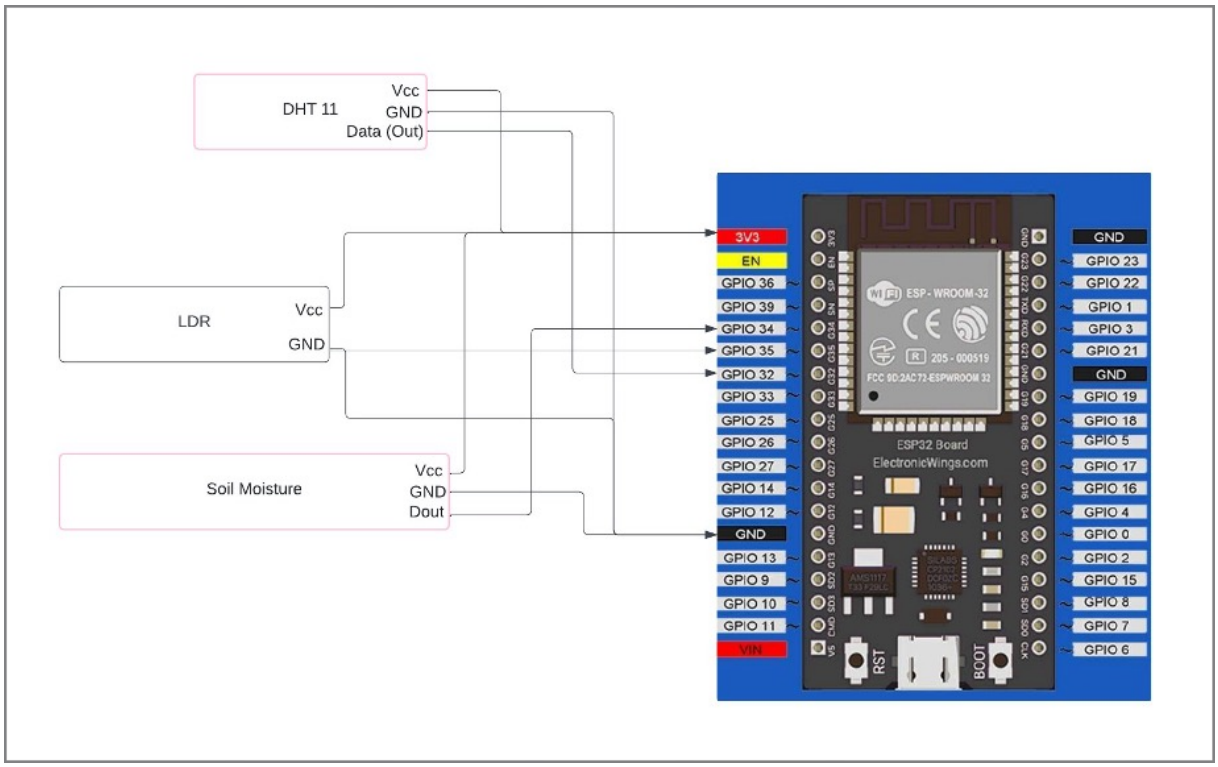
Smart Crop Management System

Aim:- The aim of this experiment is to create an IoT crop management system using an ESP32 microcontroller. This system will monitor various environmental parameters such as temperature, humidity, light intensity, and soil moisture, and send email notifications when any of these parameters exceed predefined thresholds.(Hardware+Software)

Components :- ESP32 microcontroller, DHT11 temperature and humidity sensor, Soil moisture sensor, LDR (Light Dependent Resistor), Breadboard and jumper wires

Circuit Diagram :-



Source Code :-

```
#include <WiFi.h>
#include <ESP_Mail_Client.h>
#include <Arduino.h>
#include "DHT.h"

#define DHTPIN 32            // Digital pin connected to the DHT sensor
#define DHTTYPE DHT11        // DHT 11

#define SOIL_MOISTURE_PIN 34  // Soil moisture sensor pin
#define LDR_PIN 35           // LDR sensor pin

#define WIFI_SSID "Meet"
#define WIFI_PASSWORD "Tobham@2304"
```

