SPRINT – 3

DATE	**12 November 2022**
TEAM ID	**PNT2022TMID27433**
PROJECT NAME	**Smart Farmer - IoT Enabled Smart Farming Application**

SMART FARMER – SENSOR DATA VISUALIZATION IN IBM WATSON IOT PLATFORM AND NODE RED

Description:

This Smart Irrigation System is used to help farmers in the irrigation process. The System provides data on the parameters which can be used to monitor the condition of the field to maintain and protect the crops. The parameters like temperature, humidity, the water level in the field, etc., can be accessed through the system. The sensors in the system monitor the parameters and provide them to the farmer through the Wi-Fi module to the IBM cloud to take the necessary measures.

Program:

```
#include <Wire.h>                  //Includes the library for connections
#include <ESP32Servo.h>            //Includes the library for Servo motor
#include <LiquidCrystal_I2C.h>     //Includes the library for LED
#include <DHTesp.h>                //Includes the library for DHT22 sensor


// WiFi libraries:
#include <WiFi.h>
#include <WiFiClient.h>
#include <PubSubClient.h>
```

```
#define ORG "oqy2ad"          // Organization ID of IBM Cloud
#define DEVICE_TYPE "ESP32"
#define DEVICE_ID "NodeMCU"
#define TOKEN "123456789"

// Publishing Event in Watson IOT platform:
char server[] = ORG ".messaging.internetofthings.ibmcloud.com";
//oqy2ad.messaging.internetofthings.ibmcloud.com
char pubTopic[] = "iot-2/evt/status1/fmt/json";
char authMethod[] = "use-token-auth";
char token[] = TOKEN;
char clientId[] = "d:" ORG ":" DEVICE_TYPE ":" DEVICE_ID;

const char *ssid = "Wokwi-GUEST";
const char *password = "";
const char led = 4;

const int servoPin = 2;
const int echo = 12;
const int trig = 14;
const int r = 27;
const int g = 26;
const int b = 25;
const int y = 33;
const int sec = 0;
const int dht = 15;
long lastMsg = 0;
```

```
Servo s;
#define I2C_ADDR 0x27
#define LCD_COLUMNS 20
#define LCD_LINES 4

LiquidCrystal_I2C lcd(I2C_ADDR, LCD_COLUMNS, LCD_LINES);
DHTesp dhtSensor;
WiFiClient wifiClient;
PubSubClient client(server, 1883, NULL, wifiClient);

void setup()
{
  Serial.begin(115200);
  Wire.begin();
  pinMode(A0, INPUT);          // Temperature Sensor
  pinMode(trig, OUTPUT);       // Ultra sonic Trigger
  pinMode(echo, INPUT);        // Ultra sonic Echo
  pinMode(b, OUTPUT);          // BLUE light for LED
  pinMode(g, OUTPUT);          // GREEN light for LED
  pinMode(r, OUTPUT);          // RED light for LED
  pinMode(y, OUTPUT);          // YELLOW light for LED
  pinMode(led, OUTPUT);        // LED for WiFi
  s.attach(servoPin, 500, 2400); // Servo Motor
  lcd.init();                  // LCD Display
  lcd.setBacklight(0);
  dhtSensor.setup(dht, DHTesp::DHT22);
```

```
Serial.println();
// Connecting the ESP32 with WiFi:
pinMode(led, OUTPUT);
Serial.print("Connecting to ");
Serial.print(ssid);
WiFi.mode(WIFI_STA);
WiFi.begin(ssid, password, 6);
while (WiFi.status() != WL_CONNECTED)
{
   delay(500);
   Serial.print(".");
}
Serial.println("");
Serial.print("WiFi connected, IP address: ");
Serial.println(WiFi.localIP());

// Connecting to IBM Cloud:
if (!client.connected())
{
   Serial.print("Reconnecting client to ");
   Serial.println(server);
   while (!client.connect(clientId, authMethod, token))
   {
      Serial.print(".");
      delay(500);
   }
   /*client.setCallback(receivedCallback);
```

```
        if (client.subscribe(subTopic))
        {
           Serial.println("subscribe to cmd OK");
        }
        else
        {
           Serial.println("subscribe to cmd FAILED");
        }*/
        Serial.println("Bluemix connected");
        Serial.println("");
    }
}

float readDistanceCM()
{
    digitalWrite(trig, LOW);
    delayMicroseconds(2);
    digitalWrite(trig, HIGH);
    delayMicroseconds(10);
    digitalWrite(trig, LOW);
    int duration = pulseIn(echo, HIGH);
    return duration * 0.034 / 2;
}

void loop()
{
```

```
client.loop();
long now = millis();
// Temperature:
TempAndHumidity data = dhtSensor.getTempAndHumidity();
float t = data.temperature;
float h = data.humidity;
Serial.println("Temperature: " + String(t) + " degrees");
Serial.println("Moisture: " + String(h) + " %");

// Ultrasonic sensor:
float distance = readDistanceCM();
Serial.print("Measured distance: ");
Serial.println(readDistanceCM());

// LCD Display:
lcd.setBacklight(1);
lcd.clear();
digitalWrite(b, 0);
digitalWrite(g, 0);
digitalWrite(r, 0);
digitalWrite(y, 0);

// Conditions:
```

