Design and Implementation of Microcontroller Based Security Door System (Using Mobile Phone & Computer Set)

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***Abstract*—This paper presents the design and implementation of microcontroller based security door system (using mobile phone and computer set). The security door can either receive command through the mobile phone or through the computer system (configured to output data through the parallel port). Considering the high rate of crime and insecurity, there is an urgent need to design a security door that takes proper measure to prevent intrusion, unwanted and unauthorized user(s). To solve these problems associated with other security doors, the project uses a computer system running on visual basic (6.0), DTMF decoder and microcontroller as its main components to control the door. The result of these processes led to a security door which can be accessed by entering the corresponding keys of the assigned codes on the mobile phone, or by entering the corresponding code in a computer set interfaced with the system. The door opens automatically when the right code is entered and remains open for (10 seconds) before closing back. The designed system has been proven to be a reasonable advancement in access control and door security system technology.**

***Index Terms*—dual tone multi – frequency (DTMF), global system Mobile (GSM), mobile phone, security door system.**

I. Introduction

Over the years, various control systems have been designed to prevent access to unauthorized user. The main reason for providing locks for our buildings (home, office, church, school, etc) is for security of our lives and property. It is therefore important to have a stress free and convenient means of achieving this purpose. Automatic doors have become a standard feature on many different types of buildings and they are becoming increasingly popular every day with respect to developing an effective electronic devices geared towards providing adequate security. 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 unwanted / unauthorized user. In addition, there was a need to automate home so that user can take advantage of the technological advancement in GSM technology and computer control system. It is also interesting to know that commonly used devices like a telephone land line or the Global System of Mobile communication (GSM) can possess features which can be used domestically by individuals or industries to operate appliances like; door, electric bulb, television, refrigerator, air condition, robotic arm, etc.

A. Statement of Problem

The previous lock methods have proven to be a bit unsatisfactory in one way or the other. Though, some have advantages outweighing the disadvantages while others have much more disadvantages. Due to the fact that live and property may be at stake, it is important to always have a reliable lock system, putting into consideration the high rate of crime and insecurity. Most door lock systems also require carrying external lock devices which complete the system; this may include keys, cards, remote controls, etc. On losing any of these devices, one may need to change the lock system in order to apply precaution(s) in case they have fallen into wrong hands.

Also, due to the rapid growth in computer, GSM control system and technology advancement in general, it may be seen worthwhile to move with the recent trends either privately-in our homes or in our establishments.

B. Objectives

To design a security door that has appreciated advantages over those in existence.

To design a security door that ease problems of unauthorized duplication of keys or access cards.

To design and construct a security door with an alarm system that alert the user if a wrong code is entered more than the administered number of error counts.

To design a security door that will enable us exercise other numerous uses / benefits associated with our mobile phones and computer system.

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Investigate the feasibility and efficiency of implementing DTMF as a method of communication.

C. Historical Background

Lew the Will and Lee Horton instigated the idea of building an automatic sliding door back in 1954, when they saw that existing swing doors had difficulty operating in Corpus Christi's (a catholic festival) winds. So instead of always fixing glass doors shattered by Corpus Christi's wind they tried to give the problem a lasting solution. Their work led to the invention of an automatic sliding door that would circumvent the problem of high winds and their damaging effect [1]. Their work was later patented and in 1960, Horton Automatics developed and sold the first automatic sliding doors in America. Their automatic doors used mat actuator as the access control mechanism. Over the years, modifications have been made to improve this door. In 1999, the manager of building, security systems at the University of Maryland and one time head of security for the Washington, D.C. from 1978-1988, designed and implemented a centrally controlled, electronic door access system to secure the University of Mary land [2].

D. Automatic Doors

The automatic slide door invented by law the will and Lee Horton were not the only kinds of automatic doors that exist. Many other types of doors have also been patented and achieved commercially, they includes: - Automatic slide door, Automatic swing doors, Automatic folding doors and Automatic revolve doors [3].

