Ahsanullah University of Science & Technology
Department of Computer Science & Engineering
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CSE 3216
Microcontroller Based System Design Lab

Project Final Report

Project Name: ***Greenhouse Monitoring System***

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Objective

The climate change has brought unpredictable weather conditions that have resulted many problems. One of the biggest problem for mankind in the 21st century's is food shortage.Global warming and other weather factors have leaded to desertification.This issue can be solved by greenhouses, that play a main role in increasing the crop yield per unit area and represent the suitable environment for off-corps yields.
Greenhouse systems have been designed for monitoring and controlling micro climatic parameters, like temperature,humidity degree, soil moisture and light ratio to provide best condition for the plants to grow inside greenhouses. We are trying to build a system which will make the proper environment like greenhouse with proper components and necessities.

Social Values

Agriculture has been one of the primary occupations of mankind since early civilization and even today, manual interventions in farming are inevitable. Greenhouses form an important part in agriculture and horticulture sectors of a country as they can be used to grow plants under controlled climatic conditions for optimum production.
All plants and vegetation require certain conditions for their proper growth. Therefore, it is necessary to bring the environmental nature under control in order to make those setting as close to the ideal ones as possible. To create an optimal environment, the main climatic and environmental parameters such as temperature, humidity, light intensity, ground water etc need to be controlled to create optimal environment. So, this project, **Greenhouse Monitoring System** being fully implemented could ensure to make the process better for an ideal environment for agricultural improvement.

Required Components

These following parts and tools are required for building this project,

- **Arduino Mega:** It is used for controlling and creating interactions with other necessary components.
- **LM032L:** This is a 20x2 Liquid Crystal Display which can display 20 characters per line and there are 2 such lines and in our project it displays the environment settings.
- **DHT11 Temperature and Humidity Sensor:** It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin. We are showing the surrounding temperature and humidity with the help of it.
- **Motor:** We are using several motors for appearing as the fan for humidity problem and the water pump for detecting water level.
- **LDR sensor:** It is a light dependent sensor and this sensor is used for sensing the lights.
- **BC547 Transistor:** This is an NPN transistor which is basically used to switch ground on a device. We have used it for detecting the soil moisture.
- **Servo motor:** Servo motor is a rotary actuator, consists of a suitable motor coupled to a sensor for position feedback. We have used this servo motor to represent our motor for watering.
- **1K, 10K Resistor:** This resistors are required for reducing current flow, biasing active elements, dividing voltages etc.
- **LED:** Different types of LED light pins have been used for signal and representing spray by blinking LED.
- **Button:** It is required for turning the motor off/on by sensing the soil moisture.
- **Switch:** It is required for directing the level of water tank.
- **1K POT:** This is required for controlling the flow of electric current. We have used it with the BC547 transistor for acting as an adjustable voltage divider.

- **Male to Male, Female to Female and Male to Female wires:** These are required for connecting the components with each other as needed.

Design

The circuit diagram is given below.