/*If the temperature is Greater than 30 and less than 40 and also humidity is greater than 30 and less than 70 then the GREEN light will be turned ON indicating the Normal condition */

```
if (t > 30 & t < 40 && h > 30 & h < 70)
{
```

```
    digitalWrite(g, 1);
    s.write(90);
    Serial.println("Normal Condition");
    Serial.println("Water Partially Flows");
    lcd.setCursor(3, 1);
    lcd.println("ON Motor");
    delay(2000);
    lcd.clear();
  }
```

/*If the temperature is greater than 40 OR the humidity is less than 30, then the RED light will be turned ON indicating the Hot or Low humid condition */

```
  else if (t > 40 | h < 30)
  {
    digitalWrite(r, 1);
    s.write(180);
    Serial.println("High Temperature or Low humid condition");
    Serial.println("Water Fully Flows");
    lcd.setCursor(3, 1);
    lcd.println("ON Motor");
    delay(2000);
    lcd.clear();
  }
```

/*If the level of water is MORE in the field it will be indicated by distance sensor for less than 10cm, then the YELLOW light will be turned ON indicating the high water level */

```
  else if (distance < 10)
```

```
{
   digitalWrite(y, 1);
   s.write(0);
   Serial.println("Water Does Not Flow");
   Serial.println("Water is Full in the field");
   lcd.setCursor(2, 1);
   lcd.println("Drain the water");
   delay(2000);
   lcd.clear();
}
```

/*If the temperature is less than 30 OR the humidity is greater than 70, then the BLUE light will be turned ON indicating the Cool or High humid condition */

