Smart Agriculture Monitoring System

Department:CSE

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PROBLEM STATEMENT

Farmers need to cope and adapt with climate change,which affect farmers ability to grow food.I ncreasing volatile weather and extreme events (like flood and droughts) change growing seasons and limit the availability of water,allow weeds,pest and fungi to thrive.
Agriculture operations waste about 60% of water consumed each year(mainly due to traditional irrigation methods).Ideally under-watering or over-watering can cause yield reduction.This calls for the need to adopt smart irrigation system

How does a System Work?

In this project, we are going to build a **Smart Farming System using IoT**. The objective of this project is to offer assistance to farmers in getting Live Data (Temperature, Humidity, Soil Moisture, Soil Temperature) for efficient environment monitoring which will enable them to increase their overall yield and quality of products. This smart agriculture using IoT system powered by NodeMCU consists of a DHT11 sensor, Moisture sensor, DS18B20 Sensor Probe, LDR, Water Pump, and 12V led strip. When the IoT-based agriculture monitoring system starts, it checks the Soil moisture, temperature, humidity, and soil temperature. It then sends this data to the IoT cloud for live monitoring. If the soil moisture goes below a certain level, it automatically

The smart farming is based on IoT that will be implemented using NodeMCU ESP8266 ,with

other components like DHT11 Sensor,Moisture sensor,DS18B20 Sensor Probe,LDR,Water

pump.

- The data will be managed and displayed on the adafruit.io cloud service.

- Open weather API will be required to get weather forecast.

- The water monitoring system will use Ardui

Role of Temperature and Humidity Sensor

The DHT11 sensor, DS18B20, and moisture sensor are commonly used in smart agriculture monitoring systems to measure temperature, humidity, and soil moisture levels respectively.

The DHT11 sensor is a low-cost temperature and humidity sensor that can measure temperatures between 0 and 50°C with an accuracy of ±2°C and humidity between 20% and 90% RH with an accuracy of ±5%. This sensor is commonly used in greenhouses, crop storage rooms, and other agricultural environments where temperature and humidity control is important.

The DS18B20 sensor is a digital temperature sensor that can measure temperatures between -55 and 125°C with an accuracy of ±0.5°C. This sensor is commonly used to measure soil temperature, which is an important factor in crop growth.

The moisture sensor is used to measure the moisture content in the soil. This sensor can be used to monitor soil moisture levels in real-time, which can help farmers make informed decisions about irrigation and fertilization. The sensor works by measuring the electrical conductivity of the soil, which is directly related to the moisture content.

In a smart agriculture monitoring system, these sensors can be connected to a microcontroller or a single-board computer such as Arduino or Raspberry Pi, which can then transmit the data to a cloud-based platform for analysis and visualization. This allows farmers to monitor their crops in real-time and make data-driven decisions to optimize crop yields and reduce costs.

COMPONENTS USED

- **ESP8266**

  ESP8266MOD is a popular WiFi module that can be used for a wide range of IoT projects, including smart home automation, weather monitoring, and industrial automation. ESP8266MOD is a versatile module that can be programmed using the Lua scripting language or the Arduino IDE.

- **DHT Sensor:**

  DHT stands for Digital Humidity and Temperature.The DHT sensor is a low-cost digital sensor for sensing temperature and humidity. This sensor can be easily interfaced with any micro-controller such as Arduino, Raspberry Pi to measure humidity and temperature instantaneously.

  DHT is used in a sun tracking solar system to monitor the temperature and humidity of the surrounding environment for optimizing efficiency and protecting the system from adverse conditions.

