

ASSIGNMENT 3

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REGISTRATION NO: 20BEC1174

DATE: 06/06/2023

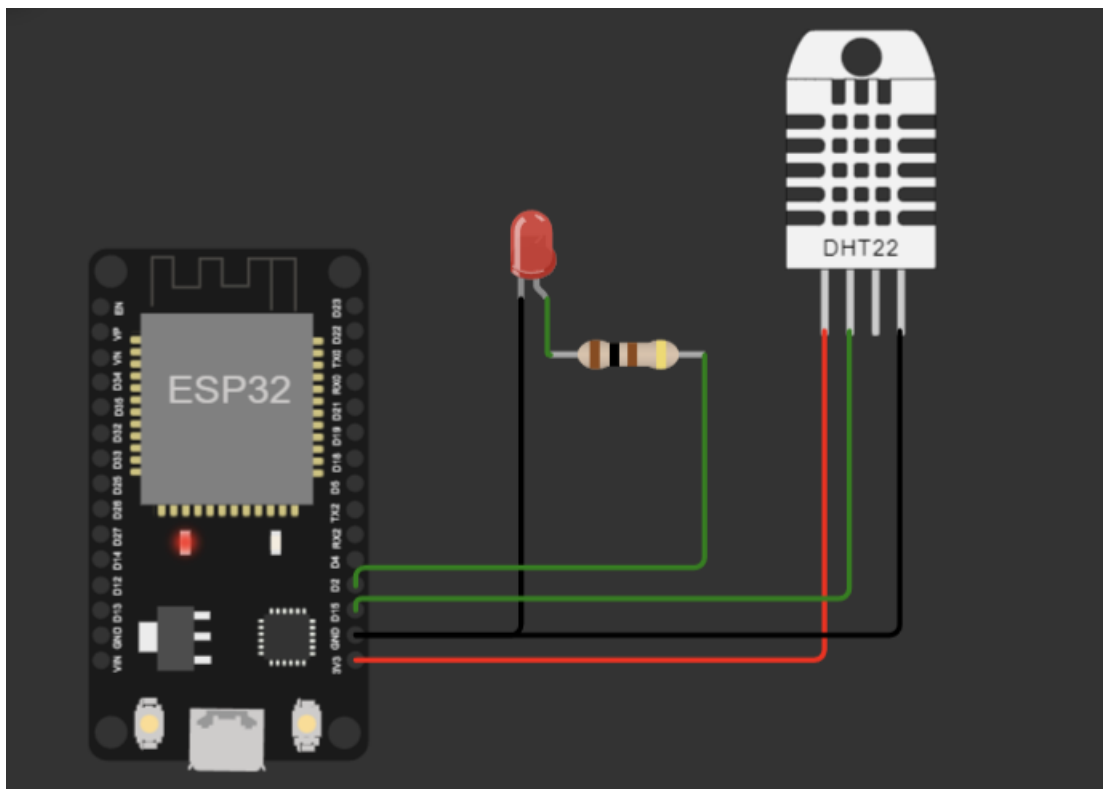
Sending Commands to WOKWI through Node-Red Dashboard using IBM Watson IoT

Aim: To construct a circuit with DHT11 Temperature Sensor and LED using ESP32 board in WOKWI and send commands to the circuit to switch on and off the LED.

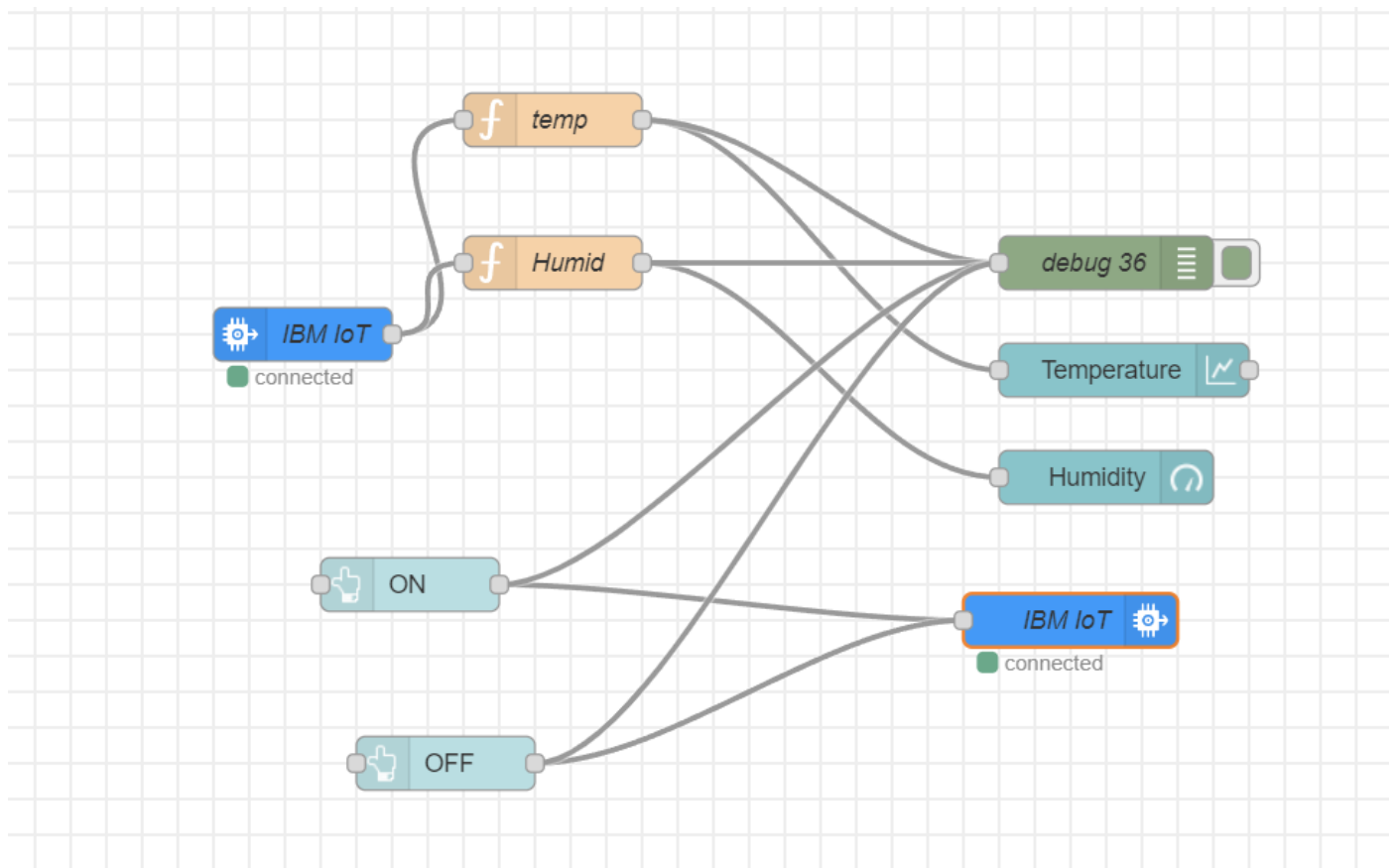
Software required: WOKWI , IBM WATSON IoT, Node Red, Node Red Dashboard

