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SCHOOL OF ENGINEERING

Bachelor of Technology
in
COMPUTER SCIENCE AND ENGINEERING (ARTIFICIAL INTELLIGENCE & MACHINE LEARNING)

COMPUTER ORGANIZATION AND ARCHITECTURE PROJECT REPORT ON

DIGITAL DOOR LOCK USING ARDUINO

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CERTIFICATE

This is to certify that Computer Organization and Architecture (22AM2405) Project titled **"DIGITAL DOOR LOCK USING ARDUINO"** is carried out by **Kasala Bhavana (ENG22AM0153), Lakshya U Reddy (ENG22AM0169), Nishat N Shahu (ENG22AM0184), Tanya Gopal (ENG22AM0193),** bonafide students Fourth semester of Bachelor of Technology in Computer Science and Engineering (Artificial Intelligence & Machine Learning) at the School of Engineering, Dayananda Sagar University.

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Dayananda Sagar University	Dayananda Sagar University	Dayananda Sagar University	Dayananda Sagar University
Date: 03/6/2024	Date: 03/6/2024	Date:	Date:

DECLARATION

We **Kasala Bhavana (ENG22AM0153), Lakshya U Reddy (ENG22AM0169), Nishat N Shahu (ENG22AM0184), Tanya Gopal (ENG22AM0193),** are students of fourth semester B. Tech in **Computer Science and Engineering (Artificial Intelligence & Machine Learning)**, at School of Engineering, **Dayananda Sagar University**, hereby declare that the Computer Organization and Architecture Project titled **"DIGITAL DOOR LOCK USING ARDUINO"** has been carried out by us and submitted in partial fulfilment for the award of degree in **Bachelor of Technology in Computer Science and Engineering (Artificial Intelligence & Machine Learning)** during the academic year **2023-2024.**

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LCD	Liquid Crystal Display
PIN	Personal Identification Number

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ABSTRACT

In today's digital age, the rapid growth in technology makes the world a global village and has gone a long way in protecting lives and properties. Nevertheless, this growth in technology has brought much development as well as an increasing rate of crime, attacks by thieves, vandals and intruders. This therefore calls for the need of improving the modern security systems in homes, offices and other buildings for the protection of lives and properties.

This project focuses on developing a microcontroller based digital door lock security system using keypad which will provide complete security solution to lives and properties at homes, schools and offices. The security system contains a 4X4 keypad input unit for entering the Personal Identification Number (PIN) and a display unit in form of Liquid Crystal Display (LCD) for visual display of information. It also contains a servo motor that serves as a switching for locking and unlocking the door and a programmed microcontroller that processes the input information and take appropriate action. When a user enters a PIN into the security system installed at any entrance, the system captures the PIN and compares it with the stored PINs for a match. If the captured PIN matches with any of the stored PINs, access granted is displayed on the LCD and the door opens; otherwise, access denied is displayed on the LCD and the door remains closed.

Keywords— Security, Servo, PIN, Keypad, Access, Microcontroller, LCD

CHAPTER 1 INTRODUCTION

Every living being wishes to be safe whether it is a safety related to his belongings or safety of his own precious life. We have been taking several measures in order to attain it to live a worry-free life. In this project we propose a smart locking system which is designed to work based on the Internet of Things to prevent unauthorized access and trespassing. Normally the common targets where unauthorized access takes place are homes, Banks, Financial organization, Government offices and organization, and shops. Such activities are performed with an intention of stealing money, or any important documents for personal gain. The main aim of our project is to provide a useful and a feasible solution to many of such issues.

People used to lock doors with physical keys, and they required the key to unlock doors. If they lost the key, it was unlikely to repair, and it was expensive. Now, those door lock systems may be replaced with new locking technologies.

The Arduino, Servo motor, 4*4 keypad module, and jumper wires comprise the password-based door lock system. In this project, we will use the keypad to enter a password and then use the servo motor to open the door lock. The Arduino is the program's brain, controlling the entire system. The password or pin code is entered using the 4*4 keypad module. The servo motor pushes (locks) or pulls (unlocks) the door's latch.

1.1 SOCIAL IMPACT

Enhanced Security: By implementing such a system, homes, schools, and offices can enhance their security measures. This could potentially reduce the risk of unauthorized access, break-ins, and theft, thus contributing to a safer environment for residents, students, and employees.

