# Digital Code Lock using 8051 Microcontroller

by


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## ABSTRACT

Security plays a pivotal role in our everyday life and it is a genuine matter of concern. Microcontrollers form the most significant part of several security and surveillance systems which plays an important role in ensuring safety of our priced possessions. An access control system for doors and safety vaults forms a vital part of security. 8051 microcontroller based Door Locker is an access control system which gives authority to only a certain people to access the safe possession or restricted areas. The system is fully controlled by the 8 bit microcontroller AT89C51 which has a 4Kbytes of ROM for the program memory. The system has a Keypad by which the password can be entered through it. When they entered password equals with the password stored in the memory then the relay gets on and so that the door is opened. If we entered a wrong password for more than three times then the Alarm is switched on. The code for the functioning of the microcontroller is written in C language and on Keil Software and the hex file generated is added to the microcontroller.

# TABLE OF CONTENTS

# CHAPTER 1
# INTRODUCTION

Nowadays people focus more on keeping valuable possessions at home owing to the pandemic. In such cases, there must be a secure environment to keep everything safe. A Password based Door Security System serves the purpose. The system comprises a number keypad, 16X2 LCD and they are connected to the 8 bit microcontroller AT89C51. This is one of the popular Microcontrollers. It has 40 pins and there are 32 input/output lines. The microcontroller has a program memory of 4 Kilobytes. The microcontroller continuously monitor the keypad and if somebody enters the password it will check the entered password with the password which was stored in the memory and if it they are same then the microcontroller will switch on the corresponding device.
The system will allow the person who knows the password and it will not allow who don't know the password and the system will also show the persons who try to break the protection barrier.

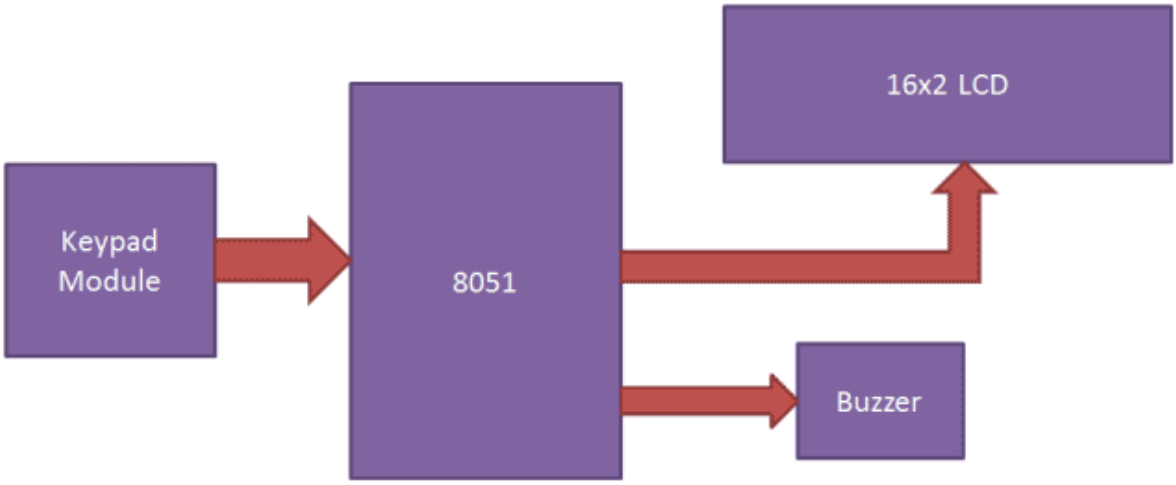


Fig1: Block Diagram

# CHAPTER 2

## Relevant Work

We briefly review the recent work that we have done on Microcontroller based Digital Code Lock system.

### 2.1. Objective of the Work:

The project is aimed to build a password protected system using components like 8051 Microcontroller, Keypad Module, 16X2 LCD. In case the password entered is incorrect an error message is displayed and if the entered password is incorrect for three times, an alarm starts buzzing, thereby warning the authorities.

### 2.2. Methodology used:

An administrator controlled password is stored in the program memory of AT89C51 and when the system is initialized, it asks for input from the user. If the password entered is correct the relay starts and the access is granted else, it is denied. Using the C language we code and generate a hex file which is then fed into the microcontroller so that it can function automatically. The software used were Keil Vision 5 and Proteus 8.