Hardware

- NodeMCU ESP8266
- Soil Moisture Sensor
- DHT11 Sensor
- DS18B20 Waterproof Temperature Sensor Probe
- LDR
- Submersible Mini Water Pump
- 12V LED Strip
- 7805 Voltage Regulator
- 2×TIP122 Transistor
- Resistor (4.7K, 10K)
- Capacitor (0.1µF, 10 µF)

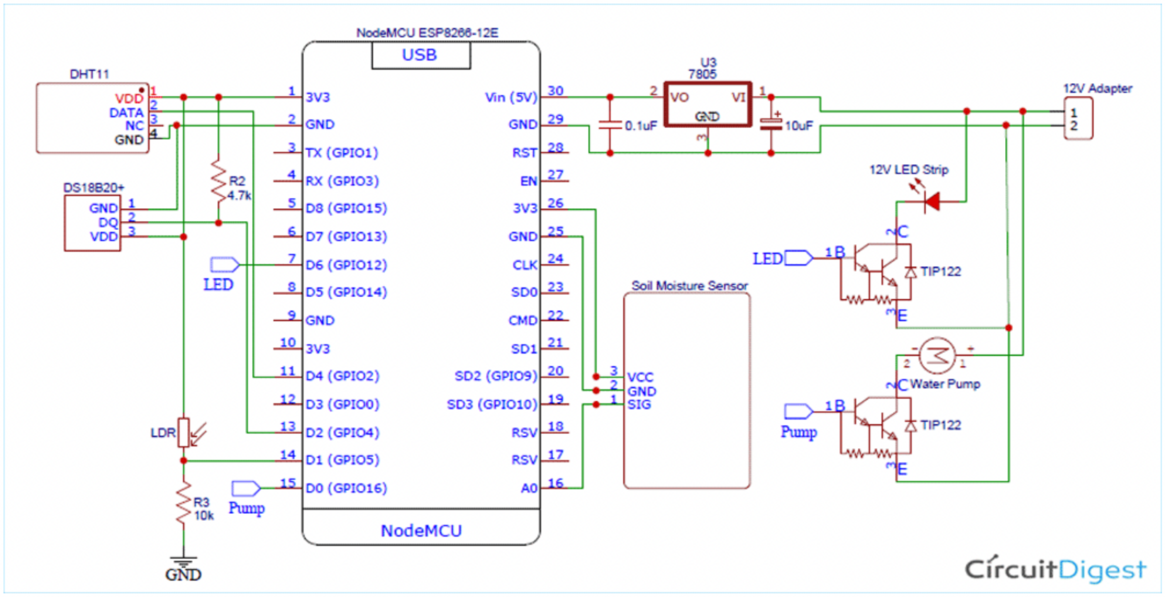
Online Services

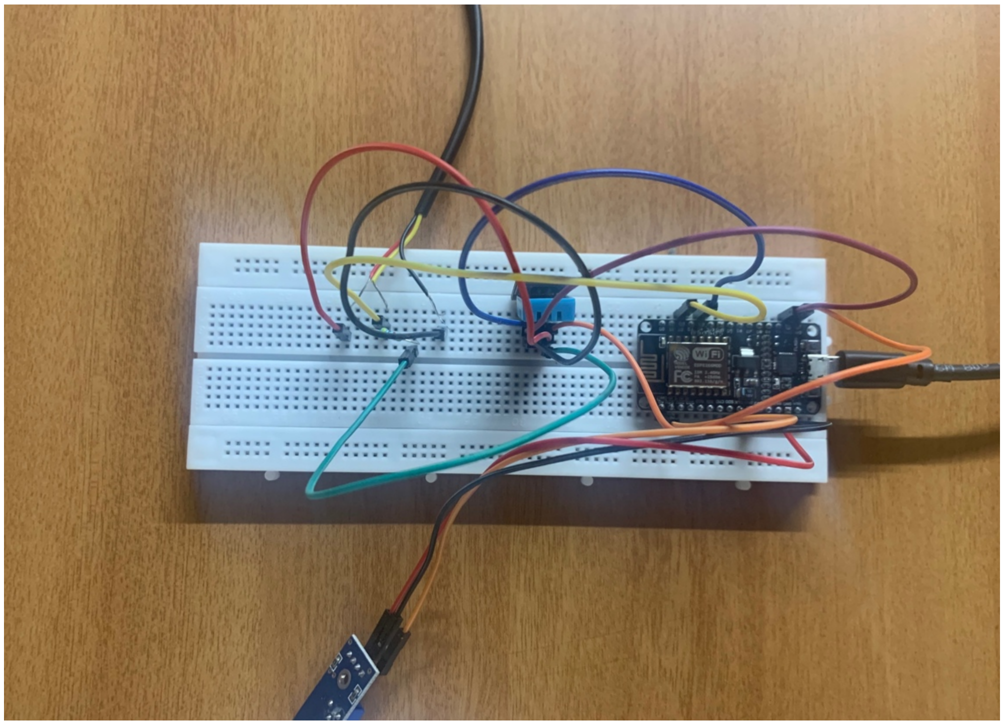
- Adafruit IO

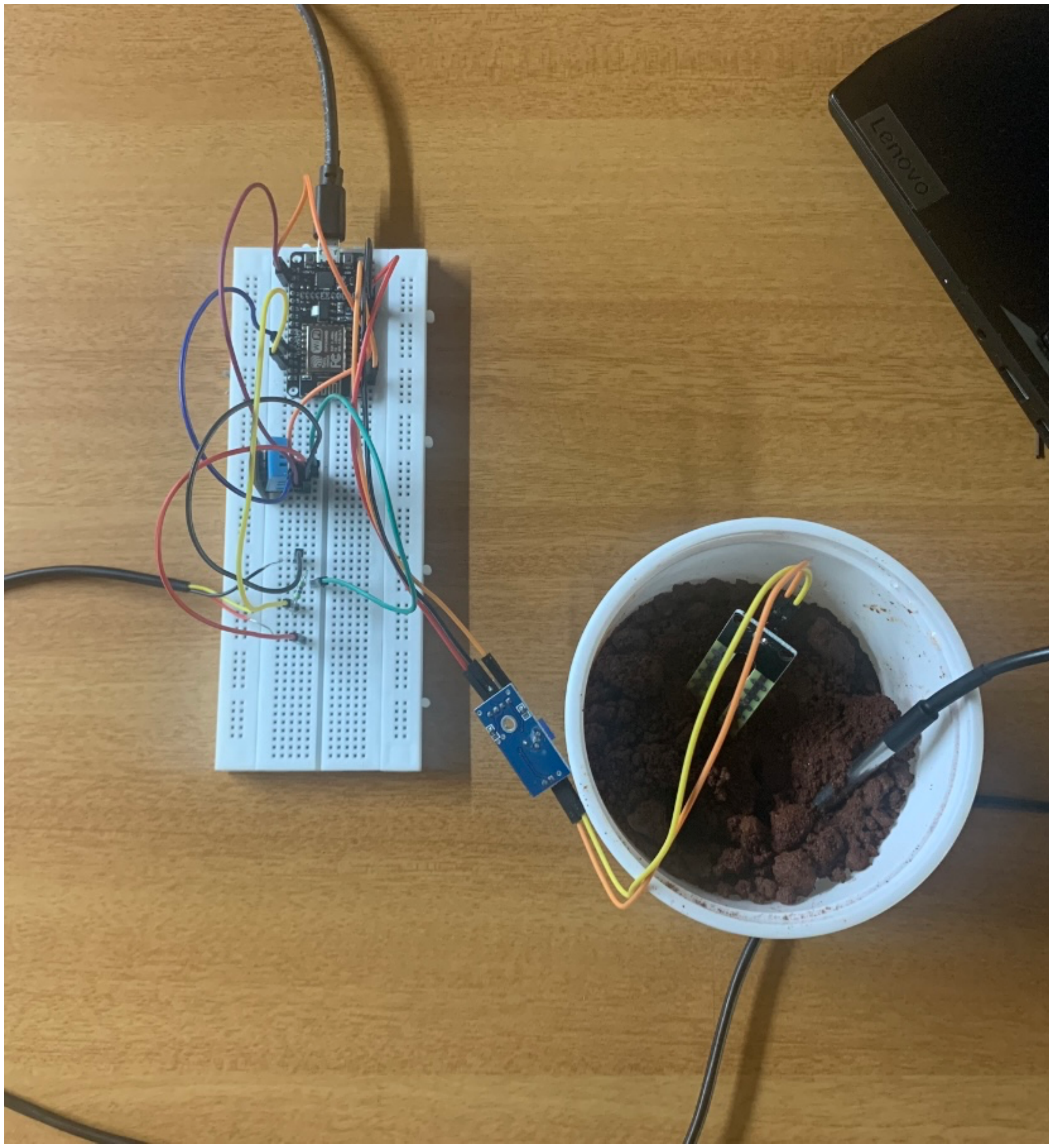
SCHEMATIC DIAGRAM

Smart Agriculture System Circuit Diagram

The complete schematic for the **Smart Agriculture System** is given below:





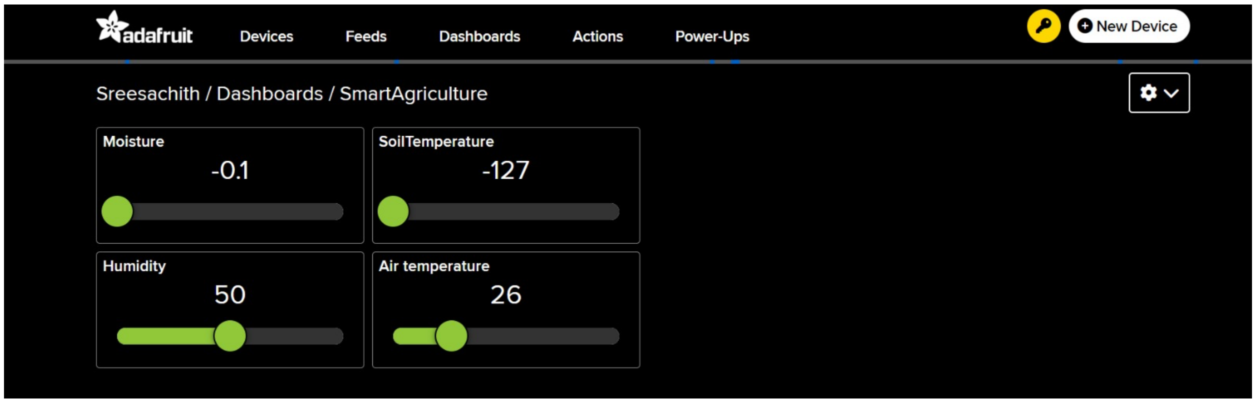


This circuit isn't that hard. Here we have used 4 sensors i.e. DHT11, DS18B20 sensor probe, LDR and Soil Moisture Sensor, one 12V LED Strip, 12V water pump, 7805 voltage regulator, and two TP122 transistors to control Led strip and water pump. 7805 is used to get the regulated 5V from the 12V adapter, DHT11 sensor is used to get the temperature and humidity readings. The DS18B20 sensor probe is used to get the soil temperature and a soil moisture sensor is used to read the Soil moisture so that the water pump can be turned on/off automatically.

Software:

Adafruit IO Setup

Adafruit IO is an open data platform that allows you to aggregate, visualize, and analyze live data on the cloud. Using Adafruit IO, you can upload, display, and monitor your data over the internet, and make your project IoT-enabled. You can control motors, read sensor data, and make cool IoT applications over the internet using Adafruit IO.



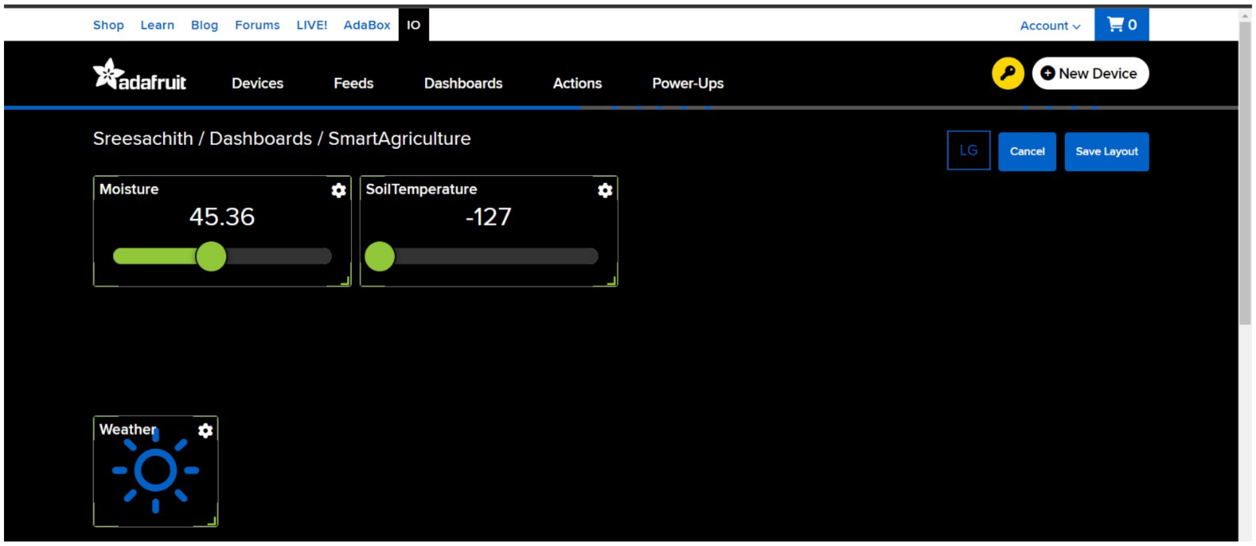
Sreesachith / Dashboards / SmartAgriculture