Components Required: ESP32, 1K Resistor, Push button, Connecting wires

Circuit Diagram:



Flow:



Simulation: WOKWI:

The screenshot displays the WOKWI simulation environment. On the left, the 'sketch.ino' file is open, showing the following code:

```
1 #include <WiFi.h> // Library for WiFi
2 #include <PubSubClient.h> // Library for MQTT
3 #include "DHT.h" // Library for DHT11
4 #define DHTPIN 15 // what pin we're connected to
5 #define DHTTYPE DHT22 // define type of sensor DHT 11
6 #define LED 2
7
8 DHT dht (DHTPIN, DHTTYPE); // creating the instance by passing pin and type of dht connect
9
10 void callback(char* topic, byte* payload, unsigned int payloadLength);
11
12 //-----credentials of IBM Accounts-----
13
14 #define ORG "z3850" // IBM ORG/PROJECT ID
15 #define DEVICE_TYPE "noderedled" // Device type mentioned in IBM Watson IoT Platform
16 #define DEVICE_ID "12345" // Device ID mentioned in IBM Watson IoT Platform
17 #define TOKEN "12345678" // Token
18 String data;
19 float h, t;
20
21 //-----Customise the above values-----
22 char server[] = ORG ".messaging.internetofthings.ibmcloud.com"; // Server Name
23 char publishTopic[] = "iot-2/evt/Data/rmt/json"; // topic name and type of event perform a
24 char subscribTopic[] = "iot-2/cmd/command/rmt/string"; // cmd REPRESENT command type AND
25 char authMethod[] = "use-token-auth"; // authentication method
26 char token[] = TOKEN;
27 char clientId[] = "d:" ORG ":" DEVICE_TYPE ":" DEVICE_ID; // client id
28
29 //-----
30
31 //-----
32 WiFiClient wificlient; // creating the instance for wificlient
33 PubSubClient client(server, 1883, callback, wificlient); // calling the predefined client
34
35 void setup() // configuring the ESP32
36 {
37   // pinMode(LED, OUTPUT);
38 }
```

On the right, the 'Simulation' window shows a visual representation of the hardware. It includes an ESP32 microcontroller board connected to a DHT22 temperature and humidity sensor. The simulation status bar at the top right indicates a runtime of 00:53.253 and 99% completion. The output console at the bottom shows the following log:

```
subscribe to cmd OK
temp:47.70
Humid:54.50
Sending payload: {"temp":47.70,"Humid":54.50}
Publish ok
temp:47.70
```

Code :

```
#include <WiFi.h>//library for wifi
#include <PubSubClient.h>//library for MQTT
#include "DHT.h"// Library for dht11
#define DHTPIN 15      // what pin we're connected to
#define DHTTYPE DHT22  // define type of sensor DHT 11
#define LED 2

DHT dht (DHTPIN, DHTTYPE);// creating the instance by passing pin and typr of dht
connected

void callback(char* subscribetopic, byte* payload, unsigned int payloadLength);

//-----credentials of IBM Accounts-----

#define ORG "zz3850"//IBM ORGANITION ID
#define DEVICE_TYPE "noderedled"//Device type mentioned in ibm watson IOT Platform
#define DEVICE_ID "12345"//Device ID mentioned in ibm watson IOT Platform
#define TOKEN "12345678"      //Token
String data3;
float h, t;

//----- Customise the above values -----
char server[] = ORG ".messaging.internetofthings.ibmcloud.com";// Server Name
char publishTopic[] = "iot-2/evt/Data/fmt/json";// topic name and type of event
perform and format in which data to be send
char subscribetopic[] = "iot-2/cmd/command/fmt/String";// cmd REPRESENT command type
AND COMMAND IS TEST OF FORMAT STRING
char authMethod[] = "use-token-auth";// authentication method
char token[] = TOKEN;
char clientId[] = "d:" ORG ":" DEVICE_TYPE ":" DEVICE_ID;//client id

//-----
WiFiClient wifiClient; // creating the instance for wificlient
PubSubClient client(server, 1883, callback ,wifiClient); //calling the predefined
client id by passing parameter like server id,portand wificredential

void setup()// configureing the ESP32
{
    Serial.begin(115200);
    dht.begin();
    pinMode(LED,OUTPUT);
    delay(10);
    Serial.println();
    wificonnect();
    mqttconnect();
}

void loop()// Recursive Function
{
    h = dht.readHumidity();
    t = dht.readTemperature();
```

```

Serial.print("temp:");
Serial.println(t);
Serial.print("Humid:");
Serial.println(h);

PublishData(t, h);
delay(4000);
if (!client.loop()) {
    mqttconnect();
}
}

/*.....retrieving to
Cloud.....*/

void PublishData(float temp, float humid) {
    mqttconnect();//function call for connecting to ibm
    /*
        creating the String in in form JSon to update the data to ibm cloud
    */
    String payload = "{\"temp\":";
    payload += temp;
    payload += "," " \"Humid\":";
    payload += humid;
    payload += "}";

    Serial.print("Sending payload: ");
    Serial.println(payload);

    if (client.publish(publishTopic, (char*) payload.c_str())) {
        Serial.println("Publish ok");// if it sucessfully upload data on the cloud then it
        will print publish ok in Serial monitor or else it will print publish failed
    } else {
        Serial.println("Publish failed");
    }
}

void mqttconnect() {
    if (!client.connected()) {
        Serial.print("Reconnecting client to ");
        Serial.println(server);
        while (!client.connect(clientId, authMethod, token)) {
            Serial.print(".");
            delay(500);
        }

        initManagedDevice();
        Serial.println();
    }
}