E. Access Control and Security

To control access, a door must be modified in some manner to provide signals to the system to let it know whether or not the door is to be open or close, prohibiting passage of unauthorized persons.

Simple access control is frequently used by corporate organizations and firms to limit access to their facilities, eliminating the need for a guard as well as the cost and headache associated with key control.

II. Concepts of DTMF Technology

The DTMF system uses eight different frequency signals transmitted in pairs to represent sixteen different numbers, symbols and letters [4], [5].

The Table I below shows how the frequencies are organized, while Fig. 1 shows the pin – out diagram of the DTMF decoder.

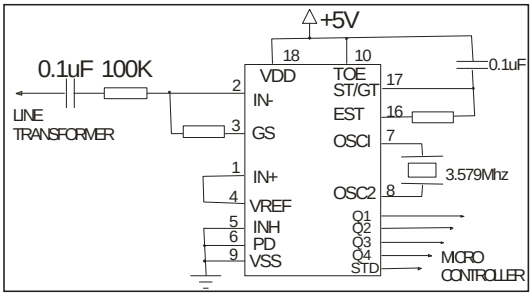

Figure 1. Pin out diagram of the DTMF decoder

TABLE I. DTMF Frequency Matrix Arrangement

		High-Group Frequencies			
		1209Hz	1336Hz	1477Hz	1633Hz
Low-Group Frequencies	697Hz	1	ABC 2	DEF 3	A
	770Hz	GHI 4	JKL 5	MNO 6	B
	852Hz	PRS 7	TUV 8	WXY 9	C
	941Hz	*	OPER 0	#	D

III. System Design

See Fig. 2 below.

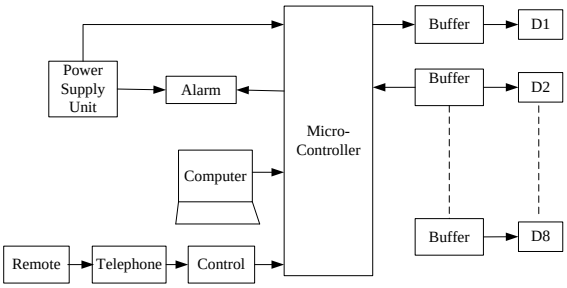

Figure 2. Block diagram of the security door system (using mobile phone & computer set)

A. System Analysis

A microcontroller is a computer-on-a chip. It can also be described as a single chip computer. The 8952 is a low power, high performance CMOS 8-bit microcontroller with 8kbytes of flash programmable and erasable read only memory EPROM [6]. It is compatible with the industry standard 8051 and 8052 instruction set and pin-out. By combining an industry standard 8-bit CPU with ROM on a monolithic chip, the 8952 is a powerful micro-computer which provides a highly flexible and cost effective solution to many embedded control applications [7].

The 8952 provides the following features:

* 8kbytes of ROM
* 256 bytes of RAM
* 32 I/0 lines
* Three 16 – bit timer/counters
* Six vector, two-level interrupt architecture
* Full duplex serial port
* On-chip oscillator and clock circuitry

B. The Parallel Interface Circuitry

The Parallel Port is the most commonly used port for interfacing homemade projects. The port is composed of 4 control lines, 5 status lines and 8 data lines. It's found commonly at the back of the PC as a D-Type25 Pin female connector. This will be a serial RS-232 port and thus, is a totally incompatible port.

Visual basic 6.0 cannot access the computer parallel port directly unlike serial port. Some DLL (Dynamic Link Libraries) that was built in embedded C must have

been deployed in the system32 (the system registry) first. And a module that can reference to this DLL must have been declared in the program. This module contains some functions like VB-in and VB-out, which VB 6.0 uses to read from and write to the port respectively.

They are often used to connect devices or receive large amount of data. They transfer 8 bits (one byte) of a time using a cable with 8 data line-they're also known as DB 25 since they have 25 female pin connector.

