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DESIGN AND FABRICATION OF A PASSWORD PROTECTED AUTOMATIC SLIDING DOOR

M T Islam[1], R Pal[2] and M A Islam[3]

[1-2]Department of Mechanical Engineering, CUET, Chittagong-4349, Bangladesh
[3]Department of Electrical and Electronic Engineering, IIUC, Chittagong, Bangladesh

[1]tazul2003@yahoo.com

Abstract- *In this project, a modern electro-mechanical sliding door using a password protection is introduced which will open & close automatically by sensing the existence of human or any object with sensor. In this system when anyone insert the wrong password , the LCD display wants then correct password and if password matches, the door will open and after sometimes it will close automatically by using an IR sensor. After that when anyone wants to leave he has to click a push button which will again open the door and close after 10 seconds delay. Receiver diode sends the signal to the microcontroller so that the steeper motor starts to rotate. The rotation will continue for few seconds. After that, motor will start to rotate reversely, that means the door will start to close.*

Keywords: Sliding door, Password, LCD, Microcontroller

1. INTRODUCTION

Science and technology has become a part of our daily life. We are using science and technology for our comfort. In every second we are heading to a new technology. Every moment we are inventing some new technologies and developing the previous studies. These technologies are related to our daily life and uses. Technology makes our life easy to live. It saves time, money, energy and serves comfort.

Automation is one of the smartest technologies of today's world. Automation defines as-" A device or system that independently carries out a task that was formerly carried out by a human ". Automation (ancient Greek: =self-dictated) or industrial automation or numerical control is the use of control systems such as computers to control industrial machinery and processes, reducing the need for human intervention. Automation is the replacement of man power with machine power, as man would no longer be needed to run it as there are machines that can do a man's job for no pay. Right now, men use machines to do work, but soon automation replace man altogether, and many people believe that is bad[1].

Advantages commonly attributed to automation include higher production rates and increased productivity, more efficient use of materials, better product quality, improve safety, reduces factory lead times. Higher output and increased productivity have been two of the biggest reasons in justifying the use of automation. Despite the claims of high quality from good workmanship by humans, automated systems typically perform the manufacturing process with less variability than human workers, resulting in greater control and consistency of product quality. Also, increased process control makes more efficient use of materials, resulting in less scrap.

The need for automatic doors has been on the increase in recent times. Now a days we often see automatic door around us in corporate offices, shopping mall, gates, lifts, garages, and many other places. Replacing a manual door with an automatic door, needs no physical effort to open and close the door. Probably the greatest single benefit of password protected automatic doors is the ability to offer easy access to anyone and to provide "privacy on demand"[2].

2. PREVIOUS WORK ANALYSIS

To enhance the security different types of doors is being introduced regularly. The main focusing point of every automatic door manufacturer is to attract the customer by ensuring security as well as facilitating the consumer. There are several types of doors is being used today. Password based automatic door is not a new idea. It is being used in many fields by various methods. Now-a-days, such a system can be found in home, industrial and business for security purpose. No other security techniques are as safe as password protected automatic door. Previously, CMOS was used to implement with many circuitries to accomplish the task. But at present microcontrollers have made the task much easier. Fixed password (defined by manufacturer) was used in some applications. There is also a drawback found in that scheme that it cannot store the password when power is removed.

There is a project found related to automatic door system without any password system by using the only IR sensor. We are trying to develop a system comprises of keypad, HD44780 20x2 LCD along with pic16F628a microcontroller. LCD provides user with messages and notifications to inform about the current system state. User can perform operations such as opening and closing the door by pressing the correct password[1].

Another project named „PIC microcontroller based electronic lock system", in which hardware part consists of keypad, microcontroller, appliances controller (relay driver), LCD and power supply unit. But there is a predefined password stored in microcontroller, when user press correct password lock will be open. LCD notifies all the current status to the user. When correct password matches microcontroller sends signal to actuate the relay for opening the door. The main drawback of the system was the password could not be changed once it was stored[2].

