MICROCONTROLLER BASED SECURITY LOCKSYSTEM WITH PASSWORD

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Abstract

Microcontroller based security lock system is an access control system that allows only authorized persons. The electronic controlled assembly allows the system to unlock the device with password. This system has a keypad which the password can be entered through it. If the entered password is correct then the word "CORRECT" will display on LCD and the lock opens. If the incorrect password is entered three times then the word "THIEF" will display on LCD and the alarm will ring by producing sound from buzzer. This circuit can be used in bank for security, steel safe and security door lock to secure them against thief. The microcontroller based security lock system is designed and constructed by using major components programmed microcontroller PIC18F452, 4×4 keypad, LCD (Liquid Crystal Display) and abuzzer.

Keywords: microcontroller, keypad, LCD, security lock

Introduction

Security is a prime concern in day-to-day life. Everyone wants to be as much secure as possible. An access control for doors forms a vital link in a security chain. The microcontroller based digital lock for door is an access control system that allows only authorized persons to access a restricted area. An electronic lock or digital lock is a device which has an electronic control assembly attached to it. They are provided with an access control system. This system allows the user to unlock the device with a password. The password is entered with the use of a keypad. The user can also set the password to ensure better protection. The password is stored in the EEPROM so that the user can change it at any time. The system has a keypad by which the password can be entered through it. When the entered password equals with the password stored in the memory then the system opens the door by rotating door motor and a message is displayed on LCD. If the password entered in keypad is incorrect, then the security alarm is rung and a message is also displayed on LCD. Keypad and LCD are very commonly used input and output devices. It is very interested to design and construct a security lock system. So, in this research, the security lock system based on PIC 18F452 microcontroller was designed and constructed with a password control. This system consisted of a programmed microcontroller PIC18F452, 4×4 keypad to enter password and LCD to display the message.[microcontroller projects]

Materials and Methods

Block Diagram of the Constructed System

The security lock system was designed and constructed by using major components programmed PIC18F452, 2 lines 16 character LCD module, 8 MHz crystal oscillator, 4×4 keypad and a buzzer. The whole system consisted of power supply section, main processing section, motor driving section, display section and alarm section. The block diagram of the whole system was presented in figure 1.

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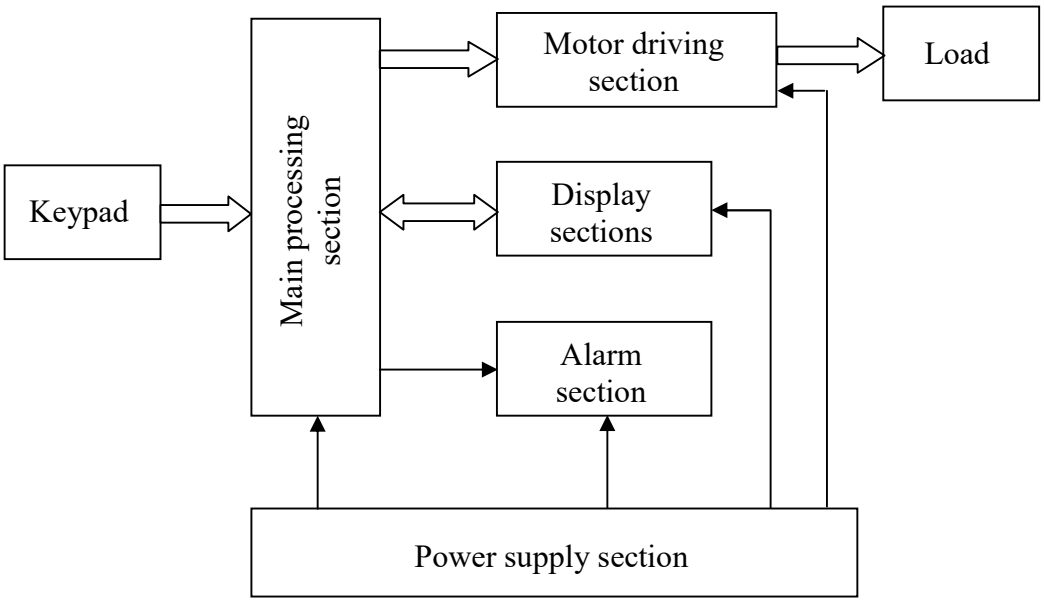

Figure 1 Block diagram of security lock system

PIC Microcontroller

The microcontroller is an exciting new device in the field of electronics control. It is a complete computer control system on a single chip. Microcontrollers are constructed with the Harvard Architecture and used mostly in RISC (Reduced Instruction Set Computer) method, which has separate address bus and data bus, so can have different bit widths. Microcontroller includes EPROM (Erasable Programmable Read Only Memory) program memory, user RAM (Random Access Memory) for storing program data, timer circuits, an instruction set, special function registers, power on reset, interrupt, low power consumption and a security bit for software protection. The Microchip's PIC is a special type of microprocessor called microcontroller. PICs use data memory (RAM) of a small number of 8 bit registers and program memories (EEPROM) are 12 bits, 14 bits or 16 bits wide. The number of instructions of the microcontroller of midrange is usually less than 50.