Moisture -0.1

SoilTemperature -127

Humidity 50

Air temperature 26



Sreesachith / Dashboards / SmartAgriculture

Moisture 45.36

SoilTemperature -127

Weather

Code:

Language used :Embedded C

```
#include <ESP8266WiFi.h>

#include <DallasTemperature.h>

#include <OneWire.h>

#include "DHT.h"

#include "Adafruit_MQTT.h"

#include "Adafruit_MQTT_Client.h"

#include <ArduinoJson.h>

const char *ssid =  "realme 8s 5G";     // Enter your WiFi Name

const char *pass =  "k3e6g36z"; // Enter your WiFi Password

WiFiClient client;

#define MQTT_SERV "io.adafruit.com"

#define MQTT_PORT 1883

#define MQTT_NAME "Sreesachith" // Your Adafruit IO Username

#define MQTT_PASS "aio_Brsg87XE6Y9dMNbTioIo80gHyltJ" // Adafruit IO AIO key

const char server[] = "api.openweathermap.org";

String nameOfCity = "Jaipur,IN";

String apiKey = "e8b22b36da932dce8f31ec9be9cb68a3";

String text;

const char* icon="";

int jsonend = 0;

boolean startJson = false;

int status = WL_IDLE_STATUS;

#define JSON_BUFF_DIMENSION 2500
```

```
unsigned long lastConnectionTime = 10 * 60 * 1000;     // last time you connected to the server, in milliseconds

const unsigned long postInterval = 10 * 60 * 1000;  // posting interval of 10 minutes (10L * 1000L; 10 seconds delay for testing)

const int ldrPin = D1;

const int ledPin = D0;

const int moisturePin = A0;  // moisteure sensor pin

const int motorPin = D8;

float moisturePercentage;              //moisture reading

int temperature, humidity, soiltemp;

#define ONE_WIRE_BUS 4   //D2 pin of nodemcu

#define DHTTYPE DHT11   // DHT 11

#define dht_dpin D4

DHT dht(dht_dpin, DHTTYPE);

OneWire oneWire(ONE_WIRE_BUS);

DallasTemperature sensors(&oneWire);

const unsigned long Interval = 50000;

unsigned long previousTime = 0;

//Set up the feed you're publishing to

Adafruit_MQTT_Client mqtt(&client, MQTT_SERV, MQTT_PORT, MQTT_NAME, MQTT_PASS);

Adafruit_MQTT_Publish Moisture = Adafruit_MQTT_Publish(&mqtt,MQTT_NAME "/f/Moisture"); // Moisture is the feed name where you will publish your data

Adafruit_MQTT_Publish Temperature = Adafruit_MQTT_Publish(&mqtt,MQTT_NAME "/f/Temperature");

Adafruit_MQTT_Publish Humidity = Adafruit_MQTT_Publish(&mqtt,MQTT_NAME "/f/Humidity");

Adafruit_MQTT_Publish SoilTemp = Adafruit_MQTT_Publish(&mqtt,MQTT_NAME "/f/SoilTemp");

Adafruit_MQTT_Publish WeatherData = Adafruit_MQTT_Publish(&mqtt,MQTT_NAME "/f/WeatherData");
```

```
//Set up the feed you're subscribing to

 Adafruit_MQTT_Subscribe LED = Adafruit_MQTT_Subscribe(&mqtt, MQTT_NAME "/f/LED");

 Adafruit_MQTT_Subscribe Pump = Adafruit_MQTT_Subscribe(&mqtt, MQTT_NAME "/f/Pump");

void setup()

{

  Serial.begin(9600);

  delay(10);

  dht.begin();

  sensors.begin();

  mqtt.subscribe(&LED);

  mqtt.subscribe(&Pump);

  pinMode(motorPin, OUTPUT);

  pinMode(ledPin, OUTPUT);

  pinMode(ldrPin, INPUT);

  digitalWrite(motorPin, LOW); // keep motor off initally

  digitalWrite(ledPin, HIGH);

  text.reserve(JSON_BUFF_DIMENSION);

  Serial.println("Connecting to ");

  Serial.println(ssid);

  WiFi.begin(ssid, pass);

  while (WiFi.status() != WL_CONNECTED)

  {

    delay(500);

    Serial.print(".");              // print ... till not connected

  }

  Serial.println("");
  Serial.println("WiFi connected");

}

void loop()

{

 unsigned long currentTime = millis();

 MQTT_connect();