The lines in DB 25 connector are divided into; Data line (data bus) = 8 lines, Control lines = 4 lines,

And Status line = 5 lines.

Each section is accessed by its own address and will act independently from the rest. This is almost as if they were different ports. The addresses are as shown in table II below.

TABLE II. ADDRESS OF THE DIFFERENT PORT LINES

Port	Address (Decimal)	Address (Hex)
Data Lines	888	378h
Control Lines	890	37Ah
Status Lines	889	379h

The Data register has 8 non-inverted lines and is used to write to the parallel port i.e. for outputting. It has port address of 888 or 378 hex. The control register has 4 lines of which 3 of the lines are inverted and is to control peripheral devices and also for outputting.

Data is transferred over data lines while the control lines are used to control the peripheral. The peripheral returns status signals back to the computer through status lines.

C. Flow Chart for the Administering of Codes

Fig. 3 below shows the Flow chart for the administering of codes

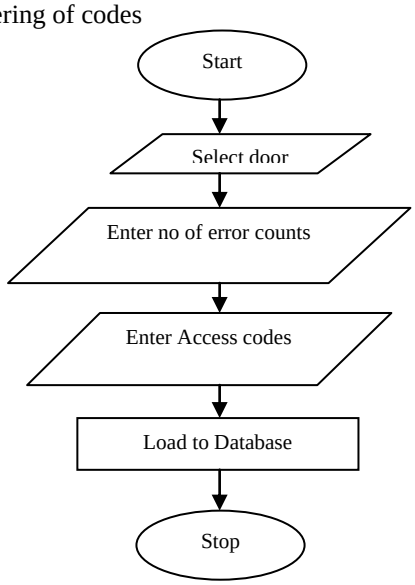

Figure 3. Flow chart for the administering of codes

D. System Flow Chart

Fig. 4 below shows the system flow chart

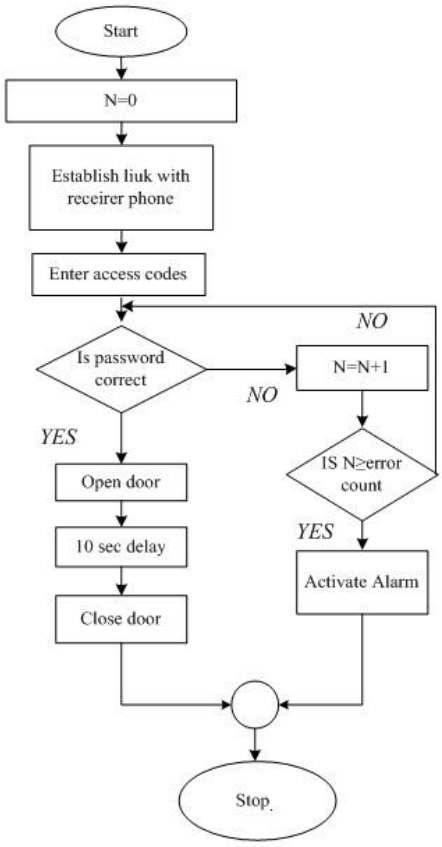

Figure 4. System flow chart

IV. SOFTWARE DEVELOPMENT

The program of the system is of two types; the assembly language program and the visual basic program. The AT89C52 onboard the system is used to store all the assembly language code that control the activities of the system. The program of the system was written in assembly language and was programmed with (Top universal programmer).The interfacing of the system was achieved with a computer set running on visual basic (6.0). Fig. 5 below shows the introduction form of the Security Door System.

Figure 5. Introduction form

The administrator assesses these doors with the form shown in Fig. 6.