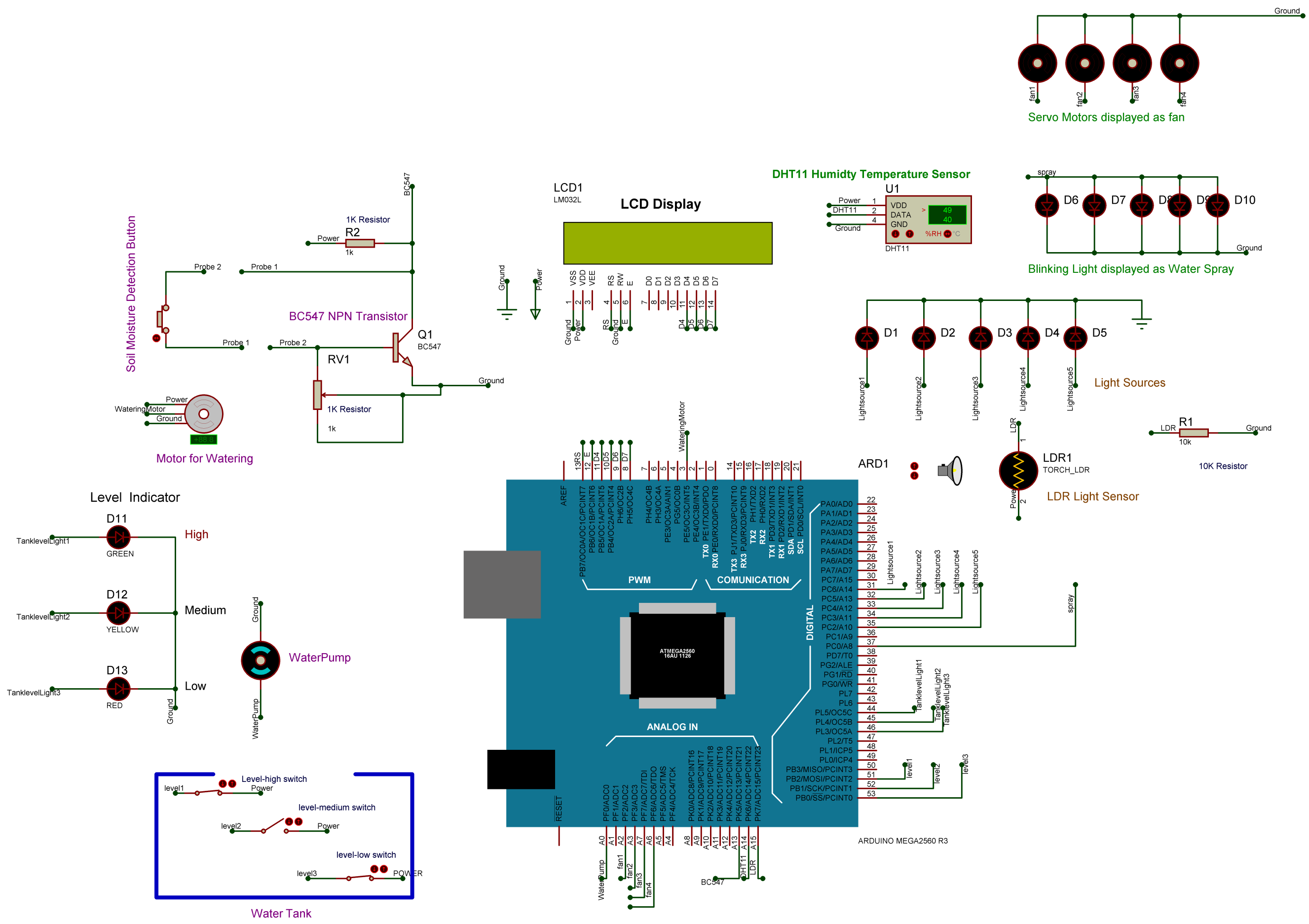


Figure 1: Diagram for Greenhouse Monitoring System

Working Procedure

For making a **Greenhouse Monitoring System**, many parameter measurements are required to monitor and control for the good quality and productivity of plants. But to get the desired results there are some very important factors which come into play like Temperature, Humidity, Light, Water etc which are necessary for a better plant growth. As our system had to be implemented in a software system and not in a practical way, we needed to make some assumptions to make the project work perfectly with the project perspectives. We have demonstrated the features of our system, but some features needed to be theoretically explained or shown into some different components to make the idea presentable in a proper way.
The working procedure of the features of our system is described below, where every details of every features are explained thoroughly,

Light Intensity:

Light intensity is very important for the growth of the plants. If the light intensity is improper, then it affects the growth of the plants in various ways. To resolve this problem, we need two systems which are light intensity detector and way of solving improper light intensity to the plants. For detecting light intensity, we have used LDR Sensor and to solve the intensity problem, we have used artificial lights.

- **LDR Sensor:** If we start the system, the environmental light will be absorbed by the material of the sensor and it will show the light intensity amount into the LCD display of our system. When the light falls on the LDR, its resistance gets decreased and it can detect the intensity of light is not low and when its dark the resistance gets increased and the sensor detects that light intensity is low. In our system we are using the movement of torch to detect the light source which can be controlled.

- **Artificial Lights:** When the LDR detects the light intensity and if the intensity is low, it means the plants need extra lights to maintain its growth. To solve this problem, we have put 5 LED lights which will be representing artificial lights and it will create a process by which the plants will be getting enough lights. We have given some conditions where we measured the intensity and set the LED to that amount of need. For example, if the light intensity is below 100, it will turn all 5 lights in and if the amount is below 400, then it will turn 2 LED lights automatically. Whole process of turning the lights is shown in the LCD display.