Analyzing all the previous tasks, this research project is taken in hand to remove the mentioned drawbacks and to make it user friendly and cost effective.

The main goal of this project is to develop a user defined password protected automatic door system using microcontroller and also sensor. User will be able to open the door by giving the correct password and also can change the current password.

3. MAIN COMPONENTS OF THE PASSWORD PROTECTED AUTOMATIC SLIDING DOOR SYSTEM

The password protected automatic sliding door have the following components:

Rack and pinion: A rack and pinion is a pair of gears which convert rotational motion into linier motion(Fig.1). The circular pinion engages teeth on a flat bar on the rack. Rotational motion applied to the pinion will cause the rack to move to the side, up to the limits of its travel. This arrangement provides a mechanical advantage than other mechanisms such as reticulating ball, but much less backlash and greater feedback or steering "feel".

Keypad: A 4×4 matrix keypad is used to give commands and the password to the MCU. It consists of 16 keys (S2-S17) arranged in the form of a square matrix of four rows and four columns. Each key in the matrix is labeled according to the operation assigned to it. The connections from the pin-outs of the keypad to the MCU pins are shown in Fig. 1. Rows 1 through 4 are connected to pins RB3, RB2, RB1 and RB0 of Port B of the MCU, respectively. Columns 1 through 4 are connected to pins RB4 through RB7 of Port B, respectively.

Figure 1: Rack and Pinion and keypad

LCD: A Liquid Crystal Display (LCD) is a flat panel display, electronic visual display, or video display that uses the light modulating properties of liquid crystals. Liquid crystals do not emit light directly .LCD's are available to display arbitrary (as in a general-purpose computer display) or fixed images which can be displayed or hidden, such as pre-set words, digits, and 7-segment displays as in a digital clock. They use the same basic technology, except that arbitrary images are made up of a large number of small pixels, while other displays have larger elements.. An LCD is a low cost display. It is easy to interface with a micro-controller because of an embedded the black blob on the back of the board).This controller is standard across many displays 44780) which means many micro-controllers (including the Arduino) have libraries that make displaying messages as easy as a single line of code. In this project A l6x2 LCD display has been used to show the current status. It is shown in Fig. 2


Figure 2: LCD display

Crystal oscillator : A crystal oscillator is in electronic oscillator circuit that uses the mechanical resonance of a vibrating crystal of piezoelectric material to create an electrical signal with a very precise frequency. This frequency is commonly used to keep track of time (as in quartz wristwatches), to provide a stable clock signal for digital integrated circuits, and to stabilize frequencies for radio transmitters and receivers. The most common type of piezoelectric resonator used is the quartz crystal, so oscillator circuits designed around them became known as "crystal oscillators".

A crystal oscillator is needed to provide clock pulse in microcontroller. In this project an 8 MHz crystal oscillator has been used to generate clocking signal for performing the operation of microcontroller. A crystal oscillator is shown in Fig.3

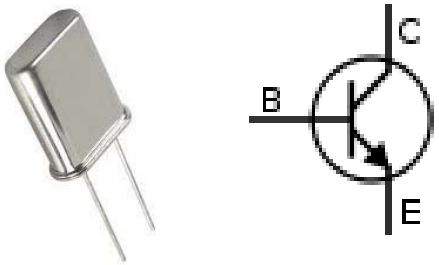

Figure.3: A crystal oscillator and Transistor (NPN type)

Transistor : A transistor is a semiconductor device used to amplify and switch electronic signals and electrical power. It is composed of semiconductor material with at least three terminals for connection to an external circuit. A voltage or current applied to one pair of the transistor's terminals changes the current through another pair of terminals. Because the controlled (output) power can be higher than the controlling (input) power, a

transistor can amplify a signal. Today, some transistors are packaged individually, but many more are found embedded in integrated circuits. An NPN transistor is composed of two n-type semiconductors separated by thin section of p-type. The transistor has three terminals namely Emitter, Base & Collector. For an ECB transistor, input is drawn to emitter while output is taken from the collector. In this project we used NPN transistors model no BD135(Fig.3)

Steeper motor: Stepper motor (or step motor) is a brushless DC electric motor that divides a full rotation into a number of equal steps (Fig.4). The motor's position can then be commanded to move and hold at one of these steps without any feedback sensor (an open-loop controller), as long as the motor is carefully sized to the application. Switched reluctance motors are very large stepping motors with a reduced pole count, and generally are closed-loop commutated are very large stepping motors with a reduced pole count, and generally are closed-loop commutated.