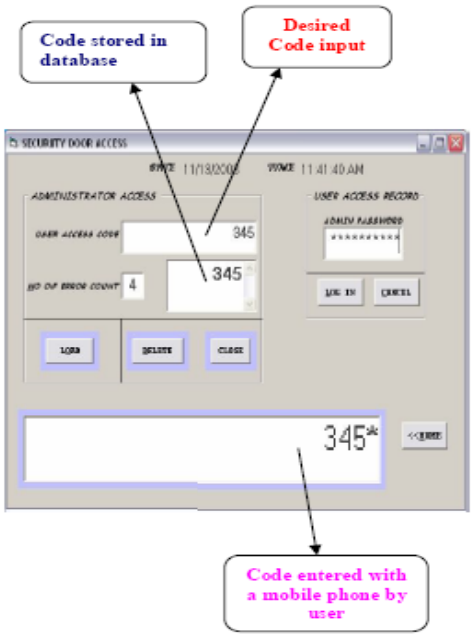

Figure 6. Desired codes entered by administrator

Here, the code which was assigned to the user and the expected error count was successfully entered into the database. The device was also seen to respond to only the assigned code. It is also interesting to know that when the administrator load more than one code into the database, the system recognize all the codes loaded by opening and closing the door with respect to each code.

Fig. 7 below shows how to access the security door using different codes.

Figure 7. Assigning more than one code for opening and closing the door

Also, provision was made for extreme cases were the device may have malfunctioned and no longer responds to the assigned codes. In such condition, an emergency open button is used which can be only accessed by the administrator. In the test carried out, the administrator accessed this form by entering correctly a restricted password as shown below. Once the Open button was clicked, the door automatically open and close back after 10secs. Fig. 8 below shows how to access the Security Door in case the system malfunctions.

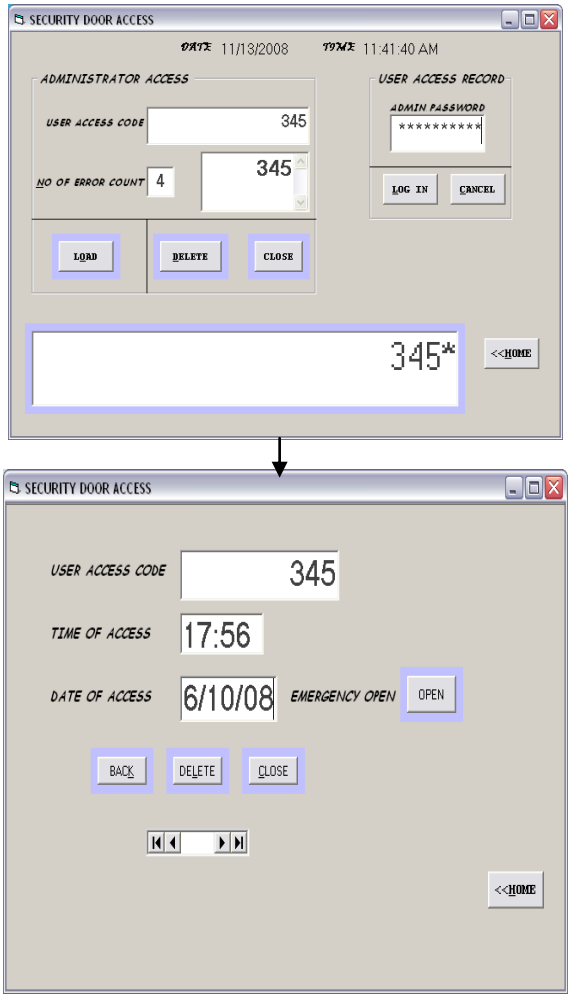

Figure 8. Assessing the administrators restricted form

Also, when a wrong code was entered by an intruder exceeding the no of error counts; alarm was triggered through the loud speaker made available in the system. The use of wrong code form is shown in Fig. 9 below.

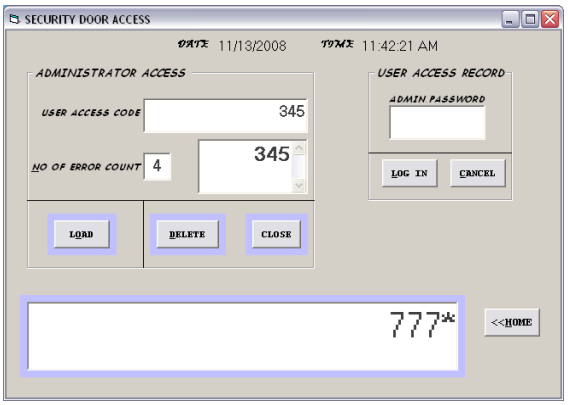

Figure 9. The use of a wrong code

Program flow

Fig. 10 below shows how the forms are linked together.

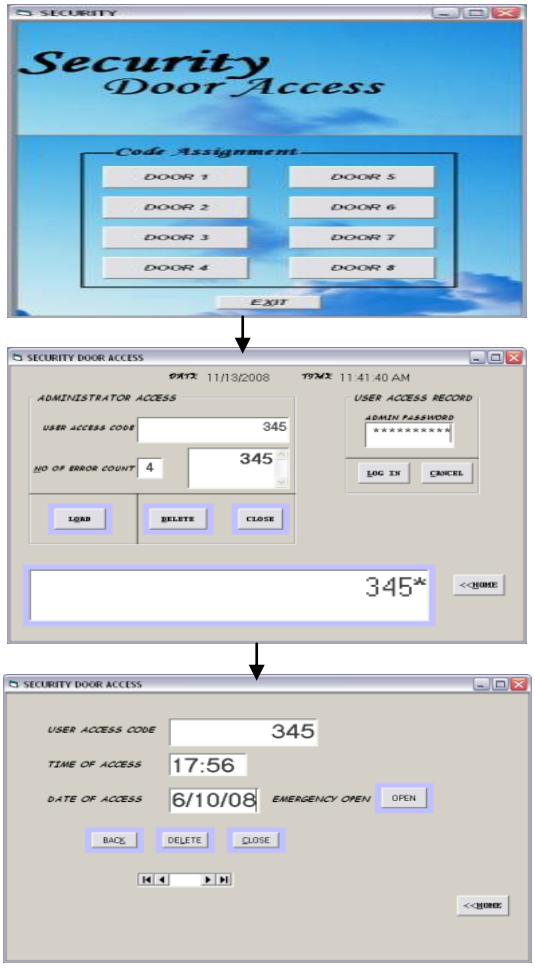

Figure 10. Linking of forms in the program

A. *Steps for Assembling the Program of the Security Door System (Assembly Language Program)*

a) Type the program in notepad.
b) Save it as "Securitydoor.asm" in drive C: /. Ensure that drive C: / has the 3 applications (A51, OHS51 and L51) required to assembly the program.
c) Launch the "run" command from the start menu and type the commands;

A51.securitydoor.asm
L51.securitydoor.obj and
OHS51.securitydoor.obj

And then click OK; In case of syntax error in program code, program will not be compiled and HEX file will not be generated. Errors need to be corrected in the original program file (the one typed in Notepad) and then the source file may be compiled again. The best approach is to write and test small, logical parts of the program to make debugging easier.

An assembler is a software tool or a program-designed to simplify the task of writing computer programs. It performs the clerical task of translating symbolic code into executable object code. This object code may then be programmed into one of the PM-51 processor to which the 8051 belongs, which AT89c52 is one of them. After assembling, the AT89C52 microcontroller was programmed with (Top2005+ universal programmer).

B. *Results*

The result of these processes led to a security door which can be opened by pressing the keys of the assigned codes on the mobile phone, or by entering the corresponding code in a computer set interfaced with the system. The door opens automatically when the right code is entered and remains open for (10 seconds) before closing back.

V. CONCLUSIONS

The design and implementation of microcontroller based security door system (using mobile phone & computer set) has been proven to be a reasonable advancement in door security system technology and access control. The computer interface has expanded the flexibility of the multi-functional Microcontroller. The work done here is original and has not been published. This is a major breakthrough in digital design and technological advancement in general

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