HOME AUTOMATION SYSTEM

by

NAGHARJUN M	18BLC1129
AADIL ABDUL GHANI	18BLC1151
SANJAY THOLANI	18BLC1090
ADIT C JAIN	17BLC1047

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Dr.V.PRAKASH

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Vandalur – Kelambakkam Road

Chennai – 600127

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BONAFIDE CERTIFICATE

Certified that this project report entitled "**HOME AUTOMATION SYSTEM"** is a bonafide work of **NAGHARJUN M-18BLC1129, AADIL ABDUL GHANI-18BLC1151, SANJAY THOLANI-18BLC1090 and ADIT C JAIN-17BLC1047 who** carried out the Project work under my supervision and guidance for **ECE4003 – Embedded Systems Design**

Dr.V.PRAKASH

Assistant Professor

School of Electronics Engineering (SENSE),

VIT University, Chennai

Chennai – 600 127.

ABSTRACT

In this project, a control mechanism is developed to optimize the power consumption in household devices. The need for energy efficient devices and declining resources for energy production has put in a state to look for new opportunities to efficiently manage and deliver optimize power. The control mechanism which has been developed is largely used at industry level helping them to optimize power. These control mechanisms are not at basic consumer level where the user is very large. This project shows the method to make every home appliances such as like lights, air conditioners, fans, washing machines to work through the android application in our smart phone. This method certainly can serve a huge potential application to the handicapped and the bedridden patients who can control appliances staying where they are and it can reduces the overall tediousness of them as well.

ACKNOWLEDGEMENT

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We thank our parents, family, and friends for bearing with us throughout the course of our project and for the opportunity they provided us in undergoing this course in such a prestigious institution.

Nagharjun M **AADIL ABDUL GHANI**

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SANJAY THOLANI **ADIT C JAIN**

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1. INTRODUCTION

1.1 OBJECTIVES AND GOALS

- To develop a home automation system where a keypad is connected to the door, if anyone comes near the door(micro-servo) within the range of 40cm, then keypad will take input and if the password entered is correct, the door will open and the door will remain open for 2 seconds.
- Then it will check again if anyone is still within 40cm, if yes, then the door will remain open for 2 more seconds and if no, then the door will be closed automatically.
- Once entered the room, if the room detects any sort of movement, the light (LED) will automatically be lighting(turn on).
- If there is no movement in the room, then the light will remain off. Further it will detect the room temperature and if that is greater than 20 (in degree Celsius) then a fan(motor) will be running, otherwise, the fan will remain stopped.

1.2 APPLICATIONS

- Home application
- Office application
- Personal Space application
- Private Application
- Security Application
- Automation Application

