International Journal of Research in Advent Technology, Vol.3, No.7, July 2015
E-ISSN: 2321-9637

Remote Monitoring and Control of Intelligent Security Door System with SMS Alert

Isizoh A. N.[1], Obute K. C.[2], Nwobodo H. N.[3], Okide S. O.[4], Okafor LoisAnthony U.[5]
Dept. of Electronic and Computer Engr.[1], Dept. of Electrical Engineering[2], Dept. of Computer Science[4]
Nnamdi Azikiwe University, Awka, Nigeria[1, 2,4]
E-mail: anthonyisizoh@yahoo.com[1], kingsleyunizikedu@yahoo.com[2], samuelokide@yahoo.com[4]
Dept. of Computer Engineering, Enugu State University of Science and Tech.,Enugu, Nigeria[3]
Email: nnennanwobodo@yahoo.com[3]
Dept. of Physics Education, Fed. College of Education (T), Umunze, Nigeria[5].
E-mail: loisanny@yahoo.com[5]

Abstract- This Paper Presents The Design And Implementation Of A Low Cost Electronic Door Lock System With Short Message service (SMS) alert. The system was designed such that AT89C52 microcontroller serves as its controller which is interfaced to a Global System for Mobile Communication (GSM) module (that enables a GSM message or alert to be sent), a liquid crystal display (for display of information), and a keypad (that serves as input device where the security code is entered). An SMS alert is sent to a predefined phone number if a wrong password is entered for a certain number of times (three times) to inform the home owner of a possible intrusion. The door opens automatically when the right code is entered and remains open for 10 seconds before closing. Real-time simulation of the system was carried-out using Proteus software. It tested ok and proved to be a reasonable advancement in access control and door security system technology.

Key Words: Decoder, GSM module, keypad, Microcontroller, security, SMS.

1. INTRODUCTION

Over the years, home security has been a major issue of concern because of the dramatic increase in crime rate, and everybody wants to take proper measure to prevent intrusion or unauthorized entry. The main reason for providing locks for homes, offices, churches, schools and other buildings is for security of lives and property [1].

Various control systems have been previously designed to prevent access to unauthorized users. It is therefore important to have a stress free and convenient means of achieving this purpose through the use of intelligent security door locks.

An electronic security door lock with short message service (SMS) alert uses a GSM module interfaced to a microcontroller [2]. A Liquid crystal display (LCD) is used to show the predefined password entered through a keypad and an alarm is activated when a wrong code is entered for a predefined number of times. An SMS is also sent to a predefined phone number if the wrong password is entered for a certain number of times to alert the home owner of a possible intrusion.

2. ANALYSIS

Block Diagram of the System

The block diagram of the designed system is shown in figure 1. It comprises of the response unit, the controller, the display unit, the input unit, the external memory unit, and the power supply unit.

