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Access Control Using Smartcard And Passcode

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Abstract: *Over the years, access control systems have become more and more sophisticated and several security measures have been employed to combat the menace of insecurity of lives and property. This is done by preventing unauthorized entrance into buildings through entrance doors using conventional and electronic locks, discrete access code, and biometric methods such as the finger prints, thumb prints, the iris and facial recognition. In this paper, a prototyped door security system is designed to allow a privileged user to access a secure keyless door where valid smart card authentication guarantees an entry. The model consists of hardware module and software which provides a functionality to allow the door to be controlled through the authentication of smart card by the microcontroller unit.*

I. Introduction

Access control using door security systems has been in existence in prehistoric times, the systems used then were of different standards ranging from the simple bolt and crossbars to intricate locks which were hand crafted by locksmiths and other practicing professionals. As time went by these systems evolved with improvements on the flaws of the previous generations[1].

The most recent advancement or trend in door security technology consists mainly of authentication (providing a piece of private information) systems. These systems include Biometrics, Passwords, Bluetooth mobile devices, Memory cards, Smart cards etc [4].

Despite the high level of security offered by the biometric system it is expensive to implement and the password system is a one factor authentication system as such it is not highly reliable [2].

This paper therefore presents a low cost prototype of a door security system designed to allow a privileged user to access a secure automated door where valid smart card and passcode authentication guarantees an entry.

In the proposed system an automated door is controlled with a card reader and the card reader is controlled by a control program embedded in a microcontroller unit. Implementing the system with a microcontroller will be of great value, cheaper, portable and much benefit to organizations who consistently seek a better means of door access control for their firm

II. System Design

The design and construction of this system consist of a hardware design module, an application program (firmware) for microcontroller unit and a database designed using Microsoft Access 2007 and Visual basic 6.0 for users' credentials authentication. The firmware and the database make up the software design module.

Components of the hardware design are shown in Figure 1

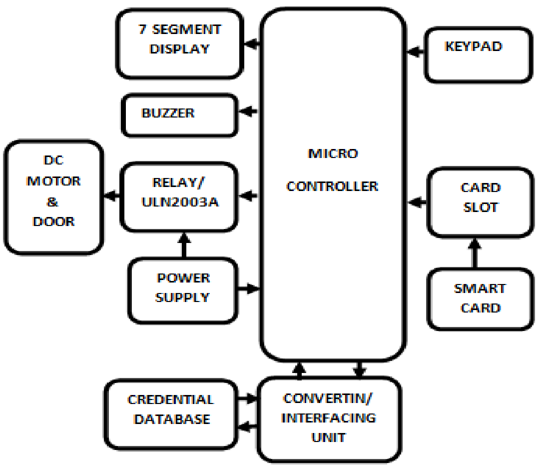


Figure (1): System Block Diagram

DC Motor and Door System

The servo motor and door system are attached together; they constitute part of the output unit of the Access control system.

The door system is made of a dark glass sliding door of about 680mm × 450mm and thickness of 0.3mm. The door is fitted on a door post of 740mm × 495mm × 80mm frame made from aluminum steel where the door slides on. The door system is attached to the motor and placed on a rail on which it slides. The direction of movement depends on the polarity of the voltage supplied by the switching unit.

The dc motor is responsible for the movement of the sliding door; the motor used in this design is a 40W 12V 4000mA dc motor.

The motor is connected to the switching unit (the relay section) and the power supply unit. If the power supply results in a positive voltage the motor rotates clockwise, if it results in a negative voltage the motor rotates anticlockwise (see figure).

Relay Section

The relay and ULN2001A (relay driver) are responsible for all the switching operations of the electronic access door.

The operation of the relay depends on the voltage and current rating. The voltage rating is the voltage that is applied across the terminals of the electromagnet, while the current rating is the maximum current that it can withstand. The relay rating for this project is 12V dc, 10A.

For a relay to function and be controlled properly, especially in a digital circuit, a relay driver is required for interfacing of TTL signals with high voltage loads. In order to achieve this, ULN2001A chip was used.

The ULN2001A is a monolithic high voltage and high current Darlington transistor arrays.

Two relays were used to achieve clockwise and anticlockwise rotation of the dc motor attached to the sliding door. The centre tapped terminals of the relays are connected to both ends of the dc motor. They are then interlaced with the microcontroller via pin 1 and 2 of ULN2001A (see figure 2).

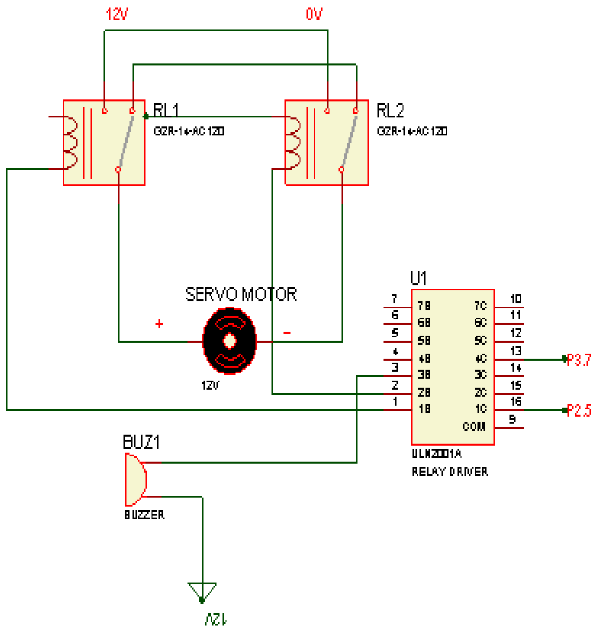


Figure (2): Relay and Relay Driver (Switching) Unit.

Power Supply Unit

The power supply unit is responsible for providing electromotive force (EMF) to power the circuit components that make up the system. The power supplies were designed to convert high voltage AC mains electricity to a suitable low voltage supply for electronic circuits and other devices.

The system requires two power supply system, a 5V/500mA dc supply to power the microcontroller and a 12V/4000mA to drive the relay and the motor (load).

Figure(3) below shows the power supply configuration used to power and drive the dc motor used in this design, it requires a current of 4000mA, in order to achieve this, two centre tap Ac 220/240V, 50Hz. Dc 2 × 12V/1.5A transformers were connected in parallel to double the output current of the dc supply.

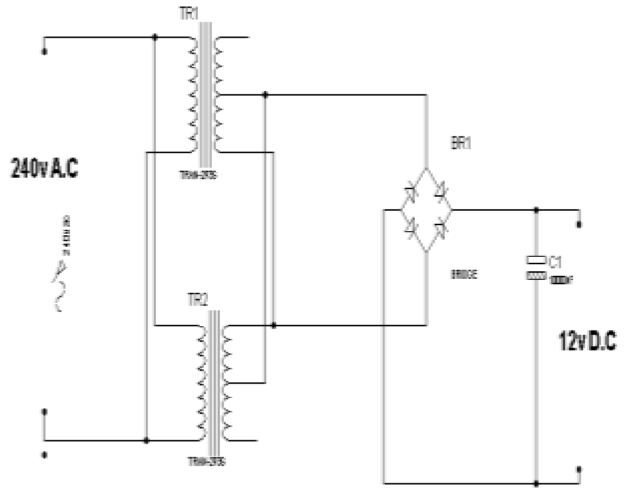


Figure (3): 12V (4000mA) Power Supply Configuration.

Microcontroller Section

The microcontroller section constitutes the control and monitoring unit which is responsible for handling all the system operations. It receives data from the input unit processes it and then transmits the processed information to the appropriate unit where they are to carry out one function or the other [3].
The microcontroller used in the fabrication of the electronic access control system is the AT89c52 a variant of the 8051 microcontroller architecture, it comes with a wide range of features which makes it accessible to a wide range of applications [3, 5].

Smart Card Unit

For the smart card unit a prototype smart card was designed, this was achieved by mounting AT24c64 EEPROM on a Vero board of size 4.5 × 3.5 cm.
A single line data program was stored in the EEPROM to enable the microcontroller read and write data into the device via an 8 bit expansion slot that was gotten from the system board of a computer monitor.

Keypad

The keypad is a part of the input device used in this security system to input authentication digits. A 4×4 matrix keypad was used in this project; at the lowest level, keypads are organized in a matrix of rows and columns. The microcontroller accesses both rows and columns through ports; therefore, with an 8-bit port a 4x4 keypad which has 16 keys requires a single port or 8 I/O lines to be interfaced to a microcontroller. When a key is pressed, a row and a column make a contact; otherwise, there is no connection between rows and columns.

TABLE (1): Keypad Connection to the Microcontroller

PORT 3.2 (D0)	Key 1	Key 2	Key 3	Key 4
PORT 3.3 (D1)	Key 5	Key 6	Key 7	Key 8
PORT 1.2 (D3)	Key 9	Key 10	Key 11	Key 12
PORT 1.3 (D2)	Key 13	Key 14	Key 15	Key 16
	PORT 1.7	**PORT 1.6**	**PORT 1.5**	**PORT 1.4**

Buzzer

The buzzer makes up the alarm system which sounds each time a button is pushed on the keypad, it comprises of a 5V buzzer with a maximum current of 20mA and driven by the ULN2001A IC, when there is a 1 at the out terminal the buzzer will not sound and when there is a 0 the buzzer sounds.

Converting and Interfacing Unit

This unit is responsible for the communication between the microcontroller and the computer.

When developing projects that use microcontrollers, it is always helpful to have the microcontroller communicate with a computer for data logging, debugging or boot loading purposes. Serial communication is quite popular because most microprocessors have UART (Universal Serial Asynchronous Receiver Transmitter) hardware already built in. Most microcontrollers operate at logic voltage levels (0 to 5V DC) and uses TTL logic (transistor to transistor logic), whereas the standard computer serial port (RS232) operates at -12v to +12v DC. Connecting a microcontroller directly to the serial port will instantly damage the circuitry inside of it. Most people incorporate voltage level converter chips (such as the MAX 232) and the necessary capacitors into their projects so they can communicate with the computer, this can be expensive and very time consuming.

Communication between the microcontroller and the computer was achieved in this project by using a special universal serial bus (USB) to logic level converter, the CA-45 Connectivity Adapter Cable (PL 2303HX USB to UART RS232 COM CABLE MODULE CONVERTER), with the drivers installed, every time the USB to Logic Level converter is plugged into the computer or hub, a new COM port is automatically created in the computer and assigned to the USB to Logic Level converter cable. The microcontroller can then communicate with the computer software as if it were communicating over a simple serial port.

The CA-45 adapter has four cables. The red cable is connected to a 5V supply (V_{cc}), the black cable is connected to ground (GND), the green cable which is for data transmission (TXD) is connected to P3.0 (RXD) of the microcontroller, while the white cable which is for receiving data (RXD) is connected to P3.1 (TXD) of the microcontroller.

III. Software Design

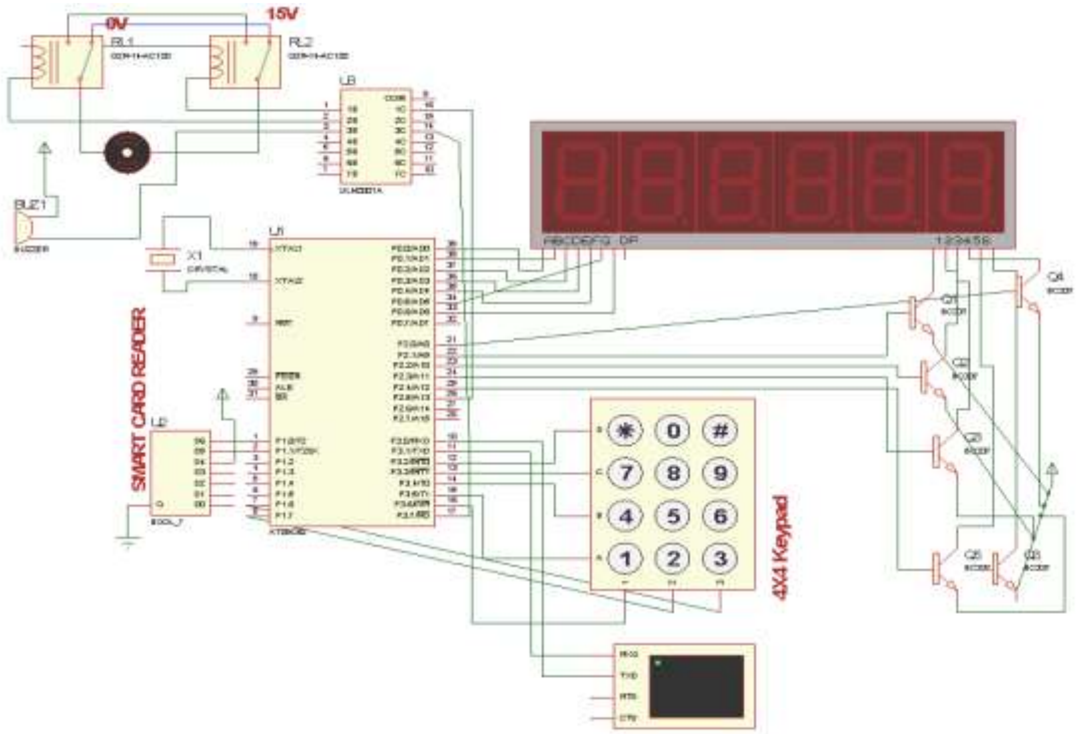
Microcontrollers are just silicon wafers until they are programmed on what to do according to requirement.

Microcontroller programming is a term used to describe a set of instructions which is provided by the manufacturer to aid the development of user (application) programs.