Primarily, the microcontroller is capable of storing and running a program (its most important feature). The microcontroller contains a CPU (Central Processing Unit), RAM , ROM , I/O (Input/Output) lines, serial and parallel ports, timers and sometimes other built-in peripheral such as analog-to-digital converter and digital-to-analog converter.

The PIC18F452 contains 32K bytes of flash program memory type, 16384 single word instructions on chip program memory, 1536 bytes on chip RAM and 256 bytes of data EEPROM[Datasheetspdf.com]. The pin diagram and photograph of PIC18F452 is shown in figure 2 and figure 3.

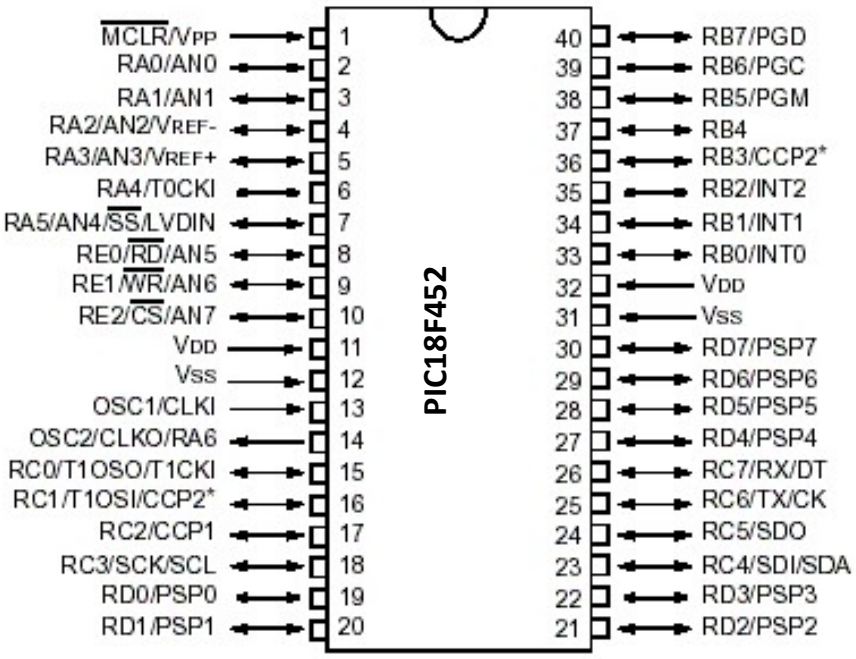

Figure 2 Pin diagram of PIC18F452

Figure 3 Photograph of PIC18F452

Design and Construction of the System

Power Supply Section

In this section, + 5V regulated power supply circuit was constructed by using step-down transformer, full-wave rectifier, filter capacitors and 7805 regulator IC. Firstly, AC 220V was reduced to AC 12V by using step-down transformer and it was converted into corresponding DC voltage with the help of full-wave rectifier. This DC voltage was filtered with 470 μF capacitor. The filtered DC voltage was applied to the input terminal of 7805 voltage regulator. The common terminal of L7805 was grounded and the output terminal produced +5V. In order to filter the fluctuation, the regulated + 5V line was also filtered with 10 μF capacitor. Schematic diagram of power supply section was shown in figure 4.

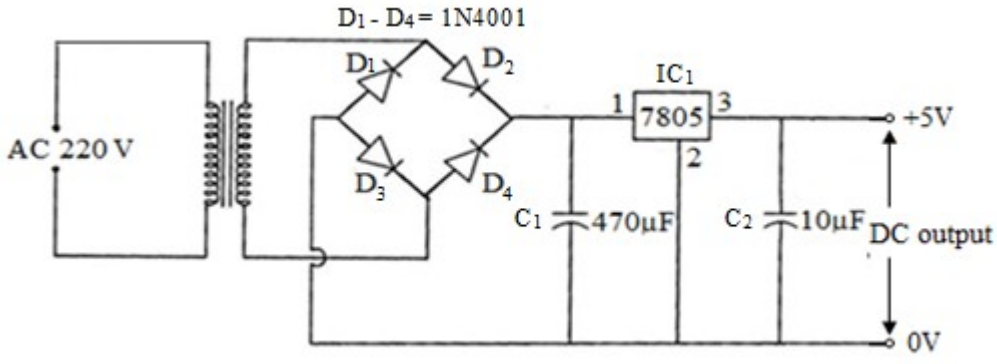

Figure 4 Schematic diagram of power supply section

Main Processing Section

The main processing device of the whole system was PIC18F452 microcontroller. An 8MHz crystal was fitted between OSC 1 and OSC 2 pins of microcontroller and these pins were also filtered with 22 pF capacitors. PORTD of PIC18F452 microcontroller was configured as input. This PORT accepted the data from keypad. In this circuit, the alphanumeric data were sent to LCD by using 4-bit mode. PORTB of microcontroller was used as the digital output to send the data and also to control the LCD. RA0 and RA1 of microcontroller were used to display LED. When the password from keypad was correct, the correct LED was on and the password was incorrect, the incorrect LED was on. RC2 of microcontroller was used as to produce alarm sound from buzzer. RC4 to RC7 of microcontroller were used as the digital output to control the stepper motor. Pin 12 and pin 31 of microcontroller were connected to ground and pin 11 and pin 32 are connected to + 5V dc supply voltage. Schematic diagram of main processing section was shown in figure 5.