Temperature:

Temperature is a very important part for proper plantation. If the temperature is too high, it will create harm to the growth or the existence of the trees. To resolve the problem, we have put a sensor to measure the temperature and put some fans to maintain its temperature. To detect the temperature, we have used DHT11 sensor and for solving the temperature issue, we have represented motors as fans to prolong the temperature.

- **DHT11 sensor:** When we turn the system on, the DHT11 sensor will start to work and detect the temperature and give a signal to the pin as output and we have shown the output through the LCD display. We have measured the temperature in Celsius scale.

- **Motors represented as fans:** When the temperature exceeds from a defined level or exceeds to a critical level, the system automatically turns on the motor and LCD monitor displays how many fans have turned on. Again when the temperature comes in normal range or comes below the defined level, the motors get turned off automatically and the LCD monitor shows that all fans are off.

Humidity:

As humidity is a great issue for plantation, it needs to be in a proper condition to have the quality in control. So, for a greenhouse monitoring system, it needs to have the feature of controlling the humidity for trees. In our system, we have used DHT11 sensor to perceive the humidity level and if the humidity gets changed from its desired proper state, to control the humidity, we have represented blinking LED lights as water spray.

- **DHT11 sensor:** The DHT11 sensor is a temperature and humidity detector sensor which detects the humidity level of the surrounding environment of trees and shows the output or the measurement of humidity in the display of LCD.

- **Blinking LED represented as spray:** In our system, we have made the condition that if the humidity of the environment is below the defined levels, water sprays are automatically turned on and if the humidity level exceeds from the defined level, sprays are automatically turned off. Instead of sprays, we have shown if the humidity level is low, the LED lights will start blinking which means it will start spraying water. All these instructions will be displayed in the LCD monitor.

Soil Moisture:

Soil moisture works as a medium of supplying nutrients to growing plants. So it's necessary to keep the soil moisture in a minimal level so that the plants can grow in its proper way. In our monitoring system, we have used BC547 transistor to detect the soil moisture and if the moisture level gets low, we have instructed the water motor to transfer water to maintain the moisture level properly.

- **BC547 Transistor:** The BC547 transistor contains two probes and resistance to detect the soil moisture. If moisture is present in the soil then there is conduction between the two probes and due to this conduction, the transistor remains in on state and the Arduino Pin remains low. When Arduino reads low signal, it means the soil moisture is normal. Otherwise, the transistor gets in off state and if the Arduino reads high signal, then it indicates that the soil moisture is low.

- **Servo motor represented as water motor:** If the soil moisture gets low, it will be shown in the display of LCD and then the water motor will get indication for turning the motor on. Also, when the soil moisture is in normal state, the LCD will show that soil moisture is normal and the motor is off. We have used servo motor to represent water motor and controlled its direction to certain instructed levels.

Water level:

For watering the plants, we have showed a water tank in our design which contains 3 switches. As we cannot detect water in the design, we have improvised the switches as water level of the water tank. When the lower switch is turned on then it means the water level is low, which will be shown in the display and it will instruct the water pump to turn on. Again when the lower switch and the middle switch is turned on, it will indicate that the water level is medium and it will instruct the motor to be turned on. At last, when all of the three switches are on, it will mean that the water tank is full and the pump will get the instruction to be turned off and it will turn off. We have used motor to represent the water pump. All of these instructions will be displayed in the LCD monitor properly.

Budget

Equipment	Quantity	Budget(Tk)
Arduino Mega	1	750
20x2 LCD	1	360
DHT11 Sensor	1	150
Mini Fan	4	100
Spray	5	200
LDR Sensor	1	50
Bulb	5	500
BC547 Transistor	1	50
Battery-9V	2	80
1K POT	3	40
1K Resistor	3	15
10K Resistor	1	10
Male to Male, Female to Female and Male to Female wire	As required	200
RS-360 Mini DC 4-12V Water Pump	1	450
Switch	3	200
Card Board	3	250
Cutter	1	50
Pipe	1	40
Total		**3495**

This is still the estimated budget. As the real project could not be completed, the real budget remains unknown but most probably will not vary by much.