### 2.3. Results obtained:

After simulating the circuit with the code on Proteus, we could see proper functioning of all the modules and the results were the same as expected.

### 2.4. Research Gap:

Implementation of alarm based system to ensure even safer system is the research gap that we made possible in our project.

# CHAPTER 3

## System Description.

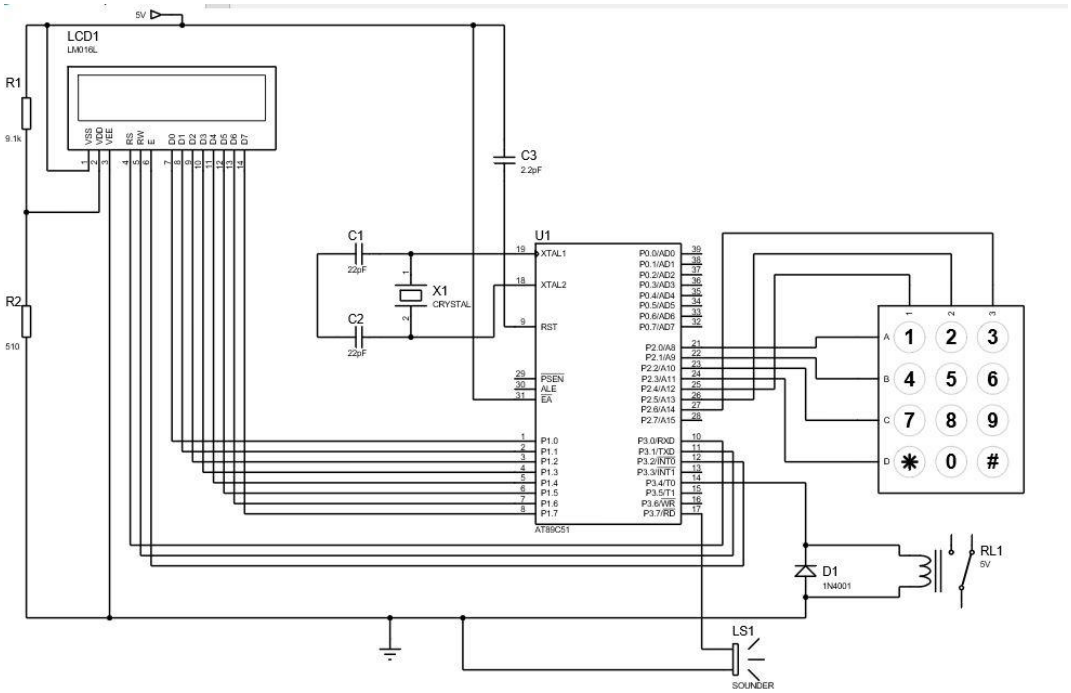


**Fig2: Circuit Diagram**

In this section we explain about our circuit diagram shown in Fig2.

### 3.1 AT89C51 Microcontroller:

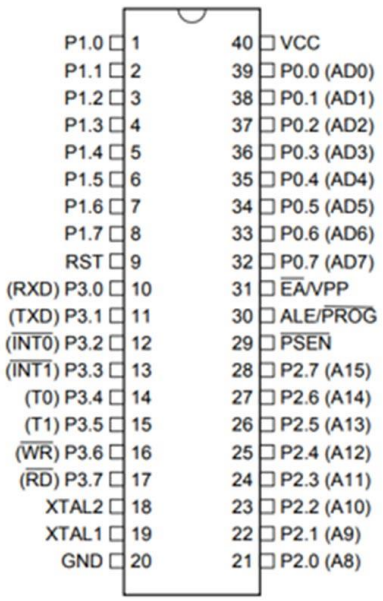


Fig3: AT89C51

The **AT89C51** is an age old 8-bit microcontroller from the Atmel family. It works with the popular 8051 architecture and hence is used by most beginners till date. It is a 40 pin IC package with 4 kilobytes flash memory. It has four ports and all together provides 32 Programmable GPIO pins. It does not have in-built ADC module and supports only USART communication. Although it can be interfaced with external **ADC IC** like the ADC084 or the ADC0808. Atmel microcontroller can be programmed with different software's that is available in the market. Arduino, Keil uVision are the most used platforms to name a few. If you are planning on serious programming and expansion with community support then Keil is recommended. In order to program the Atmel microcontroller we will need an IDE (Integrated Development Environment), where the programming takes place. A compiler, where our program gets converted into MCU readable form called HEX files. An IPE (Integrated Programming Environment), which is used to dump our hex file into our MCUs