• Peace of Mind: Knowing that their property is protected by a reliable security system can provide individuals with peace of mind. This is particularly important for families with young children or elderly members who may be vulnerable to security threats.

• Convenience and Accessibility: Digital door lock systems offer convenience by eliminating the need for physical keys. This can be especially beneficial for individuals with mobility issues

or disabilities who may find it difficult to manipulate traditional locks. It also eliminates the risk of lost keys and the need for costly rekeying.

• Deterrent to Crime: Visible security measures such as digital door locks can act as a deterrent to potential criminals. Knowing that a property is equipped with a sophisticated security system may discourage unauthorized individuals from attempting to break in.

Chapter 2 PROBLEM DEFINITION

Traditional mechanical door locks are susceptible to various security risks such as unauthorized duplication of keys and brute force attacks. The project seeks to design and implement a digital door lock security system utilizing microcontroller technology, keypad input, and servo motor control. The system will provide secure access control for homes, schools, and offices by allowing authorized users to enter a Personal Identification Number (PIN) via a keypad interface.

Chapter 3 LITERATURE REVIEW

N.H. Ismail et al [1] prototyped an Android-based home door locks application using Bluetooth technology. The system consists of Android App, Bluetooth model, Arduino microcontroller, and an electromagnetic (EM) lock. The author designed an Android Apps called Lock It to allow the user to lock and unlock the door. Once wireless communication between Smartphone Bluetooth and Bluetooth module is established through a pairing process, user's key selections are sent as radio frequency (RF) signal to the main controller board installed at the door. Arduino Uno microcontroller is used to interpret key selections and determines whether to release electromagnetic (EM) lock or not.

Author Subhankar et al [2] in his paper represents a finger print recognition biometrics system based on real time embedded system which will provides a complete security solution lives and properties. Fingerprint recognition is carried out by a biometric fingerprint scanner that is connected to Arduino microcontroller that validates the authentication. The system stores the finger print of authorized users and access is granted to only users whose fingerprints are stored in the system while access is denied to others not stored in the system. If the user's fingerprint has a positive match, the door will open otherwise the GSM module gets triggered and the system admin gets a SMS and the buzzer connected will be initiated to alert the security personnel.

The developed system was able to successfully lock and unlock door wirelessly which can help disabled people to lock and lock the door wirelessly using Android Smartphone. A small inconvenience of this new technology is that you have to launch the app every time. It's not as simple as having your phone on your body and merely walking by the card reader [3].

The system proves to be secure and accurate method of door access control system, granting access to users whose fingerprint matched to the one stored in the system. However, the system uses lots of components embedded in it making it very expensive compared to such systems in the market [4].

Chapter 4 PROJECT DESCRIPTION

4.1 PROPOSED DESIGN

This project aims to develop a Digital Door Lock using Arduino. The digital door lock system is made up of two important subsystems, which are the hardware subsystem and the software subsystem. The software subsystem is written in C programming languages using Arduino IDE and uploaded to the microcontroller, which commands the functioning of the hardware subsystem. The hardware subsystem contains microcontroller, which helps to incorporate the information from the code to the various hardware parts of the digital door lock. In this project, the Arduino Uno microcontroller and the 4x4 matrix keypad are the two main hardware components used.

System Block Diagram

Figure 1 depicts our digital door lock security system block diagram; it contains a 4X4 keypad, power supply, Arduino Microcontroller, a servo, and an LCD.