Figure 4: Steeper motor

Resistor : A resistor is a passive two - terminal electrical component that implements electrical resistance as a circuit element.. The current through a resistor is in direct proportion to the voltage across the resistor's terminals (Fig.5). This relationship is represented by Ohm's law:

I=V/R

Where *I* is the current through the conductor in units of amperes, *V* is the potential difference measured across the conductor in units of volts, and *R* is the resistance of the conductor in units of ohms.

Resistors are common elements of electrical networks and electronic circuits and are ubiquitous in electronic equipment. Practical resistors can be made of various compounds and films, as well as resistance wire (wire made of a high-resistivity alloy, such as nickel-chrome). Resistors are also implemented within integrated circuits, particularly analog devices, and can also be integrated into hybrid and printed circuits. Resistors are designed to cause a voltage drop by resisting the flow of electricity to a given point. In this project it is use to drop the voltage.

Light Emitting Diode (LED)(Fig.5): A light-emitting diode (LED) is a semiconductor light source. LEDs are used as indicator lamps in many devices and are increasingly used for general lighting. Appearing as practical electronic components in 1962 early LEDs emitted low-intensity red light, but modern versions are available across the visible, ultraviolet, and infrared wavelengths, with very high brightness.

When a light-emitting diode is switched on, electrons are able to recombine with holes within the device, releasing energy in the form of photons. This effect is called electroluminescence, and the colour of the light (corresponding to the energy of the photon) is determined by the energy band gap of the semiconductor. An LED is often small in area (less than 1 mm^2), and integrated optical components may be used to shape its radiation pattern. LEDs have many advantages over incandescent light sources including lower energy consumption, longer lifetime, improved physical robustness, smaller size, and faster switching.

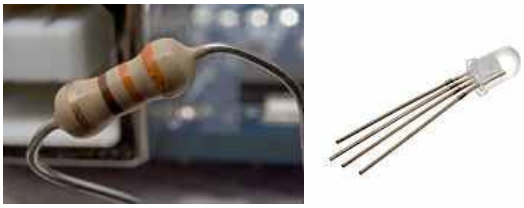

Figure.5: Resistor & LED

Voltage regulator (Fig.6) : A voltage regulator is designed to automatically maintain a constant voltage level. A voltage regulator may be a simple "feed-forward" design or may include negative feed back control loops. It may use an electromechanical mechanism, or electronic components. Depending on the design, it may be used to regulate one or more AC or DC voltages.

Electronic voltage regulators are found in devices such as computer power supplies where they stabilize the DC voltages used by the processor and other elements. In automobile alternators and central power station generator plants, voltage regulators control the output of the plant. In an electric power distribution system, voltage regulators may be installed at a substation or along distribution lines so that all customers receive steady voltage independent of how much power is drawn from the line.

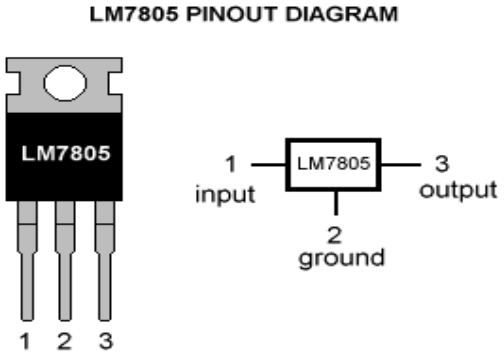

Figure.6: voltage regulator

Adaptor (Fig.7): AC adapters are used with electrical devices that require power but do not contain internal components to derive the required voltage and power from mains power. An adapter is a device that converts attributes of one device or system to those of an otherwise incompatible device or system.

