for attention.

For example, if we want to call a number then we have to instruct the Modem via AT Command as ATD+91XXXXXXXXXX; Here D stands for dial. Similarly to receive a call ATA and to hang a call ATH where A stands for answer and H stands for hang up.

In our project, we are sending a SMS when someone wants to access the system. And when the system gets completely locked down, it will wait for a SMS that has to be a proper key phrase to break the lock.

III. DESCRIPTION OF THE SYSTEM

In our designed prototype, there will be a keypad, three buttons (Enter, Clear, Set), two LEDs (Red and Green), LCD display, microcontroller, camera module and GSM Modem (Fig.1). The keypad will be used to type the 4 digits password. Among the three buttons, one button is used to enter while the user is done typing the password, one button is for clear the password field if the user has entered a wrong password and one button is for setting a new password. The green LED will glow indicating that the user has

successfully got access to the system. The red LED will glow when the user has entered a wrong password. And the buzzer will be activated after entering three times back to back wrong password.

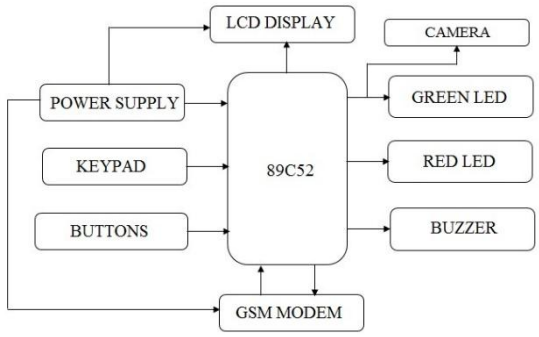

Fig. 1.Block Diagram of the System.

When the system is powered on it will initialize itself and then it will send the default password provided with the system via SMS to the cellular device. Now the system is ready to accept password. One can also change the password just by pressing the Set button in the system. Once the user presses it, a message will be displayed on the LCD screen asking to enter the old password. If the user enters the correct password then only it will give the field on LCD to enter a new password.