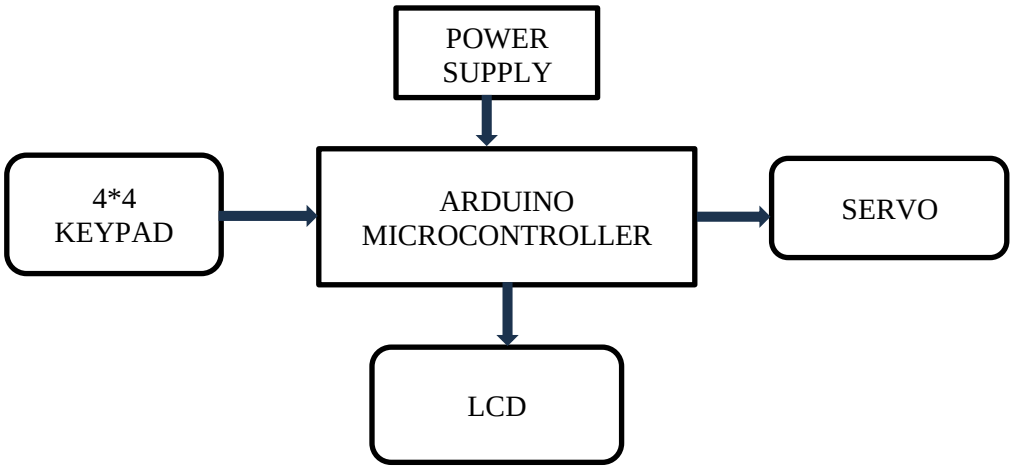

Figure 4.1: System Block Diagram

Table 4.1: Hardware Components Description

ITEM	**MODE**	**DESCRIPTION**
Power Supply	Input	Supplies 5V to Arduino Microcontroller which powers all other models
4X4 Keypad	Input	It helps in inputting PIN in the system
Servo	Output	Unlock the door or remain locked depending on the PIN entered
LCD	Output	Displays the state of the system and PIN entered.

CHAPTER 5 REQUIREMENTS

5.1 HARDWARE REQUIREMENTS

- Arduino board: A microcontroller development board designed for prototyping and creating electronic projects with ease.

Figure 5.1: Arduino Board

- Keypad: A 4x4 matrix keypad for PIN input.

Figure 5.2: Keypad

- LCD Display: A 16x2 character LCD for displaying system status and messages.

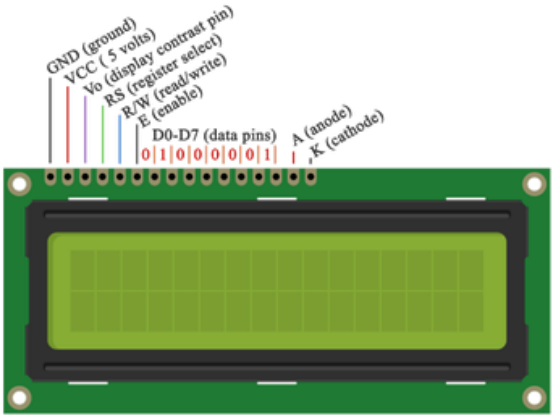

Figure 5.3: LCD Display

- Servo Motor: A servo motor capable of smoothly controlling the door lock mechanism.

Figure 5.4: Servo Motor

- Power Supply: A stable power source, either through battery power or a regulated power supply.

5.2 SOFTWARE/SYSTEM REQUIREMENTS

- Firmware Development: Firmware will be developed using Arduino IDE or a similar environment.
- User Interface: A user-friendly interface will be designed for entering PINs via the keypad and displaying feedback on the LCD.
- Authentication Algorithm: Algorithms will be implemented to compare entered PINs with stored values and control the servo motor based on authentication results.
- Security Features: Measures will be incorporated to prevent unauthorized access, including limiting PIN attempts and protecting stored PIN data.

5.3 CIRCUIT DIAGRAM

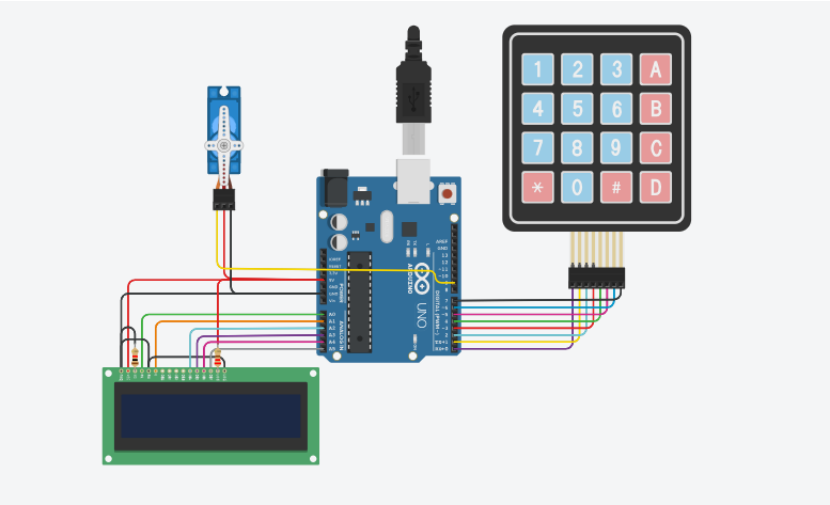

Figure 5.5: Circuit Diagram

Circuit Connections:

•Servo Motor:

- Connect the signal (control) wire of the servo motor to pin 9 of the Arduino board.
- Connect the power (VCC) wire of the servo motor to the 5V pin on the Arduino.
- Connect the ground (GND) wire of the servo motor to any ground (GND) pin on the Arduino.