```

```

void wificonnect() //function defination for wificonnect
{
    Serial.println();
    Serial.print("Connecting to ");

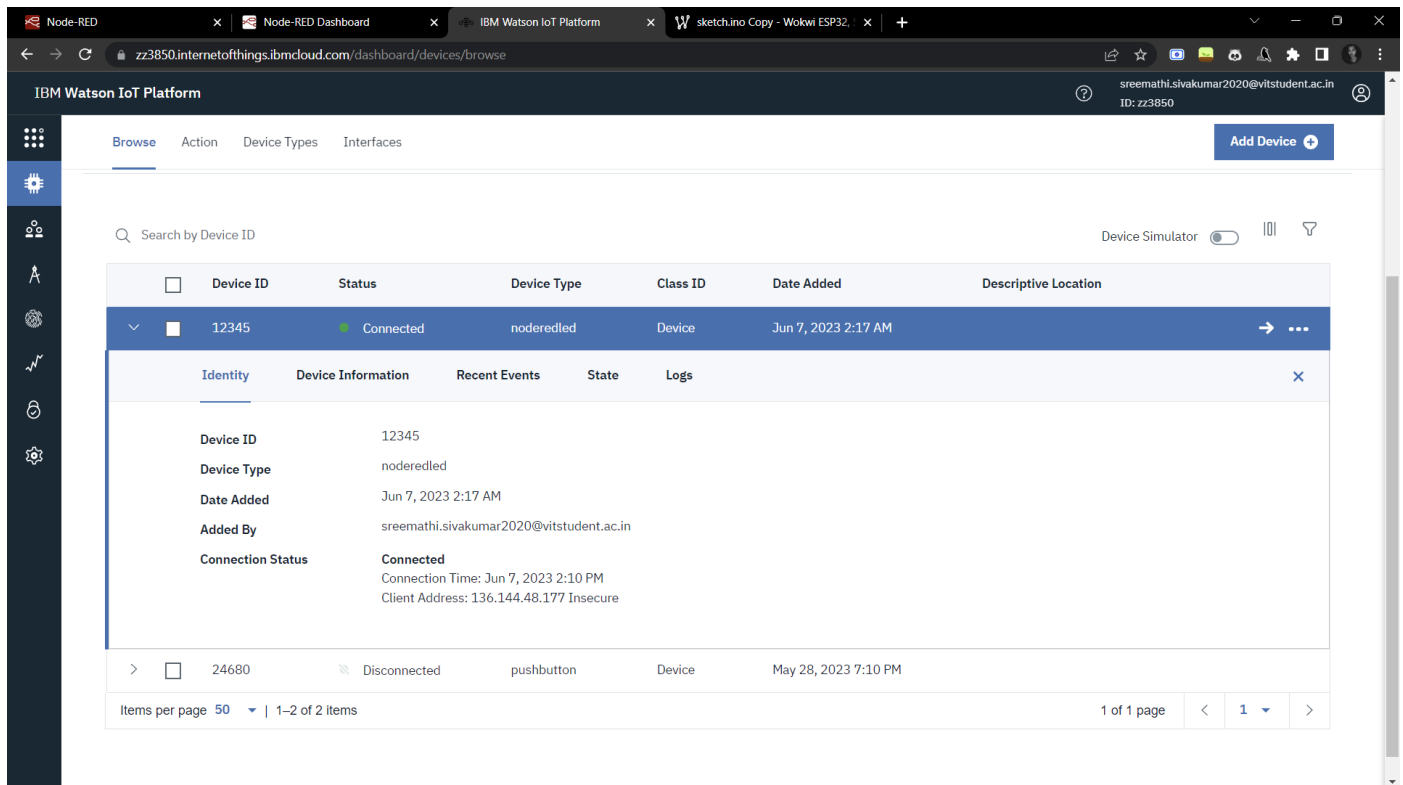
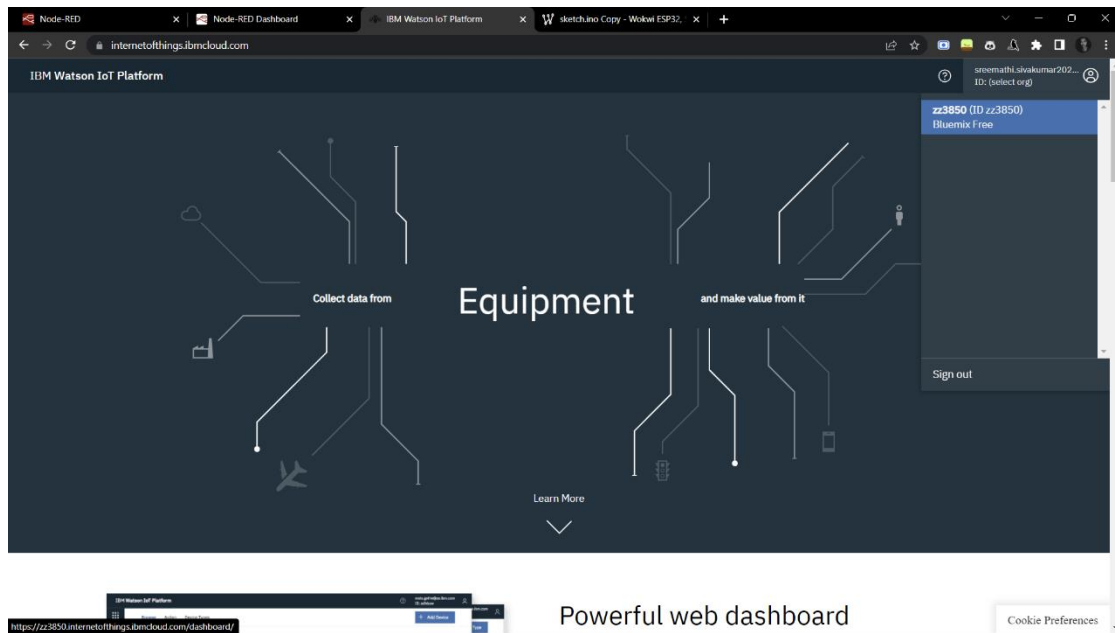
    WiFi.begin("Wokwi-GUEST", "", 6);//passing the wifi credentials to establish the
connection
    while (WiFi.status() != WL_CONNECTED) {
        delay(500);
        Serial.print(".");
    }
    Serial.println("");
    Serial.println("WiFi connected");
    Serial.println("IP address: ");
    Serial.println(WiFi.localIP());
}

void initManagedDevice() {
    if (client.subscribe(subscribetopic)) {
        Serial.println((subscribetopic));
        Serial.println("subscribe to cmd OK");
    } else {
        Serial.println("subscribe to cmd FAILED");
    }
}

void callback(char* subscribetopic, byte* payload, unsigned int payloadLength)
{
    Serial.print("callback invoked for topic: ");
    Serial.println(subscribetopic);
    for (int i = 0; i < payloadLength; i++) {
        //Serial.print((char)payload[i]);
        data3 += (char)payload[i];
    }
    Serial.println("data: "+ data3);
    if(data3=="lighton")
    {
        Serial.println(data3);
        digitalWrite(LED,HIGH);
    }
    else
    {
        Serial.println(data3);
        digitalWrite(LED,LOW);
    }
    data3="";
}