Figure. 7: Adapter

Bread board (Fig.8):A breadboard (or proto board) is usually a construction base for prototyping of electronics. The term "breadboard" is commonly used to refer to a solder less bread board (plug board).

A breadboard originally was a flat wooden cutting board used to support a loaf of bread (or other foods) while it was being sliced; this original meaning is still in use, but has a new additional meaning as "a base for prototyping". The concept of "bread boarding" as prototyping is not confined to electronic design; "mechanical breadboards" have been and continue to be used by mechanical engineers.

Strip board (Fig.8): Strip board is a widely used type of electronics prototyping board characterized by a 0.1 inch (2.54 mm) regular (rectangular) grid of holes, with wide parallel strips of copper cladding running in one direction all the way across one side of the board. It is commonly known by the name Vero board, which is a trademark, in the UK, of British company Vero Technologies Ltd and company Canadian Pixel Print Ltd. In using the board, breaks are made in the tracks, usually around holes, to divide the strips into multiple electrical nodes. With care, it is possible to break between holes to allow for components that have two pin rows only one position apart such as twin row headers for IDCs.

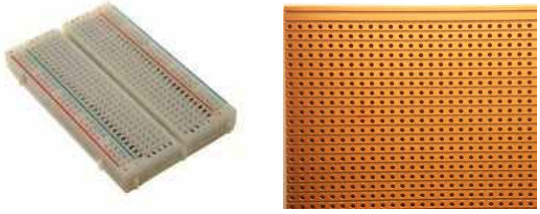

Figure. 8: Bread board and strip board

IR sensor (Fig.9) : The IR sensor is a very simple device that works by producing infrared light off an object and detecting the reflecting with a photo-transistor that is tuned to the same frequency of light. The LED is mounted next to the photo-transistor; however, the emitted light from the LED does not directly shine into the photo-transistor.

Figure. 9: IR sensor and buzzer

Buzzer :A buzzer or beeper is an audio signalling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers and confirmation of user input such as a mouse click or keystroke. Early devices were based on an electromechanical system identical to an electric bell without the metal gong. Similarly, a relay may be connected to interrupt its own actuating, current causing the contacts to buzz. Often these Units are anchored to a wall or ceiling to use it as a sounding board. The word “buzzer” comes from the rasping noise that electromechanical buzzers made. A piezoelectric element may be driven by an oscillating electronic circuit or other audio signal source, driven with a piezoelectric audio amplifier. In this project buzzer system is used to indicate whether the password that has been pressed is right or wrong. For the purpose of alarm also buzzer has been used here. This is shown in figure.

Microcontroller (PIC-16F877A)(Fig.10): A microcontroller is a small computer on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals. Program memory in the form of NOR flash or OTP ROM is also often included on chip, as well as a typically small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purpose applications. Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, power tools, toys and other embedded systems. By reducing the size and cost compared to a design that uses a separate microprocessor, memory, and input/output devices, microcontrollers make it economical to digitally control even more devices and processes. Mixed signal microcontrollers are common, integrating analog components needed to control non-digital electronic systems. Some microcontrollers may use four-bit words and operate at clock rate frequencies as low as 4 kHz, for low power consumption (single-digit mill watts or microwatts). They will generally have the ability to retain functionality while waiting for an event such as a button press or other interrupt; power consumption while sleeping (CPU clock and most peripherals off) may be just Nan watts, making many of them well suited for long lasting battery applications. Other microcontrollers may serve performance-critical roles, where they may need to act more like a digital signal processor (DSP), with higher clock speeds and power consumption.