• **Keypad**:

- Connect the row pins of the keypad to pins 0, 1, 2, and 3 on the Arduino.
- Connect the column pins of the keypad to pins 4, 5, 6, and 7 on the Arduino.

• **LCD Display**:

- Connect the VSS (ground) pin of the LCD display to any ground (GND) pin on the Arduino.
- Connect the VDD (power) pin of the LCD display to the 5V pin on the Arduino.
- Connect the V0 (contrast) pin of the LCD display to a variable resistor (potentiometer), with one end connected to the 5V pin and the other end connected to ground. The center pin of the potentiometer should connect to the V0 pin.
- Connect the RS (register select) pin of the LCD display to analog pin A0 on the Arduino.
- Connect the R/W (read/write) pin of the LCD display to analog pin A1 on the Arduino.
- Connect the E (enable) pin of the LCD display to analog pin A2 on the Arduino.
- Connect the D4, D5, D6, and D7 pins of the LCD display to analog pins A3, A4, A5, and A6, respectively, on the Arduino.

CHAPTER 6 METHODOLOGY

FLOW CHART:

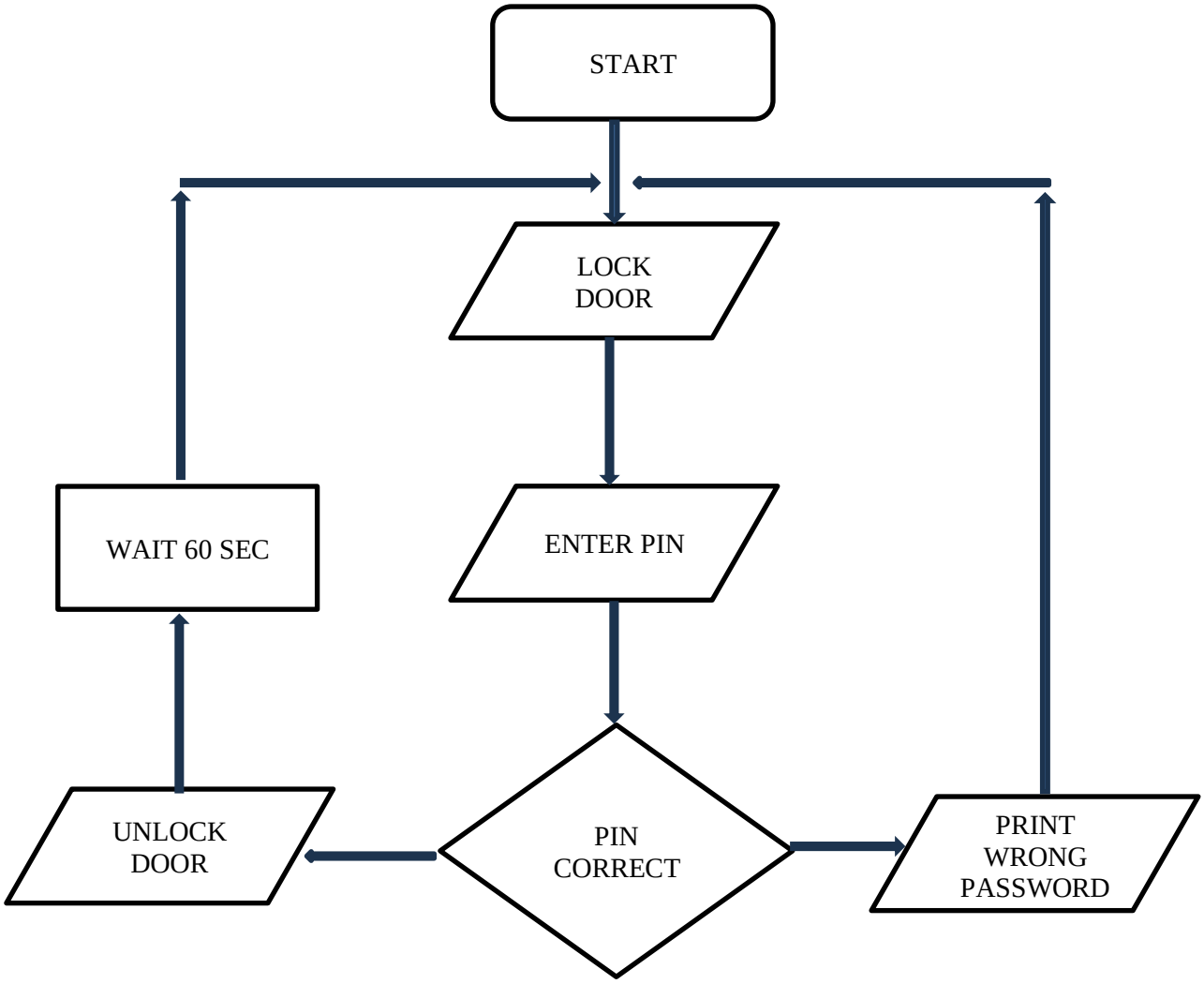

Figure 6.1: FLOW CHART

PSEUDO CODE:

1. Initialize components and constants:
   - Define Password_Length as 5
   - Include Servo, LiquidCrystal, and Keypad libraries
   - Create Servo, LCD, and Keypad objects
   - Initialize variables: pos, Data array, Master password, data_count, door status, customKey

2. Setup function:
   - Attach servo to pin 9 and set initial position to closed
   - Initialize LCD with 16x2 dimensions
   - Display "Protected Door" on LCD
   - Call loading("Loading") function
   - Clear LCD

3. Main loop function:
   - If door is open:
     - Get key input
     - If key is '#':
       - Close the servo
       - Display "Door is closed" on LCD for 3 seconds
       - Set door status to false
   - If door is closed:
     - Call Open() function

4. Loading function:
   - Display loading message with dots incrementing every second

5. ClearData function:
   - Reset Data array and data_count

6. ServoClose function:
   - Gradually close the servo from 90 to 0 degrees

7. ServoOpen function:

- Gradually open the servo from 0 to 90 degrees

8. Open function:
   - Prompt user to enter password on LCD
   - Capture key input and store in Data array
   - If Data array is filled:
     - Check if input matches Master password
     - If correct:
       - Open servo
       - Display "Door is Open" on LCD for 5 seconds
       - Call loading("Waiting") function
       - Display "Time up!closing" on LCD for 1 second
       - Close servo
     - If incorrect:
       - Display "Wrong Password" on LCD
     - Clear Data array and reset data_count

CHAPTER 7 RESULT

In figure 7.1, the user enters four digits PIN through the 4X4 keypad module; the entered PIN will be displayed on LCD. Once the user enters the full password, the system compares it with the predefined master password. If they match, the door servo motor opens the door, and a success message is displayed on the LCD. After a certain period (5 seconds in this code), the system waits before closing the door automatically. If the entered password does not match the master password, an error message is displayed on the LCD, indicating that the password is incorrect.

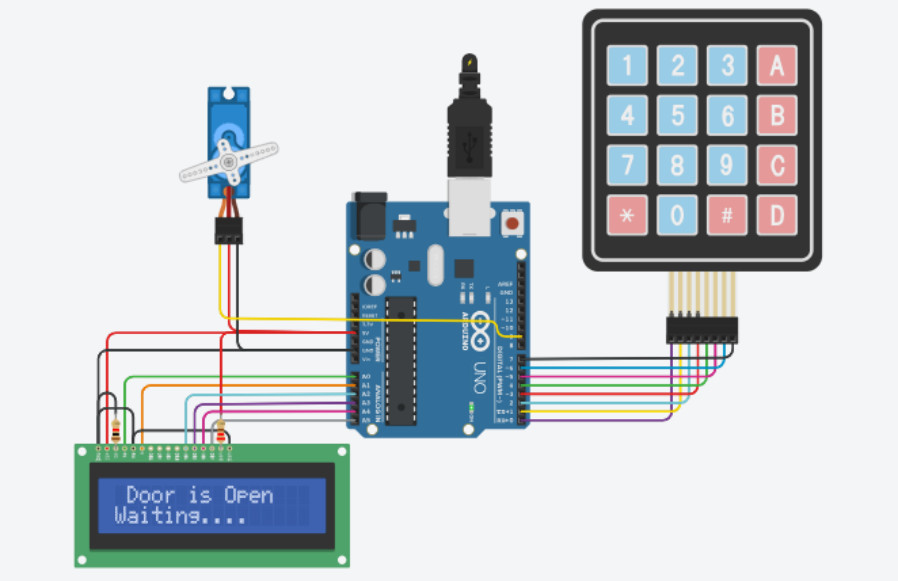

Figure 7.1: Output

Table 7.1: System Test Results

TEST	PIN	NO. OF TRAILS	SUCCESS	FAILED
1	9743	3	3	0
2	6115	1	1	0
3	1234	2	2	0
4	3290	3	3	0

The system success rate (SR) and failure rate (FR) is calculated using equation (1) and (2) respectively to determine how much success and failure our system recorded against registered and non-registered users.