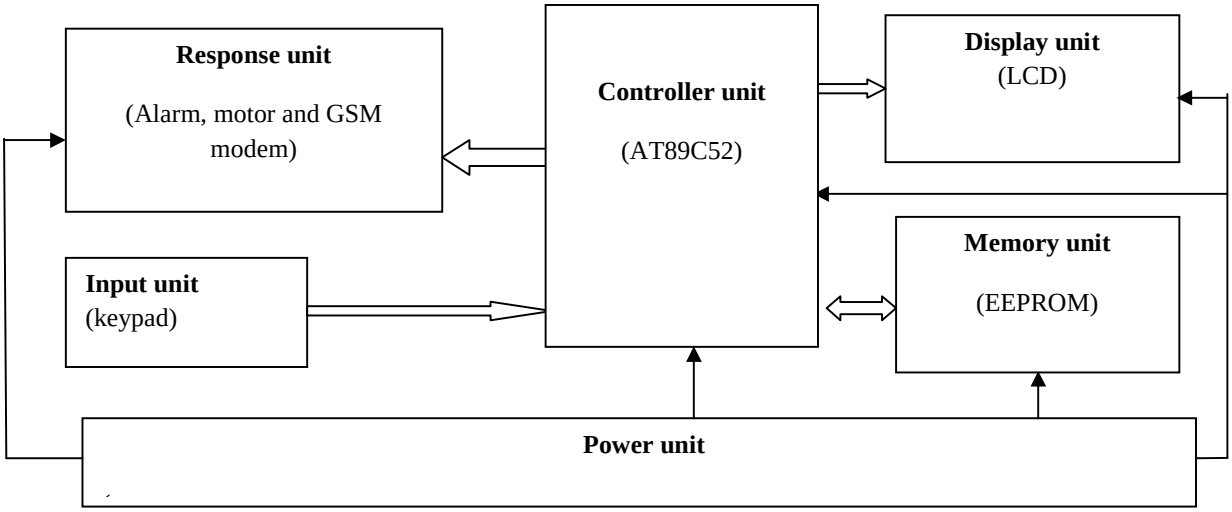


Fig..1: Block diagram of the system

In general, the block diagram of the system has:
i) the Power Supply Unit which is built using a 24v/500mA center tapped transformer, a smoothing capacitor and a voltage regulator.
ii) the Input Unit which is basically a 4x3 matrix keypad constructed with push buttons.
iii) the Display Unit which is a 16X2 LCD display with backlight
iv) the Control Unit which consists of a microcontroller in which the control program is burnt into its ROM
v) the Response Unit which consists of a GSM module and an electric motor interfaced to the microcontroller unit through a DB9 connector and transistor.
vi) the Memory Unit which is basically an Electrically Erasable Programmable Read Only Memory (EEPROM).

Power Unit
In every electrical or electronic system, the power unit is the most important part because the overall functionality of the system depends on it. Most electronic devices make use of direct current as opposed to alternating current supplied by Power Company which is 240V AC [3]. This mains supply has to be reduced to 12V AC using a step down transformer; and passed through a bridge rectifier to be converted to 12V DC and then through a filtering capacitor for a smoother DC output. Appropriate voltage regulators are then used to get the required voltage outputs, in this case 12V and 5V voltage regulator.

The Controller Unit
The Microcontroller (AT89C52) is known as a single integrated chip or device which has features like the Central Processing Unit, memory, input and the output ports [4]. It can also be called a miniaturized computer in the sense that it has input and output ports, the central processing unit, Random Access Memory (RAM) and the Read Only Memory (ROM). It is a programmable memory device which accepts hexadecimal codes and produces an output according to the instruction written in either C-language or assembly language. Microcontroller consumes relatively low power (milliwatts), and will generally have the ability to "sleep" while waiting for an interesting peripheral work [5]. The specific features of the AT89C52 microcontroller used in this paper are as follows:

- Compatible with MC5-51 products
- 8Kb of ROM in system programmable flash memory-endurance: 1000 write/Erase cycle.
- 4.0-6V operating range
- Fully static operation: 0Hz-33MHz
- 256 bytes of internal RAM
- 32 programmable 1/O lines
- Six interrupts sources
- Full duplex UART serial channel
- Fast programmable time

The AT89C52 is a low powered microcontroller, high performance CMOS 8-bit microcontroller which is compatible with the industry standard 80C51 instruction set and pin-out [6].

The on-chip flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. By combining a versatile 8bit CPU with in-system programmable flash on a monolithic chip, the Atmel AT89C52 is a powerful microcontroller which provides a highly flexible and cost effective solution to many embedded control applications. It is also designed with a 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 interrupts system to continue functioning. The power-down mode saves the RAM contents but freezes the oscillators, disabling all other chip functions until the next external interrupt or hardware reset [7].