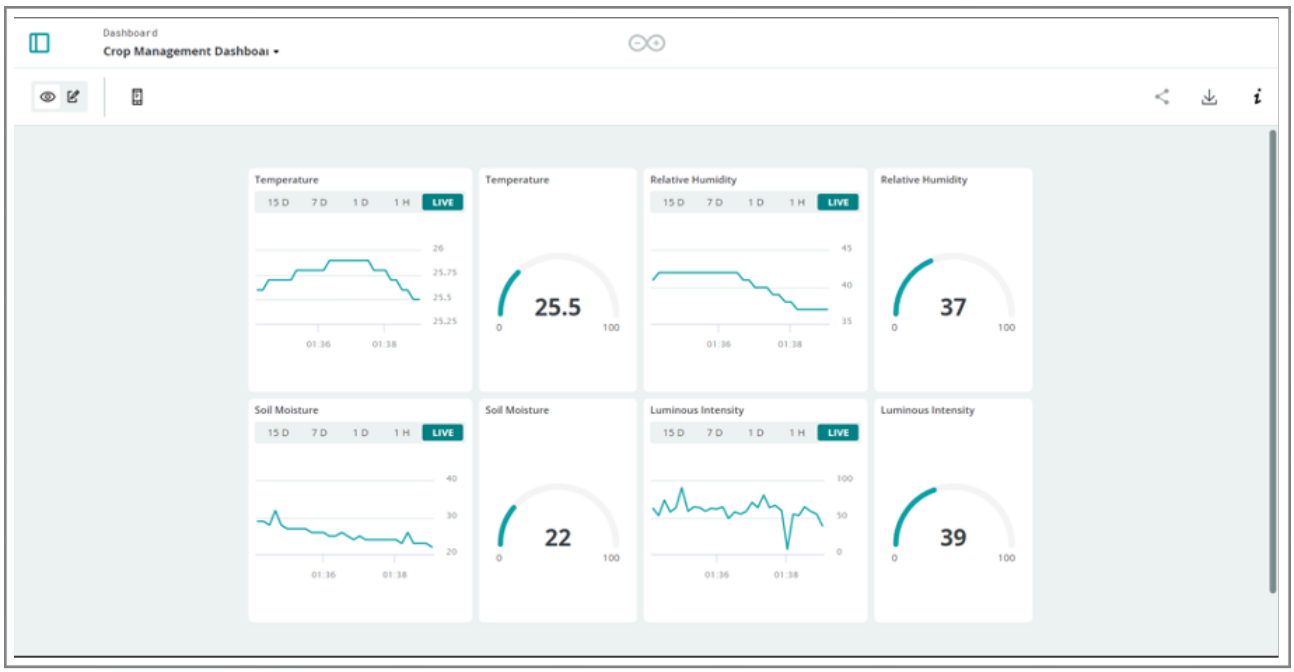
```
#define SMTP_server "smtp.gmail.com"
#define SMTP_Port 587

#define sender_email "cropmaster63@gmail.com"
#define sender_password "ytgz xaip avos ffja"
#define Recipient_email "meetbhatt2304@gmail.com"
#define Recipient_name "GOD"

SMTPSession smtp;

// Define thresholds for sensor readings
const float TEMPERATURE_THRESHOLD = 20.0;   // Example thresholds, adjust as needed
const float HUMIDITY_THRESHOLD = 70.0;      // Example thresholds, adjust as needed
const int LIGHT_THRESHOLD = 10;             // Example thresholds, adjust as needed
const int SOIL_MOISTURE_THRESHOLD = 30;     // Example thresholds, adjust as needed

DHT dht(DHTPIN, DHTTYPE);

void setup() {
  Serial.begin(115200);
  Serial.println();
  Serial.print("Connecting to WiFi...");

  // Connect to WiFi
  WiFi.begin(WIFI_SSID, WIFI_PASSWORD);
  while (WiFi.status() != WL_CONNECTED) {
    Serial.print(".");
    delay(200);
  }
  Serial.println();
  Serial.println("WiFi connected.");
  Serial.println("IP address: ");
  Serial.println(WiFi.localIP());
  Serial.println();

  // Initialize SMTP session
  smtp.debug(1);

  // Configure email session
  ESP_Mail_Session session;
  session.server.host_name = SMTP_server;
  session.server.port = SMTP_Port;
  session.login.email = sender_email;
  session.login.password = sender_password;
  session.login.user_domain = "";

  // Connect to SMTP server
```

```
  if (!smtp.connect(&session)) {
    Serial.println("Failed to connect to SMTP server");
    return;
  }

  pinMode(SOIL_MOISTURE_PIN, INPUT);
  pinMode(LDR_PIN, INPUT);

  dht.begin();

  // Read sensor data and send email on boot
  float temperature = dht.readTemperature();
  float humidity = dht.readHumidity();
  int lightIntensity = analogRead(LDR_PIN);
  int soilMoisture = (100 - (analogRead(SOIL_MOISTURE_PIN) / 4095.00) * 100);

  // Check if any sensor reading exceeds the threshold
  if (temperature > TEMPERATURE_THRESHOLD ||
      humidity > HUMIDITY_THRESHOLD ||
      lightIntensity > LIGHT_THRESHOLD ||
      soilMoisture < SOIL_MOISTURE_THRESHOLD) {
    // Initialize the message
    SMTP_Message message;
    message.sender.name = "ESP32";
    message.sender.email = sender_email;
    message.subject = "Sensor Threshold Exceeded on Boot";

    // Create message content
    String content = "Sensor readings exceeded threshold on boot:\n";
    content += "Temperature: " + String(temperature) + "°C\n";
    content += "Humidity: " + String(humidity) + "%\n";
    content += "Light Intensity: " + String(lightIntensity) + "\n";
    content += "Soil Moisture: " + String(soilMoisture) + "\n";

    // Set message content
    message.text.content = content.c_str();

    // Add recipient
    message.addRecipient(Recipient_name, Recipient_email);

    // Send email
    if (!MailClient.sendMail(&smtp, &message)) {
      Serial.println("Error sending Email, " + smtp.errorReason());
    } else {
      Serial.println("Email sent successfully on boot!");
    }
  }
}
```

```
void loop() {
  // Read sensor data
  float temperature = dht.readTemperature();
  float humidity = dht.readHumidity();
  int lightIntensity = analogRead(LDR_PIN);
  int soilMoisture = (100 - (analogRead(SOIL_MOISTURE_PIN) / 4095.00) * 100);

  // Check if any sensor reading exceeds the threshold
  if (temperature > TEMPERATURE_THRESHOLD ||
      humidity > HUMIDITY_THRESHOLD ||
      lightIntensity > LIGHT_THRESHOLD ||
      soilMoisture < SOIL_MOISTURE_THRESHOLD) {
    // Initialize the message
    SMTP_Message message;
    message.sender.name = "ESP32";
    message.sender.email = sender_email;
    message.subject = "Sensor Threshold Exceeded";

    // Create message content
    String content = "Sensor readings exceeded threshold:\n";
    content += "Temperature: " + String(temperature) + "°C\n";
    content += "Humidity: " + String(humidity) + "%\n";
    content += "Light Intensity: " + String(lightIntensity) + "\n";
    content += "Soil Moisture: " + String(soilMoisture) + "\n";

    // Set message content
    message.text.content = content.c_str();

    // Add recipient
    message.addRecipient(Recipient_name, Recipient_email);

    // Send email
    if (!MailClient.sendMail(&smtp, &message)) {
      Serial.println("Error sending Email, " + smtp.errorReason());
    } else {
      Serial.println("Email sent successfully!");
    }
  }

  // Delay before next reading
  delay(60000); // Delay for 1 minute before checking again
}
```