$SR = SAvg\ STAvg \times 100$ (1)

Where: $SAvg$ and $STAvg$ is system successful average and system successful trial average respectively for registered users. It has 100% successful access once current PIN is entered.

$FR = FAvg\ FTAvg \times 100$ (2)

Where: $FAvg$ and $FTAvg$ is system failure average and system failure trial average respectively for non-registered users. Access will be 100% denied once unregistered PIN is entered.

CONCLUSION

In conclusion our project, digital door lock using keypad is effective in providing security to lives and properties as long as the PIN is not shared with unauthorized person. The system is cheap, affordable, small and relatively easy enough to install with just a couple of steps.

Furthermore, our project aims to enhance security by providing robust security measures, including PIN-based authentication, data encryption, and tamper detection, to prevent unauthorized access and safeguard premises and property. Its user-friendly interface, customization options, and reliability underscore its effectiveness in meeting user needs and expectations

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APPENDIX

Source Code:

```
#include <Keypad.h>
#include <LiquidCrystal.h>
#include <Servo.h>
#define Password_Length 5
Servo myservo;
LiquidCrystal lcd(A0, A1, A2, A3, A4, A5);
int pos = 0;
char Data[Password_Length];
char Master[Password_Length] = "9743";
byte data_count = 0, master_count = 0;
bool Pass_is_good;
bool door = false;
char customKey;
const byte ROWS = 4;
const byte COLS = 4;
char keys[ROWS][COLS] = {
  {'1', '2', '3', 'A'},
  {'4', '5', '6', 'B'},
  {'7', '8', '9', 'C'},
  {'*', '0', '#', 'D'}
};
```

```
byte rowPins[ROWS] = {0, 1, 2, 3};
byte colPins[COLS] = {4, 5, 6, 7};
Keypad customKeypad( makeKeymap(keys), rowPins, colPins, ROWS, COLS);
void setup()
{
  myservo.attach(9, 2000, 2400);
  ServoClose();
  lcd.begin(16, 2);
  lcd.print("Protected Door");
  loading("Loading");
  lcd.clear();
}
void loop()
{
  if (door == true)
  {
    customKey = customKeypad.getKey();
    if (customKey == '#')
    {
      lcd.clear();
      ServoClose();
      lcd.print("Door is closed");
      delay(3000);
```

```
      door = false;
    }
  }
  else
    Open();
}
 void loading (char msg[]) {
  lcd.setCursor(0, 1);
  lcd.print(msg);

  for (int i = 0; i < 9; i++) {
    delay(1000);
    lcd.print(".");
  }
}
 void clearData()
{
  while (data_count != 0)
  {
    Data[data_count--] = 0;
  }
  return;
}
```

```
void ServoClose()
{
  for (pos = 90; pos >= 0; pos -= 10) {
    myservo.write(pos);
  }
}
void ServoOpen()
{
  for (pos = 0; pos <= 90; pos += 10) {
    myservo.write(pos);
  }
}
void Open()
{
  lcd.setCursor(0, 0);
  lcd.print("Enter Password");
  customKey = customKeypad.getKey();
  if (customKey)
  {
    Data[data_count] = customKey;
    lcd.setCursor(data_count, 1);
    lcd.print(Data[data_count]);
    data_count++;
  }
```

```
if (data_count == Password_Length - 1)
    { if (!strcmp(Data, Master))
      { lcd.clear();
        ServoOpen();
        lcd.print(" Door is Open ");
        door = true;
        delay(5000);
        loading("Waiting");
        lcd.clear();
        lcd.print(" Time up!closing ");
        delay(1000);
        ServoClose();
        door = false;  }
      else
      {lcd.clear();
        lcd.print(" Wrong Password ");
        door = false;   }
      delay(1000);
     lcd.clear();
      clearData();
    }
}
```