The AT89C52 has 40 pins which is divided into four ports used as input/output ports: port 1 (pins 1-8), port 3(pins 10-17), port 2(pins 21-28), and port 0 (pins 32-39); with the following special pins:
i) Reset pin (pin 9): Upon applying a high pulse to this pin, the microcontroller will reset and terminate all activities. This is often referred to as a power-on reset. Activating a power-on reset will cause all values in the registers to be lost.
ii) XTAL1 and XTAL2 (pins 19 and 18 respectively): Used to provide external clock to the microcontroller, by connecting a crystal oscillator (11.0592MHz) across the two pins. The speed of AT89C52 refers to the maximum oscillator frequency connected to in between XTAL1 andXTAL2.
iii) VSS (pin 20): Used to ground microcontroller.
iv) VCC (pin 40): Use to power the microcontroller, +5V.
v) PSEN (pin 29): It is called Program Store Enable.
vi) ALE (pin 30): It is called Address Latch Enable. It is used for data and address transmission.
vii) EA (pin 31): It is called External Access pin. It is used to read external memory.

Display Unit:
The type of display used in this research is the LCD which is finding widespread use in replacing LED. This is due to the following reasons:
i) The declining prices of LCDs.
ii) The ability to display numbers, character, and graphics.
iii) Ease of programming for characters and graphics.
iv) Low power consumption.
The function of each LCD pin is presented in table 1.

Table 1: LCD pins description

Pin	**Symbol**	**Description**
1	V_{SS}	Ground
2	V_{CC}	+5Vpower Supply
3	V_{EE}	Power supply to control contrast
4	RS	RS = 0, To select command register. RS = 1, To select data register.
5	R/W	Rw= 0 for write , Rw = 1 for read
6	E	Enable
7-14	DB_0 - DB_7	The 8-bit data bus
15	a	Backlight anode
16	k	Backlight cathode

Input Unit
The input unit comprises of the keypad that allows user to interact with microcontroller. A 4x3 keypad can be developed using 12 push buttons. The keys are arranged into rows and columns equally and adequately spaced. All buttons on a row are connected together and linked to one pin of connector, same for other rows. All buttons on the same column are connected together and linked to one pin of connector using 10K pull-up resistors; same for other columns. The keypad is interfaced to the microcontroller in rows before the columns, and occupying port 1 of the microcontroller. This is shown in figure 2.

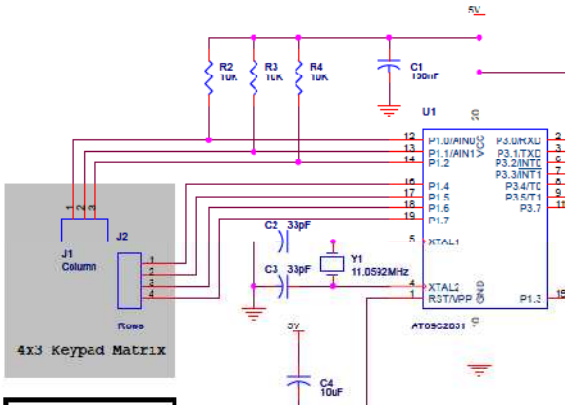


Fig 2: A 4x3 matrix keypad sub-circuit connection

Memory Unit

EEPROM stands for Electrically Erasable Programmable Read Only Memory. It is a non-volatile memory; meaning that it retains its content even when power is off. It stores information permanently. The prime advantage of EEPROM is that it's content can be erased electrically and stores new data programmably [8]. There are many kinds of EEPROM devices that are available from various reputed manufactures like ATMEL, NXP, Microchip etc. But one of the most commonly used EEPROM 24CXX family is 24C01. Figure 3 shows how 24C01 EEPROM is interfaced to a microcontroller.

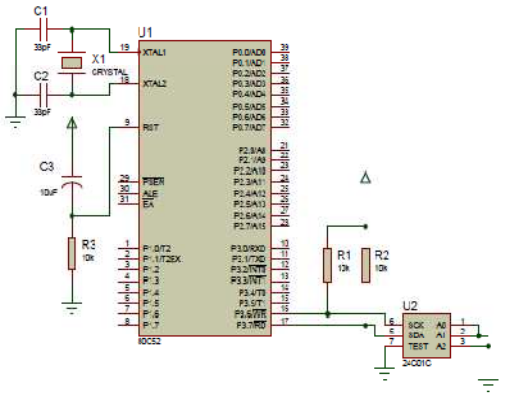


Fig 3: Interfacing 24C01 EEPROM to AT89C52

Any read or write operation in 24C01 requires a sequence of interaction with the controller. This involves the following steps:

1) To set Start condition to initiate any Read or Write operation.
2) To transfer a bit to/from EEPROM.
3) A superset of these is used to transfer a word to/ from EEPROM.
4) To monitor acknowledgements for the receipt or transfer of each word.
5) A superset of signals for transferring words perform Read or Write operations**.**
6) Setting the Stop condition to terminate the operation.

