

Microcontroller Based Efficient Door Lock System

Submitted By:
Md. Nasiruzzaman
ID-2010-3-60-002

Supervised By:
Dr. Md. Nawab Yousuf Ali
Associate Professor
Department of Computer Science and Engineering
East West University

A Project Submitted in Partial Fulfillment of the Requirements for the Degree
of Bachelor of Science in Computer Science and Engineering



DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

EAST WEST UNIVERSITY BANGLADESH

January 2016

ABSTRACT

This project deals with door lock security system to restrict unauthorized access. It is all performed by a servo controlled by a microcontroller. On the outside, there will be a keypad to enter password by the user. Inside, there will be two switches to lock or unlock the door and to reset the system. The servo is attached with the lock inside the door. As locking and unlocking is possible from both sides, it allows entry and exit of a person without any assist from any side.

Unlike ordinary systems available around us, this gives user freedom to use any level of complex password entries for a single constant default password. On the outside of the door, user can enter a large number of random entries including the correct password in the input to make the password look very difficult to others. And wrong password trails will put the system in hold for a while.

DECLARATION

I hereby, declare that all the work presented in this project is the outcome of the investigation and research performed by me under the supervision of Dr. Md. Nawab Yousuf Ali, Associate Professor, Department of Computer Science and Engineering, East West University, Dhaka, Bangladesh. I also declare that neither it nor part of it has been submitted for the requirement of any degree or diploma or for any other purposes except for publications.

Countersigned

Signature

Dr. Md. Nawab Yousuf Ali
Associate Professor
Department of CSE
East West University
Dhaka, Bangladesh

Md. Nasiruzzaman

LETTER OF ACCEPTANCE

The project entitled “Microcontroller Based Efficient Door Lock System” is submitted by Md. Nasiruzzaman, ID-2010-3-60-002 to the department of Computer Science and Engineering, East West University, Dhaka, Bangladesh is accepted by the Department for the partial fulfillment of the requirements for the degree of BSc in Computer Science and Engineering.

Supervisor

Dr. Md. Nawab Yousuf Ali

Associate Professor
Department of CSE
East West University
Dhaka, Bangladesh

Chairperson

Dr. Shamim H. Ripon

Associate Professor and Chairperson
Department of CSE
East West University
Dhaka, Bangladesh

ACKNOWLEDGEMENT

I am truly grateful to the Almighty Allah, whose blessings have always been enormous and who gave me the ability and strength to complete this project. I would like to dedicate my project to my parents, who enlightened me the value of education and always keep me on the right track. It is a great honor and pleasure for me to record this deep sense of gratitude and insightful indebtedness to my respected supervisor, **Dr. Md. NawabYousuf Ali** for his valuable contribution, constant guidance, intuitive advice, helpful criticism, valuable suggestions, commendable support, and also endless patience for the completion of this project work. I am very much grateful to him and feel proud to have worked with him because it was not possible for me to complete this work without his inspiring enthusiasm and encouragement.

LIST OF CONTENTS

ABSTRACT -----	ii
DECLARATION -----	iii
LETTER OF ACCEPTANCE -----	iv
ACKNOWLEDGEMENT -----	v
LIST OF FIGURES -----	vii
 CHAPTER 1: INTRODUCTION	
1.1 Objective -----	1
1.2 Differences with Traditional Systems -----	1
1.3 Introduction to the Project -----	2
 CHAPTER 2: EQUIPMENT PROFILE	
2.1 Equipment List -----	3
2.1.1 Processing Unit -----	3
2.1.2 Outdoor Unit -----	5
2.1.3 Indoor Unit -----	5
2.2 Arduino IDE -----	7
 CHAPTER 3: IMPLEMENTATION	
3.1 Description -----	8
3.2 Exceptionality -----	9
3.3Connections -----	11
3.3.1 Outdoor Unit -----	11
3.3.2 Indoor Unit-----	11
3.4Arduino Code -----	12
 CHAPTER 4: CONCLUSION AND FUTURE WORK	
4.1 Conclusion -----	22
4.2 Future Possible Improvements -----	22
REFERENCES -----	24