```

IBM Watson lot:



Node Red Nodes:

Node-RED Dashboard

Flow 1

Flow 3

common

function

temp

Humid

IBM IoT

ON

OFF

Edit ibmiot node

Properties

Name: ibmiotpikey

API Key: a-zz3850-gmaeicm46n

API Token:

Server-Name: zz3850.messaging.internetofthings.ibmcloud.co

Scalable: ☐ Application ID:

Keep Alive: 60 Seconds ☐ Use Clean Session

debug

6/7/2023, 12:22:16 PM node: debug 36
iot-2/type/noderedded/id/12345/evl/Data/fmt/json :
msg.payload : number
54.5

6/7/2023, 2:34:12 PM node: debug 36
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Node-RED Dashboard

Flow 1

Flow 3

common

function

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Humid

IBM IoT

ON

OFF

Edit ibmiot node

Properties

Authentication: API Key

API Key: ibmiotpikey

Input Type: Device Event

Device Type: ☐ All or ☐ noderedded

Device Id: ☐ All or ☐ 12345

Event: ☒ All or ☐ Data

Format: ☒ All or ☐ Json

QoS: 0

Name: IBM IoT

Service: registered

Use the Input Type property to configure this node to receive Events sent by IoT Devices, Commands sent to IoT Devices, Status Messages referring to IoT Devices, or Status Messages referring to IoT Applications
Check the info tab, to get more information about each of the fields

debug

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Node-RED Dashboard

127.0.0.1:1880/#flow/b1dd18cf25f90c67

Node-RED

filter nodes

Flow 1

Flow 3

common

- inject
- debug
- complete
- catch
- status
- link in
- link call
- link out
- comment

function

- function
- switch
- change
- range
- template

IBM IoT

connected

temp

Humid

ON

OFF

Edit function node

Delete

Cancel

Done

Properties

Name

temp

Setup

On Start

On Message

On Stop

```
1 msg.payload = msg.payload.temp
2 return msg;
```

debug

all nodes

all

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Enabled

Node-RED Dashboard

127.0.0.1:1880/#flow/b1dd18cf25f90c67

Node-RED

filter nodes

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Flow 3

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IBM IoT

connected

temp

Humid

ON

OFF

Edit function node

Delete

Cancel

Done

Properties

Name

Humid

Setup

On Start

On Message

On Stop

```
1 msg.payload = msg.payload.Humid
2 return msg;
```

debug

all nodes

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Node-RED Dashboard

127.0.0.1:1880/#flow/b1dd18cf25f90c67

Node-RED

filter nodes

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Flow 3

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- function
- switch
- change
- range
- template

IBM IoT

temp

Humid

ON

OFF

Edit button node

Delete

Cancel

Done

Properties

Group

[Home Automation_Switchboard] Home

Size

auto

Icon

optional icon

Label

ON

Tooltip

optional tooltip

Color

optional text/icon color

Background

optional background color

When clicked, send:

Payload

lighton

Topic

msg.topic

If msg arrives on input, emulate a button click:

Class

Optional CSS class name(s) for widget

Name

Name

Enabled

debug

all nodes

all

6/7/2023, 12:22:16 PM node: debug 36
iot-2/type/noderedded/id/12345/ev1/Data/fmt/json :
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54.5

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Node-RED Dashboard

127.0.0.1:1880/#flow/b1dd18cf25f90c67

Node-RED

filter nodes

Flow 1

Flow 3

common

- inject
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- link out
- comment

function

- function
- switch
- change
- range
- template

IBM IoT

temp

Humid

ON

OFF

Edit button node

Delete

Cancel

Done

Properties

Group

[Home Automation_Switchboard] Home

Size

auto

Icon

optional icon

Label

OFF

Tooltip

optional tooltip

Color

optional text/icon color

Background

optional background color

When clicked, send:

Payload

lightoff

Topic

msg.topic

If msg arrives on input, emulate a button click:

Class

Optional CSS class name(s) for widget

Name

Name

Enabled

debug

all nodes

all

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Node-RED Dashboard

127.0.0.1:1880/#flow/b1dd18c25f90c67

Node-RED

filter nodes

Flow 1 Flow 3

common

- inject
- debug
- complete
- catch
- status
- link in
- link call
- link out
- comment

function

- function
- switch
- change
- range
- template

temp

Humid

IBM IoT

ON

OFF

Edit ibmiot out node

Delete Cancel Done

Properties

- Authentication API Key
- API Key ibmiotpikey
- Output Type Device Command
- Device Type noderedlied
- Device Id 12345
- Command Type command
- Format String
- Data Data
- QoS 0
- Name IBM IoT
- Service registered

Note: If there is a property in the message that corresponds to any of the values entered above, then the property in the message takes precedence. See the Info tab for more details.

Enabled

debug

all nodes all

6/7/2023, 12:22:16 PM node: debug 36
iot-2/type/noderedlied/id/12345/evl/Data/fmt/json :
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Node-RED Dashboard

127.0.0.1:1880/#flow/b1dd18c25f90c67

Node-RED

filter nodes

Flow 1 Flow 3

common

- inject
- debug
- complete
- catch
- status
- link in
- link call
- link out
- comment

function

- function
- switch
- change
- range
- template

temp

Humid

IBM IoT

ON

OFF

Edit ibmiot out node > Edit ibmiot node

Delete Cancel Update

Properties

- Name ibmiotpikey
- API Key a-zz3850-gmaelcm46n
- API Token *****
- Server-Name zz3850.messaging.internetofthings.ibmcloud.co
- Scalable ☐ Application ID
- Keep Alive 60 Seconds ☐ Use Clean Session