Code

```
// the setup function runs once when you press reset
    or power the board
#define LDRpin A15
#define light1 31
#define light2 32
#define light3 33
#define light4 34
#define light5 35

#define dhtpin A14
#define spray 37
#define blinkingtime 6
#define fan1 A2
#define fan2 A3
#define fan3 A7
#define fan4 A6

#define soilmotor 3
#define soil A13

#define sw1 51
#define sw2 52
#define sw3 53
#define led1 44
#define led2 45
#define led3 46

#include <LiquidCrystal.h>
#include <dht11.h>
#include <Servo.h>

//LCD
const int rs = 13, en = 12, d4 = 11, d5 = 10, d6 =
   9, d7 = 8;
```

```
LiquidCrystal lcd(rs, en, d4, d5, d6, d7);

//LDR
int ldr = LDRpin;
float valueldr=0;

//WaterLevel
int motorPin= A0;
int x, y,z;

//DHT11
dht11 dht;
Servo soilservo;

int Fan1 = fan1;
int Fan2 = fan2;
int Fan3 = fan3;
int Fan4 = fan4;
int F1,F2,F3,F4 ;

void setup()
{
 Serial.begin(9600);
 //LCD
 lcd.begin(16, 2);
 lcd.setCursor(0, 1);
 lcd.clear();

 //LDR BULB
  pinMode(light1, OUTPUT);
  pinMode(light2, OUTPUT);
  pinMode(light3, OUTPUT);
  pinMode(light4, OUTPUT);
  pinMode(light5, OUTPUT);
  digitalWrite(light1, LOW);
  digitalWrite(light2, LOW);
  digitalWrite(light3, LOW);
  digitalWrite(light4, LOW);
  digitalWrite(light5, LOW);

  //DHT11
```

```
  pinMode(spray, OUTPUT);
  digitalWrite(spray, LOW);

  pinMode(fan1, OUTPUT);
  pinMode(fan2, OUTPUT);
  pinMode(fan3, OUTPUT);
  pinMode(fan4, OUTPUT);

  //soil
  soilservo.attach(soilmotor);

  //Water level
  pinMode(motorPin, OUTPUT);
  pinMode(sw1, INPUT);
  pinMode(sw2, INPUT);
  pinMode(sw3, INPUT);
  pinMode(led1, OUTPUT);
  pinMode(led2, OUTPUT);
  pinMode(led3, OUTPUT);
}

void loop() {
  //LDR
  lcd.setCursor(0, 0);
  lcd.print("Light Sensitivity : ");
  lcd.setCursor(0,1);
  valueldr = analogRead(ldr);
  lcd.print(valueldr);
  lcd.setCursor(0, 0);
  delay(2000);
  lcd.clear();
 if(valueldr <100.00)
  {
    lcd.print("TURN ON 5 LIGHTS");
    digitalWrite(light1, HIGH);
    digitalWrite(light2, HIGH);
    digitalWrite(light3, HIGH);
    digitalWrite(light4, HIGH);
    digitalWrite(light5, HIGH);
    delay(2000);
  }
```

```
  else if(valueldr <200.00)
  {
    lcd.print("TURN ON 3 LIGHTS");
    digitalWrite(light1, HIGH);
    digitalWrite(light2, LOW);
    digitalWrite(light3, HIGH);
    digitalWrite(light4, LOW);
    digitalWrite(light5, HIGH);
    delay(2000);
  }
  else if(valueldr <400.00)
  {
    lcd.print("TURN ON 2 LIGHTS");
    digitalWrite(light1, HIGH);
    digitalWrite(light2, LOW);
    digitalWrite(light3, LOW);
    digitalWrite(light4, LOW);
    digitalWrite(light5, HIGH);
    delay(2000);
  }
  else if(valueldr <500.00)
  {
    lcd.print("TURN ON 1 LIGHTS");
    digitalWrite(light1, LOW);
    digitalWrite(light2, LOW);
    digitalWrite(light3, HIGH);
    digitalWrite(light4, LOW);
    digitalWrite(light5, LOW);
    delay(2000);
  }
  else
  {
    lcd.print("LIGHTS TURNED OFF");
    digitalWrite(light1, LOW);
    digitalWrite(light2, LOW);
    digitalWrite(light3, LOW);
    digitalWrite(light4, LOW);
    digitalWrite(light5, LOW);
    delay(1000);
  }
    digitalWrite(light1, LOW);
```

```
    digitalWrite(light2, LOW);
    digitalWrite(light3, LOW);
    digitalWrite(light4, LOW);
    digitalWrite(light5, LOW);
    lcd.clear();

  //DHT11 humidity
  dht.read(dhtpin);
  lcd.setCursor(0,0);
  int humidity = dht.humidity;
  int temp = dht.temperature;
  lcd.print("Temperature : ");
  lcd.print(temp);
  lcd.print("C ");
  lcd.setCursor(0,1);
  lcd.print("Humdity : ");
  lcd.print(humidity);
  lcd.print(" % ");
  delay(2000);
  lcd.clear();
  if (humidity<50)
  {
    lcd.print("Humidity is low");
    lcd.setCursor(0,1);
    lcd.print("Spray ON");
    int count= blinkingtime;

    while(count--)
    {
      digitalWrite(spray, HIGH);
      delay(100);
      digitalWrite(spray, LOW);
      delay(100);
      digitalWrite(spray, HIGH);
      delay(100);
    }
    delay(500);
  }
  else
  {
    lcd.print("Humidity normal");
```

```
    lcd.setCursor(0,1);
    lcd.print("Spray OFF");
    delay(2000);
  }
  digitalWrite(spray, LOW);
  lcd.clear();

  //DHT11 temp

  if (temp<20)
  {
    lcd.print("Temp is ");
    lcd.print(temp);
    lcd.print(" C.");
    lcd.setCursor(0,1);
    lcd.print("All fan OFF.");
    digitalWrite(Fan1, LOW);
    digitalWrite(Fan2, LOW);
    digitalWrite(Fan3, LOW);
    digitalWrite(Fan4, LOW);
    delay(5000);
  }
  else if (temp<30)
  {
    //fan1
    lcd.print("Temp is ");
    lcd.print(temp);
    lcd.print(" C.");
    lcd.setCursor(0,1);
    lcd.print("2 FAN ON.");
    digitalWrite(Fan1, HIGH);
    digitalWrite(Fan2, HIGH);
    digitalWrite(Fan3, LOW);
    digitalWrite(Fan4, LOW);
    delay(5000);
  }
  else if (temp<40)
  {
    //fan1 &fan4
    lcd.print("Temp is ");
    lcd.print(temp);
```

```
   lcd.print(" C.");
   lcd.setCursor(0,1);
   lcd.print("3 FAN ON.");
   digitalWrite(Fan1, HIGH);
   digitalWrite(Fan2, HIGH);
   digitalWrite(Fan3, HIGH);
   digitalWrite(Fan4, LOW);
   delay(5000);
 }
 else
 {
   //all fan on
   lcd.print("Temp is ");
   lcd.print(temp);
   lcd.print(" C.");
   lcd.setCursor(0,1);
   lcd.print("All FAN ON");
   digitalWrite(Fan1, HIGH);
   digitalWrite(Fan2, HIGH);
   digitalWrite(Fan3, HIGH);
   digitalWrite(Fan4, HIGH);
   delay(5000);
 }
 lcd.clear();

   digitalWrite(Fan1, LOW);
   digitalWrite(Fan2, LOW);
   digitalWrite(Fan3, LOW);
   digitalWrite(Fan4, LOW);

//BC547

if (digitalRead(soil)==1)
{
    lcd.clear();
    lcd.print("Low Soil Moisture.");
    lcd.setCursor(0,1);
    lcd.print("Motor turned ON.");

    for(int i = 0; i <= 180; ++i)
   {
```

```

      soilservo.write(i);
      delay(20);
    }
    for(int i = 180; i >0; i--)
    {

      soilservo.write(i);
      delay(20);
    }
    delay(300);
 }
 if (digitalRead(soil)==0)
 {
     lcd.clear();
     lcd.print("Soil␣Moisture␣Normal.");
     lcd.setCursor(0,1);
     lcd.print("Motor␣turned␣OFF.");
     delay(2000);
 }

 //WaterLevel
 x= digitalRead(sw1);
 y= digitalRead(sw2);
 z= digitalRead(sw3);

// if(x==HIGH && y==LOW && z== LOW)

if (z==HIGH && y==HIGH && x==HIGH)
   digitalWrite(led1,HIGH);
if (z==HIGH && y==HIGH && x==LOW)
   digitalWrite(led2,HIGH);
if (z==HIGH && x==LOW && y==LOW)
  digitalWrite(led3,HIGH);

if (z==HIGH && x==LOW && y==LOW)
 {
     lcd.clear();
     lcd.print("Low␣Water␣level.");
     lcd.setCursor(0,1);
     lcd.print("Motor␣turned␣ON.");
```