LIST OF FIGURES

<u>Figure 1:</u> Figure of Arduino Mega 2560 -----	4
<u>Figure 2:</u> Figure of Keypad module -----	5
<u>Figure 3:</u> Figure of Servo SG90 -----	6
<u>Figure 4:</u> Figure of Indoor Switches and LEDs in Breadboard -----	7
<u>Figure 5:</u> Flowchart of “Microcontroller Based Efficient Door Lock System”-----	9
<u>Figure 6:</u> Figure of Keypad module and Arduino -----	11
<u>Figure 7:</u> Figure of Servo SG90 and Arduino -----	12
<u>Figure 8:</u> Figure of Indoor Switches and LEDs in Breadboard and Arduino-----	12

CHAPTER 1

INTRODUCTION

The technology is growing day by day. Now a day, we cannot even think a day without any technology. It is making our life easier. Everything is being automatic. Soon afterward, we will be in an automatic world. It is just the beginning of the wonderful miracles of science.

As the dependency on machines is rising, it has become very important to make the machine more intelligent and secure to prevent unwanted access to these. The security system kicks in and rescues the system from unauthorized abuse. As the systems are growing sharper, the necessity of more complex security system is increasing.

When you have something to keep secured from unwanted people or system, you have to impose some sort of security technologies. With the progress of technology, we now have so many types of security systems. Password security, Pattern security, Biometric security can be some examples.

More days are passing by and security systems are getting stronger and stronger. In an automatic system, strong security is a must. When an automatic system itself is used for security, the necessity is beyond mentioning

1.1 Objective

Objectives of making this system are:

- ✚ To make a semi-automatic locking and unlocking door
- ✚ To make the security system safer and efficient

1.2 Differences with Traditional Systems

This project represents a system that is way more flexible and secured than available ordinary security systems. It is also less costly in compare to its possible level of complexity. This system makes your security stronger and allows you to keep your password an unrevealed one. None except you will be able to get even close to the password with a guess if you raise the level of complexity.

1.3 Introduction to the Project

Chapter 1 contains the background and objective in a whole.

In chapter 2 the hardware part is described and the whole chapter narrates the overall architecture among the sections. They are Arduino, Keypad, Servo and Switches on the Breadboard. Under those, a better description is provided.

Chapter 3 is about the total implementation of the project. It represents the full system set up and full description of the algorithm uploaded in the devices involved in the system.

Chapter 4, the last one gives a summary on total system and achievement of the designed project. It also mentions some possible future work to make the system more refined and efficient.

CHAPTER 2

EQUIPMENT PROFILE

This chapter shows the hardware system of the project. The hardware system is divided into three different major parts to make the explanation easier. They are Processing Unit, Outdoor Unit and Indoor Unit.

2.1 Equipment List

Processing Unit- ArduinoMega 2560

Outdoor Unit- 4x4 Keypad

Indoor Unit- Processing Unit,Servo SG90, Ordinary Push Switch, LED, Resistor, Breadboard

Arduino IDE- The Arduino IDE

2.1.1 Processing Unit

TheArduino Mega 2560 is a microcontroller board based on the [ATmega2560](#). It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. The Mega 2560 board is compatible with most shields designed for the Uno and the former boards Duemilanove or Diecimila. The Mega 2560 is an update to the [Arduino Mega](#), which it replaces.