1.3 FEATURES

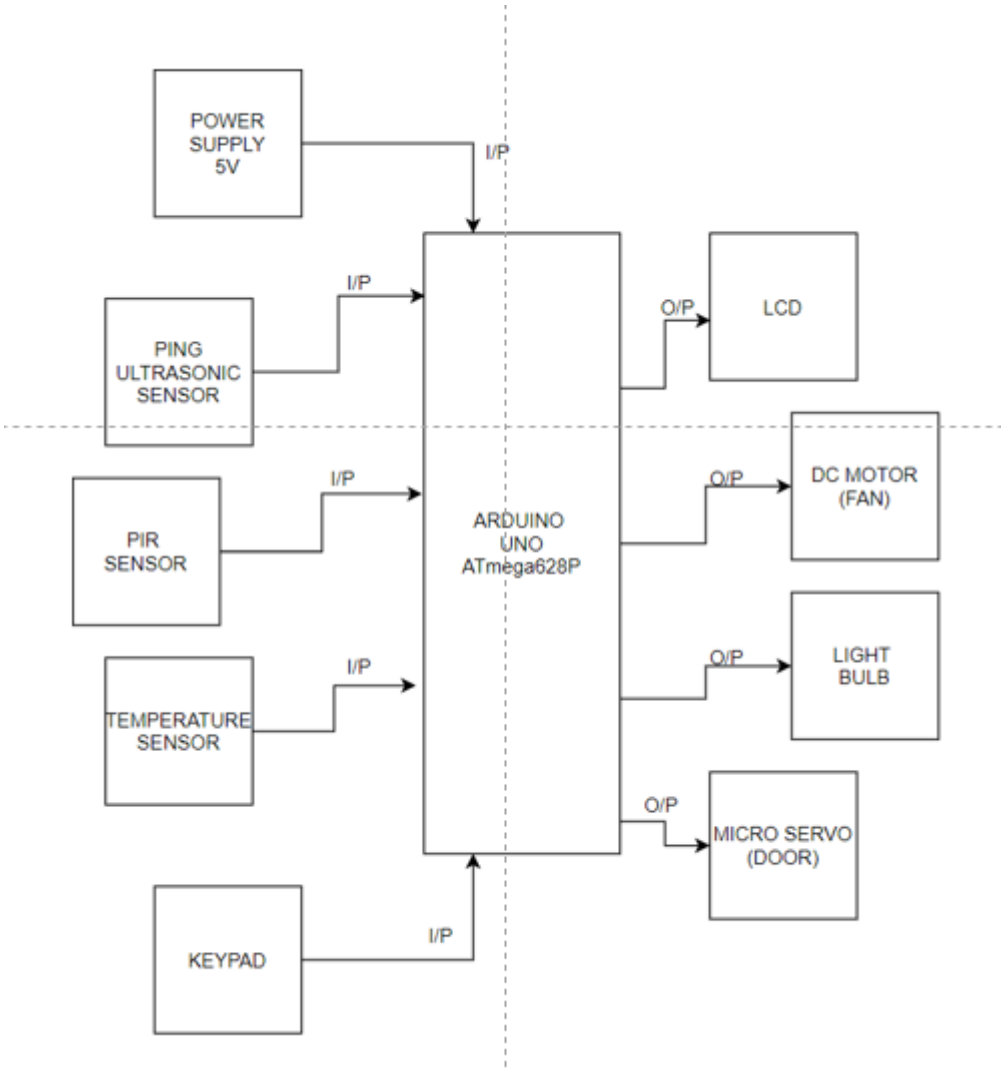
This home automation system has the following features:

- With the help of Keypad(connected to door) it takes the password input from user
- With the help of Ultrasonic sensor it checks if any person is in range of 40cm
- With the help of Micro-Servo which acts as a Door and opens when the person is within the range of 40cm.
- With the help of PIR sensor lighting(led) will be turned on

- With the help of temperature sensor the motor which acts as a fan will be turned on if temperature is more than 20°C.