Pin Description of AT89C51:

| Pin Number | Pin Name | Description |
|---|---|---|
| 1 | P1.0 | 0th pin of PORT P1 |
| 2 | P1.1 | 1st pin of PORT P1 |
| 3 | P1.2 | 2nd pin of PORT P1 |
| 4 | P1.3 | 3rd pin of PORT P1 |
| 5 | P1.4 | 4th pin of PORT P1 |
| 6 | P1.5 | 5th pin of PORT P1 |
| 7 | P1.6 | 6th pin of PORT P1 |
| 8 | P1.7 | 7th pin of PORT P1 |
| 9 | RST | Reset pin of the Microcontroller |
| 10 | (RXD) P3.0 | 0th pin of PORT P3 or Receiver pin of Microcontroller |
| 11 | (TXD) P3.1 | 1st pin of PORT P3 or Transmitter pin of Microcontroller |
| 12 | (INT0) P3.2 | 2nd pin of PORT P3 or External Interrupt 0 of MCU |
| 13 | (INT1) P3.3 | 3rd pin of PORT P3 or External Interrupt 1 of MCU |
| 14 | (T0) P3.4 | 4th pin of PORT P3 or Timer 0 interrupt of MCU |
| 15 | (T1) P3.5 | 5th pin of PORT P3 or Timer 1 interrupt of MCU |

| | | |
|---|---|---|
| 16 | (WR) P3.6 | 6th pin of PORT P3 or Write to External data memory pin |
| 17 | (RD) P3.7 | 7th pin of PORT P3 or Read from External data memory pin |
| 18 | XTAL2 | External crystal pin 2 of Microcontroller |
| 19 | XTAL1 | External crystal pin 1 of Microcontroller |
| 20 | GND | Ground pin of MCU |
| 21 | P2.0(A8) | 0th pin of PORT P2 or High-order Address bit 8 of MCU |
| 22 | P2.1(A9) | 1st pin of PORT P2 or High-order Address bit 9 of MCU |
| 23 | P2.2(A10) | 2nd pin of PORT P2 or High-order Address bit 10 of MCU |
| 24 | P2.3(A11) | 3rd pin of PORT P2 or High-order Address bit 11 of MCU |
| 25 | P2.4(A12) | 4th pin of PORT P2 or High-order Address bit 12 of MCU |
| 26 | P2.5(A13) | 5th pin of PORT P2 or High-order Address bit 13 of MCU |
| 27 | P2.6(A14) | 6th pin of PORT P2 or High-order Address bit 14 of MCU |
| 28 | P2.7(A15) | 7th pin of PORT P2 or High-order Address bit 15 of MCU |
| 29 | PSEN | Program store enable pin, Read external program memory |
| 30 | ALE/PROG | Address Latch Enable/ Program Pulse input for flashing |
| 31 | EA/VPP | Access Enable voltage/Program enable voltage |
| 32 | P0.7(AD7) | 7th pin of PORT P0 or Low-order Address bit 7 of MCU |
| 33 | P0.6(AD6) | 6th pin of PORT P0 or Low -order Address bit 6 of MCU |
| 34 | P0.5(AD5) | 6th pin of PORT P0 or Low -order Address bit 5 of MCU |
| 35 | P0.4(AD4) | 6th pin of PORT P0 or Low -order Address bit 4 of MCU |
| 36 | P0.3(AD3) | 3rd pin of PORT P0 or Low -order Address bit 3 of MCU |
| 37 | P0.2(AD2) | 2nd pin of PORT P0 or Low -order Address bit 2 of MCU |
| 38 | P0.1(AD1) | 1st pin of PORT P0 or Low -order Address bit 1 of MCU |
| 39 | P0.0(AD0) | 0th pin of PORT P0 or Low -order Address bit 0 of MCU |
| 40 | Vcc | Supply pin of MCU |

### 3.2 Keypad Module:

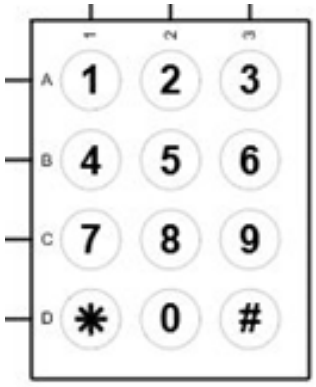


**Fig4: Keypad Module**

**Keypads** are organized in a matrix of rows and columns**.** The CPU accesses both rows and columns through ports**.** When a key is pressed, a row and a column make a contact**. Multiplexing technique** is a very efficient way to reduce number of pins used with the microcontroller for providing the input or password. Basically this technique is used in two ways - one is **row scanning** and other one is **column scanning**.