Response Unit

The Response unit consists of a GSM module that uses a SIM (subscriber identification module) to send an SMS to predefined number. The microcontroller communicates with GSM module serially, sending one bit at a time. It uses UART (universal asynchronous Receiver transmitter) IC chip transferring data synchronously [9]. The Receive and transmit pins are connected to DB9 RS232 connector of GSM module through a Line Driver MAX232. A line driver (voltage converter) is needed to convert the RS232's signals to TTL voltage levels that will be acceptable to 89C52's TxD and RxD pins.

The GSM module utilizes a registered SIM (Subscriber Identifier Module) that connects to a network provider. The program codes for interfacing LCD, keypad and GSM module to microcontroller were adequately developed. Interfacing the GSM module to microcontroller using MAX 232 is presented in figure 4.

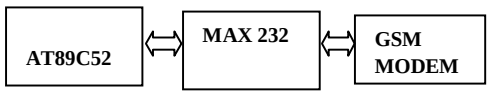
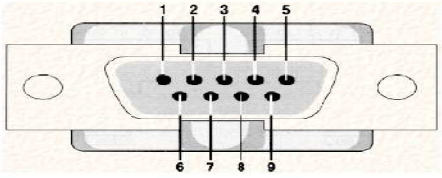


Fig 4: Interfacing GSM module to microcontroller using MAX 232

The figure 5 below shows the DB9 connector and its pin out arrangement.



RS232 DB-9 Pins

Pin	Description
1	Data carrier detect (-DCD)
2	Received data (RxD)
3	Transmitted data (TxD)
4	Data terminal ready (DTR)
5	Signal ground (GND)
6	Data set ready (-DSR)
7	Request to send (-RTS)
8	Clear to send (-CTS)
9	Ring indicator (RI)

Fig 5: The DB9 connector and its pin out

DTR (data terminal ready)
When terminal is turned on, it sends out signal DTR to indicate that it is ready for communication
DSR (data set ready): When DCE is turned on and has gone through the self-test, it asserts DSR to indicate that it is ready to communicate.
RTS (request to send): When the DTE device has byte to transmit, it assert RTS to signal the modem that it has a byte of data to transmit.
CTS (clear to send): When the modem has room for storing the data it is to receive, it sends out signal CTS to DTE to indicate that it can receive the data now.
DCD (data carrier detect): The modem asserts signal DCD to inform the DTE that a valid carrier has been detected and that contact between it and the other modem is established.
RI (ring indicator): An output from the modem and an input to a PC indicates that the telephone is ringing. It goes on and off in synchronous with the ringing sound.

The figure 6 below shows how the interfacing of a GSM module to AT89C52 microcontroller using MAX232 is done.

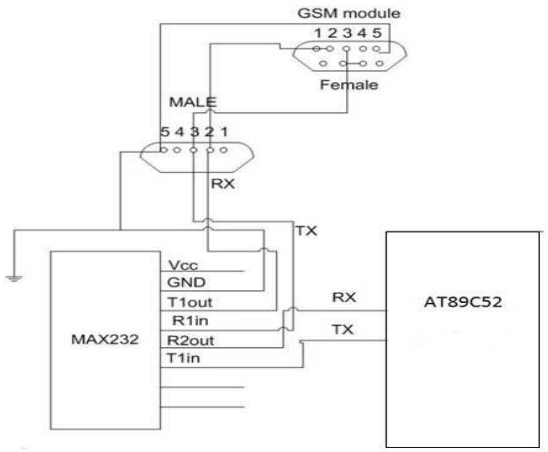


Fig 6: Interfacing GSM module to microcontroller using MAX232

Interfacing 5V DC Electric Motor to Microcontroller
Interfacing a 5V DC Electric Motor to Microcontroller is done using a relay. A relay is an electrically operated switch, current flowing through the coil of a relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off; since a relay has two switch positions.