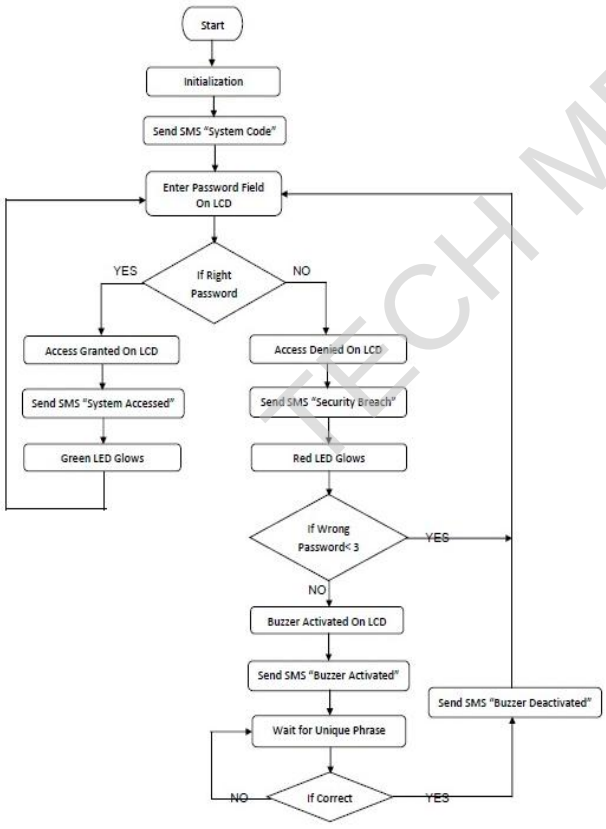

Fig. 2.Flow Chart

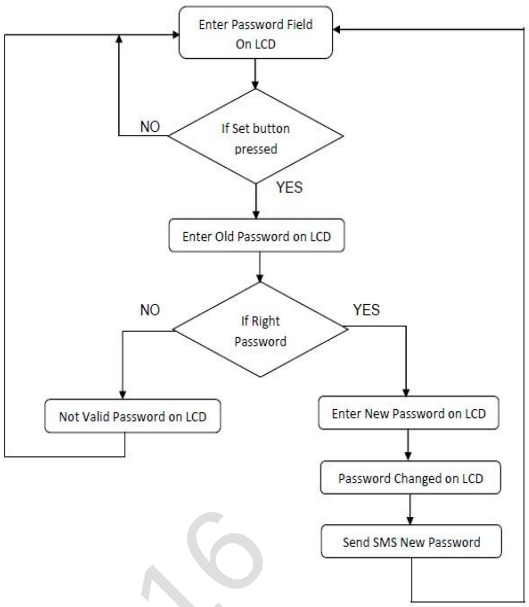

Fig. 3.Flow Chart

A. *Steps of Operation*

1. The user will enter the password through a keypad.
2. If the correct password is entered
   a) The door opens.
   b) The current status will be displayed on the LCD.
   c) A notification will be sent to the owner's phone.
3. If the entered password is wrong
   a) A warning bulb glows.
   b) The LCD will display the warning status.
   c) A notification will be sent to the owner's phone.
4. If the wrong password is entered thrice
   a) The buzzer will be activated.
   b) The system will be in locked-down state.
   c) A notification will be sent to the owner's phone.
   d) The owner has to unlock the system through phone.
5. If the system code is changed by pressing the set button
   a) The owner will be informed with the new code.

The camera module will be turned on whenever one will try to access the system and it will capture the user's image and will save that in its internal memory.

IV. IMPLEMENTATION OF THE SYSTEM

We have implemented our system using GSM SIM900A Module, 89C52 Microcontroller, 16x2 LCD Display, 4x3 Matrix Keypad, LEDS, Buzzer and Push Buttons, Camera Module and a hardware board developed by us. The basic building block diagram of the system is shown in Fig. 1.

A. *SIM900A Module*

The SIM900A Module is the heart of the system to communicate with mobile phones. In this project, it is used to send SMS as notifications. Earlier we have already discussed that this modem can be controlled via "AT" commands. Here we are using the "AT" commands that are specific to send and receives SMS. The "AT" commands are being sent from the microcontroller which is communicating with the modem by 9600 bps baud rate. For communication purpose it uses the standard serial (RS232) interface. The Rx, Tx and Gnd pins of the modem are connected with controller Tx, Rx and Gnd pins. The controller uses the UART protocol to instruct, send and receive from the modem. The development board for this module that we have used in this project is shown below (Fig.4).

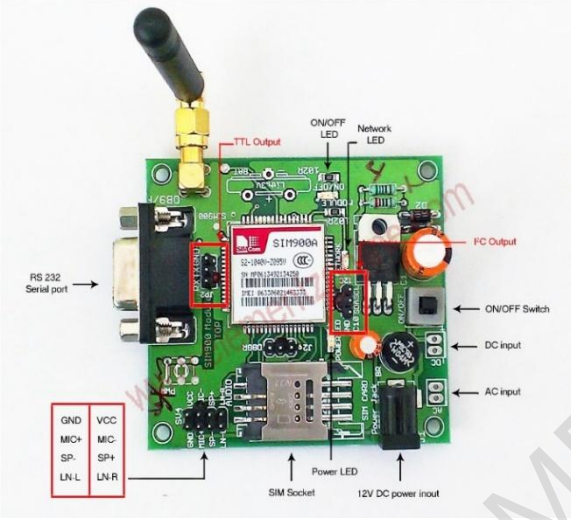

Fig.4 .GSM Development Board

B. *89C52 Microcontroller*

The Intel MCS-51(commonly referred to as 8051) is a Harvard architecture, CISC instruction set, single chip microcontroller (µC) series which was developed by Intel in 1980 for use in embedded systems. The 8051 architecture provides many functions (CPU, RAM, ROM, I/O, interrupt logic, timer, etc.) in a single package [3].

i. 8-bit ALU and Accumulator, 8-bit Registers (one 16-bit register with special move instructions), 8-bit data bus and 2×16-bit address bus/program counter/data pointer and related 8/11/16-bit operations; hence it is mainly an 8-bit microcontroller.

ii. Boolean processor with 17 instructions, 1-bit accumulator, 32 registers (4 bit-addressable 8-bit) and up to 144 special 1 bit-addressable RAM variables (18 bit-addressable 8-bit).

iii. Multiply, divide and compare instructions

iv. 4 fast switchable register banks with 8 registers each

v. Fast interrupt with optional register bank switching

vi. Interrupts and threads with selectable priority

vii. Dual 16-bit address bus – It can access 2 x 216 memory locations – 64 KB (65,536 locations) each of RAM and ROM

viii. 128 bytes of on-chip RAM (IRAM)

ix. 4 KB of on-chip ROM, with a 16-bit (64 KB) address space (PMEM).