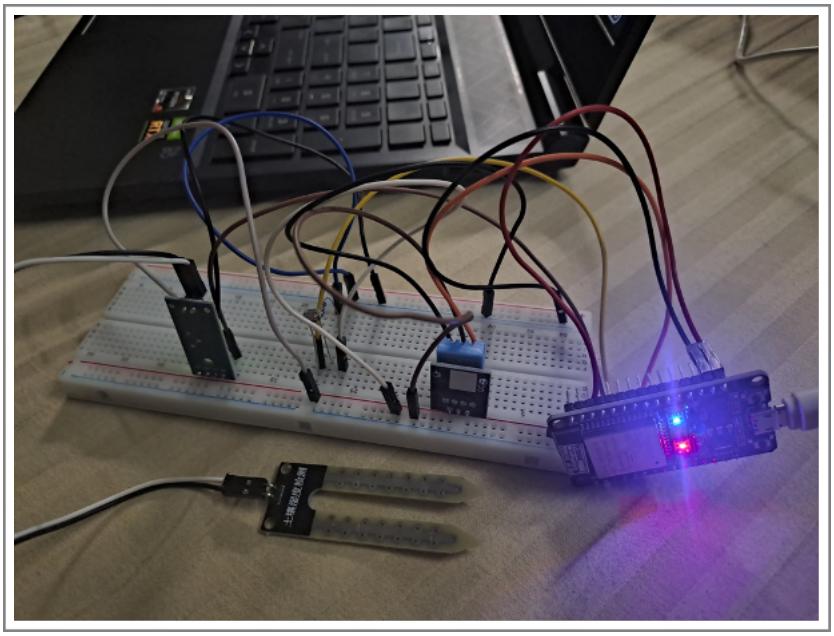
Results :-

The system successfully monitored the environmental parameters including temperature, humidity, light intensity, and soil moisture. Email notifications were sent when any of these parameters exceeded the predefined thresholds.



Snippet of Email :-

Hardware Implementation:-



Conclusion :-

The IoT crop management system demonstrated the ability to effectively monitor environmental conditions and provide timely notifications when thresholds were exceeded. This project successfully demonstrated the monitoring of environmental parameters crucial for crop management. The ESP32 microcontroller effectively interfaced with sensors to collect data of temperature, humidity, light intensity, and soil moisture. Email notifications were successfully sent via SMTP when sensor readings deviated from predefined optimal values, contributing to early detection of environmental stressors affecting crops. Further refinements could be made to enhance the system's robustness and accuracy in real-world agricultural settings.