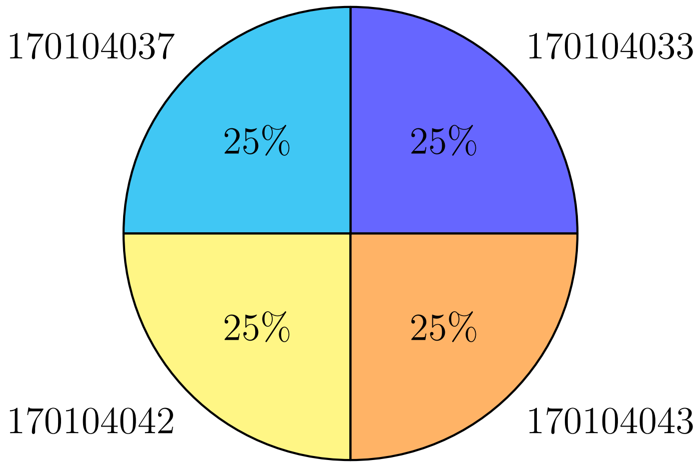
```
     digitalWrite(motorPin, HIGH);
     delay(2000);
 }
  else if (z==HIGH && y==HIGH && x==LOW)
 {
     lcd.clear();
     lcd.print("Medium Water level.");
     lcd.setCursor(0,1);
     lcd.print("Motor is ON.");
     digitalWrite(motorPin, HIGH);
     delay(2000);
 }
 else if (z==HIGH && y==HIGH && x==HIGH)
 {
      lcd.clear();
     lcd.print("Water Tank Full.");
     lcd.setCursor(0,1);
     lcd.print("Motor is Off.");
     digitalWrite(motorPin, LOW);

     delay(2000);
 }
 else
 {
     lcd.clear();
     lcd.print("Water Tank Full.");
     lcd.setCursor(0,1);
     lcd.print("Motor is Off.");
     digitalWrite(motorPin, LOW);

     delay(2000);
 }
  digitalWrite(led1, LOW);
  digitalWrite(led2,LOW);
  digitalWrite(led3,LOW);
  digitalWrite(motorPin, LOW);

lcd.clear();
}
```