 if (millis() - lastConnectionTime > postInterval) {

    // note the time that the connection was made:

    lastConnectionTime = millis();

    makehttpRequest();

  }

//}

 int ldrStatus = analogRead(ldrPin);

    if (ldrStatus <= 200) {

       digitalWrite(ledPin, HIGH);

       Serial.print("Its DARK, Turn on the LED : ");

       Serial.println(ldrStatus);

    }

    else {

      digitalWrite(ledPin, LOW);

      Serial.print("Its BRIGHT, Turn off the LED : ");

      Serial.println(ldrStatus);

     }

  moisturePercentage = ( 100.00 - ( (analogRead(moisturePin) / 1023.00) * 100.00 ) );

  Serial.print("Soil Moisture is  = ");
  Serial.print(moisturePercentage);

  Serial.println("%");

if (moisturePercentage < 35) {

  digitalWrite(motorPin, HIGH);         // tun on motor

}

if (moisturePercentage > 38) {

  digitalWrite(motorPin, LOW);          // turn off mottor

}

 temperature = dht.readTemperature();

 humidity = dht.readHumidity();

 //Serial.print("Temperature: ");

 //Serial.print(temperature);

 //Serial.println();

 //Serial.print("Humidity: ");

 //Serial.print(humidity);

 //Serial.println();

 sensors.requestTemperatures();

 soiltemp = sensors.getTempCByIndex(0);

// Serial.println("Soil Temperature: ");

// Serial.println(soiltemp);

if (currentTime - previousTime >= Interval) {

    if (! Moisture.publish(moisturePercentage)) //This condition is used to publish
the Variable (moisturePercentage) on adafruit IO. Change thevariable according to
yours.

         {

            }

    if (! Temperature.publish(temperature))
```

```
         {

           }

    if (! Humidity.publish(humidity))

         {

         //delay(30000);

          }

    if (! SoilTemp.publish(soiltemp))

       {

          }

    if (! WeatherData.publish(icon))

       {

         }

          previousTime = currentTime;

}

Adafruit_MQTT_Subscribe * subscription;

while ((subscription = mqtt.readSubscription(5000))) //Dont use this one until you are
conrolling something or getting data from Adafruit IO.

     {

    if (subscription == &LED)

     {

      //Print the new value to the serial monitor

      Serial.println((char*) LED.lastread);

        if (!strcmp((char*) LED.lastread, "OFF"))

       {

         digitalWrite(ledPin, LOW);

        }
        if (!strcmp((char*) LED.lastread, "ON"))
          {
         digitalWrite(ledPin, HIGH);
         }
     }
    if (subscription == &Pump)
      {
      //Print the new value to the serial monitor
      Serial.println((char*) Pump.lastread);

      if (!strcmp((char*) Pump.lastread, "OFF"))
       {
        digitalWrite(motorPin, HIGH);
       }
     if (!strcmp((char*) Pump.lastread, "ON"))
       {
        digitalWrite(motorPin, LOW);
       }
     }
    }
  delay(9000);
 // client.publish(WeatherData, icon)
}
void MQTT_connect()
{
  int8_t ret;

  // Stop if already connected.

  if (mqtt.connected())

  {

    return;

  }

  uint8_t retries = 3;

  while ((ret = mqtt.connect()) != 0) // connect will return 0 for connected

  {

       mqtt.disconnect();

       delay(5000);  // wait 5 seconds

       retries--;

       if (retries == 0)

       {

         // basically die and wait for WDT to reset me

         while (1);

       }

  }

}

void makehttpRequest() {