The source code for the microcontroller used in this design was written in an assembly language, and converted to Hex code with the aid of MIDE 6.0 and the Hex code was burned into the microcontroller via an electronic device known as Machine code loader/programmer.

The users' database which is used to assign password and monitor access to the security door was developed using Microsoft Access. Visual Basic was used to develop the administrator interface and house the users' database because of its ability to communicate to the serial port of the computer using an in-built communication protocol known as MSComm control.

IV. System Circuit Diagram



V. Circuit Operation/Process Description

The circuit is powered up by connecting its power supply terminal to a 240/220V ac source, the seven segment display immediately lights up. The AT89s52 microcontroller checks for the

presence or absence of an access card (in this case an EEPROM mounted on a 4.5 × 3.5 Vero board), if no card is detected it sends appropriate signals to the display unit, these signals are in the form of voltage pulses which are recognized by the LED seven segment display. This unit then displays 'ENTER CARD'. The verification process continues to loop until a valid card is inserted into the card reader.

When the card is inserted into a smart card reader, it makes contact with an electrical connector for 'reads and writes to' from the chip, it is via these physical contact points, that transmission of commands, data, and card status would take place.

When a credential (smart card) is presented to the reader with the card corresponding passcode, the reader sends the credential's information, usually a number, to the control panel, a highly reliable processor. The control panel compares the credential's number to an access control list, grants or denies the presented request, and sends a transaction log to the database. When access is denied based on the access control list, the door remains locked. If there is a match between the credential and the access control list, the control panel through a microcontroller operates a relay which completes the circuit of a servo motor that in turn unlocks the door.

When access is granted, the door is unlocked for a predetermined time and the transaction is recorded. When access is refused, the door remains locked and the attempted access is recorded. The system will also monitor the door and alarm if the door is forced open or held open too long after being unlocked. The reader would provide a feedback through a seven segment display to show when access is granted or denied. (See system flow chart below).

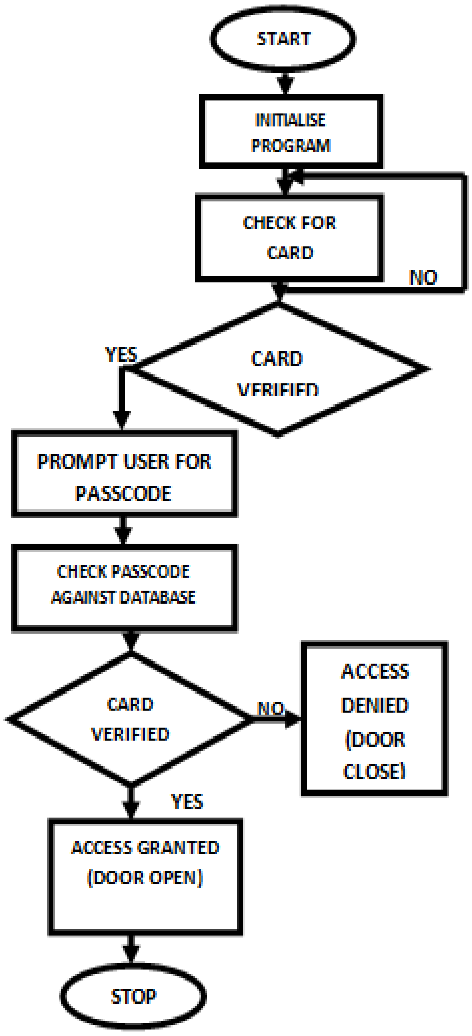


FIGURE (4): SYSTEM FLOW CHART

VI. Result

FIGURE (4): OVERALL SYSTEM/DESIRED OUTPUT

VII. Conclusion

This paper has successfully presented a functional, low cost and low complexity electronic access control system using smart card and passcode. A real life equivalent of the prototype can be developed with minimal development costs and with relatively low operational costs for environment where high degrees of security are required like banks, military research areas, and big private investment companies.

References

[1] Chika, E.O., and Okechukwu, O.S (2010): “Access Card Door”. University of Port Harcourt, Rivers State.

[2] Hurley, Edward (2002): “Smart cards have their advantages over passwords”. Online available: http://searchsecurity.techtarget.com. Date Accessed: 19/12/ 2012.

[3] Kenneth, Ayala (1991): The 8051 Microcontroller, West Publishing Company, New York.

[4] Oke, A.O., O.M. Olaniyi, O.T. Arulogun, and O.M. Olaniyan (2009): “Development of a Microcontroller-Controlled Security Door System”. *Pacific Journal of Science and Technology*. 10(2):398-403.

[5] ATMEL At89c52 datasheet. Online available: http//www.atmel.com. Date Accessed: 5/9/2012.