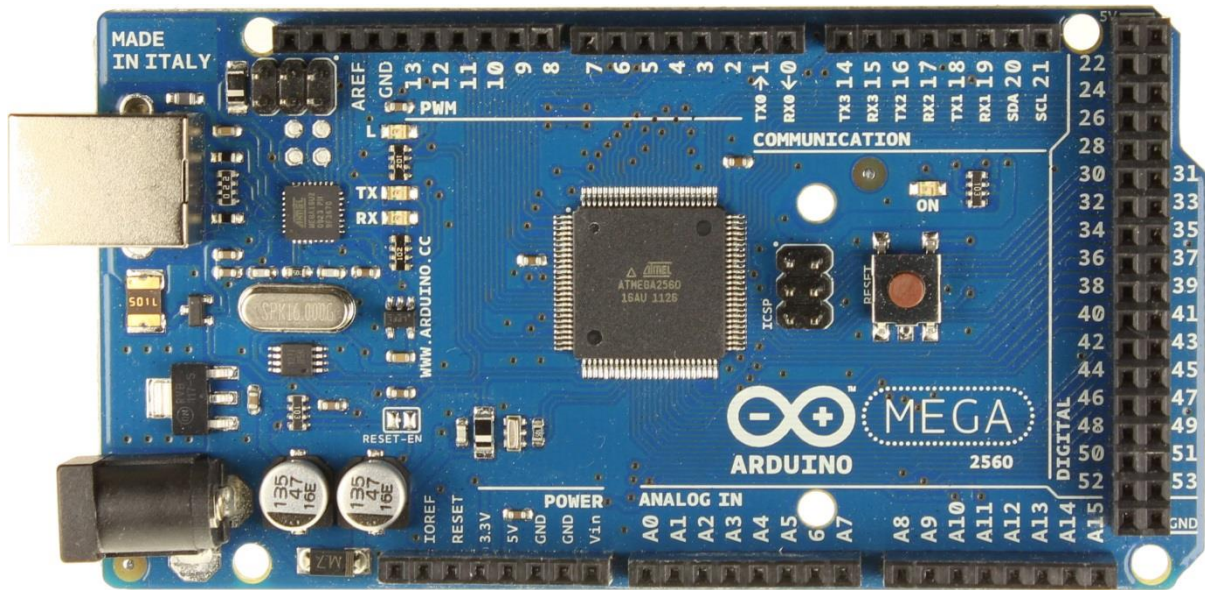


Figure 1: Figure of Arduino Mega 2560

Technical Specs:

Microcontroller	ATmega2560
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	54 (of which 15 provide PWM output)
Analog Input Pins	16
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	256 KB of which 8 KB used by bootloader
SRAM	8 KB
EEPROM	4 KB
Clock Speed	16 MHz

2.1.2 Outdoor Unit

4x4 Keypad:

This 16-button 4x4 keypad provides a useful human interface component for microcontroller projects. It also provides a simple way to mount the keypad in a variety of applications.

The buttons are: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, *, #, A, B, C, D

The 8 connection pins are: c1, c2, c3, c4, r1, r2, r3, r4



Figure 2: Figure of Keypad module

2.1.3 Indoor Unit

Processing Unit:

The brief description about the processing unit is already described above. Please refer to section 2.2.1.

Servo:

A servomotor is a [rotary actuator](#) or [linear actuator](#) that allows for precise control of angular or linear position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors. Servomotors are not a specific class of motor. It is often used in robotics or automated manufacturing.



Figure 3: Figure of Servo SG90

Technical Specs:

Operating Speed (4.8V no load)	0.12sec/60 degrees
Operating Voltage	4.2-6V
Stall Torque	22.2 oz/in (1.6 kg/cm)
Temperature Range	0°C_ 55°C
Dead Band Width	10us
Dimension	23x12.2x29mm
Weight	9g

Push Switch, LED, Resistor and Breadboard:

A push switch is a device that sends a signal to the destination. It remains on for a very short time, only while it is pushed in. it can be used for many purposes.

A light-emitting diode (LED) is a two-lead semiconductor light source. It is a p–n junction diode, which emits light when activated. When a suitable voltage is applied to the leads, electrons are able to recombine with electron holes within the device, releasing energy in the form of photons.

A breadboard is a construction base for prototyping of electronics. It enables us to manage several types of simple or complex connections, like series or parallel.

A resistor is a device that helps to reduce the flow of current through the circuit. The resistor is applied in a circuit in series connections.

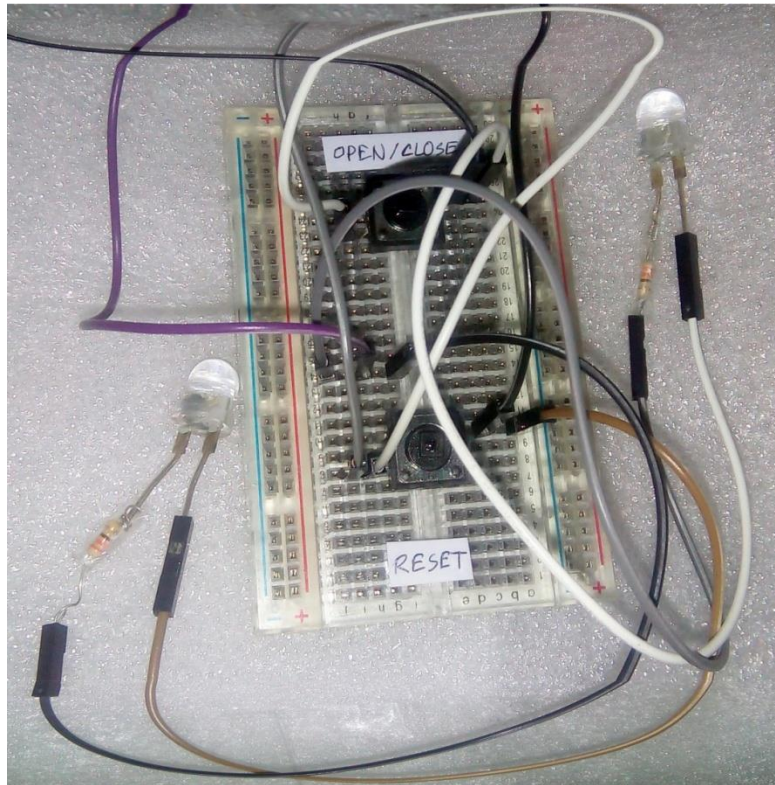


Figure 4: Figure of Indoor Switches and LEDs in Breadboard

2.2 Arduino IDE

All the logics and ideas were turned into an algorithm and it was converted to some codes in Arduino Platform. The logics are written in mostly 'C' because the syntaxes are little similar. But the codes for taking readings from parts and sending signals to them are different. As a language, Arduino also has some header files containing many libraries. 'Keypad' and 'Servo', these two libraries are used here. A few functions to operate the keypad and the servo are used from these libraries.

Chapter 3

IMPLEMENTATION

This is the most crucial part of this project. For the successful completion of this project, it is very important for the hardware devices to interact with each other and work in proper synchronization. The keypad is used as the interface for the incoming person here and the switches on the breadboard is used by the user inside the door. The arduino will process the whole thing and the servo will move the lever to lock or unlock the door.

3.1 Description

The “Microcontroller Based Efficient Door Lock System” is designed to enable a user to lock or unlock from inside or outside the door automatically with or without any help from the other side.

The keypad outside the gate will allow user to enter his/her password, which is fixed when the code is installed. The password is allowed to be from ‘0’ to ‘9’ and ‘B’, ‘C’ and ‘D’. Combination of any numbers and or letters from the range is allowed to be entered as a password. The ‘A’ button of the keypad is reserved to lock the door from the outside. The ‘*’ button is for resetting the password input to the system from the outside. And the ‘#’ is to check the given password string to the default password of the system. If the password matches, the door will be unlocked. But if it doesn’t match, it will remain in same state. After several numbers of wrong tries, the system will hold itself and it will take no more commands for some time. The time has to be fixed while installing the code.

The breadboard inside the door contains two push switches. Two LEDs are connected to the switches with two resistors of 330ohm attached, just to blink when the particular button is pressed. The first one is the Lock / Unlock switch. If it is pressed, the door lock will change its state. If it is locked, it will be unlocked and if it is unlocked, it will get locked. The second one is a reset switch to reset the whole system from the inside. If this button is pressed, the lock lever is moved to lock position regardless its current position and the system will hold itself from taking commands for some time. This time also has to be fixed while installing.

password in various ways. The password can be long and complex with the help of extra 3 alphabets. Or can it also be made complex while entering password it in the system by pressing the buttons on the keypad?

A complex password is just the matter of setting it up a complex combination of numbers and letters that is difficult to guess. It can be set in any existing system also with same level of complexity with same number of available keys. But what if, user wants the complexity to be variable? More like, very complex when security is required and very simple when simplicity is needed. In that critical moment, “Microcontroller Based Efficient Door Lock System” comes to the rescue.

This system has a unique password entry procedure that allows the user to enter any number of random digits or letters before and after the default password and a minimum number of random inputs must exist after the default password. When the user wants to make it complex, he/she can enter a lot of random inputs to make it look very complex. Maximum numbers to input can be declared while setting up the system. Here, the number is set to 1000, which means, the user can enter up to 1000 password inputs where the default password is same small one of may be 4 or 5 digits.

A few examples of the acceptable types of password entries are given bellow.

Let, the Default Password is _ ‘ 1 3 5 7 B ’ and Number of Random Input is _ 2 ,

The acceptable passwords may be,

‘ 45216BC32546486415468684 1357B 67 654324431 ’

‘ 25412 1357B 7D 3556BD ’

‘ 1357B C5 ’

‘ 1357B 12 55487631 ’

‘ 2454212461 1357B CD ’

(Note: The spaces among numbers are to distinguish the strings. They are to be ignored. Any other pattern of combination will be considered not a match.)

3.3 Connections

There are two keypads to be used as interface, one servo for executing the commands and one microcontroller for controlling all other devices. The connection diagrams are mentioned bellow.

3.3.1 Outdoor Unit

The Outdoor Unit contains only the Keypad which has 4 row pins and 4 column pins or total 8 pins. All these pins are connected to the pins of Arduino. Connected pins are numbered as,

C1-53, C2-52, C3-51, C4-50, R1-49, R2-48, R3-47, R4-46

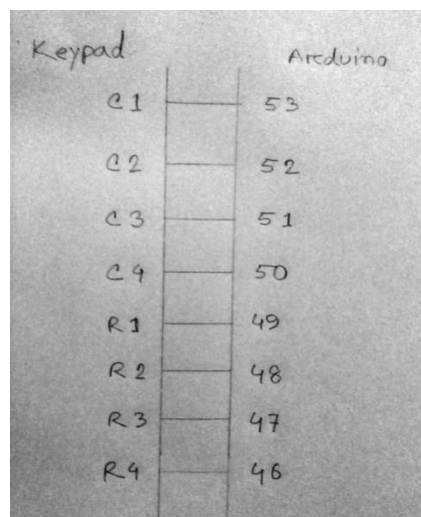


Figure 6: Figure of Keypad module and Arduino

3.3.2 Indoor Unit

Inside the door, there is a servo moving the locking lever. That has three wires coming out of that. They are Red, Brown and Orange. These three are connected to the arduino as the following diagram.

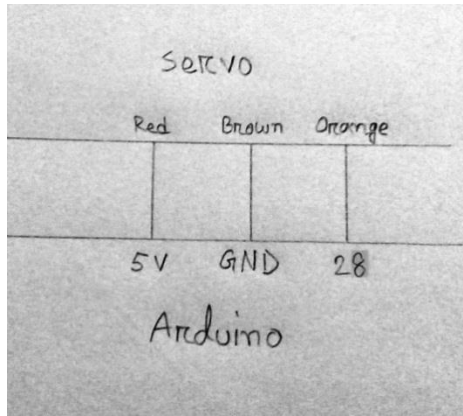


Figure 7: Figure of Servo SG90 and Arduino

There is also a breadboard inside the door that contains two switches and LEDs. They are connected to the Arduino as well. The following diagram shows the connections.

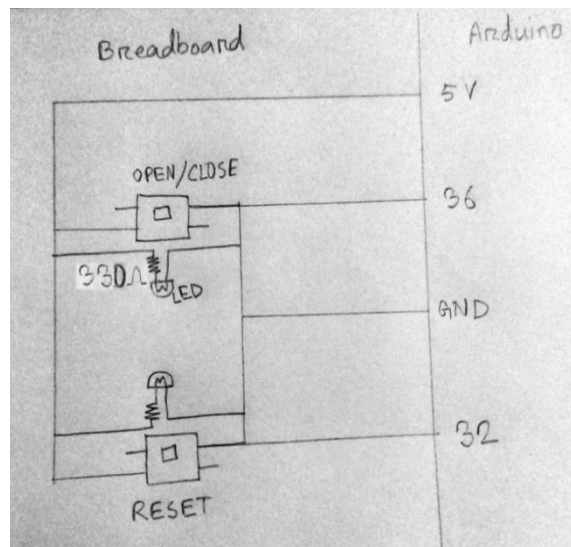


Figure 8: Figure of Indoor Switches and LEDs in Breadboard and Arduino

The Arduino board will be connected with a standard USB 2.0 cable with the power source (PC). Or a 5V adapter can also be used for the power supply. Then from Arduino, all the other devices will be powered with the pins those connect them.