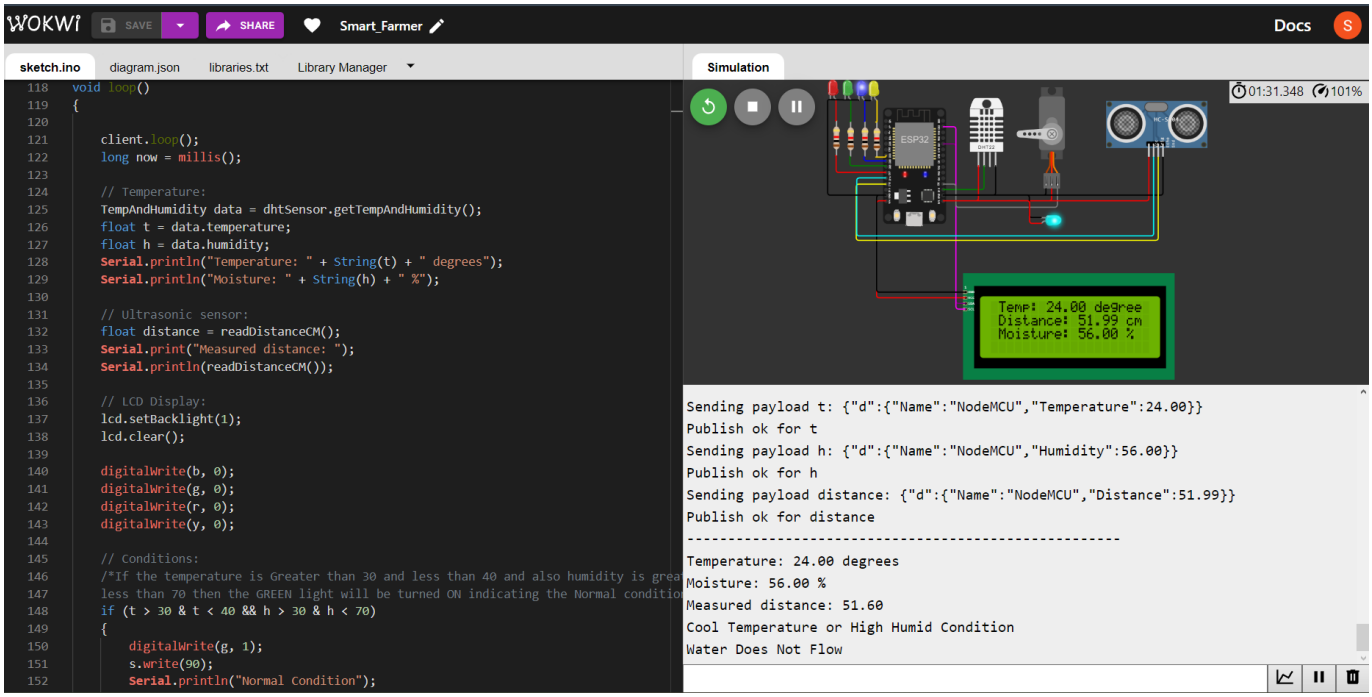
```
else if (t<30 | h> 70)
{
   digitalWrite(b, 1);
   s.write(0);
   Serial.println("Cool Temperature or High Humid Condition");
   Serial.println("Water Does Not Flow");
   lcd.setCursor(3, 1);
   lcd.println("OFF Motor");
   delay(2000);
   lcd.clear();
}

else
{
```

```
    digitalWrite(b, 1);
    s.write(0);
    Serial.println("Water Does Not Flow");
}

lcd.setCursor(1, 0);
lcd.print("Temp: ");
lcd.print(t);
lcd.print(" degree");
lcd.setCursor(1, 1);
lcd.print("Distance: ");
lcd.print(distance);
lcd.print(" cm");
lcd.setCursor(1, 2);
lcd.print("Moisture: ");
lcd.print(h);
lcd.print(" %");
delay(3000);
lcd.clear();

// Sending payload:
Serial.println("");
if (now - lastMsg > 5000)
{
    lastMsg = now;
    //Payload for Temperature:
    String payloadt = "{\"d\":{\"Name\":\"" DEVICE_ID "\"";
```

```
payloadt += ",\"Temperature\":";
payloadt += t;
payloadt += "}}";
Serial.print("Sending payload t: ");
Serial.println(payloadt);

if (client.publish(pubTopic, (char *)payloadt.c_str()))
{
   Serial.println("Publish ok for t");
}
else
{
   Serial.println("Publish failed");
}
delay(3000);

//Payload for Humidity:
String payloadh = "{\"d\":{\"Name\":\"" DEVICE_ID "\"";
payloadh += ",\"Humidity\":";
payloadh += h;
payloadh += "}}";
Serial.print("Sending payload h: ");
Serial.println(payloadh);

if (client.publish(pubTopic, (char *)payloadh.c_str()))
{
   Serial.println("Publish ok for h");
```

```
    }
    else
    {
      Serial.println("Publish failed");
    }
    delay(2000);

    //Payload for Distance:
    String payloadd = "{\"d\":{\"Name\":\"" DEVICE_ID "\"";
    payloadd += ",\"Distance\":";
    payloadd += distance;
    payloadd += "}}";
    Serial.print("Sending payload distance: ");
    Serial.println(payloadd);

    if (client.publish(pubTopic, (char *)payloadd.c_str()))
    {
      Serial.println("Publish ok for distance");
    }
    else
    {
      Serial.println("Publish failed");
    }
    delay(2000);
  }
  Serial.println("-------------------------------------------------");
}
```

Sending Payloads through the Simulator:



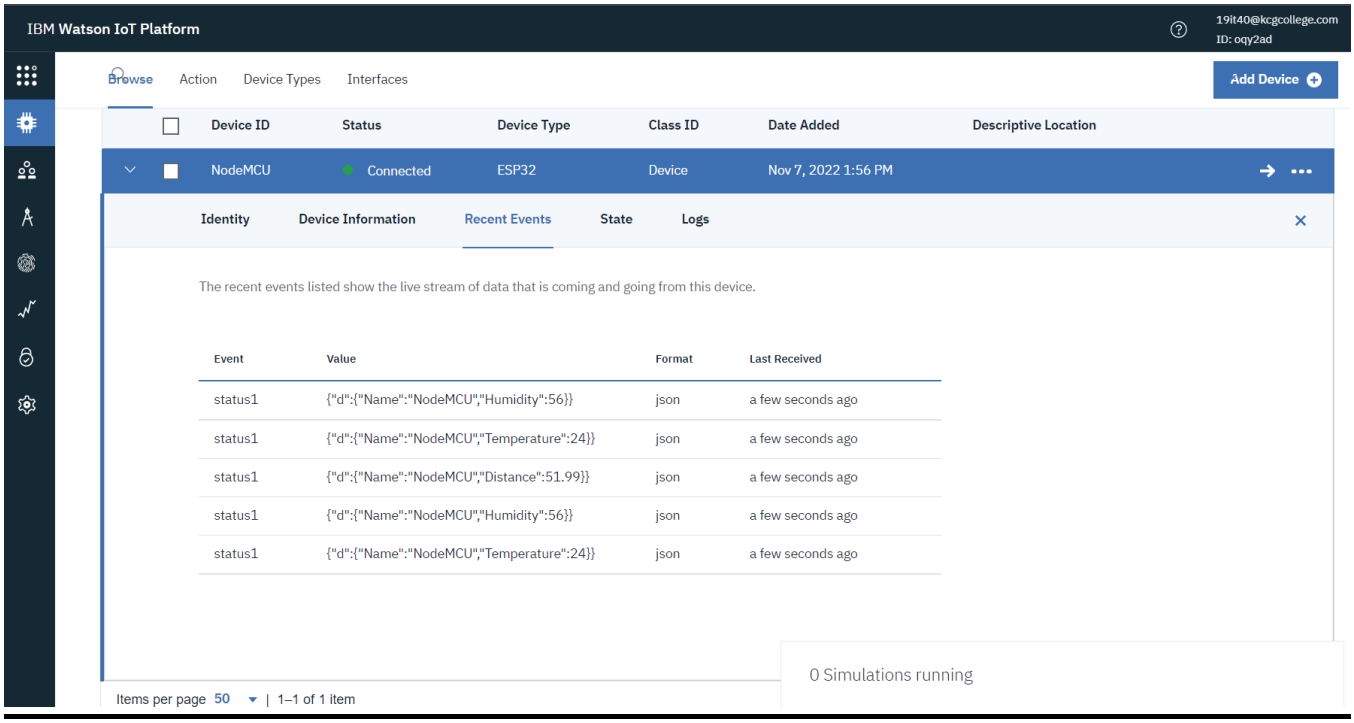
Payload Sending and Visualization Process in IBM and Node RED:

The data from the simulator is sent in payloads to the Watson IoT platform. The data will be viewed in the devices tab. The JSON data can be viewed in recent events. These data can also be visualized using the cards in which each parameter data is viewed separately in any kind of visual representation.