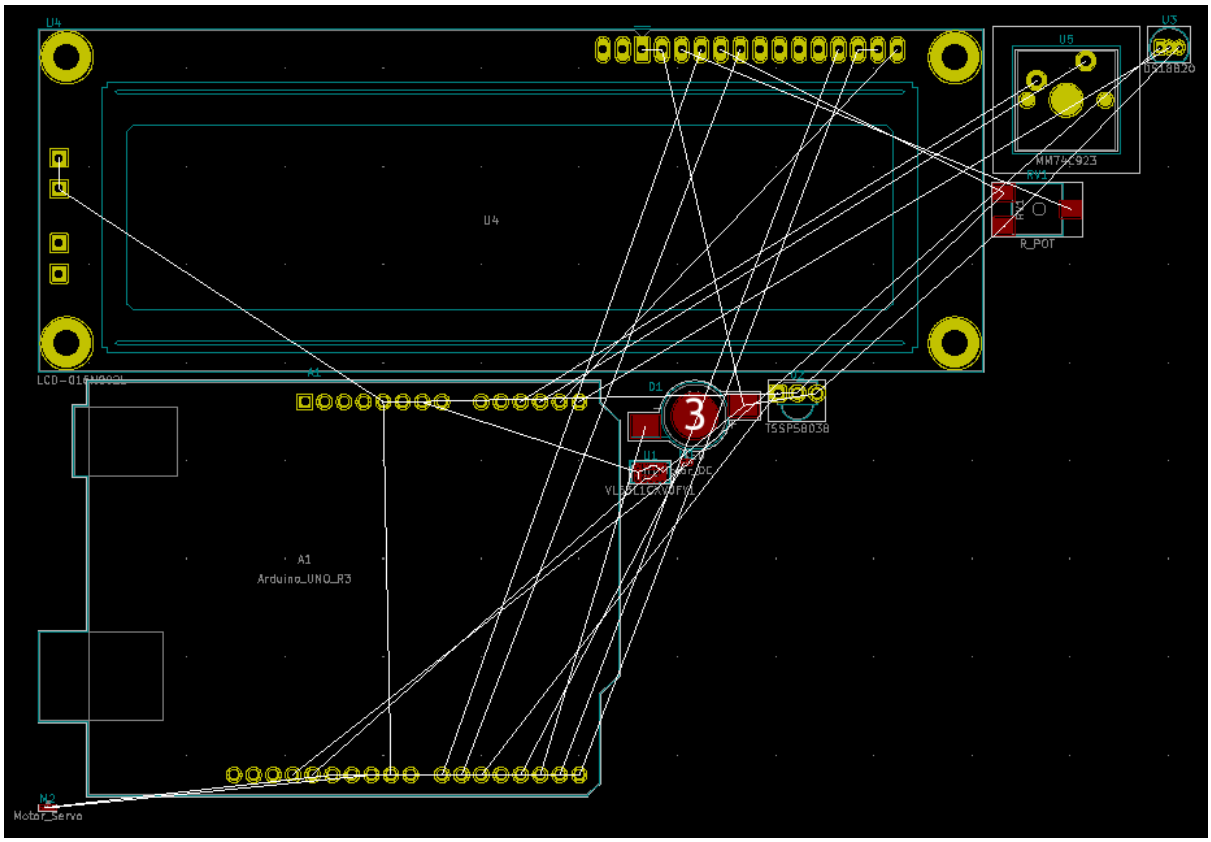
2. DESIGN

2.1 BLOCK DIAGRAM



2.2 HARDWARE ANALYSIS

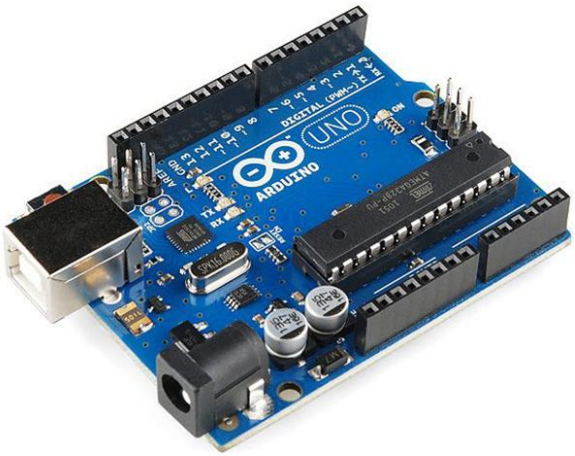
PCB DESIGN



1. PIR Sensor - PIR sensors are more complicated than many of the other sensors explained in these tutorials (like photocells, FSRs and tilt switches) because there are multiple variables that affect the sensors input and output. To begin explaining how a basic sensor works, we'll use this rather nice diagram

The PIR sensor itself has two slots in it, each slot is made of a special material that is sensitive to IR. The lens used here is not really doing much and so we see that the two slots can 'see' out past some distance (basically the sensitivity of the sensor). When the sensor is idle, both slots detect the same amount of IR, the ambient amount radiated from the room or walls or outdoors. When a warm body like a human or animal passes by, it first intercepts one half of the PIR sensor, which causes a positive differential change between the two halves. When the warm body leaves the sensing area, the reverse happens, whereby the sensor generates a negative differential change. These change pulses are what is detected.

2. Arduino ATMEGA328.- The **ATmega328** is a single-chip microcontroller created by Atmel in the megaAVR family (later Microchip Technology acquired Atmel in 2016). It has a modified Harvard architecture 8-bit RISC processor core.he Atmel 8-bit AVR RISC-based microcontroller combines 32 KB ISP flash memory with read-while-write capabilities, 1 KB EEPROM, 2 KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts. The device achieves throughput approaching 1 MIPS per MHz.



3. Ultrasonic Sensor -Ultrasonic distance sensor determines the distance to an object by measuring the time taken by the sound to reflect back from that object. The frequency of the sound is somewhere in the range of ultrasound, this ensures more concentrated direction of the sound wave because sound at higher frequency dissipates less in the environment. A typical ultrasonic distance sensor consists of two membranes. One membrane produces sound, another catches reflected echo. Basically they are speaker and microphone. The sound generator generates short (the length is a couple of periods) ultrasonic impulses and triggers the timer. Second membrane registers the arrival of the sound impulse and stops the timer.From the timers time it is possible to to calculate the distance traveled by the sound. The distance to the object is half of the distance traveled by the sound wave.The ultrasonic sensors have quite a lot of use in everyday life. They are used to replace measuring tapes in measuring devices at construction sites. Cars are equipped with ultrasonic parking sensors. Besides measuring distances, they can just register the presence of the object in the measuring range, for example in danger zones of working machines. If ultrasound transmitter and receiver are separated, the flowing speed of the substance between them can be measured, because the sound wave travels slower upstream and vice versa.