Enabled 3 nodes use this config On all flows

debug

all nodes all

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Node-RED Dashboard

127.0.0.1:1880/#flow/b1dd18cf25f90c67

Node-RED

Flow 3

common

- inject
- debug
- complete
- catch
- status
- link in
- link call
- link out
- comment

function

- function
- switch
- change
- range
- template

IBM IoT

connected

temp

Humid

ON

OFF

Edit gauge node

Properties

- Group: [Home Automation_ Switchboard] Home
- Size: auto
- Type: Gauge
- Label: Humidity
- Value format: {{value}}
- Units: Percentage
- Range: min 0 max 100
- Colour gradient: [Green, Yellow, Red]
- Sectors: 0 optional optional 100
- Class: Optional CSS class name(s) for widget
- Name:

debug

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Node-RED

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- function
- switch
- change
- range
- template

IBM IoT

connected

temp

Humid

ON

OFF

Edit chart node

Properties

- Group: [Home Automation_ Switchboard] Home
- Size: auto
- Type: Line chart
- X-axis: last 1 hours OR 1000 points
- X-axis Label: HH:mm:ss
- Y-axis: min -40 max 80
- Legend: None Interpolate linear
- Series Colours: [Blue, Green, Red, Purple, Orange]
- Blank label: display this text before valid data arrives
- Class: Optional CSS class name(s) for widget

debug

6/7/2023, 12:22:16 PM node: debug 36
iot-2/type/noderedded/id/12345/evt/Data/fmt/json :
msg.payload : number
54.5

6/7/2023, 2:34:12 PM node: debug 36
iot-2/type/noderedded/id/12345/evt/Data/fmt/json :
msg.payload : number
47.7

6/7/2023, 2:34:12 PM node: debug 36
iot-2/type/noderedded/id/12345/evt/Data/fmt/json :
msg.payload : number
54.5

6/7/2023, 2:34:35 PM node: debug 36
iot-2/type/noderedded/id/12345/evt/Data/fmt/json :
msg.payload : number
47.7

6/7/2023, 2:34:35 PM node: debug 36
iot-2/type/noderedded/id/12345/evt/Data/fmt/json :
msg.payload : number
54.5

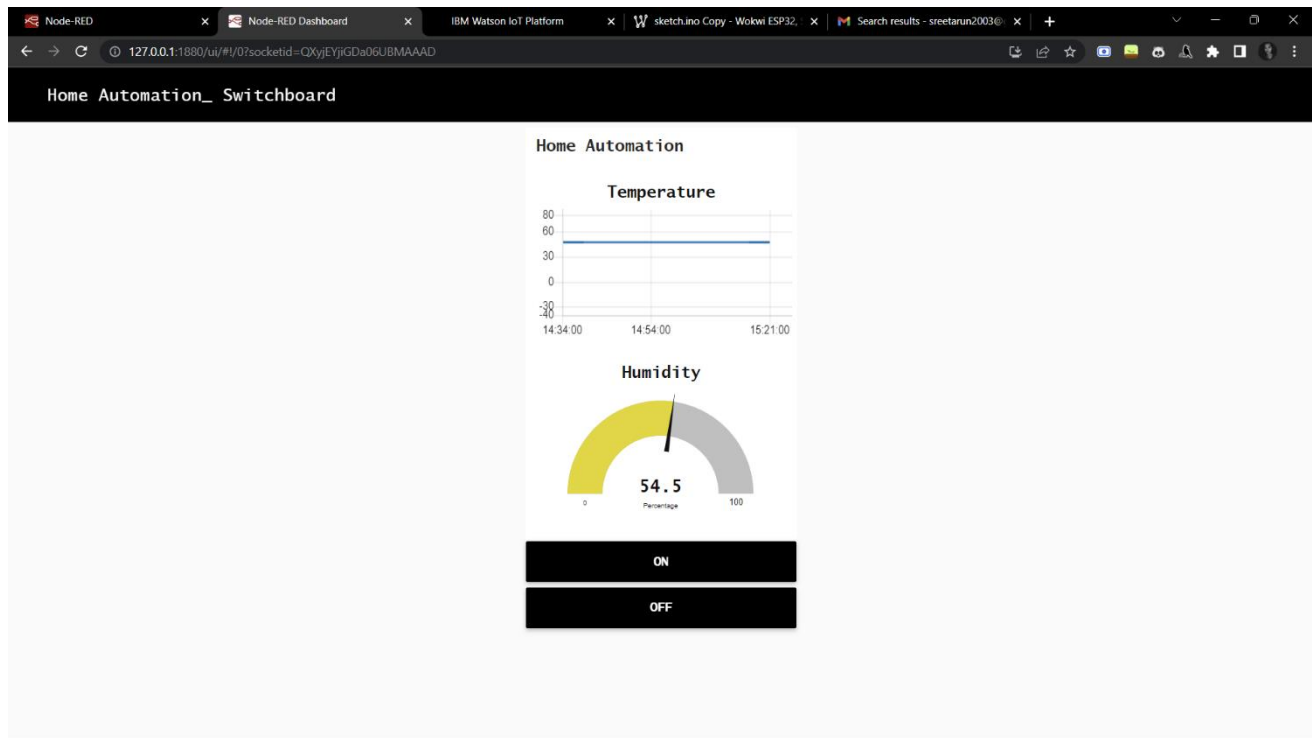
6/7/2023, 2:34:41 PM node: debug 36
iot-2/type/noderedded/id/12345/evt/Data/fmt/json :
msg.payload : number
47.7

6/7/2023, 2:34:42 PM node: debug 36
iot-2/type/noderedded/id/12345/evt/Data/fmt/json :
msg.payload : number
54.5

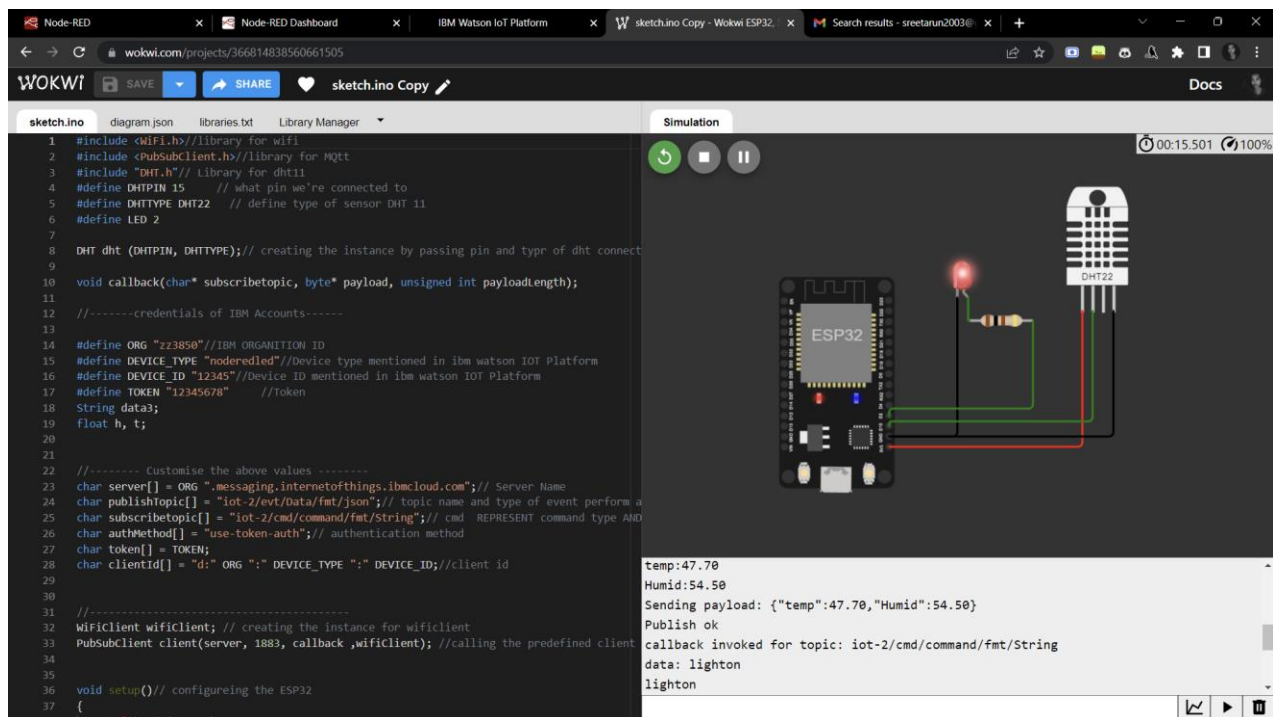
Outputs:

LIGHT ON

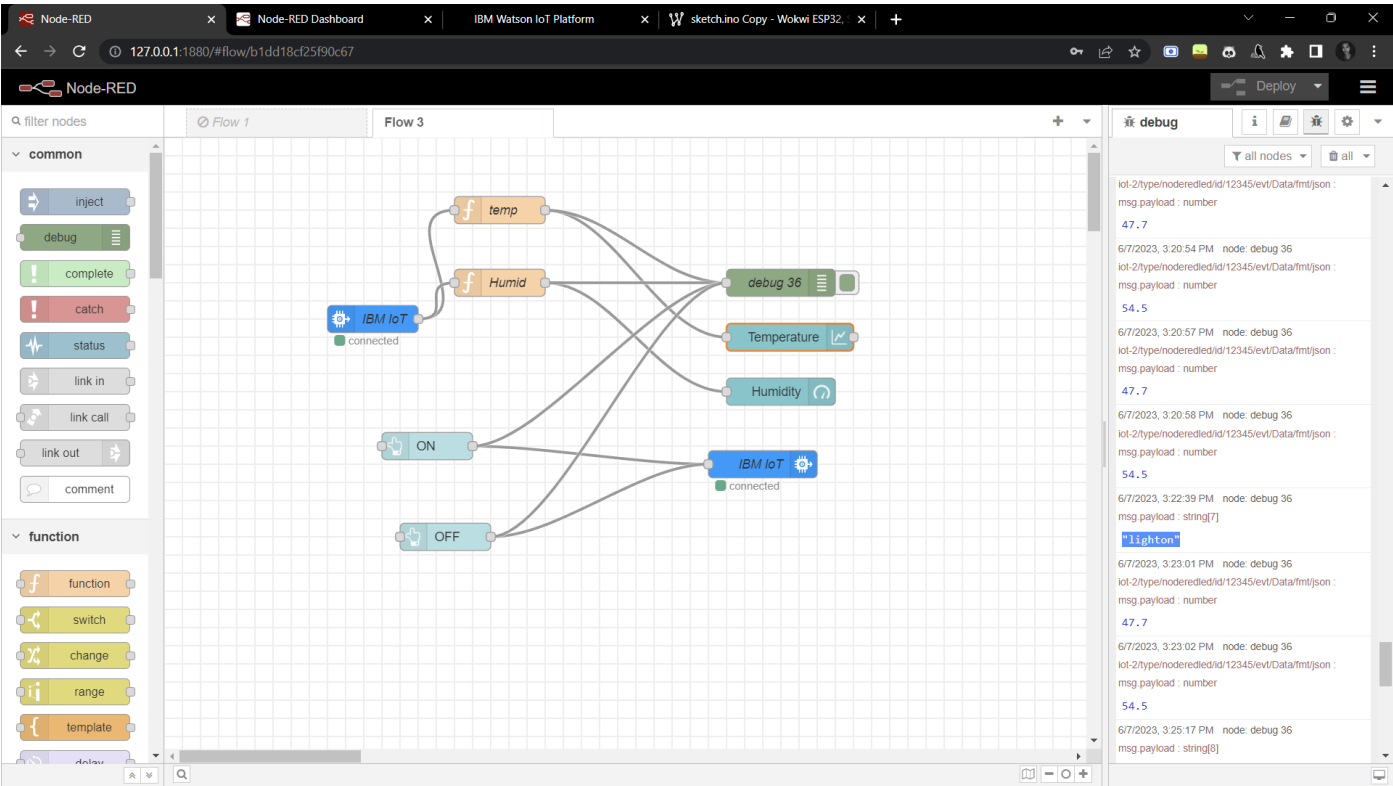
Node Red Dashboard:



WOKWI:

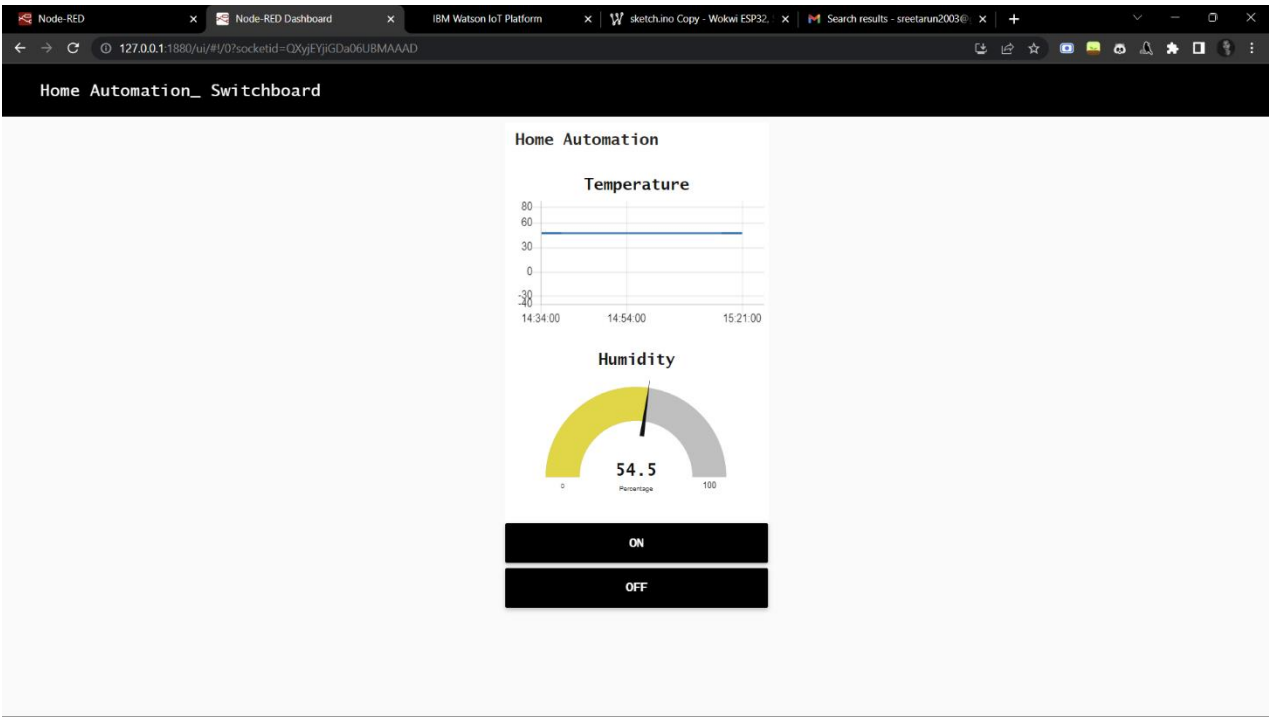


Node Red Debug:



LIGHT OFF

Node Red Dashboard:



WOKWI:

Node-RED x Node-RED Dashboard x IBM Watson IoT Platform x sketch.ino Copy - Wokwi ESP32 x Search results - sreetaun2003@ x

wokwi.com/projects/366814838560661505

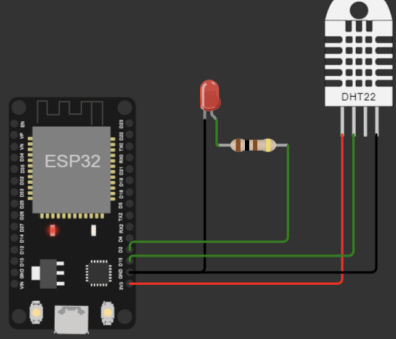
WOKWI SAVE SHARE sketch.ino Copy Docs

sketch.ino diagram.json libraries.txt Library Manager

```
1 #include <WiFi.h> //library for wifi
2 #include <PubSubClient.h> //library for MQTT
3 #include "DHT.h" // Library for dht11
4 #define DHTPIN 15 // what pin we're connected to
5 #define DHTTYPE DHT22 // define type of sensor DHT 11
6 #define LED 2
7
8 DHT dht (DHTPIN, DHTTYPE); // creating the instance by passing pin and type of dht connect
9
10 void callback(char* topic, byte* payload, unsigned int payloadLength);
11
12 //-----credentials of IBM Accounts-----
13
14 #define ORG "zz3850" //IBM ORGANIZATION ID
15 #define DEVICE_TYPE "noderedred" //Device type mentioned in ibm watson IOT Platform
16 #define DEVICE_ID "12345" //Device ID mentioned in ibm watson IOT Platform
17 #define TOKEN "12345678" //Token
18 String data3;
19 float h, t;
20
21
22 //----- Customise the above values -----
23 char server[] = ORG ".messaging.internetofthings.ibmcloud.com"; // Server Name
24 char publishTopic[] = "iot-2/evt/Data/fmt/json"; // topic name and type of event perform a
25 char subscribetopic[] = "iot-2/cmd/command/fmt/String"; // cmd REPRESENT command type AND
26 char authMethod[] = "use-token-auth"; // authentication method
27 char token[] = TOKEN;
28 char clientId[] = "d:" ORG ":" DEVICE_TYPE ":" DEVICE_ID; //client id
29
30
31 //-----
32 WiFiClient wificlient; // creating the instance for wificlient
33 PubSubClient client(server, 1883, callback, wificlient); //calling the predefined client
34
35
36 void setup() // configuring the ESP32
37 {
38   Serial.begin(115200);
39 }
```

Simulation

00:40.519 99%



temp:47.70
Humid:54.50
Sending payload: {"temp":47.70,"Humid":54.50}
Publish ok
callback invoked for topic: iot-2/cmd/command/fmt/String
data: lightoff
lightoff

Node Red Debug:

Node-RED x Node-RED Dashboard x IBM Watson IoT Platform x sketch.ino Copy - Wokwi ESP32 x

127.0.0.1:1880/#flow/b1dd18cf25f90c67

Node-RED Deploy

filter nodes Flow 1 Flow 3

common

- inject
- debug
- complete
- catch
- status
- link in
- link call
- link out
- comment

function

- function
- switch
- change
- range
- template

temp Humid

IBM IoT

ON OFF

debug 36

Temperature Humidity

IBM IoT

debug

iot-2/type/noderedred/evt/12345/evt/Data/fmt/json :
msg.payload : number
47.7
6/7/2023, 3:25:20 PM node: debug 36
iot-2/type/noderedred/evt/12345/evt/Data/fmt/json :
msg.payload : number
54.5
6/7/2023, 3:25:24 PM node: debug 36
iot-2/type/noderedred/evt/12345/evt/Data/fmt/json :
msg.payload : number
47.7
6/7/2023, 3:25:24 PM node: debug 36
iot-2/type/noderedred/evt/12345/evt/Data/fmt/json :
msg.payload : number
54.5
Copy value
6/7/2023, 3:25:29 PM node: debug 36
msg.payload : string[8]
"lightoff"
6/7/2023, 3:25:30 PM node: debug 36
msg.payload : string[8]
"lightoff"
6/7/2023, 3:25:33 PM node: debug 36
iot-2/type/noderedred/evt/12345/evt/Data/fmt/json :
msg.payload : number
47.7
6/7/2023, 3:25:33 PM node: debug 36
iot-2/type/noderedred/evt/12345/evt/Data/fmt/json :
msg.payload : number

Temperature and Humidity Monitoring

IBM Watson IOT:

The screenshot shows the IBM Watson IoT Platform dashboard. The top navigation bar includes 'Browse', 'Action', 'Device Types', and 'Interfaces'. The left sidebar contains icons for various IoT functions. The main content area is titled 'Recent Events' and displays a table of events. The table has columns for 'Event', 'Value', 'Format', and 'Last Received'. The events listed are all 'Data' events with a value of '{"pushbutton status":0}' or '{"pushbutton status":1}', a format of 'json', and a last received time of 'a few seconds ago'. Below the table, it indicates 'Items per page 50' and '1-1 of 1 item'. A status bar at the bottom right shows '0 Simulations running'.

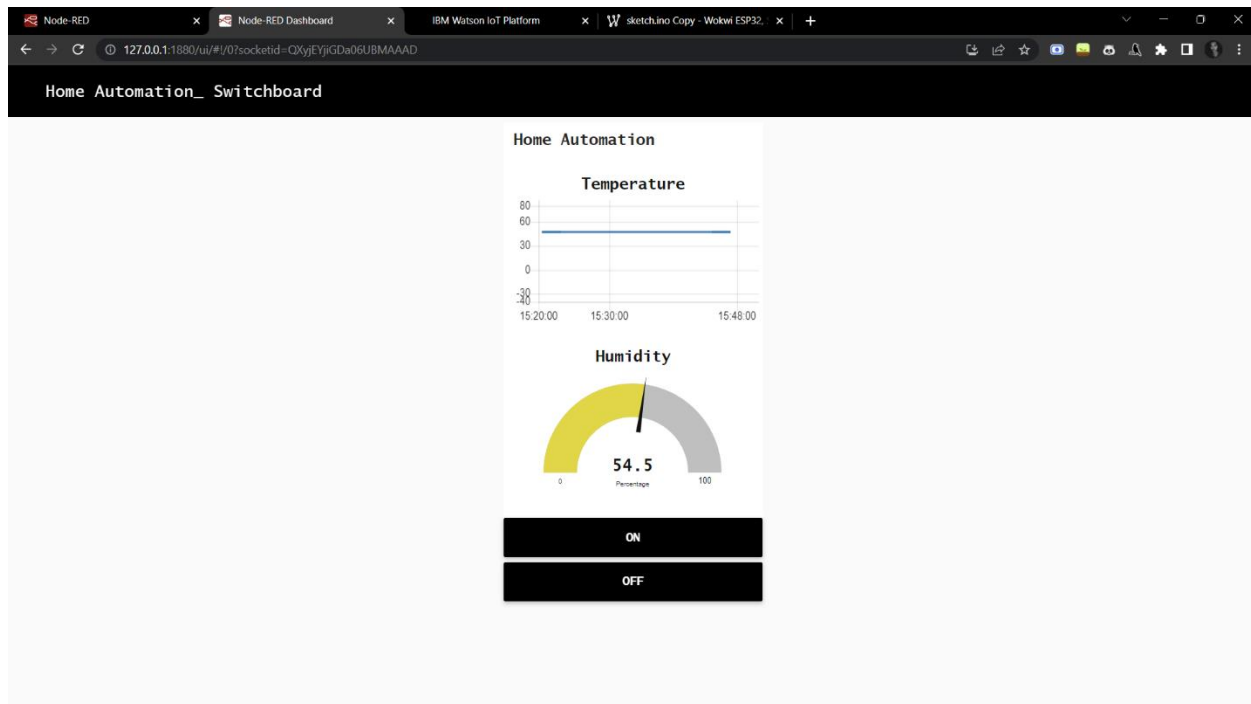
Event	Value	Format	Last Received
Data	{"pushbutton status":0}	json	a few seconds ago
Data	{"pushbutton status":0}	json	a few seconds ago
Data	{"pushbutton status":1}	json	a few seconds ago
Data	{"pushbutton status":0}	json	a few seconds ago

Node Red Debug:

The screenshot shows the Node-RED web interface. The top navigation bar includes 'Node-RED', 'Node-RED Dashboard', 'IBM Watson IoT Platform', and 'Sketchino Copy - Wokwi ESP32'. The left sidebar contains a 'filter nodes' search bar and a list of nodes categorized under 'common' and 'function'. The main workspace displays a flow diagram with nodes for 'temp', 'Humid', 'ON', 'OFF', 'IBM IoT', 'Temperature', 'Humidity', and 'debug 36'. The right sidebar shows the 'debug' console with a list of messages. The messages are all 'msg payload: number' and include a timestamp and a node ID. The messages are:

- 6/7/2023, 3:46:54 PM node: debug 36
iot-2/type/noderedredid/12345/evl/Data/fmt/json :
msg payload: number
54.5
- 6/7/2023, 3:46:57 PM node: debug 36
iot-2/type/noderedredid/12345/evl/Data/fmt/json :
msg payload: number
47.7
- 6/7/2023, 3:46:58 PM node: debug 36
iot-2/type/noderedredid/12345/evl/Data/fmt/json :
msg payload: number
54.5
- 6/7/2023, 3:47:01 PM node: debug 36
iot-2/type/noderedredid/12345/evl/Data/fmt/json :
msg payload: number
47.7
- 6/7/2023, 3:47:02 PM node: debug 36
iot-2/type/noderedredid/12345/evl/Data/fmt/json :
msg payload: number
54.5
- 6/7/2023, 3:47:05 PM node: debug 36
iot-2/type/noderedredid/12345/evl/Data/fmt/json :
msg payload: number
47.7
- 6/7/2023, 3:47:06 PM node: debug 36
iot-2/type/noderedredid/12345/evl/Data/fmt/json :
msg payload: number
54.5

Node Red Dashboard:



Result:

Thus, the temperature and humidity values from WOKWI has been uploaded to IBM Watson IoT using wifi module of ESP32 successfully and is visualized in the Node Red Dashboard. The LED of the circuit is switched ON and OFF using the buttons in the dashboard and IBM IoT out Node and is successfully verified.