Here we are going to explain row scanning:

First we have to define 7 pin for keypad module. In which first 3 pins are column and last 4 pins are rows.

For row scanning we need to give data or signal to column pins and read that data or signal from row pin. Now suppose we give below data to column pins:

C1=0;
C2=1;
C3=1;

And we read this data at row pins (by default row pins are HIGH due to pull-up resistor).

If user presses key number ‘1’ then R1 changes HIGH to LOW means R1=0; and controller understands that user has pressed key ‘1’. And it will print ‘1’ on the LCD and store ‘1’ in array. So this HIGH to LOW change at R1, is the main thing by which controller understands that some key, corresponding to Column 1, has been pressed.

Now if user presses key number ‘2’ then R1 remains at HIGH as C1 and R1 both are already at HIGH. Hence there will be no change, it means microcontroller understands that nothing has been pressed in column one. And likewise this principal goes for all another pins.

So in this step controller only waits for keys in column one: ‘1’, ‘4’, ‘7’ and ‘*’.Now if we want to track the keys in other columns (like in col 2), then we need to change the data at columns pins:

C1=1;
C2=0;
C3=1;

This time controller only waits for keys in column two: ‘2’, ’5’, ’8’and ‘0’, because change (HIGH to LOW) only occurs when column two keys will be pressed. If we press any key in col 1, 3 or 4 then no change will occur, because these columns are at HIGH, and Rows are already at HIGH. So likewise keys in column C3 can also be tracked by making them 0, at a time.

### 3.3 16X2 LCD:


**Fig5: LCD**

16×2 LCD module is a very common type of LCD module that is used in 8051 based embedded projects. It consists of 16 rows and 2 columns of 5×7 or 5×8 LCD dot matrices.It is available in a 16 pin package with back light, contrast adjustment function and each dot matrix has 5×8 dot resolution. The pin numbers, their name and corresponding functions are shown in the table below:

| Pin No: | Name | Function |
|---|---|---|
| 1 | VSS | This pin must be connected to the ground |
| 2 | VCC | Positive supply voltage pin (5V DC) |
| 3 | VEE | Contrast adjustment |
| 4 | RS | Register selection |
| 5 | R/W | Read or write |
| 6 | E | Enable |
| 7 | DB0 | Data |
| 8 | DB1 | Data |

| | | |
|---|---|---|
| **9** | **DB2** | Data |
| **10** | **DB3** | Data |
| **11** | **DB4** | Data |
| **12** | **DB5** | Data |
| **13** | **DB6** | Data |
| **14** | **DB7** | Data |
| **15** | **LED+** | Back light LED+ |
| **16** | **LED-** | Back light LED- |

VEE pin is meant for adjusting the contrast of the LCD display and the contrast can be adjusted by varying the voltage at this pin. This is done by connecting one end of a POT to the Vcc (5V), other end to the Ground and connecting the center terminal (wiper) of the POT to the VEE pin.

The LCD has two built in registers namely **data register** and **command register.** Data register is for placing the data to be displayed, and the command register is to place the commands. The 16×2 LCD module has a set of commands each meant for doing a particular job with the display. High logic at the RS pin will select the data register and Low logic at the RS pin will select the command register. If we make the RS pin high and the put a data in the 8 bit data line (DB0 to DB7), the LCD module will recognize it as a data to be displayed. If we make RS pin low and put a data on the data line, the module will recognize it as a command.

R/W pin is meant for selecting between read and write modes. High level at this pin enables read mode and low level at this pin enables write mode.

E pin is for enabling the module. A high to low transition at this pin will enable the module.
DB0 to DB7 are the data pins. The data to be displayed and the command instructions are placed on these pins.

LED+ is the anode of the back light LED and this pin must be connected to Vcc through a suitable series current limiting resistor. LED- is the cathode of the back light LED and this pin must be connected to ground.