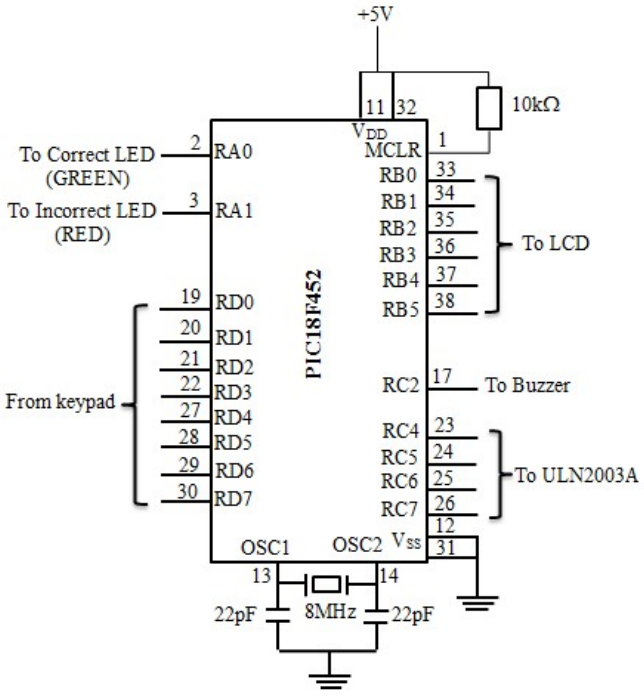

Figure 5 Schematic diagram of main processing section

Motor Driving Section

The motor driving circuit was constructed by using ULN2003A IC. In this circuit, pin 8 of motor driving IC was connected to ground and pin 9 was connected to +5V. Pin 1 to pin 4 of motor driver IC was controlled by RC4 to RC7 of microcontroller IC. Schematic diagram of motor driving section was shown in figure 6.

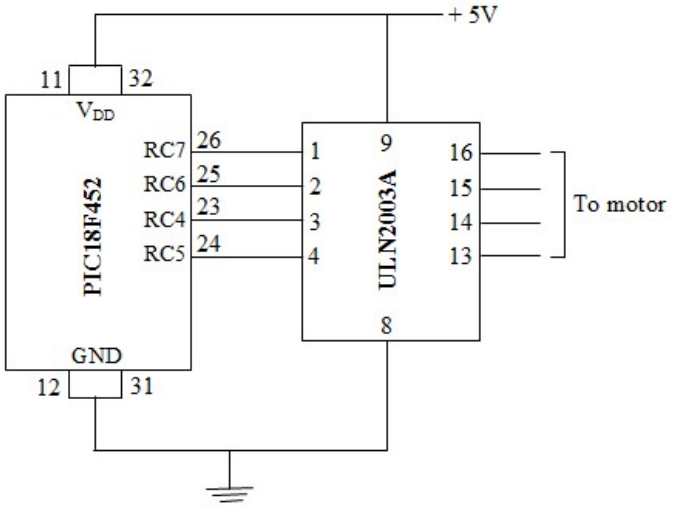

Figure 6 Schematic diagram of motor driving section

Display and Alarm Section

The security lock system consisted of two display sections, LCD and LED. A2-line 16-character LCD was used to display the data from microcontroller. Pin 1 of LCD was connected to ground. Pin 2 of LCD was connected to + 5V and pin 3 was connected to the ground via 10 kΩ variable resistor to adjust the contrast of LCD character. Pin 4 (RS) of LCD was controlled by RB4. Pin 5 of LCD was connected to ground. Pin 6 (E) of LCD was controlled by RB5. Data bits of LCD were connected to RB0 to RB3 respectively. LCD back light pins were directly applied +5V and ground. RA0 and RA1 were connected to "Correct LED" and "Incorrect LED". Schematic diagram of display section was shown in figure 7.

The alarm section consisted of a transistor and a buzzer. The power supply pin of buzzer was connected to + 5V and ground pin of buzzer was connected to collector of transistor. Schematic diagram of alarm section was shown in figure 8.