Relay is interfaced to the microcontroller using two NPN BC547 transistors because of the different voltage of operation. The relay works on 12V while the microcontroller and the motor operate on 5V. They act as switches connected to microcontroller and operate when forward biased by microcontroller to vary direction of motor rotation to open or close door. The operation causes one of the relays to change from normally closed (grounded) to normally open (VCC) or vice versa. Figure 7 shows how the two relays are connected to the electric motor for switching on both directions.

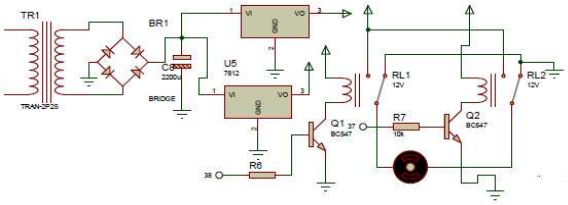


Fig. 7: Showing two relays connected to an electric motor for switching

Interfacing Buzzer to Microcontroller

The buzzer is operated by a 5V DC supply and is interfaced to the AT89C52 microcontroller using a BC547 NPN transistor biased through a 1k resistor as specified by the datasheet information. Here the transistor acts as a switch activating or deactivating alarm biased by microcontroller.

Circuit Diagram of the System

The complete circuit diagram of the system is presented in figure 8. In the diagram, the sub-circuits of all the integral parts of the system are brought together. Proteus software was used to draw the circuit diagram.