### 3.4 Alarm

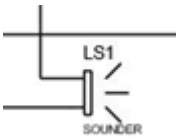


**Fig6: Alarm**

If the password entered is wrong for three consecutive times, the alarm starts buzzing and the admin is aware of the theft or any malpractice.

### 3.5 Methodology:

Circuit Explanation: Circuit diagram for this **Digital lock using 8051** has been shown below and can easily be understood. Keypad module's Column pins are directly connected to pin P2.4, P2.5, P2.6 and Row pins are connected to P2.0, P2.1, P2.2, P2.3 of 89c51 microcontroller's port 2. A 16x2 LCD is connected with 89C51 microcontroller. Control pin RS, RW and En are directly connected to pin P3.0 (Transmission), P3.1 (Receiving) and P3.2 (interrupt). And data pin D0-D7 is connected to pins P1.0-P1.7 of 89C51. The buzzer is connected at pin P3.6 through a resistor and a relay switch which functions when the door is opened is connected to P3.4.

Program Explanation: We have used a predefined password in the program, this password can be defined by the user in the code below. When user enters a password to the system, then system compares the user entered password with stored or predefined password in Code of Program (2940). If a match occurs then LCD will show "Access Grated" and if the password doesn't match then LCD will show "Access Denied" and buzzer will continuously beep for some time.

# CHAPTER 4

## Experimental Setup

This system comprises a bit complex design in order to protect the safe from intruders and alarm the user in case any breach was detected. Therefore the design of this system comprises of three basic steps, they are:

### Initialization:

- The system needs to be initialized by pressing the "*" key in the keypad.
- This locker will not respond to any of the key press before initialization using "*" key.
- It will Turn ON the LCD and count of trials is initialized to zero.
- A command "Enter Password" in the LCD and blink of cursor will convey that the system is ready for password input.

### Password Input:

- The strength of the password in our system is 4 characters.
- The password input can be fed into the system by using keys from 1,2……9
- As soon as you enter four characters controller will verify if the entered password matches with the system password.
- Based on the password verification by the controller there will be two cases totally.

CASE 1:

- If the password matches, LCD will display as Message "Locker Open" and relay will gets activated.
- After the usage of the protected locker, you need to turn off the system by means of pressing "#" key in the keypad
- The relay as the system will get turned off.

CASE 2:

- If the password doesn't match, LCD will display a Message "Wrong Password" in it. And the trial count will be incremented by one in the microcontroller.
- Then the user have to initialize the system by pressing "*" before making the next try.
- If a user entered the correct password in the second attempt then the trail count will be back to zero. Then the user have to lock the system after usage after pressing "#"
- But if the user failed to enter correct password for three continuous attempts, then alarm will start to alert the security surrounding there.
- Then the system will not respond to any of the key inputs therefore the intruder cannot stop the alarm.
- The alarm can be stopped only by turning off the system which should be accessible only to the original user.

### Turning System Off:

- Now the Last thing after usage of the system is to turn them off using the "#" key.
- This applies only in the case if the user entered correct password.
- If the number of trial gets over the system enters into to alert mode. Then it cannot be turned off using "#" during that period of time.