4. Micro Servo (door) -

It is tiny and lightweight with high output power. This servo can rotate approximately 180 degrees (90 in each direction), and works just like the standard kinds but smaller. You can use any servo code, hardware or library to control these servos.It comes with a 3 horns (arms) and hardware.

DC motor.-A **DC motor** is any of a class of rotary electrical motors that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current in part of the motor.

DC motors were the first form of motor widely used, as they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings. Small DC motors are used in tools, toys, and appliances. The universal motor can operate on direct current but is a lightweight brushed motor used for portable power tools and appliances. Larger DC motors are currently used in propulsion of electric vehicles, elevator and hoists, and in drives for steel rolling mills. The advent of power electronics has made replacement of DC motors with AC motors possible in many applications.

LCD. -A **DC motor** is any of a class of rotary electrical motors that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current in part of the motor.

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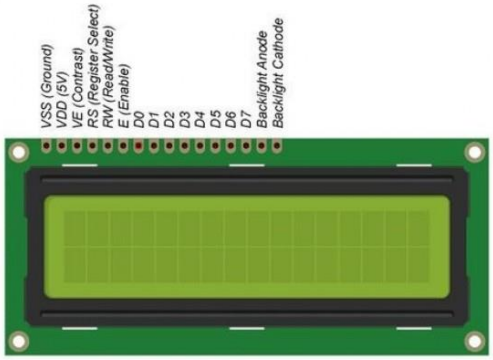
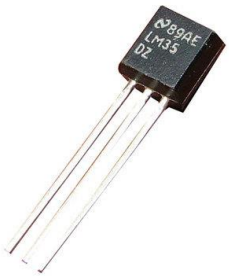


7.Temperature Sensor LM35 - Have you ever left your smartphone in your car on a hot day? If so, your screen might have displayed an image of a thermometer and a warning that your phone has overheated. That is because there is a tiny embedded temperature sensor that measures the interior temperature of your phone. Once the inside of the phone reaches a certain temperature (iPhones shut down at **approximately 113 degrees Fahrenheit**, for example), the temperature sensor sends an electronic signal to an **embedded computer**. This, in turn, restricts users from accessing any applications or features until the phone has cooled back down, as running programs would only further damage the phone's interior components.

A temperature sensor is an electronic device that measures the temperature of its environment and converts the input data into electronic data to record, monitor, or signal temperature changes. There are many different types of temperature sensors. Some temperature sensors require **direct contact** with the physical object that is being monitored (contact temperature sensors), while others indirectly measure the temperature of an object (non-contact temperature sensors).

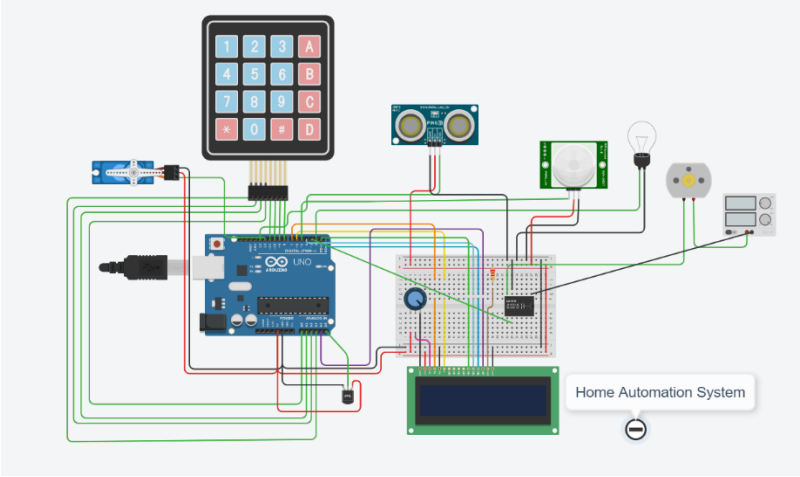


10. Keypad- As given in above table a **4X4 KEYPAD** will have **EIGHT TERMINALS**. In them four are **ROWS of MATRIX** and four are **COLUMNS of MATRIX**. These 8 PINS are driven out from 16 buttons

present in the MODULE. Those 16 alphanumeric digits on the MODULE surface are the 16 buttons arranged in MATRIX formation.