Members Contribution



Difficulties

- We have faced some difficulties while implementing the soil moisture sensor into the project. Then we came to another approach by using BC547 transistor for detecting soil moisture.
- We also faced some problem presenting the water tank to measure the water level. Then we used components to design the tank and used switch to show the water level.
- We could not show all required components in 16x2 LCD for which, we had to move on to 20x2 LCD in mid project.
- We had to search for libraries of different components to be used by Proteus.
- Making simulation as close to real world scenario as possible to ensure that the simulation may come handy when implementing in real life, we faced some difficulties.

Future Work

- For future, we plan to implement the circuit design into hardware level for making a complete and appropriate running hardware project.
- Also, we want to include GSM Module System to the system to make it more efficient.

Conclusion

Greenhouse Monitoring System will be very efficient for growing good quality plants and plant production. The main advantage of this project is that, all the functions to be performed by the artificial lights, motor, pump, sprays etc to control the climatic conditions like temperature, relative humidity, light intensity, soil moisture levels in the Greenhouse environment are all automated and it does not require any human intervention. Also, if the system is implemented practically, the plantation growth and production rate will improved in a very high rate which will develop our agricultural field.

Changes with Proposal

While completing the project with the project proposal ideas, we needed to change something for the betterment of the project design.

- We wanted to use water sprays but it was a failed attempt by us for the proteus, so we used blinking LED to represent spray.
- Also, in the proposal we had no plan for adding the water level detecting system, but later we have shown the process of detecting the water level.
- Lastly, we wanted to use appropriate artificial lights for maintaining the light intensity, but later we had to represent the lights with LED.

Project Link:
https://github.com/SadiaTasnim/GreenHouseMonitoringSystem