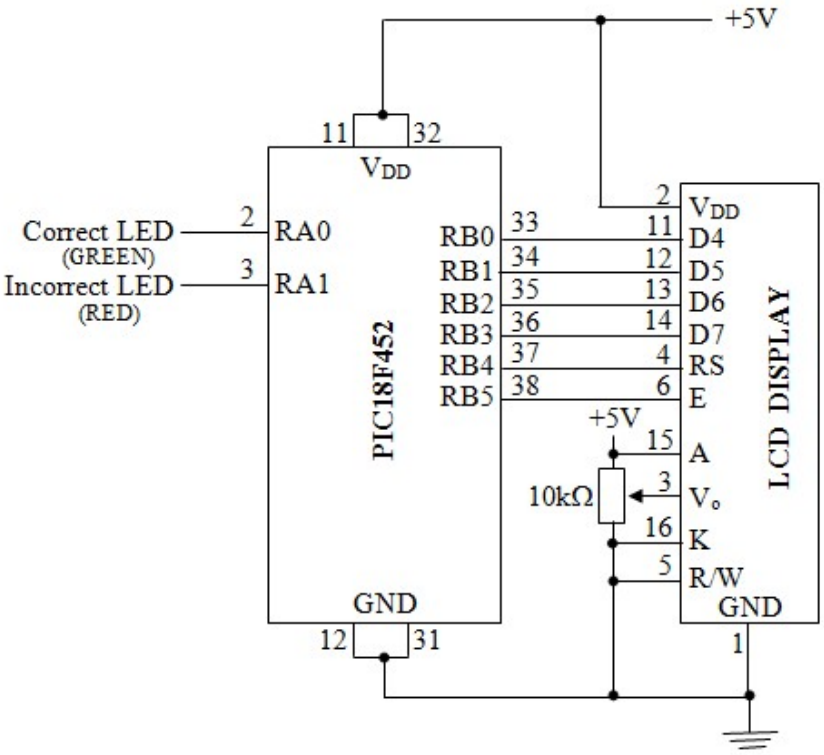

Figure 7 Schematic diagram of display section

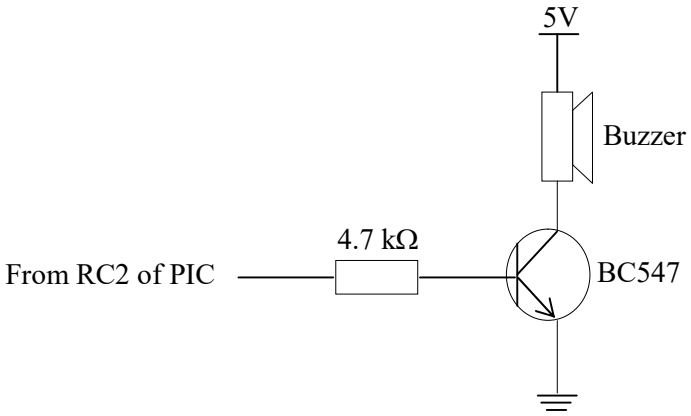

Figure 8 Schematic diagram of alarm section

Complete Circuit of the Whole System

The keypad, main processing section, display section, alarm section, motor driving section and power supply section altogether formed the complete circuit of the whole system. The columns of keypad are connected to RD0 to RD3 and rows are connected to RD4 to RD7. The LCD is connected to PORTB. The password is entered with the use of keypad. When the entered password is correct, the security door lock system will open. When incorrect password is entered, the security alarm will ring. Complete circuit diagram and flow chart of security lock system is shown in figure 9 and figure 10.