2.3 (SNAPSHOTS-PROJECT , TEAM, RESULTS)

OVERALL HARDWARE CIRCUIT



3. SOFTWARE

3.1 SOFTWARE – CODING AND ANALYSIS

ALGORITHM

- Start

- Create variables and Initialise variables for
    - Servo motor
    - Temperature sensor
    - Keypad
    - Ultrasonic sensor
    - fan and bulb
    - password
    - flag to check whether door is open or not.

- In setup function;
    - initialise the lcd
    - initialise the servo
    - set the respective pinModes.

- In microsecondsToCentimeters function:
    - The speed of sound is 340 m/s or 29 microseconds per centimeter.
    - The ping travels out and back, so to find the distance of the object we take half of the distance travelled.
    - Therefore we return microseconds/29/2

- In loop function;
    - Read the value of Temperature sensor with analogRead and convert into required range(to get degree celsius)
    - Read the value of Ultrasonic sensor and convert the duration into distance i.e. call function microsecondsToCentimeters(duration) and save return value in distance variable.
      if(distance < 40):

```
Take the keypad input
if wrong password:
        set flag fl = 1
else:
        set flag fl = 0
if fl == 1:
        Print wrong pass in lcd
        set fl = 0
        clear lcd and reset row
else:
        Print door open in lcd
        for(angle = 0; angle < 180; angle += 1):
                servo_test.write(angle);
        clear lcd
        Print door closing in lcd
        for(angle = 180; angle >= 1; angle -= 1):
                servo_test.write(angle);
        clear lcd, reset row, set open = 1
if open == 1:
        Read PIR sensor i.e. digitalRead(sensor_pin)
        if digitalRead(sensor_pin) == HIGH:
                digitalWrite(bulb,HIGH)
                if temperature > 20:
                        digitalWrite(fan,HIGH)
                else:
                        digitalWrite(fan,LOW)
else:
        digitalWrite(bulb,LOW)
        digitalWrite(fan,LOW)
```

EXPLANATION:

- Initialize the LCD(for displaying correct or wrong password) and Calculate the temperature recorded by the temperature sensor corresponding to degree Celsius.

- Calculate the distance between the person and the door in centimeters[using ultrasonic sensor].
- If distance < 40: Enable keypad and take input for password, if it is correct password, then open the door(servo) keep it open for 10s then close it and the corresponding tasks will follow. else: Keypad not enabled.
- If there is movement, PIR sensor detects it and turns on the light bulb, if the temperature > 20 turn on the fan else turn the fan off. else turn off the light bulb and the fan.

CODE:

```
#include <Keypad.h>

#include <LiquidCrystal.h>

#include <Servo.h>


Servo servo_test;

int angle = 0;

const int TMP36_pin = A5;

LiquidCrystal lcd(7,6,1,4,0,A4);


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] = {A3,A2,A1,A0};
```

```
byte colPins[COLS] = {11,10,9,8};
int LCDRow = 0;
int i=0;
int pingPin = 13;
float duration;
float distance;
int c=0;
char password[4] = {'1','0','9','0'};
int fl = 0;
int sensor_pin=5;
int bulb=2;
int fan=3;
int open=0;
Keypad keypad = Keypad( makeKeymap(keys), rowPins,colPins,ROWS,COLS);
void setup()
{
 //Serial.begin(9600);
 lcd.begin(16,2);
 lcd.clear();
 servo_test.attach(12);
 lcd.setCursor(LCDRow,0);
 pinMode(sensor_pin, INPUT);
 pinMode(bulb,OUTPUT);
 pinMode(fan,OUTPUT);
}

long microsecondsToCentimeters(long microseconds) {
 return microseconds / 29 / 2;
```