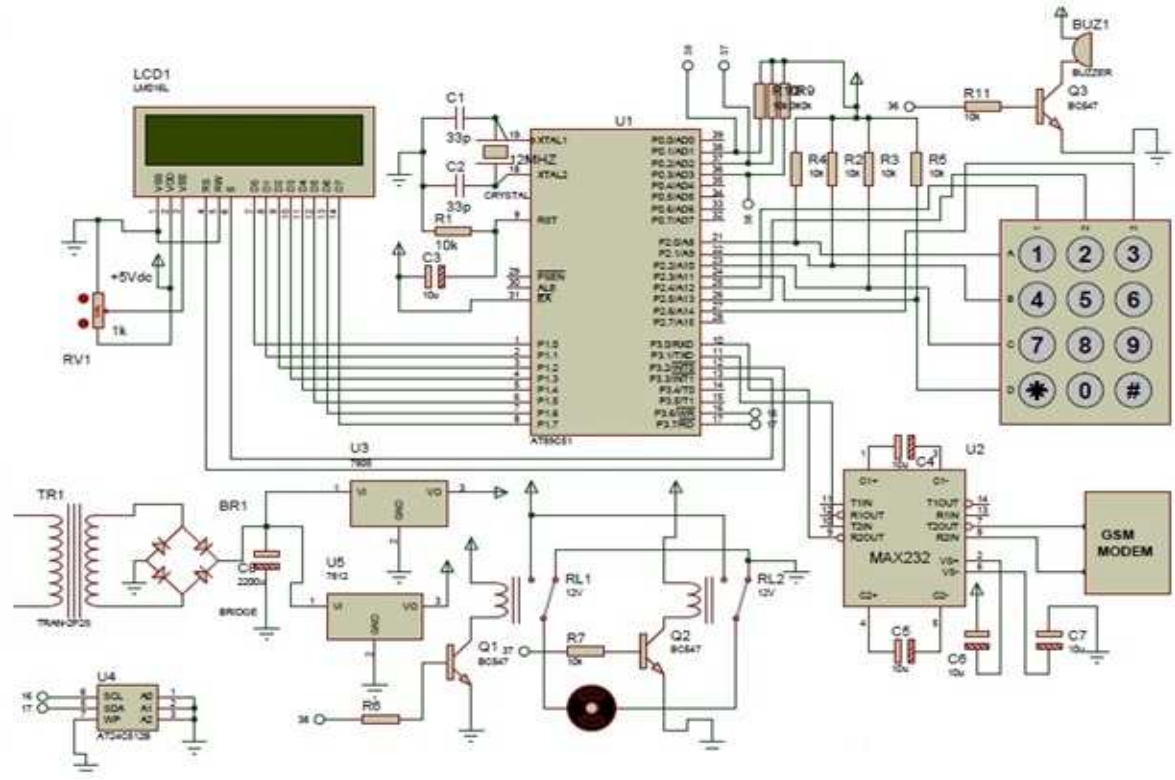


Fig. 8: Complete circuit diagram of the system

3. SOFTWARE IMPLEMENTATION

The flowchart for the development of the software part of the system is given in figure 9 below.