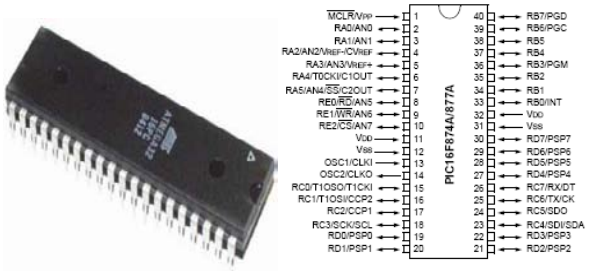

Figure.10: Microcontroller and it’s pin diagram

3. STRUCTURAL DESIGN AND FABRICATION

Design is a subject of problem solving constraints. In this project we have design a door made with plywood, which is 15cm height, 10cm width and thickness is 4mm. the has two parts, one part is fixed and another part is sliding. The sliding part of the door is coupled with steeper motor by using rack and pinion. For this purpose I studied different types of door control system and its related arrangements. I studied about LED, transistor, voltage regulator etc. I have also studied about different types of IC and its working functions. By studying books, searching internet, discussing with my supervisor I got an idea about the work. Then I succeeded to fulfill my project. At first I constructed a motor controlling circuit. I used BD 135 transistor to construct motor controller circuit. Then I constructed my design circuit in a bread board with programming written in Mikro C. I got the expected output. As before I said there are mainly three parts in my project- Electrical section, Controlling section and Mechanical section.

Programming : The objective of programming in this project is to instruct the microcontroller; so that it can perform the main task is to open/close the door by using the password, sensor and dedicated key or switch.

The door only open when correct password will be inserted. Then sensor sense the entering into the door and after this the door will automatically be closed. A dedicated key or switch is providing the opening and closing of door again with 10 seconds time delay, in the inner side of the room for leaving the room. I write the whole program in Mikro C. The flow chart of the program is given below.

MikroC PRO is a powerful and enriched tool for PIC micros. It is designed to provide the customer with easiest possible solution for developing applications for embedded systems, without compromising performance or control. It is a full-featured ANSI C compiler for PIC devices from Microchip. It is the best solution for developing code for PIC devices. It features intuitive IDE, power compiler with advanced optimizations, lots of hardware and software libraries, and additional tool that will help in work. Compiler comes with comprehensive help file and lots of ready to-to-use examples designed to get someone started in no time. Compiler license includes free upgrades and product life time tech support.so user can rely on our help while developing.PIC and C fit together well.

PIC is the most popular 8-bit chip in the world, used in a variety of applications. Mikro C PRO for PIC provides successful match featuring highly advanced IDE,ANSI compliant complier, board set of hardware libraries, comprehensive documentation, and plenty of ready-to-run examples.

Simulating the hardware with PROTEUS: At first we opened the proteus software. Then we took the necessary components from library. We placed PIC16F72 in middle of the window then we connected all the pins of port with the eight switches. We connected the LCD display with some pins of port C. When the connection is complete it looked like figure 4.1 then we entered the HEX file in the microcontroller which was generated from mikroC pro. Finally we simulated the circuit. The software showed no error. We tested it by entering password and it worked smoothly.