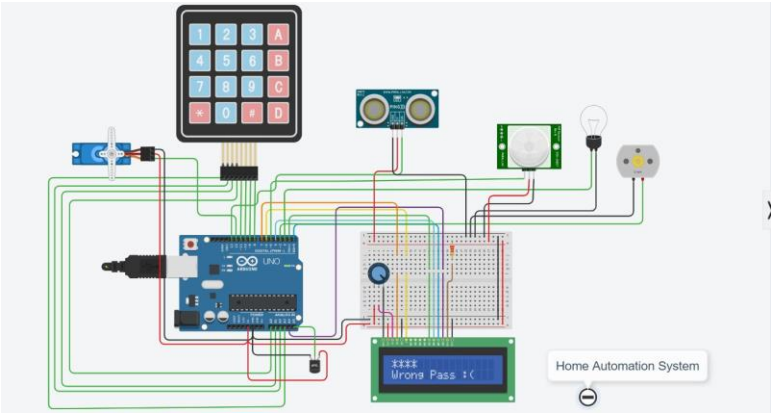
```
}
void loop()
{
 //Temperature Calculation---------------------------------
 int temp_adc_val;
 float tempC;
 temp_adc_val = analogRead(TMP36_pin);
 tempC = (temp_adc_val * 4.88);
 tempC = (tempC/10);
 tempC = tempC - 50;
 //-------------------------------------------------------



 //Ultrasonic Sensor Readings------------------------------
 delayMicroseconds(2);
 delayMicroseconds(10);
 pinMode(pingPin, OUTPUT);
 digitalWrite(pingPin, LOW);
 delayMicroseconds(2);
 digitalWrite(pingPin, HIGH);
 delayMicroseconds(5);
 digitalWrite(pingPin, LOW);
 pinMode(pingPin, INPUT);
 duration = pulseIn(pingPin, HIGH);
 distance = microsecondsToCentimeters(duration);
 //-------------------------------------------------------
```

```
//Password entering in keypad, Door Opening using Servo and
//Displaying in LCD---------------------------------------
if(distance<40){
 char key = keypad.getKey();


  if(key)
{
  Serial.print(key);
  lcd.print("*");
  if(password[LCDRow] != key)
    fl=1;
  lcd.setCursor(++LCDRow,0);
}
if(LCDRow>=4)
{
  if(fl==1)
  {
    lcd.setCursor(0,1);
    lcd.print("Wrong Pass :(");
    delay(2000);
    fl = 0;
    lcd.clear();
    LCDRow = 0;
  }
  else
          {
    lcd.setCursor(0,1);
    lcd.print("Door Open");
```

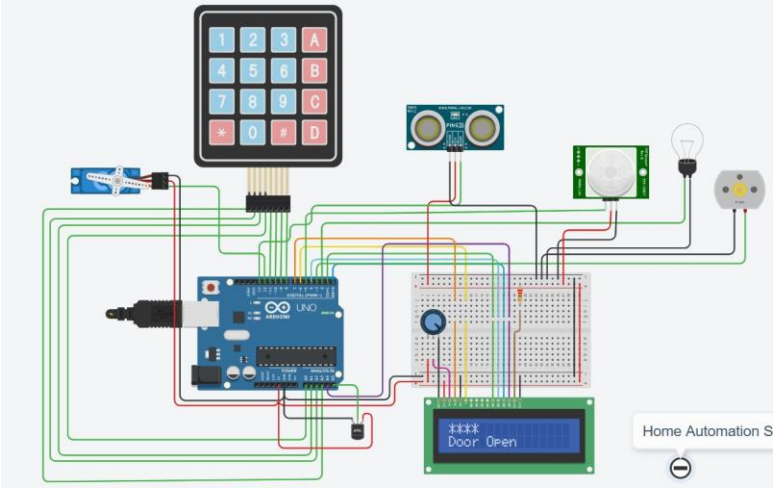
```
    for(angle = 0; angle < 180; angle += 1)
    {
      servo_test.write(angle);
      delay(5);
    }
   delay(10000);
   lcd.clear();
   lcd.print("Door Closing");
   for(angle = 180; angle >= 1; angle -= 1)
   {
    servo_test.write(angle);
    delay(5);
   }
   lcd.clear();
   fl=0;
   LCDRow = 0;
   open=1;
        }
}
}
//-------------------------------------------------------


//Fan and Light Automation using PIR and Temperature Sensor
if(open==1){
  if(digitalRead(sensor_pin)==HIGH)
   {
   digitalWrite(bulb,HIGH);
```

```
    if(tempC > 20)
    {
    digitalWrite(fan,HIGH);
    }
    else
    {
    digitalWrite(fan,LOW);
    }
    delay(12000);
  }
  else{
    digitalWrite(bulb,LOW);
    digitalWrite(fan,LOW);
  }
 }
}
```