  // close any connection before send a new request to allow client make connection to
server

  client.stop();

  // if there's a successful connection:

  if (client.connect(server, 80)) {

    client.println("GET /data/2.5/forecast?q=" + nameOfCity + "&APPID=" + apiKey +
"&mode=json&units=metric&cnt=2 HTTP/1.1");
```

```
    client.println("Host: api.openweathermap.org");

    client.println("User-Agent: ArduinoWiFi/1.1");

    client.println("Connection: close");

    client.println();

    unsigned long timeout = millis();

    while (client.available() == 0) {

      if (millis() - timeout > 5000) {

        Serial.println(">>> Client Timeout !");

        client.stop();

        return;

      }

    }

    char c = 0;

    while (client.available()) {

      c = client.read();

      // since json contains equal number of open and close curly brackets, this means
we can determine when a json is completely received  by counting

      // the open and close occurences,

      //Serial.print(c);

      if (c == '{') {

        startJson = true;         // set startJson true to indicate json message has
started

        jsonend++;

      }

      if (c == '}') {

        jsonend--;
      }

      if (startJson == true) {

        text += c;

      }

      // if jsonend = 0 then we have have received equal number of curly braces

      if (jsonend == 0 && startJson == true) {

        parseJson(text.c_str());  // parse c string text in parseJson function

        text = "";                // clear text string for the next time

        startJson = false;        // set startJson to false to indicate that a new
message has not yet started

      }

    }

  }

  else {

    // if no connction was made:

    Serial.println("connection failed");

    return;

  }

}

//to parse json data recieved from OWM

void parseJson(const char * jsonString) {

  //StaticJsonBuffer<4000> jsonBuffer;

  const size_t bufferSize = 2*JSON_ARRAY_SIZE(1) + JSON_ARRAY_SIZE(2) +
4*JSON_OBJECT_SIZE(1) + 3*JSON_OBJECT_SIZE(2) + 3*JSON_OBJECT_SIZE(4) +
JSON_OBJECT_SIZE(5) + 2*JSON_OBJECT_SIZE(7) + 2*JSON_OBJECT_SIZE(8) + 720;

DynamicJsonBuffer jsonBuffer(bufferSize);
```

```
//  DynamicJsonDocument(bufferSize);

  // FIND FIELDS IN JSON TREE

  JsonObject& root = jsonBuffer.parseObject(jsonString);

  if (!root.success()) {

    Serial.println("parseObject() failed");

    return;

  }

  JsonArray& list = root["list"];

  JsonObject& nowT = list[0];

  JsonObject& later = list[1];

  JsonObject& tommorow = list[2];

//  String conditions = list.weather.main;

  // including temperature and humidity for those who may wish to hack it in

  String city = root["city"]["name"];

  String weatherNow = nowT["weather"][0]["description"];

  String weatherLater = later["weather"][0]["description"];

  String list12 = later["weather"][0]["list"];

  Serial.println(list12);

  Serial.println(weatherLater);

  if(weatherLater == "few clouds"){

    icon = "Few Clouds";

    Serial.print(icon);

  }

  else if(weatherLater == "rain"){

    icon = "Rain";

    Serial.print(icon);
  }

  else if(weatherLater == "broken clouds"){

    icon = "Broken Clouds";

    Serial.print(icon);

  }

  else {

    icon = "Sunny";

    }

}
```

Working (Video Link):

https://youtube.com/shorts/YanUxJAzTDA?feature=share

(Copy paste /Click to watch)