x. Four 8-bit bi-directional input/output port UART (serial port)

xi. Two 16-bit Counter/timers

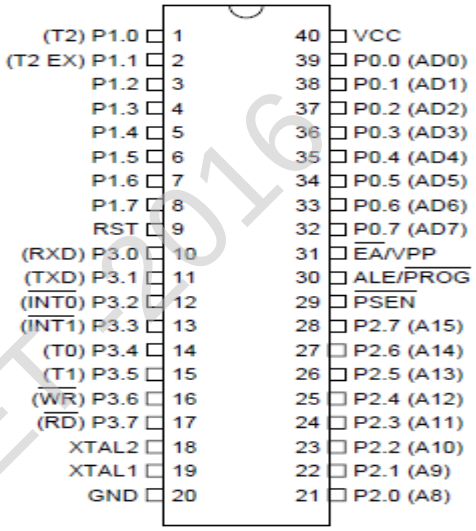

Fig. 5.Pin Diagram of 89C52

C. *LCD Display*

The HD44780U [4] dot-matrix liquid crystal display controller and driver LSI displays alphanumeric, Japanese kana characters, and symbols. It can be configured to drive a dot-matrix liquid crystal display under the control of a 4- or 8-bit microprocessor [5]. Since all the functions such as display RAM, character generator, and liquid crystal driver, required for driving a dot-matrix liquid crystal display are internally provided on one chip, a minimal system can be interfaced with this controller/driver. A single HD44780U can display up to one 8-character line or two 8-character lines. The low power supply (2.7V to 5.5V) of the HD44780U is suitable for any portable battery-driven product requiring low power dissipation.

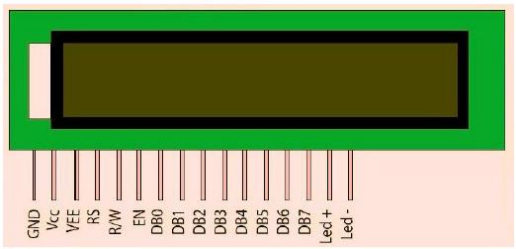

Fig. 6.LCD Display

D. 4X3 Matrix Keypad

Matrix Keypads (Fig.7) [6] are commonly used in calculators, telephones etc. where a number of input switches are required. We know that matrix keypad is made by arranging push button switches in row and columns. In the straight forward way to connect a 4×3 keypad (12 switches) to a microcontroller we need 12 inputs pins. But by connecting switches in the following way we can read the status of each switch using 8 pins of the microcontroller. The status of each key can be determined by a process called Scanning. For the sake of explanation let us assume that all the column pins (Col1 – Col3) are connected to the inputs pins and all the row pins are connected to the output pins of the microcontroller. In the normal case all the column pins are pulled up (HIGH state) by internal or external pull up resistors. Now we can read the status of each switch through scanning.

1. A logic LOW is given to Row1 and others (Row2 – Row4) HIGH
2. Now each Column is scanned. If any switch belongs to 1 row is pressed corresponding column will pulled down (logic LOW) and we can detect the pressed key.

This process is repeated for all rows.

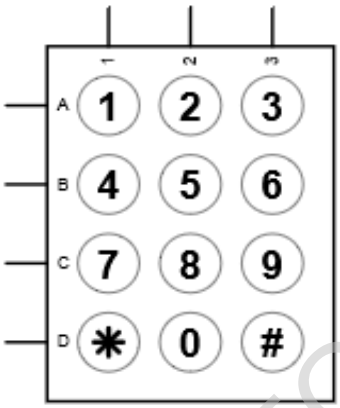

Fig. 7.Matrix Keypad.

E. Camera Module

In this system the purpose of the camera module is to take picture of the current user while accessing the system and save it to its internal memory.

F. Embedded C Language

The entire logic of this system is developed in Embedded C language (Keil Software). It is similar to C programming language and it uses the same procedure that of C to develop any logic in coding.

Fig. 9.Photograph of the developed System.

V. APPLICATIONS OF THE SYSTEM

1. Home Security
2. Banking Locker Facilities
3. Industrial Facilities
4. Commercial Buildings
5. Government and Military
6. Museums and Art Galleries
7. Ware Houses
8. Long term care Facilities

REFERENCES

[1] SIM900: http://probots.co.in/Manuals/SIM900%20GSM%20Modem%20-%20Starter%20Guide.pdf
[2] SIM900 AT Commands Manual: www.propox.com/download/docs/SIM900_AT.pdf
[3] 89C52 Datasheet with Instruction Set: http://www.atmel.com/images/doc0313.pdf
[4] 16x2 LCD Controller (HD44780U): http://fab.cba.mit.edu/classes/863.06/11.13/44780.pdf
[5] 16x2 LCD Datasheet: https://www.sparkfun.com/datasheets/LCD/ADM1602K-NSW-FBS-3.3v.pdf
[6] 4x3 Matrix Keypad: http://microforbetterlive.blogspot.in /2009/05/access-4x3-keypad.html