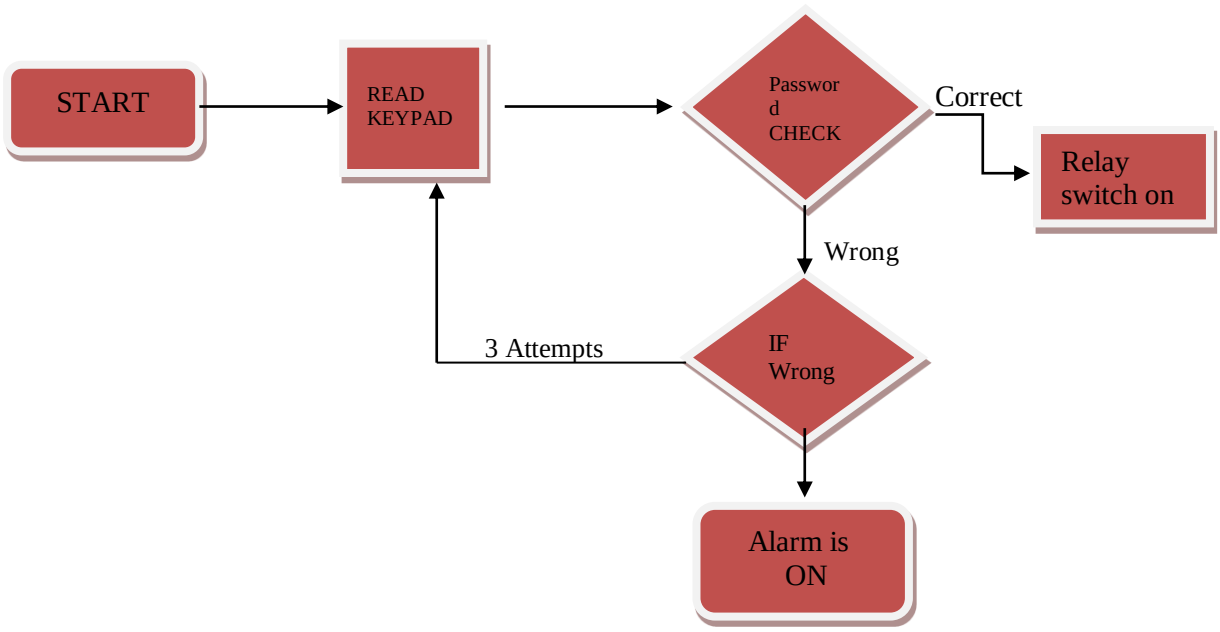


**Fig7: Flowchart Demonstrating the setup**

**Algorithm:**

1. START
2. initialise led, keypad
3. clear lod
4. print "Enter Password" on led
5. get 4 digit password using matrix keypad
6. if input "2940" then
    - 6.1 print "Locker Open"
    - 6.2 relay switch is on
    - 6.3 if next input is '*'
    - 6.3.1 go to step 4
7. else
    - 7.1 print "Wrong Password"
    - 7.2 go to step 4 if count is not 3 and input is '*'
    - 7.3 if count is 3
        - 7.3.1 alarm buzzes
        - 7.3.2 keypad and lcd turned off

8 if input is '#'
    - 8.1 go to step 2

9 STOP

# CHAPTER 5

## Experimental Results

Attaching the snippets from the real time simulation of the digital code lock using 8051