3.4 Arduino Code

```
#include <Keypad.h>
```

```
#include <Servo.h>
```

```

//      Current Password is ____ 5 6 8 B C ____
/*
Introducing the keypad to the system.
*/

const byte ROWS = 4;
const byte COLS = 4; // a rows and 4 columns
char hexaKeys[ROWS][COLS] =
{
  {'1', '2', '3', 'A'},
  {'4', '5', '6', 'B'},
  {'7', '8', '9', 'C'},
  {'*', '0', '#', 'D'}
};

byte rowPins[ROWS] = {49, 48, 47, 46};
byte colPins[COLS] = {53, 52, 51, 50};

//connect to the row and column pinouts of the keypad respectively

//initialize an instance of class NewKeypad

Keypad nasirKeypad = Keypad(makeKeymap(hexaKeys), rowPins, colPins, ROWS,
COLS);

//initialize the servo

Servo nasirServo;

/*
All the variables declared globally.
*/

char inputS[1000];
int inputIndx = 0;
int ServoPos = 0;

```

```

int But_On_Off = 36;

int But_Reset = 32;

int passLen = 5;

int randNum = 1;

// Required number of random inputs after entering the password
// that is (randNum + 1) or '2'.

Int trialErr = 0;

bool locked = false;

int ok = 0;

/*
Initialize the whole system
*/

void setup() {
Serial.begin(19200);
Serial.println("Initializing System.. ..");
nasirServo.attach(28);
pinMode(But_On_Off, INPUT);
pinMode(But_Reset, INPUT);
}

/*
Initialize the infinite loop that runs the whole system.
*/

void loop() {
input();
}

/*

```

This is where we take input from the user and send for further processing.

```
*/  
void input()  
{  
while (1) {  
charcustomKey = nasirKeypad.getKey();  
/*  
Checking the buttons in the inside the door.  
*/  
if ( digitalRead(But_On_Off) == HIGH )  
    {  
Serial.println("On/off");  
Serial.println("Inside");  
delay(1500);  
if (locked == true)  
    {  
ServoSwap(1);  
locked = false;  
    }  
else  
    {  
ServoSwap(2);  
locked = true;  
    }  
    }  
else if ( digitalRead(But_Reset) == HIGH )
```

```

    {
Serial.println("Resetting . . . ");
Serial.println("Inside");
inputIndx = 0;
trialErr = 0;
if (locked == false)
    {
ServoSwap(2);
locked = true;
    }
delay(5000);
    }
else
    {
delay(1);
    }
/*
Checking the keypad in the outside of the door.
*/
if (customKey == '*')
    {
Serial.println("Resetting . . . ");
Serial.println("Outside");
inputIndx = 0;
return;
    }

```

```
else if (customKey == '#')
    {
    Serial.println(customKey);
    checkPassword();
    return;
    }
else if (customKey == 'A')
    {
    inputIndx = 0;
    if (locked == false)
        {
        ServoSwap(2);
        locked = true;
        Serial.println("Outside");
        }
    return;
    }
else if (customKey)
    {
    Serial.println(customKey);
    inputS[inputIndx++] = customKey;
    delay(100);
    }
else
    {
    delay(1);
    }
```



```

    }
}
}
/*
This is the code where we check the given password by the user.
*/
voidcheckPassword()
{
if (inputIndx - randNum<passLen)
    {
Serial.println("Password not Matched");
inputIndx = 0;
trialErr = trialErr + 1;
if (trialErr>= 5)
    {
Serial.println("5 trial errors. Holding system for a while....");
trialErr = 0;
delay(10000);
    }
return ;
    }
else if (inputIndx - randNum - 1 >= passLen)
    {
for (int i = 0; i <inputIndx -randNum -passLen; i++)
    {
// the password is checked right here.