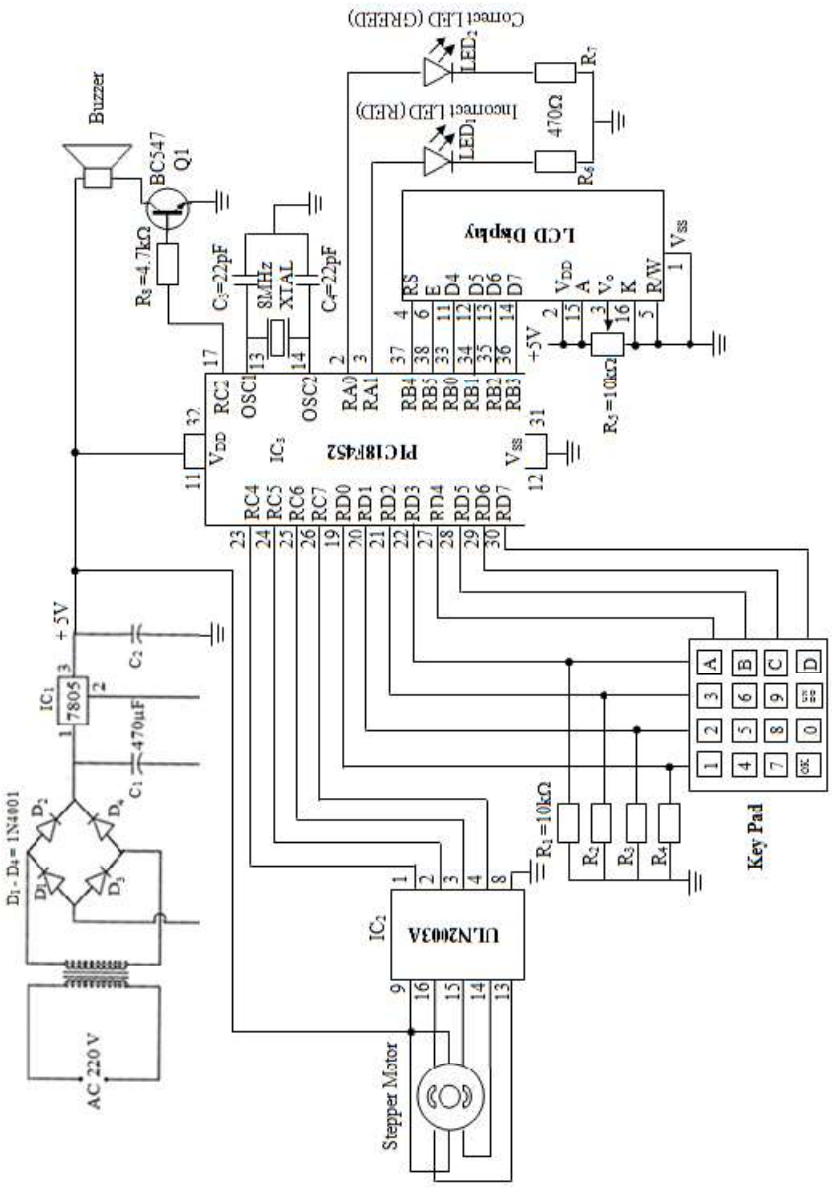

Figure 9 Complete circuit diagram of security lock system

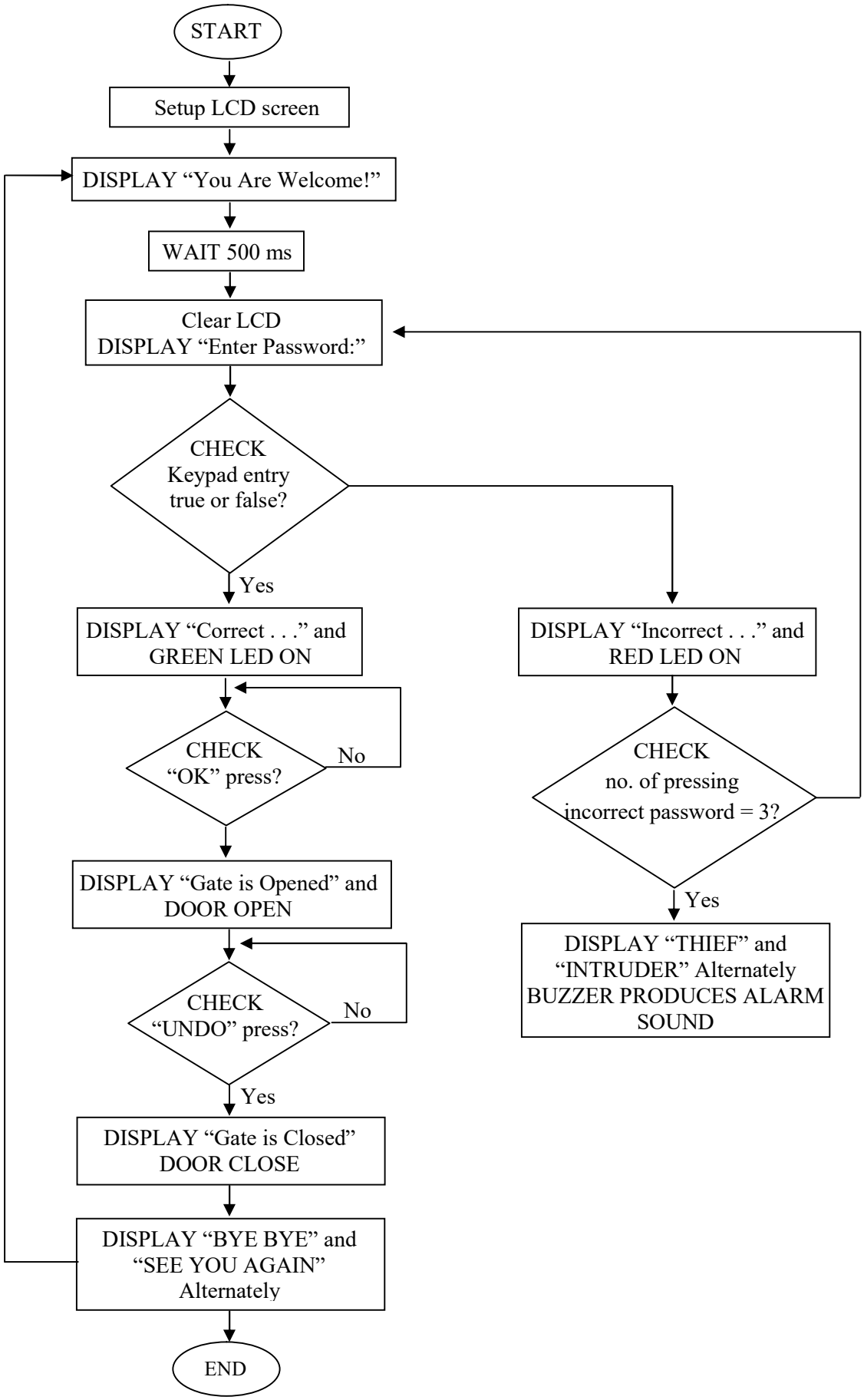

Figure 10 Flow chart of security lock system

The Printed Circuit Board (PCB)