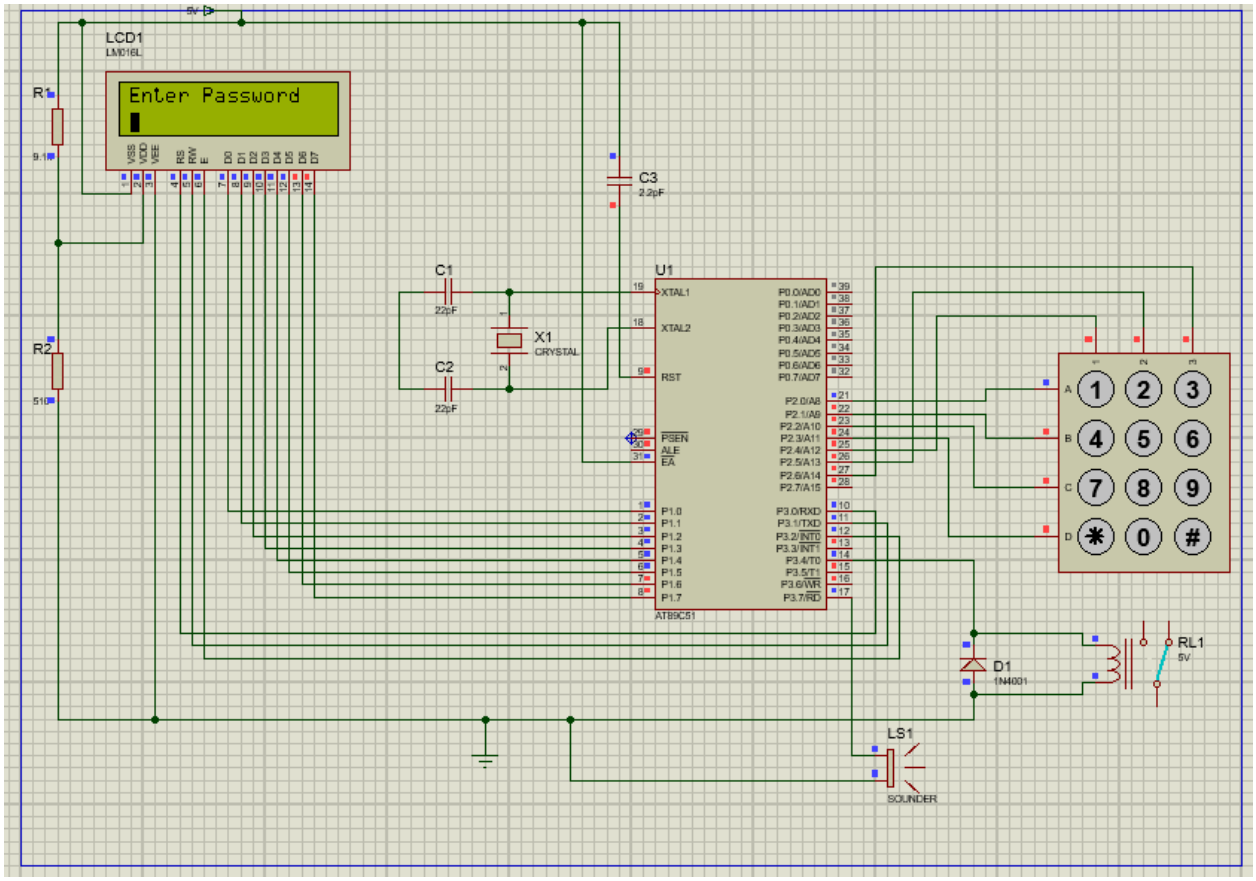


Fig8: Using '#' we initialize keypad and lcd

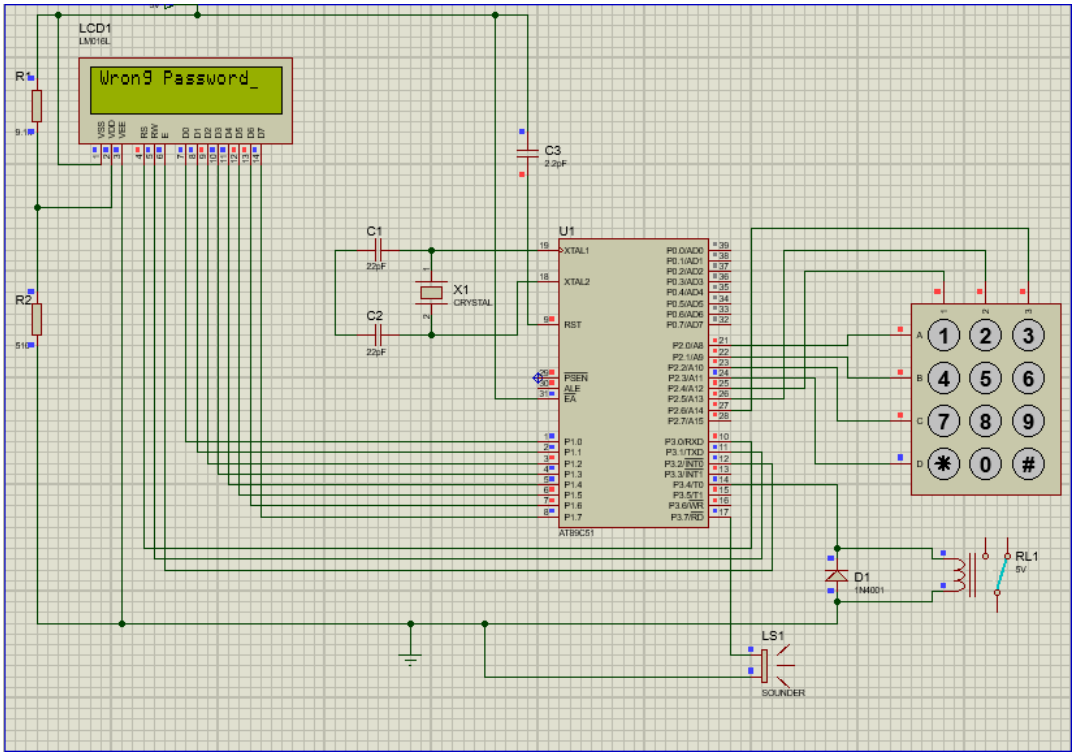


Fig9: Entered Password is wrong

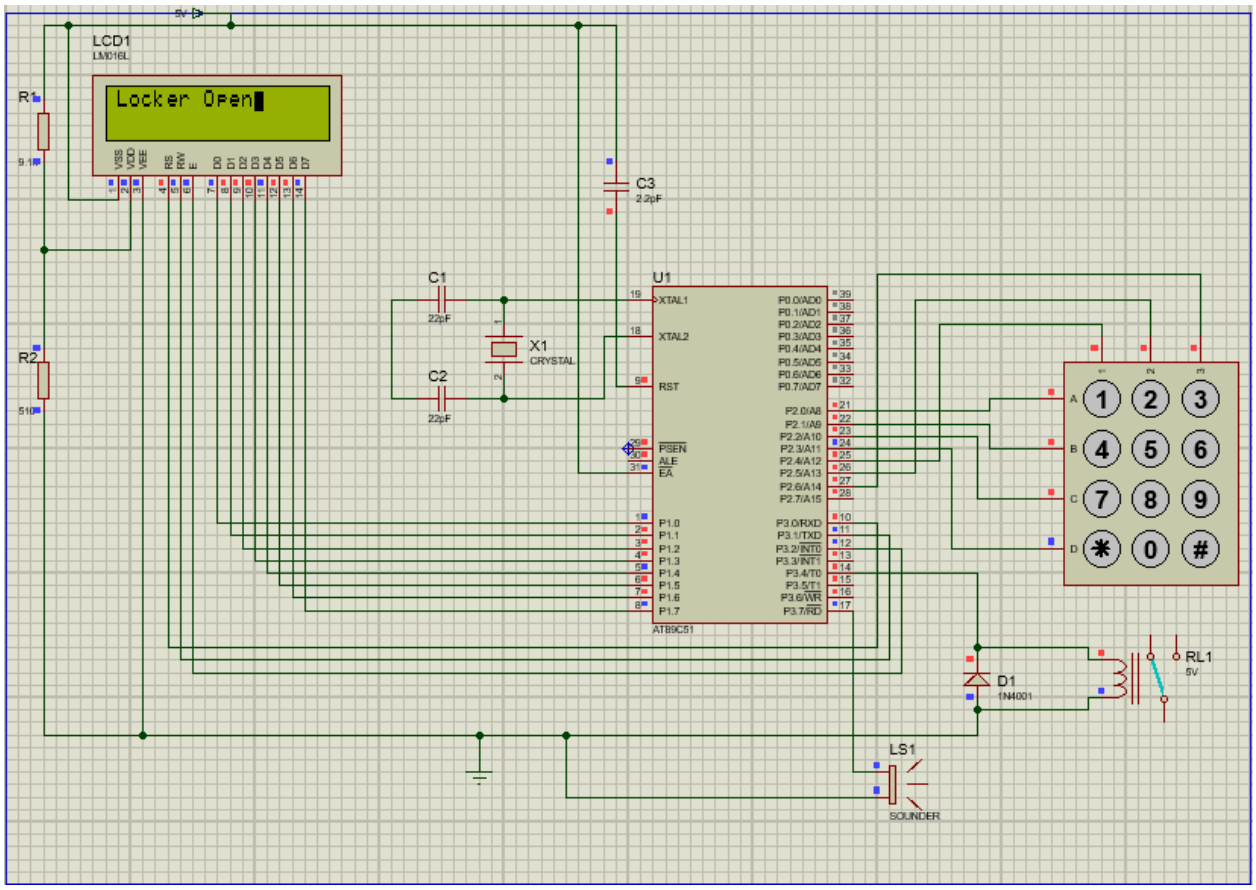


Fig10: Entered password is correct and the relay is On

**Discussions:** Hence all the three test cases namely, initializing, checking and turning off is working completely fine in the project. Also the modules like alarm and relay switch is also working perfectly.

# Chapter 6

## Conclusion

The project can be hence used to secure many households, private or government sector firms and can assure the safest place to all the valuable possessions. 8051 Microcontroller makes embedded system projects easier to be understood and operated and hence they are well known in the digital world.

## Future Scope:

1. This idea can be further extrapolated and can be used in Smart homes and using a Wi-Fi module, the system can become more secure using SMS notifications.

2. Even in automobile door locks, we can use this to make sure that car thefts do not take place.

3. In schools and colleges, a database can be added to it and every student can have their own password for attendance management system.