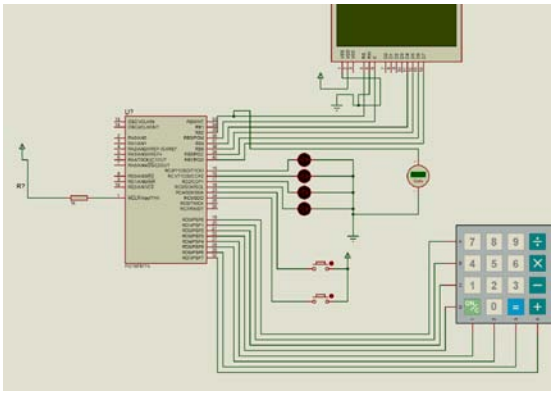

Figure.11: Circuit Diagram in Proteus

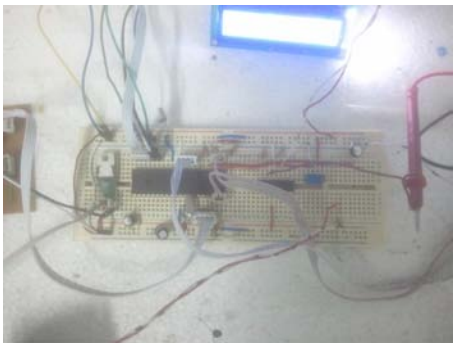

Fig.12: Electrical circuit in a bread board

4. WORKING PRINCIPLE

4.1 Flow Chart

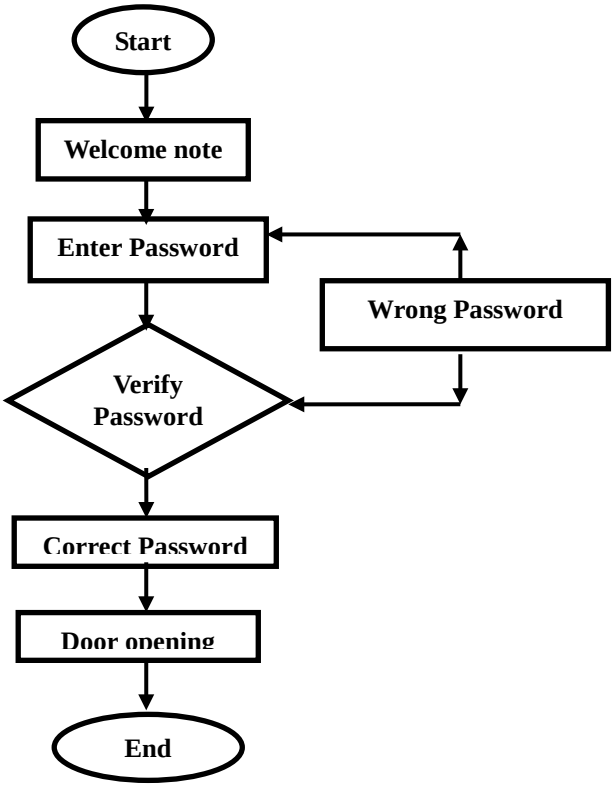

Figure 13 : Working flow chart of the charging system

Figure 14 : Complete mobile charging system

For the mechanical section I used a rack which size is 10 cm length and I used a pinion which can mesh properly with this. I used the steeper motor which gives .72 degree per step. I loaded a program in microcontroller that was 200 loops for the steeper motor. But in the experiment I see that there would require 202 loops for higher accuracy in opening and closing operation of the door. Without this negligible error I get the expected result from my project.

5. DISCUSSION

Every innovative work is started with a view to attaining a specific motto. Our main goal was to make such a type of door which will provide highest security with the sacrifice of little cost. In this regard our project is an attempt to design and implement password protected automatic door using PIC 16F877a microcontroller. PIC monitors the entered password and opens the door when the correct password is inserted. The security system available in present market is too costly to use. Especially in third world country like Bangladesh it is quite impossible for us to use something so costly in general purposes. Our project is a prototype which enables one how to make a password protected automatic door, which ensures highest security that can be made at a very low cost. If available financial and technical support from the concerned Govt. section and organizations is found, then it will be possible to commercialize the proposed door for the benefit of the people of our country.

6. CONCLUSION

From the above discussion it can be concluded that

1. In this project, a model electro-mechanical sliding door using a password protection is introduced which will open & close automatically by sensing the existence of human or any object with sensor.
2. In this system when anyone insert the wrong password , the LCD display wants then correct password and if password matches, the door will open and after sometimes it will close automatically by using an IR sensor.
3. After that when anyone wants to leave he has to click a push button which will again open the door and close after 10 seconds delay. Receiver diode sends the signal to the microcontroller so that the steeper motor starts to rotate. The rotation will continue for few seconds. After that, motor will start to rotate reversely, that means the door will start to close.

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