The circuit is constructed on a single sided PCB (printed circuit board) which is manually drawn by the use of Trax Maker PCB software. The bottom layer (solder side) is printed on the single sided copper clad. The unwanted portion of the copper is etched by ferrous chloride. After being etched, the holes are drilled. And then the top layer (component side) is printed. After that, the components are fitted to proper locations subsequently soldered the leads. Bottom layer and top layer PCB layout of security lock system are shown in figure 11 and figure 12. Multilayer PCB layout of security lock system is shown in figure 13. The blue colour represents the bottom layer and the red colour and yellow colour represent top layer.

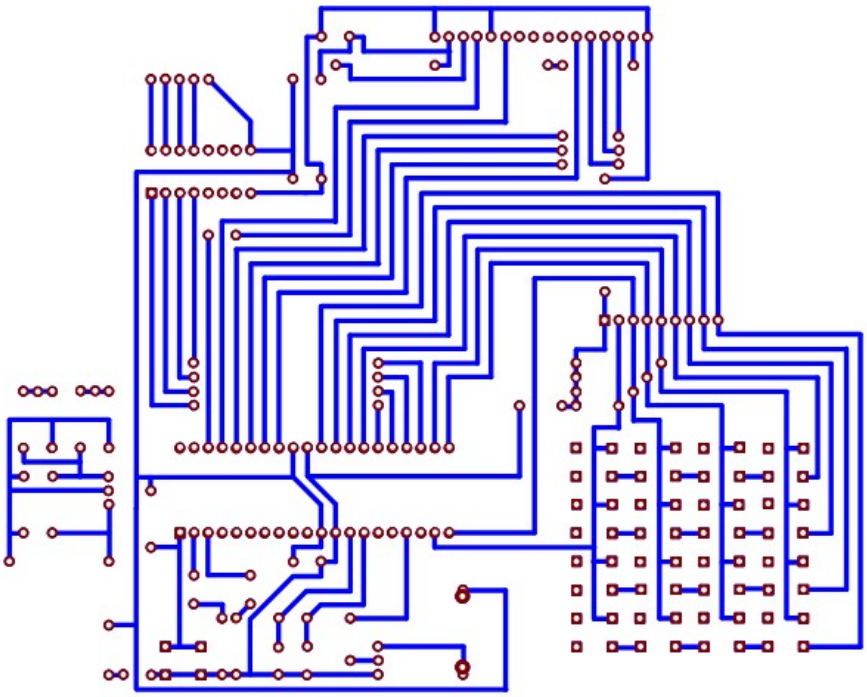

Figure 11 Bottom layer PCB layout of security lock system

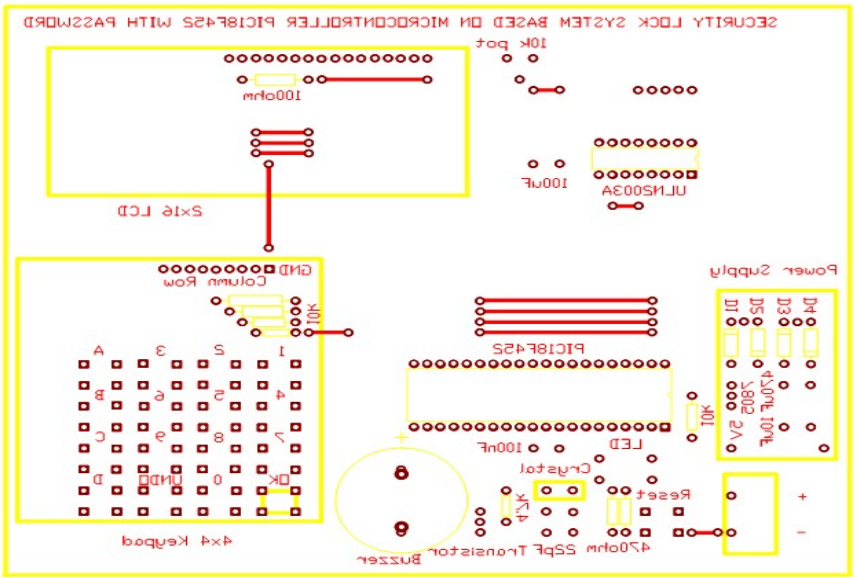

Figure 12 Top layer (Mirror View) PCB layout of security lock system

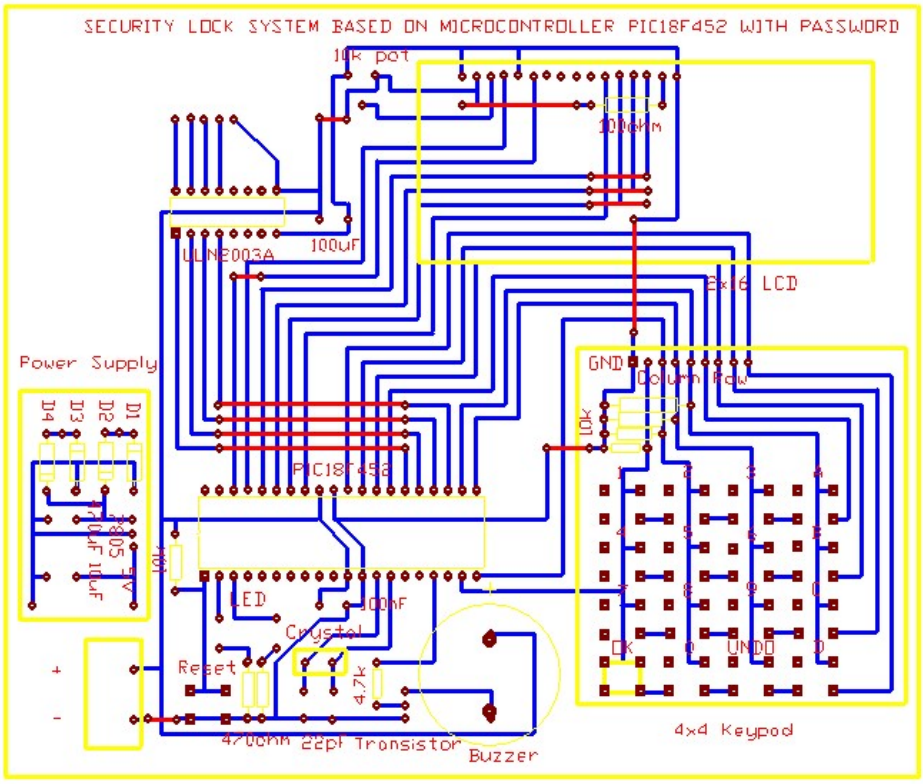

Figure 13 Multilayer PCB layout of security lock system

Results and Conclusion

Results

In the constructed system, 4×4 keypad was used to enter the password, LCD was used to display the message, the buzzer was used to produce the alarm sound and the motor was used to open and close the door. The heart of the whole system was low power, high performance PIC18F452. The program required for security lock system was written in MikroC language and the hexadecimal code was downloaded to microcontroller with the aid ofPIC-KIT2 programmer. Figure 14 showed photo of security lock system.