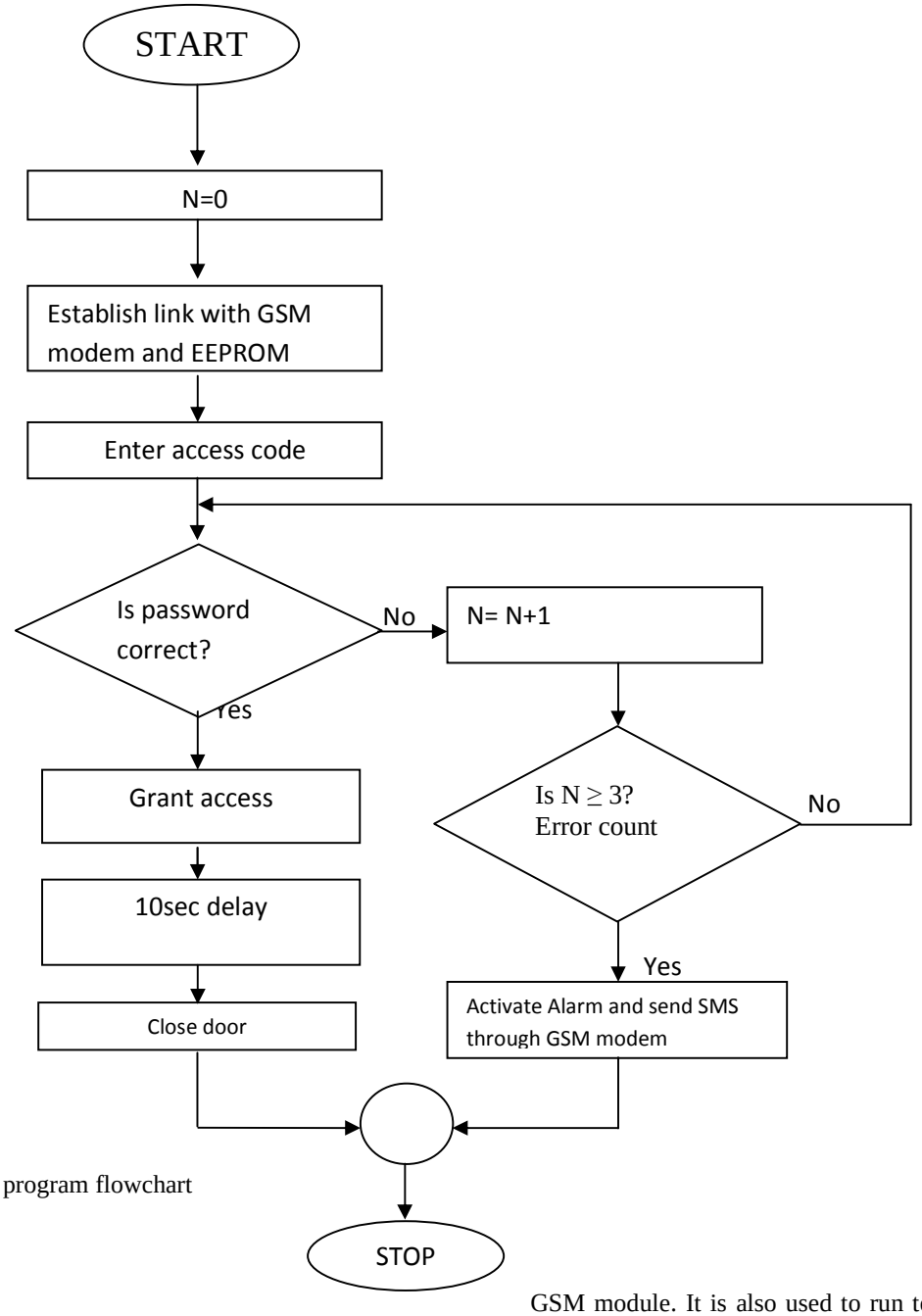


Fig. 9: The program flowchart

The control program was written in Assembly language using MIDE software which normally produces the integrated development environment (IDE). Putty was used to monitor the virtual serial communication between the microcontroller and the GSM module. It is also used to run test on the GSM module to determine its proper functioning.

The real-time simulation was carried out using Proteus. Proteus is a Software used test the workability of a designed system. It acts as a

reflection of how the system will behave if the designed virtual system is physically implemented and constructed. This gives room for corrections and alterations of parameters to be done fast and with no cost, avoiding the wastage of components and damage of expensive components or devices. The software incorporates a great amount of virtual components and tools. It has capture tools which can be used to monitor the behavior of a system in response to varied inputs.

4. CONCLUSION

This research involves the design and implementation of an electronic security door lock with SMS alert. It uses an AT89C52 microcontroller as the controller unit, in which a program written in Assembly language is burnt into it in order that a door control application is achieved. It was powered using 5V Dc rectified and regulated by a 12-0-12v/500mA AC center tapped transformer. A SIM900 GSM module was interfaced to the microcontroller through MAX232 line driver and a DB9 connector for SMS alert. This module was powered by a 12V adapter. A 4 x3 matrix keypad was used as input and a 2x16 character LCD HD44780 controller was used as a display unit powered by a 5V DC. A 5V DC motor was used to drive lock mechanism to lock or unlock the door. A 5V DC-12V DC buzzer was interfaced to the microcontroller using an NPN transistor to be activated when wrong password is entered a predefined number of times, a GSM module would also send an SMS to a predefined number.

When a predefined number (right password) is entered on the keypad located at the entrance of the door, the door will open automatically since the password has been programmed in the microcontroller; and the door remains open for 10 seconds as programmed. The number pressed will be seen on the LCD. The system was designed such that when a wrong password is entered, the door is not opened. And if the wrong password is entered for three times, an alarm is activated and the GSM module sends an SMS alert to a predefined phone number of the house owner. The design has been proved to be a reasonable advancement in access control and door security system technology.

REFERENCES

[1] Okih B.M.(2012), " Security Systems Technology and Applications", Kapapa Publishers Inc Gambia.

[2] Aruna.D.Mane1 and SirkaziMohd Arif(2003), "Locker Security System Using RFID and GSM Technology", International Journal of Advances in Engineering &Technology.

[3] Comfort O. Bolajoko and Adewale M. Folorunso (2013), " Development of a Microcontroller Based Automatic Combinational Lock System", Pacific Journal of Science and Technology, Volume 14, Number 2.

[4] Sampath K.Venkatesh(2013), "8051 Microcontroller & Embedded Systems", S.K Kataria & Sons, Publishers of Engineering and Computer Books, New Delhi.

[5] Allen L. Wyatt (2002), " Using Assembly Language", 5th Edition, Que Corporation, USA.

[6] Paul Scherz(2000), " Practical Electronics for Inventors", McGraw-Hill Inc, India.

[7] AT89C52 Datasheet (PDF) - ATMEL Corporation http://pdf1.alldatasheet.com/datasheet pdf/view/56216/ATMEL/AT89C52.html

[8] Muhammad Ali Mazidi, Janice GillispieMazidi, Rolin D. McKinley (2008), "The 8051 Microcontroller and Embedded Systems, using Assembly and C". Second Edition. McGraw-Hill Inc.