```

```

if (inputS[i] == '5' &&inputS[i + 1] == '6' &&inputS[i + 2] == '8'
    &&inputS[i + 3] == 'B' &&inputS[i + 4] == 'C' )
    {
ok = 1;
    }
}
if (ok == 1)
    {
Serial.println("Password Matched");
trialErr = 0;
ok = 0;
if (locked == true)
    {
ServoSwap(1);
locked = false;
    }
inputIndx = 0;
delay(1000);
    }
else
    {
Serial.println("Password not Matched");
inputIndx = 0;
trialErr = trialErr + 1;
if (trialErr>= 5)
    {

```

```

Serial.println("5 trial errors. Holding system for a while....");
trialErr = 0;
delay(10000);
    }
return ;
    }
}
else
    {
Serial.println("Password not Matched");
inputIndx = 0;
trialErr = trialErr + 1;
if (trialErr>= 5)
    {
Serial.println("5 trial errors. Holding system for a while....");
trialErr = 0;
delay(10000);
    }
return ;
    }
}
/*
This is where we swap the servo between open or close.
*/
voidServoSwap(int decide)
{

```

```
if (decide == 1)
{
Serial.println("Opening . . . ");
for (ServoPos = 30; ServoPos<= 90; ServoPos += 1)
{
nasirServo.write(ServoPos);
delay(10);
}
}
else
{
Serial.println("Closing . . . ");
for (ServoPos = 90; ServoPos>= 30; ServoPos -= 1)
{
nasirServo.write(ServoPos);
delay(10);
}
}
}
```

Chapter 4

Conclusion and Future Work

The world is evolving and so is the demand of safety for our data and other important things we have. “Microcontroller Based Efficient Door Lock System” can be a way to think about making our valuable things more secure in the future. This system has a unique level of security complexity that makes it stand out of the ordinary systems.

4.1 Conclusion

The project presented a work to realize the smart living. Life can be easier and safer with the help of technology. As we are going forward with time, we must accept the necessity of ease and safety.

The system that has been developed in the project, users can lock and unlock their doors using passwords. Here a password can be set or entered using keypad with a variety of combinations of digits and letters. As a lot of password combinations can be made, the system makes the security scheme more efficient and safer. Still, as a prototype, “Microcontroller Based Efficient Door Lock System” may need to be worked out more, but it can possibly compete with its efficiency with any existing security system in the world.

4.2 Future Possible Improvements

“Microcontroller Based Efficient Door Lock System” is still a prototype. It needs further improvements in its hardware section. All the parts used here are built to serve multiple purposes. If we want to make the system work industrially, we have to make purpose built parts.

Possible improvements may be microcontroller board specially designed for checking the password only, a servo of less power and cost to do the simple job, a small 2-3 button keypad for the indoor unit, etc. These changes will make it a complete system and will make it more efficient, cost effective and safe. A 5V battery can be used as the power supply and it will have to be charging from a wall socket. Then the power failure problem will be solved.

The application of the algorithm can be of several purposes. With proper hardware, we can implement password on almost anything and the password will be as strong as unbreakable. Such as, a relay can be added to be controlled as an electric switch on any electrical circuit. Even a room light or fan can be password protected.

References

1. www.arduino.cc/en/Main/ArduinoBoardMega2560 [Last access: 2-8-2015]
2. www.playground.arduino.cc/Main/KeypadTutorial [Last access: 2-8-2015]
3. www.arduino.cc/en/reference/servo [Last access: 2-8-2015]
4. www.techshopbd.com/product-categories/modules-98775/1849/4x4-keypad-matrix-red-button-techshop-bangladesh [Last access: 23-7-2015]
5. www.techshopbd.com/product-categories/switch/833/push-switch-4pin-techshop-bangladesh [Last access: 23-7-2015]
6. www.techshopbd.com/product-categories/motors/659/servo-motor-techshop-bangladesh [Last access: 23-7-2015]
7. www.arduino.cc/en/Main/Software [Last access: 2-6-2015]
8. www.gliffy.com/go/html5/launch?app=1b5094b0-6042-11e2-bcfd-0800200c9a66&templateId=4212046 [Last access: 29-12-2015]