As soon as the power supply was connected to the circuit, the system initialized with "You Are Welcome!" on the LCD display for 500 ms. This initializing stage was shown in figure 15. Then the display of cursor jumped to the second row first column of LCD and flashing the cursor. The password combination was composed with eight digit characters "2016ABCD". After pressing input combination, it was required to press OK button to check the password. If the entry password was correct, the LCD displayed the word "Correct…" and the green LED illuminated. Figure 16 showed entering correct password stage. But the door opening stepper was not opening. In this case, the "OK" button was required to press again. If the "OK" button was pressed, the LCD displayed "Gate is Opened" and the door started slide opening. This gate open stage was shown in Figure 17. After the door was fully opened, the motor stopped and the door entrance was opened. Then the door can be closed by pressing "UNDO" button. When the "UNDO" button was pressed, the LCD displayed the word "Gate is Closed" and the door slided

closing until the door was fully closed. Gate close stage was shown in figure 18. Then the system greeted with “BYE BYE” and “SEE YOU AGAIN” alternately on the LCD.

When the enter password was incorrect, LCD displayed the words “Incorrect” and “Try Again” and the red LED was illuminated. Figure 19 showed entering incorrect password stage. After that, the word “Enter Password” displayed on LCD. If incorrect password was pressed over three times, the buzzer produced the alarm sound and the words “THIEF” and “INTRUDER” displayed alternately on LCD. This stage was shown in figure 20. In this way, unauthorized entry can be easily alert the residence and neighbors to protect from burglars and thief.

Figure 14 Photo of security lock system

Figure 15 Initializing stage of security lock system

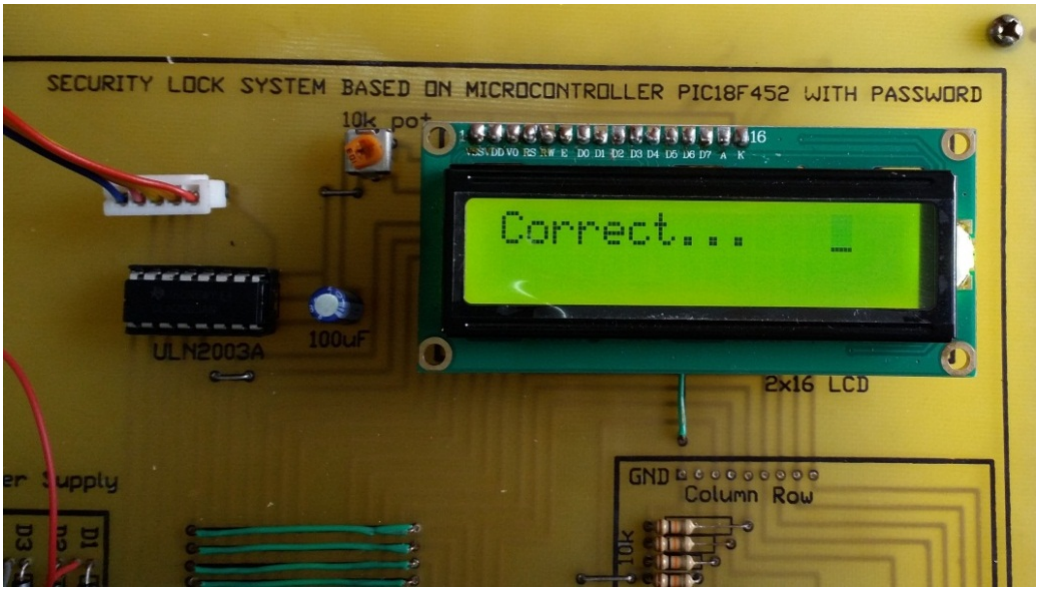

Figure 16 Entering correct password stage

Figure 17 Gate open stage of security lock system

Figure 18 Gate close stage of security lock system

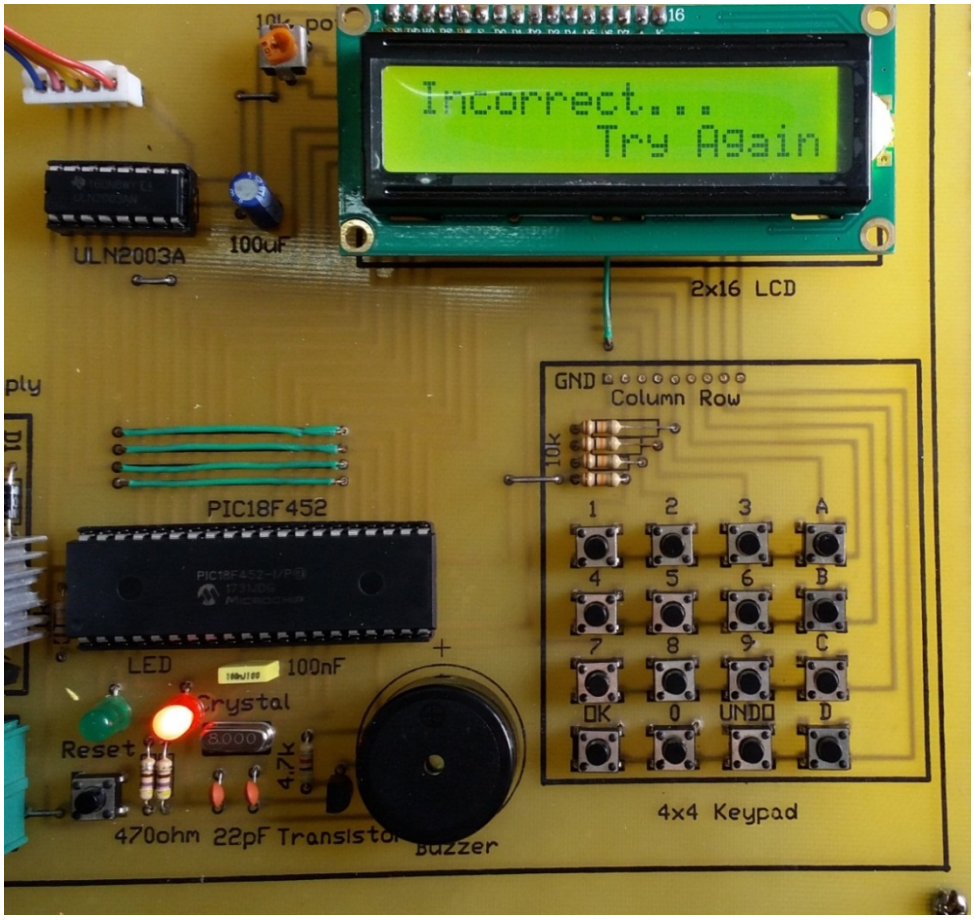

Figure 19 Entering incorrect password stage

Figure 20 Entering incorrect password three times

Conclusion

In day-to-day life, security of any object or place plays a major role. Automatic systems have less manual operations, so that the flexibility, reliabilities are high and accurate. The various innovations in security access system include code based lock, keycard lock and thumb print scan. Code based locking system is best suited in most applications because of its simplicity and reliability. Since the code based locking system is always resident in the area to be protected, there are fewer chances of security branches unlike the keycard lock system in which the access card can fall into unauthorized hands. The microcontroller based electronic combination door lock system with the alarm has successfully presented a functional and an easy way to combat crime and theft using a low cost device and can be applied everywhere security is needed. The advantages of using a security lock system are increased safety, no undetected strangers, reduce theft and no more lost keys. This circuit can be used in bank for security, steel safe and security door lock to secure them against thief.

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https://electrosome.com/uln2003-high-voltage-current-driver/