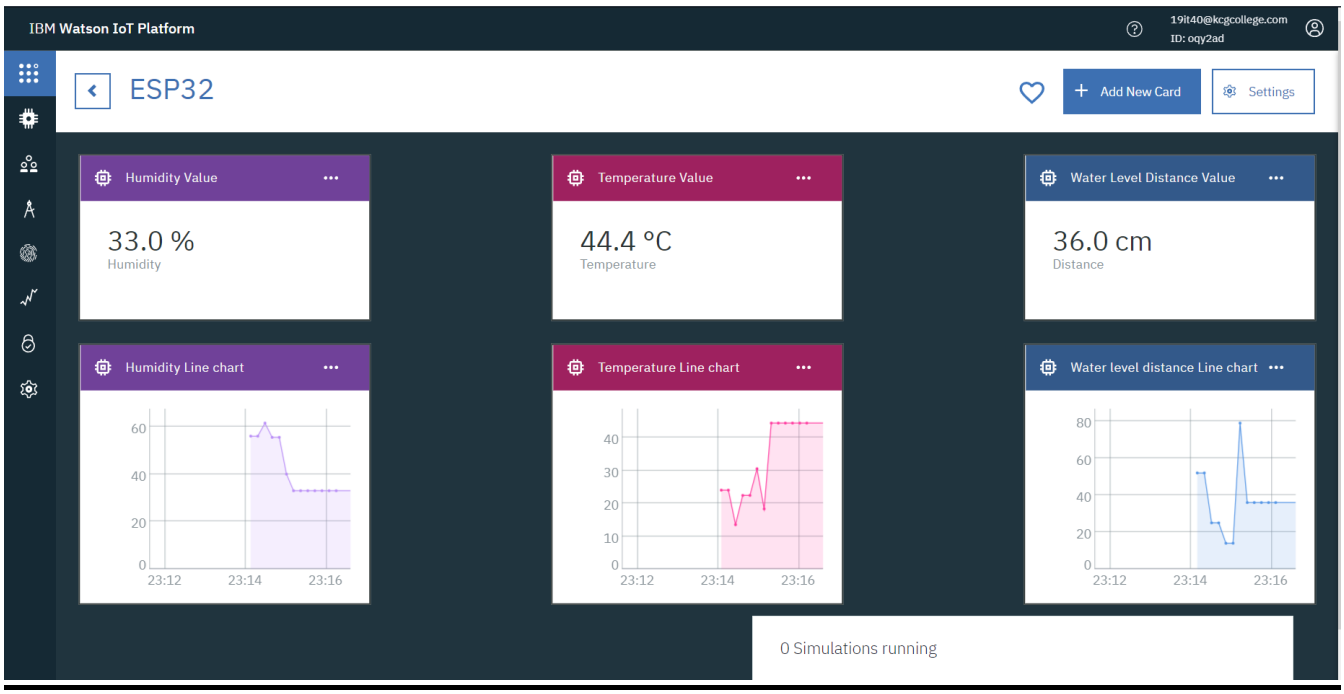
The JSON format of data from the sensor can also be visualized in Node RED. First, the flow is setup in Node RED using the nodes and then the functions are created for each parameter. Then, the Node RED is connected with IBM Cloud using the API key and Authentication Token which is created in the Apps tab in the Watson IoT platform.

The visualizations for data are created in Node RED dashboard, which is then linked with the function in the flow. After the deployment, the sensor data can be viewed in the dashboard and updated at specified intervals.

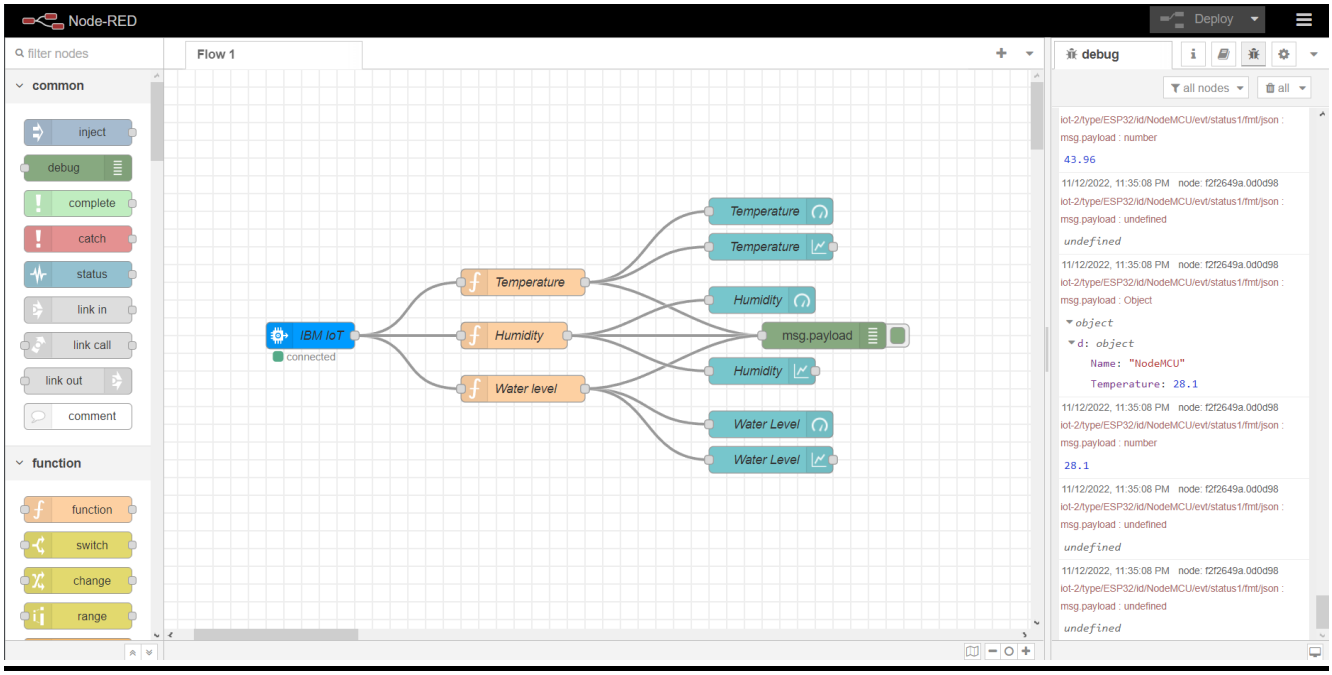
Event status in Watson IoT Platform:



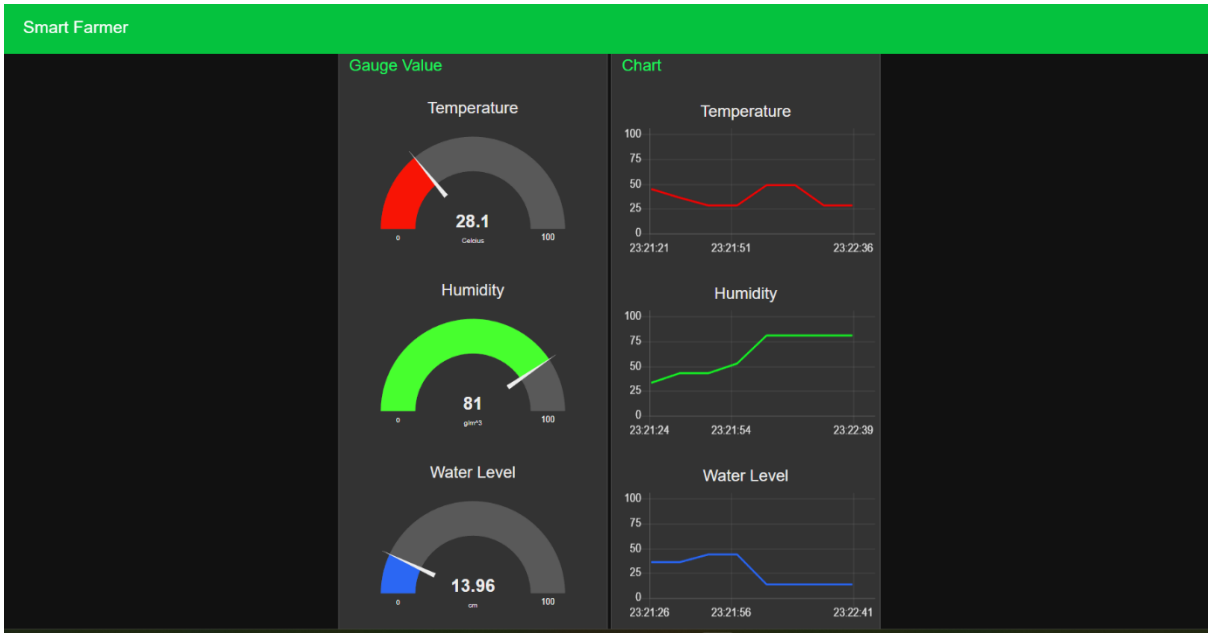
Visualizations of Data from sensors in Watson IoT platform:



Creation of Flow in Node RED:



Visualizations of data from sensors in Node RED Dashboard:



Link For Project in Wokwi:

https://wokwi.com/projects/347430571578753618

Link For Output in Node Red:

https://node-red-smartfarmer.eu-de.mybluemix.net/ui/#!/0?socketid=VA5lCj3pZbqvseYcAAAb