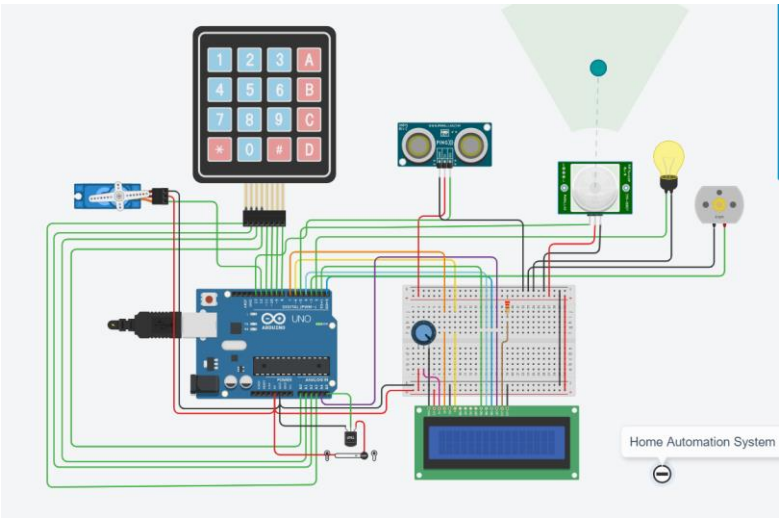
WRONG PASSWORD



CORRECT PASSWORD



FAN AND LIGHT ON



4. CONCLUSION AND FUTURE WORK

4.1 RESULT, CONCLUSION AND INFERENCE

In this project, there are several steps in implementing the project like the design of Arduino Uno circuit with the PIR sensor, Ultrasonic Sensor and connecting the power supply circuit, as well as temperature sensor .The Pairing of Automation and the Hardware, Sending signals and values of the sensor to the Arduino for it to Process and give the desired outputs, commands and controlling the devices is the other part. Arduino microcontroller act as the brain of the whole system. The microcontroller can be connected with other circuits to perform required functions. The Arduino microcontroller using IC ATMega328P and it works by entering

the suitable program that is created. The Fan used in this particular circuit is the HC-05, which requires a 5V DC power drawn from the Arduino microcontroller circuit is a pathway transmit / send data on the microcontroller and as the receive path / receiver data on the Sensor modules with microcontroller while the path Ground is a line connecting the data between PIR Sensor module with the microcontroller circuit. This system has input from Sensors of PIR, Temperature, Ultrasonic Distance sensor using Arduino software , the overall system is controlled automatically and the output is connected to the Arduino microcontroller circuit which processes the information and does the task.

Future scope for the home automation systems involves making homes even smarter. Homes may be interfaced with sensors including motion sensors, light sensors and temperature sensors and supply automated toggling of devices supported conditions. More energy is conserved by ensuring occupation of the house before turning on devices and checking brightness and turning off lights if not necessary. The system may be integrated closely with home security solutions to permit greater control and safety for home owners. the following step would be to increase this method to automate an oversized scale environment, like offices and factories. We can integrate the communication protocols like wifi, zigbee to control the home appliances while is a distant place easily using our mobile phone or laptop.

4.2 FUTURE WORK COST

Cost Analysis

- PIR Sensor - Rs.64
- Arduino ATMEGA328 - Rs.259
- Ultrasonic Sensor - Rs.75
- Micro Servo (door) - Rs.100
- DC motor - Rs.125
- LCD - Rs.94
- Temperature Sensor LM35 - Rs.65
- Bulb - Rs.10

- Connecting Wires - Rs.187
- Keypad - Rs.85

Total Cost - Rs.1034

Future Work Extra Cost

Wifi module - Rs.118

Bluetooth module - Rs.210

Android app Development - Self work

Total Cost (including future work) - Rs.1362

5. REFERENCES

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BIODATA

Name : Nagharjun M

Mobile Number : +919962115118

E-mail : nagharjun.m2018@vitstudent.ac.in

Permanent Address:

Name : Aadil Abdul Ghani

Mobile Number : +919790914399

E-mail : aadilabdul.ghani2018@vitstudent.ac.in

Permanent Address:

Name : Sanjay Tholani M

Mobile Number : +919500124790

E-mail : sanjaytholani.m2018@vitstudent.ac.in

Permanent Address:

Name : Adit C Jain

Mobile Number : +919080618016

E-mail : aditc.jain2017@vitstudent.ac.in

Permanent Address: