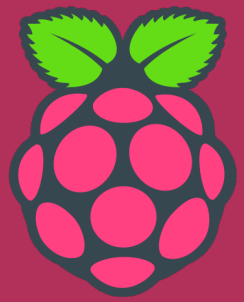
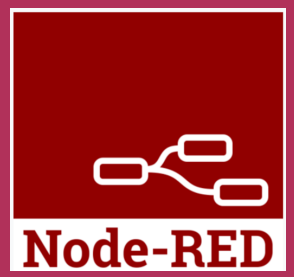
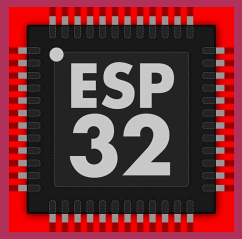
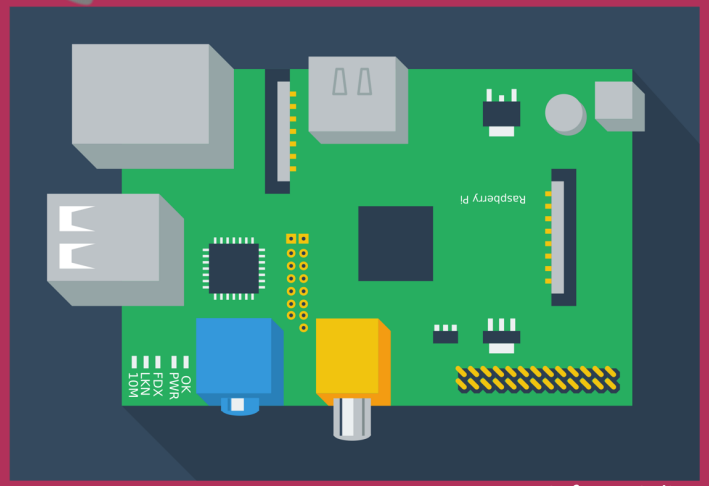


MQTT on Pi

NOV 2021







Safyzan Salim
scriptworkz ent

Scenario

You have been assigned to monitor the temperature and moisture of a server room. The results can be monitored anywhere. Your system must be able to capture 2 server racks' temperature and humidity, and also the server room's temperature and humidity too.

Future Project >>*A notification alarm will be activated if the any of the sensors passes the certain condition, e.g., rack temperature greater than 25°C, or server room's temp too high… etc.*

Prerequisites

Hardware:

- Raspberry Pi board with:
  - -Raspberry Pi OS
  - -16 GB class 10 microSD
  - -5V 2.5A power supply
- ESP32 with Temperature & Humidity Sensor, DHT11**

Software:

- Node-RED
- Arduino IDE
- Arduino Client for MQTT library
- Aedes MQTT

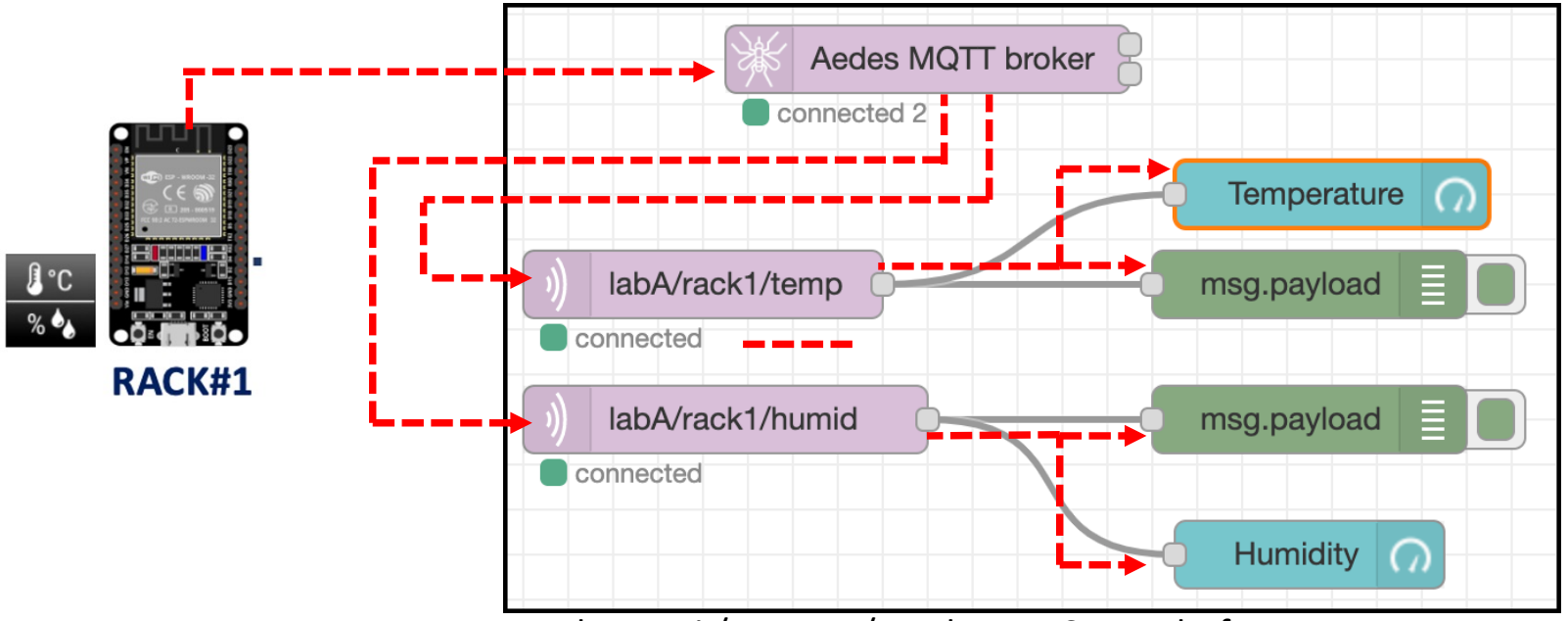
WiFi:

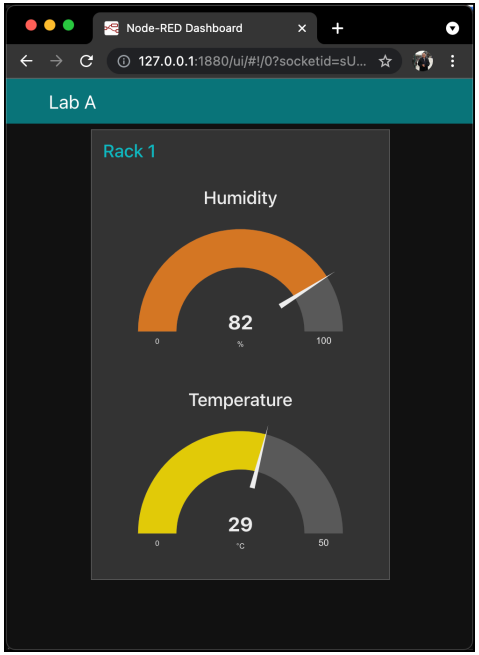
- A 2.4G AP

** This project uses Grove - Temperature & Humidity Sensor (DHT11)

How It Works

- ESP32 & DHT11 will be fixed at a rack, named Rack#1 at Lab A. Aedes broker is running on a Raspberry Pi (PC/Laptop/Mac).
- After connected to WiFi, data from ESP32 will be sent to broker.
- Since the Node-RED has subscribed topic **labA/rack1/temp** & **labA/rack1/humid** from ESP32, both information (temp & humid) will be displayed at debug & also gauges – in real time.



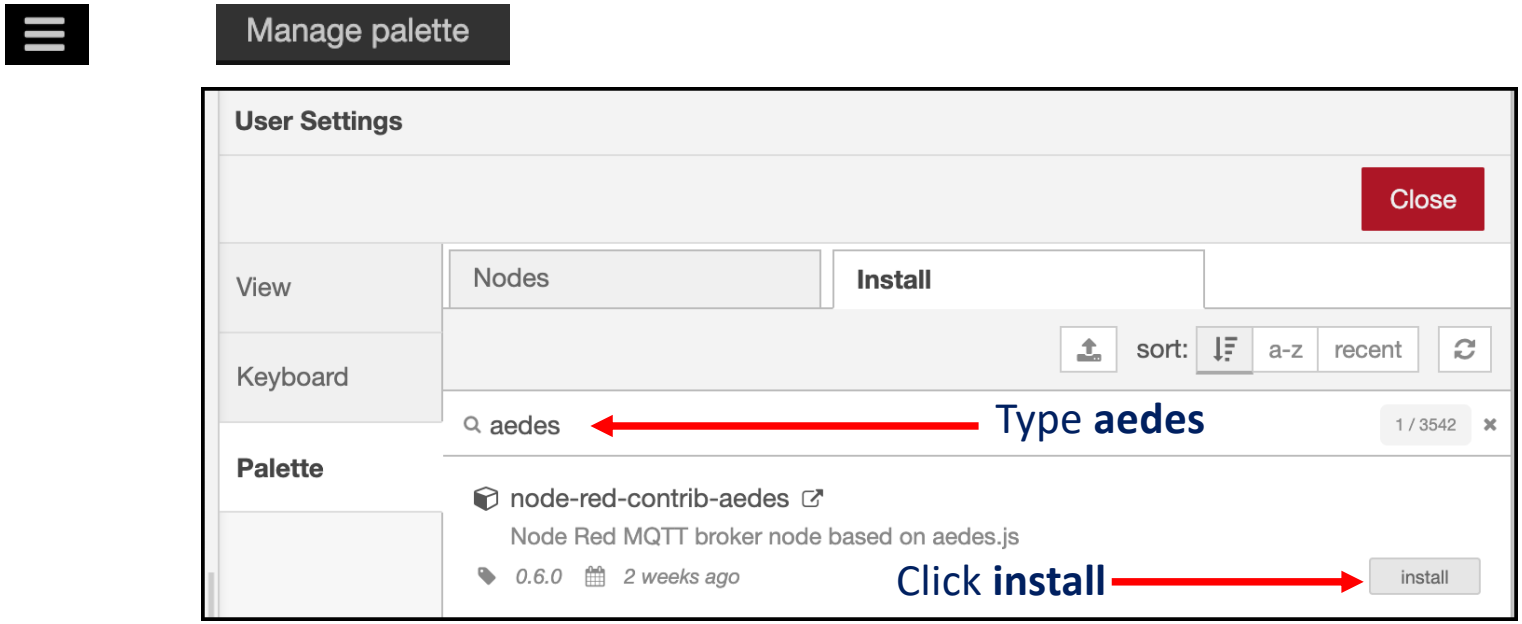


Raspberry Pi / Laptop / Desktop – Cross Platform

i. Install & Run Aedes Broker Service

- Execute Node-RED service.
- Install **Aedes** broker by clicking:

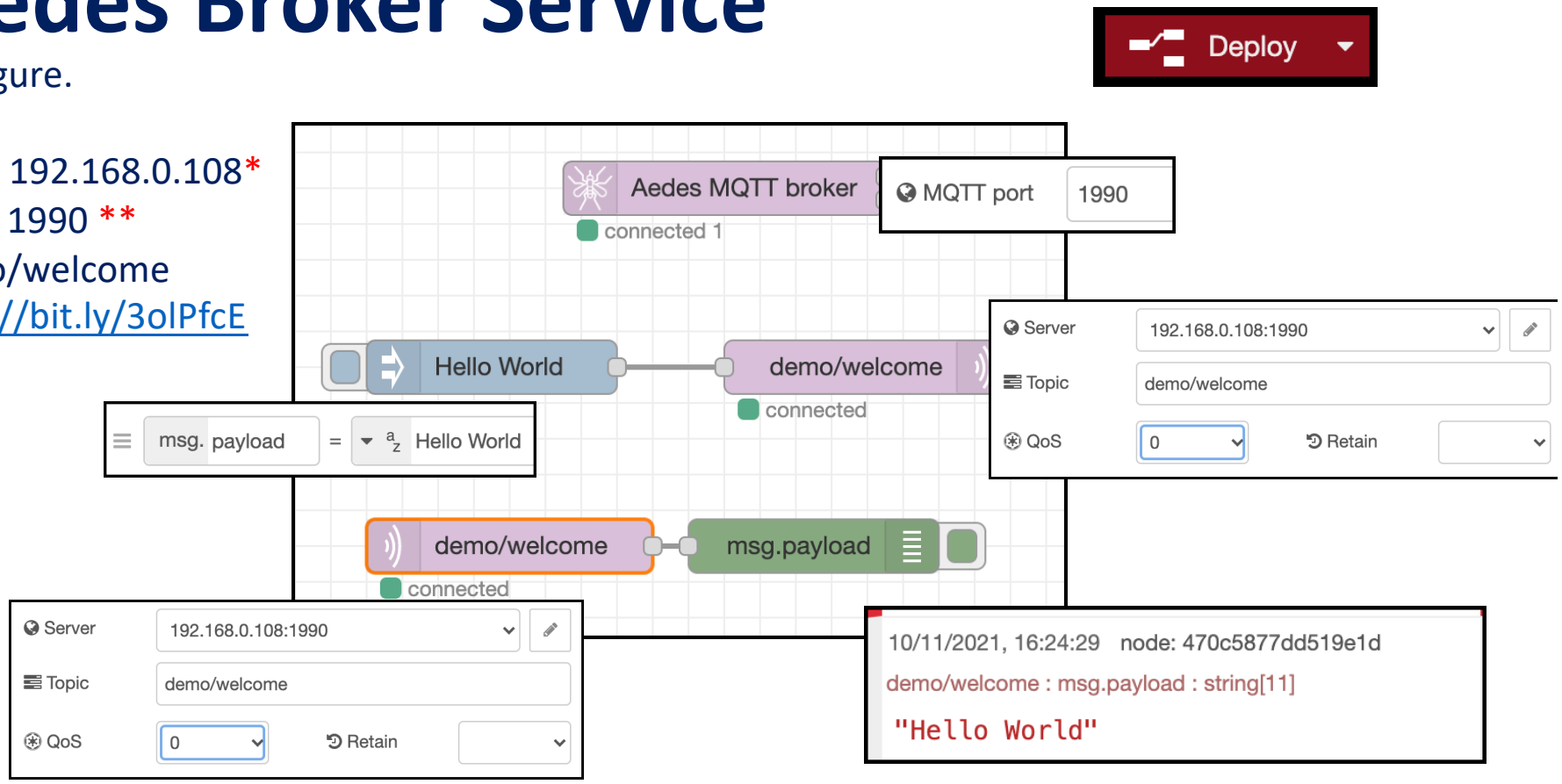
Node-RED Menu > **Manage palette** > **Install** > type **aedes** at search module > **node-red-contrib-aedes** > **install**



- Wait & make sure the install button changed to installed.

ii. Test Aedes Broker Service

- Setup as in the figure.
- Configurations:
  - BROKER IP = 192.168.0.108*
  - MQTT port = 1990 **
  - Topic = demo/welcome
- Download: https://bit.ly/3olPfcE

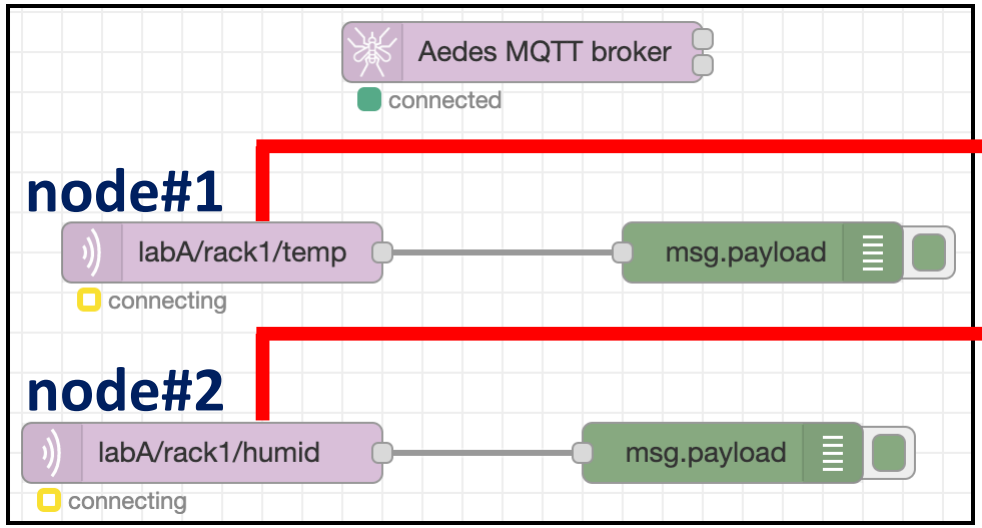


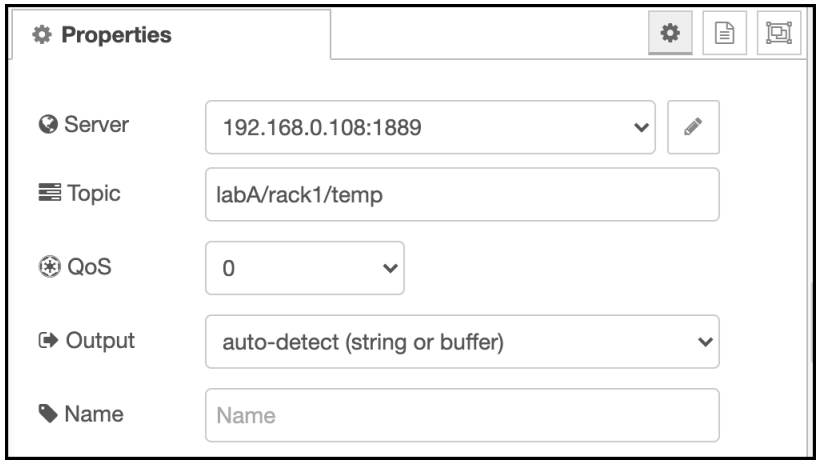
* Please check your device IP address.

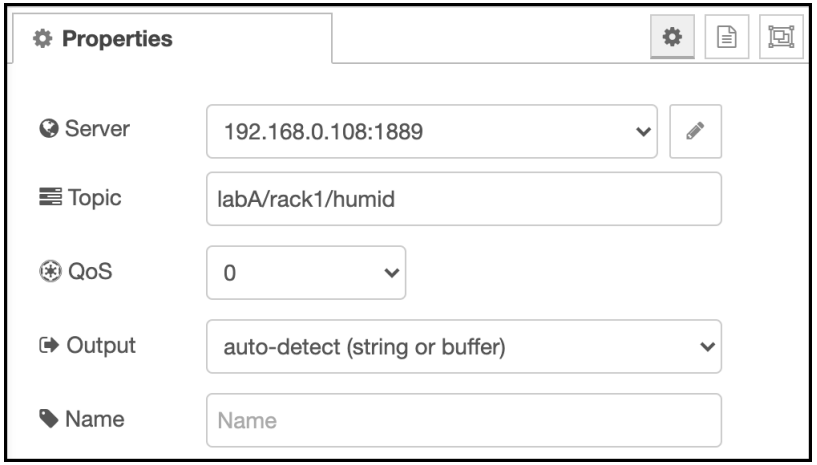
** Do not use 1880 – reserved to localhost:1880

iii. Deploying Aedes Broker

- Configurations:
  - Broker IP = 192.168.0.108*
  - MQTT port = 1889**
  - MQTT_IN = labA/rack1/temp ← **node#1**
  - MQTT_IN = labA/rack1/humid ← **node#2**
- Download palette: https://bit.ly/3qGwyTE.







* Please check your device IP address.

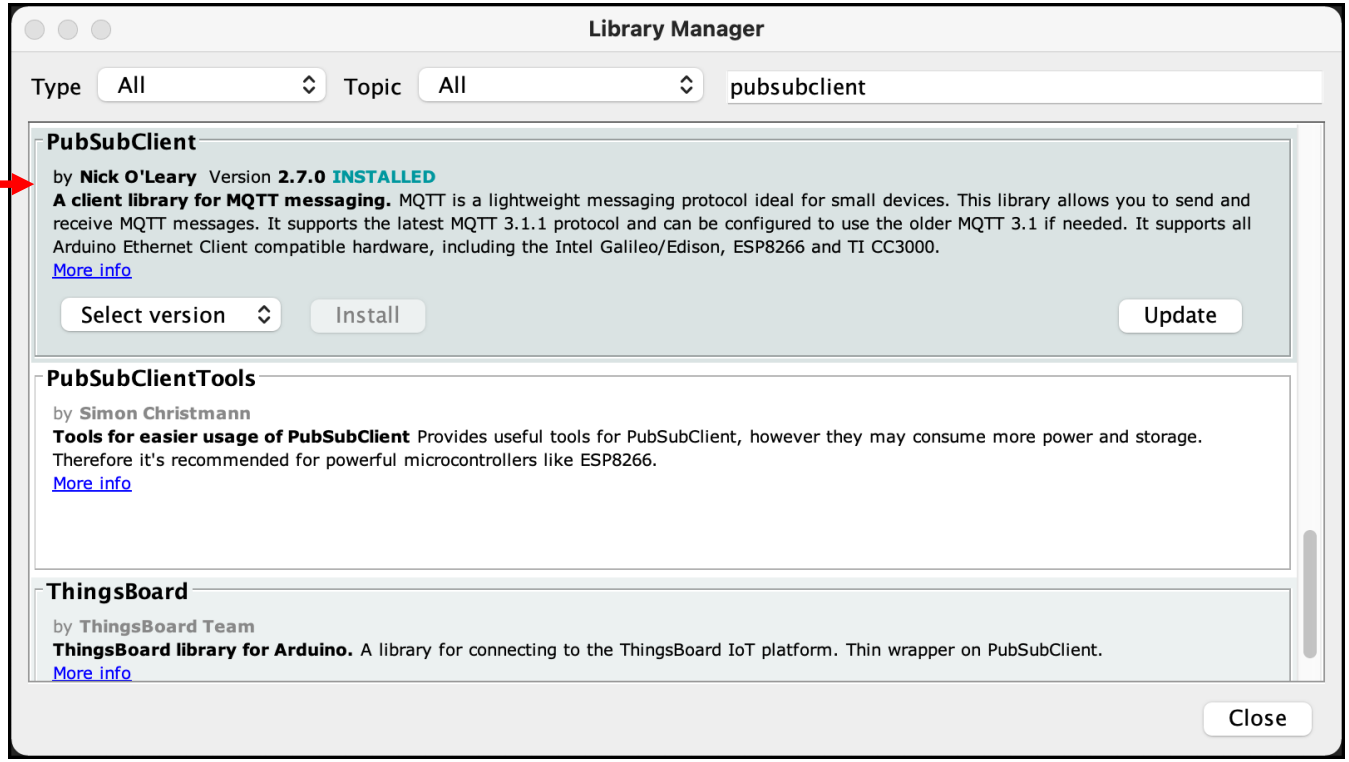
** do not use 1880 – reserved to localhost:1880

iv. Arduino Client MQTT

- Install New Library by opening **Library Manager** and search for **PubSubClient** by **Nick O'Leary – latest version**.

Sketch > Include Library > Manage Libraries

PubSubClient
Nick O'Leary



v. Arduino PubSub Sketch

- Download the file working file from https://bit.ly/30dwDnb.

sketch_nov11a-nov21-aedes-esp32-groove-dht11

```
15
16 //#include <ESP8266WiFi.h> //if you are using nodemcu
17 #include <WiFi.h> //if you are using esp32
18 #include <PubSubClient.h>
19
20 ///////GROVE DHT11/////////
21 #include "DHT.h"
22 #define DHTTYPE DHT11
23
24 #define DHTPIN 26  // connect signal to pin 26
25 DHT dht(DHTPIN, DHTTYPE);
26 ////////////////////////////
```

#16 #17 **Remove // and put // at Line#15 if you are using NodeMCU.**

#24 **Place a jumper at signal pin to pin 26 of ESP32.**

v. Arduino PubSub Sketch

- Download the file working file from https://bit.ly/30dwDnb.

```
30
31 // Update these with values suitable for your network.
32 const char* ssid = "YOUR SSID";
33 const char* password = "YOUR SSID PASSWORD";
34 const char* mqtt_server = "NODE-RED IP ADDRESS"; /// NodeRED IP Address
35 int mqtt_port = 1889; //Must match with broker's MQTT port - dont use 1880
36
```

#32 #33 **Set your SSID & password.**

#34 **IP address of your Node-RED device.**

v. Arduino PubSub Sketch

- Download the file working file from https://bit.ly/30dwDnb.

```
44 void setup() {
45   Serial.begin(115200);
46   // Start up the library
47   client.setServer(mqtt_server, mqtt_port);
48   client.setCallback(callback);
49
50   setup_wifi(); //function call
51
52   Serial.println("WiFi Connected...");
53   Serial.print("MQTT Server IP Address:");
54   Serial.print(mqtt_server);
55   Serial.print(":");
56   Serial.println(String(mqtt_port));
57   Serial.print("ESP32 IP Address: ");
58   Serial.println(WiFi.localIP());
59   Serial.println("Modbus RTU Master Online");
60
61   pinMode(LED_BUILTIN, OUTPUT);
62 }
```

From Serial Monitor

```
#50 Connecting to raspberrypi 2.4G
#52 .WiFi Connected...
#53 MQTT Server IP Address:192.168.0.108:1884
#57 ESP32 IP Address: 192.168.0.110
#59 Modbus RTU Master Online
77.00 28.90 Reading from DHT11 sensor
Attempting MQTT connection...Broker connected to ESP32
```

v. Arduino PubSub Sketch

- Download the file working file from https://bit.ly/30dwDnb.

```
63
64 void setup_wifi() {
65   delay(10);
66   // Start by connecting to a WiFi network
67   Serial.println();
68   Serial.print("Connecting to ");
69   Serial.println(ssid);
70
71   WiFi.begin(ssid, password);
72
73   while (WiFi.status() != WL_CONNECTED) {
74     delay(500);
75     Serial.print(".");
76   }
77 }
78
```

A function to connect the ESP32 / NodeMCU to existing access point (WiFi).

Check your SSID & password in case non-stop dotted line appears.

v. Arduino PubSub Sketch

- Download the file working file from https://bit.ly/30dwDnb.

```
103 void reconnect() {
104
105  // Loop until we're reconnected
106   while (!client.connected()) {
107     Serial.print("Attempting MQTT connection...");
108  // Attempt to connect
109     if (client.connect("ESP32Client")) {
110         Serial.println("Broker connected to ESP32");
111         client.subscribe("event"); // Topic at ESP32
112     } else {
113         Serial.print("failed, rc=");
114         Serial.print(client.state());
115         Serial.println(" try again in 5 seconds");
116         // Wait 5 seconds before retrying
117         delay(5000);
118     }
119   }
120 }
```

ESP32 @ NodeMCU ensure persistent connection between MCU and the broker.

v. Arduino PubSub Sketch

- Download the file working file from https://bit.ly/30dwDnb.

```
123  ////////////////////////////
124  float temp_hum_val[2] = {0}; // grove_dht set nilai 2 array = 0
125  dht.readTempAndHumidity(temp_hum_val); // baca temp & humid
126  ////////////////////////////
127 Serial.print(temp_hum_val[0]);
128 Serial.print(" ");
129 Serial.println(temp_hum_val[1]);
130  char tempValue[15], humidValue[15];
131  dtostrf(temp_hum_val[0],4, 0, humidValue); // convert float to char
132  dtostrf(temp_hum_val[1],4, 0, tempValue); // convert float to char
133  client.publish("labA/rack1/humid", humidValue); /// send char
134  client.publish("labA/rack1/temp", tempValue); /// send char
135
136  if (!client.connected()) {
137    reconnect(); //function call
138  }
```

L#124 Set 2 array elements; temp_hum_val[0] & temp_hum_val[1]. Set both value = 0.

L#125 Start to read temp & humid from sensor.

L#127 Print both values; temp & humid at Serial Monitor.

L#127 Convert temp & humid from float to char.

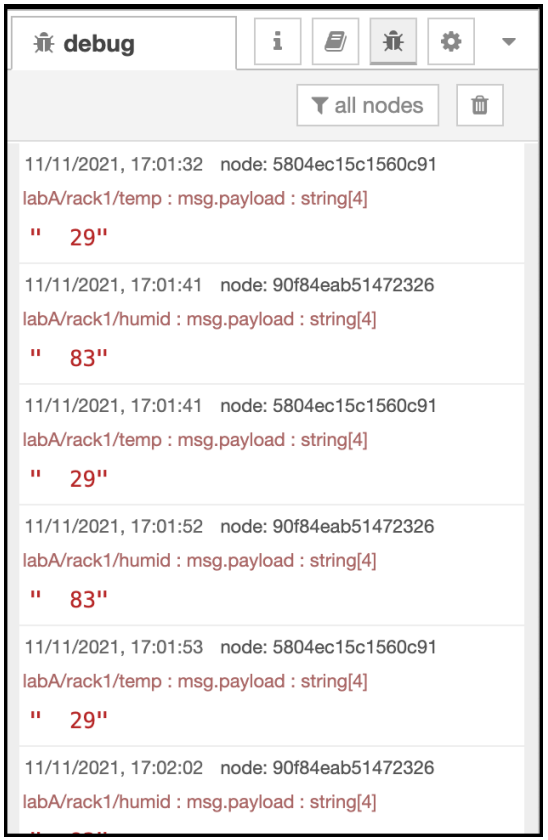
L#133 Publish the temp & humid value accordingly. Topic name must match with Node-RED's topic.

L#136 Will reconnect to broker if disconnected.

v. Arduino PubSub Sketch – Expected Output

- Arduino's Serial Monitor

- Node-RED Debug Window

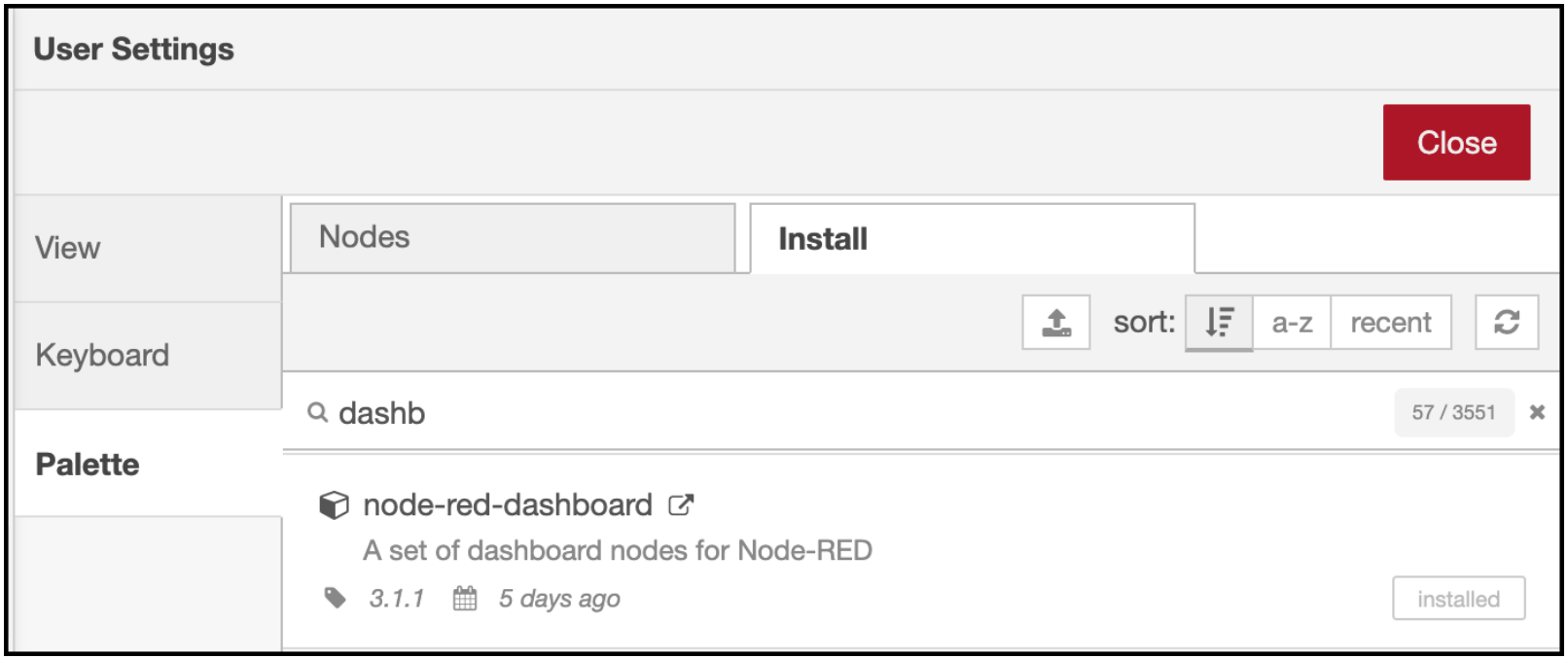


* Do check your IP address, Topic at your sketch if you did not get as expected output.

vi. Create Visual Dashboard

- Go to Node-RED **editor**.
- Install **Dashboard** broker by clicking:

Node-RED Menu > **Manage palette** > **Install** > type **dashboard** at search module > **node-red-dashboard** > **install**

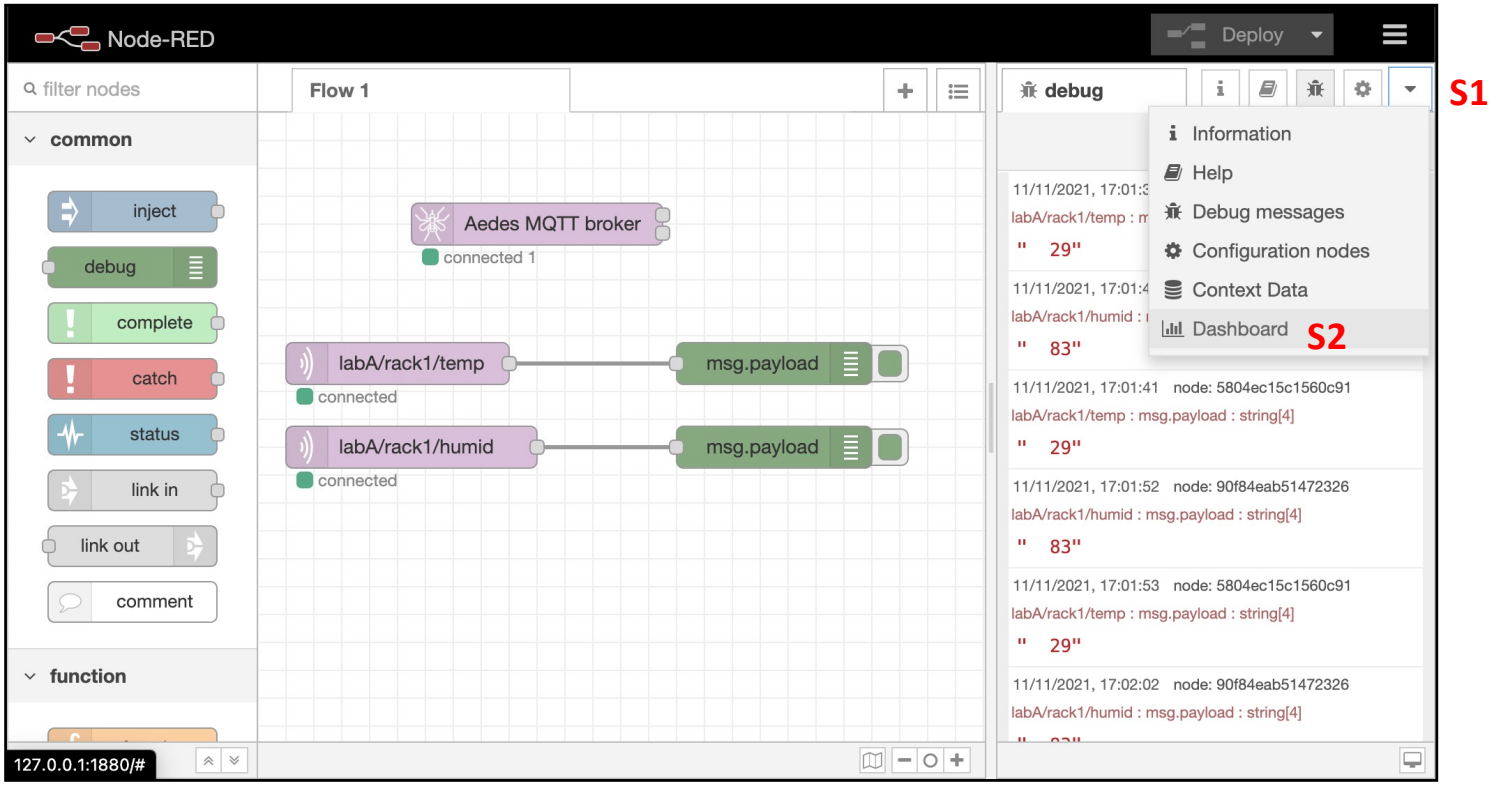


vi. Create Visual Dashboard

- In order to run a Node-RED **dashboard**, you need to create a **tab** & a **group**.
- Decide what information that you want to display.
- In our case, you should consider:
  - ✓ Classroom : **Lab A**
  - ✓ Rack ID: **1**
  - ✓ Item to visual/display: **Temperature & Humidity**
- Thus,
  - **Tab = Main Title = Lab A**
  - **Group = Sub Title = Rack1**
- FYI, more than 1 group can be hosted by 1 tab.
- Your tab can also host group from other tab.

vi. Create Visual Dashboard

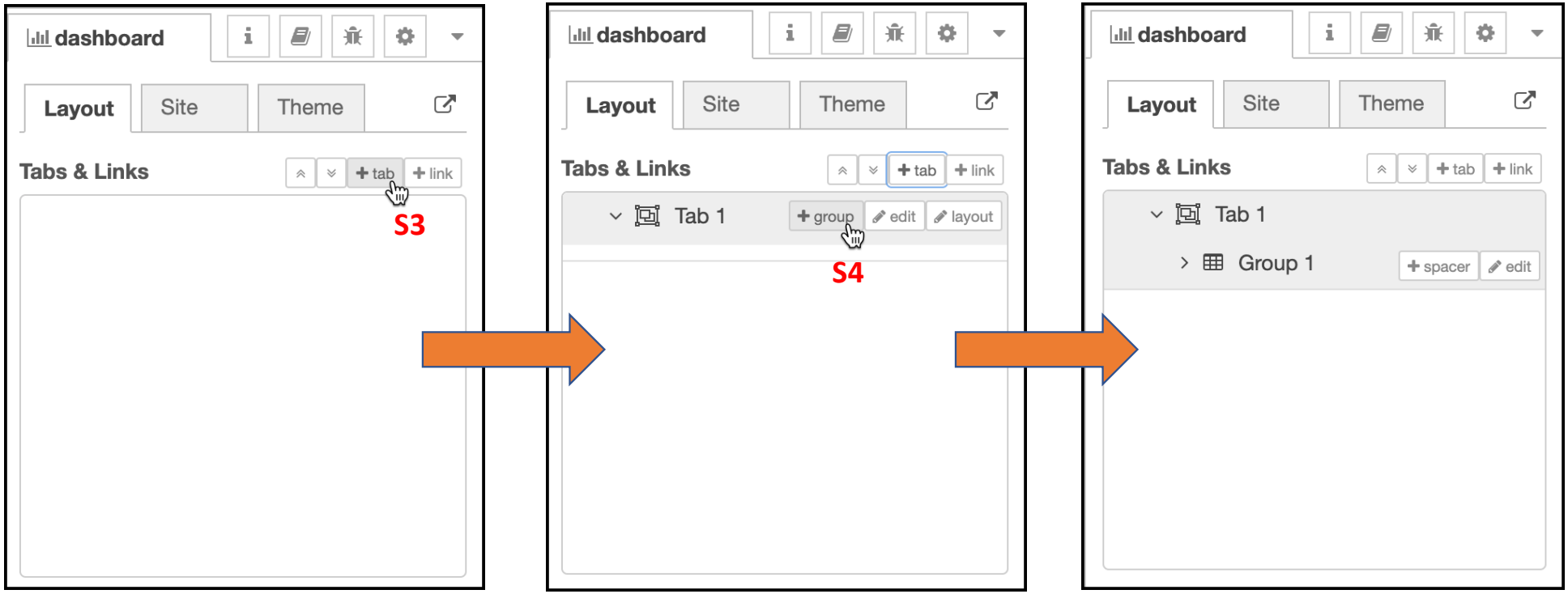
- We need to setup dashboard properties before connecting the gauge/meter node to the flow.
- **Step 1**: Click the dropdown **Menu** of Node-RED.
- **Step 2**: Click **Dashboard** link.



vi. Create Visual Dashboard

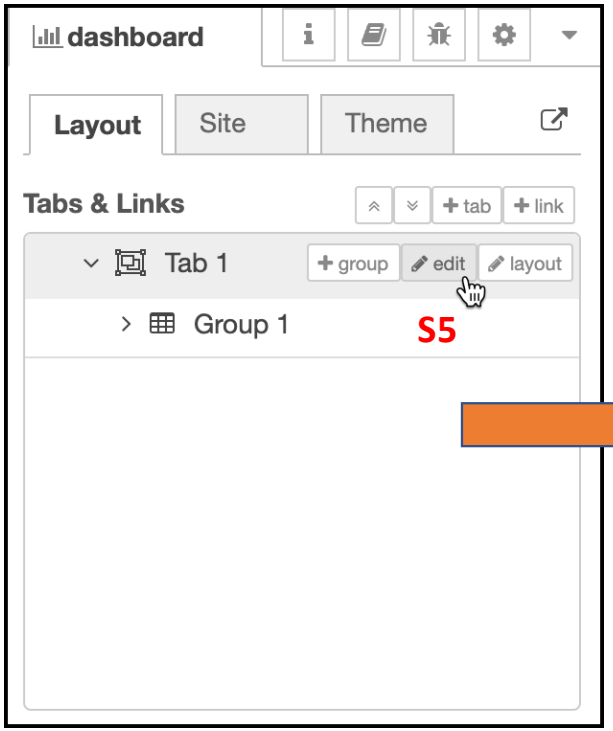
+ tab

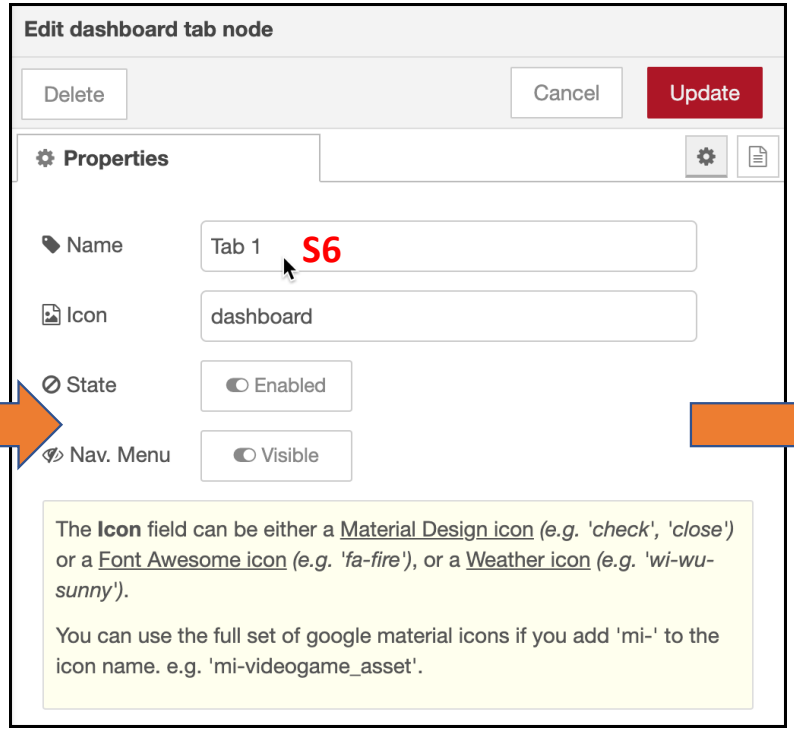
- **Step 3**: Create a project by clicking + tab .
- **Step 4**: Add element in your project by clicking at + group .
- You may edit/update/delete **tab** properties or **group** properties by clicking at edit .

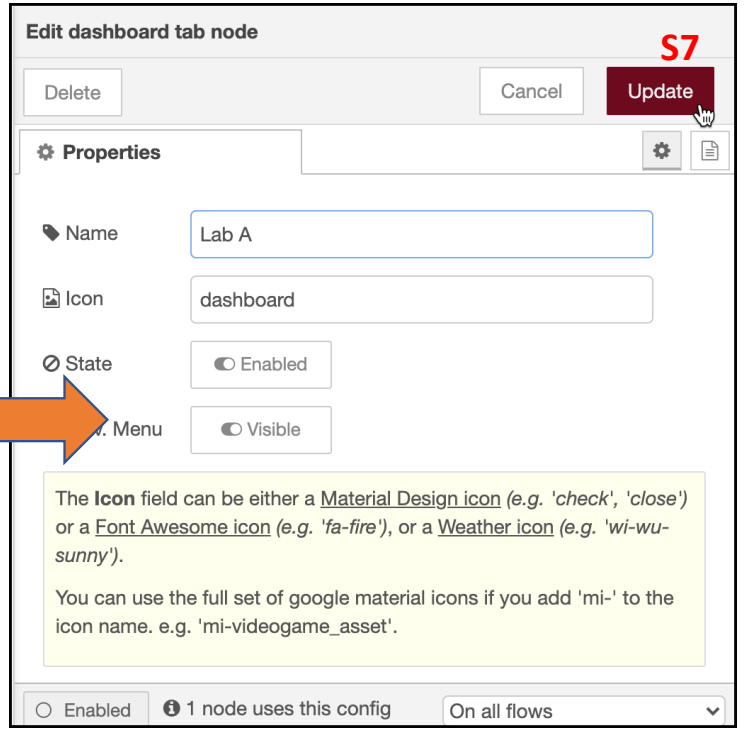


vi. Create Visual Dashboard

- **Step 5**: Click edit to edit the **Tab 1** name .
- **Step 6**: Change **Tab 1** with **Lab A**.
- **Step 7**: Next, click Update to save the setting.

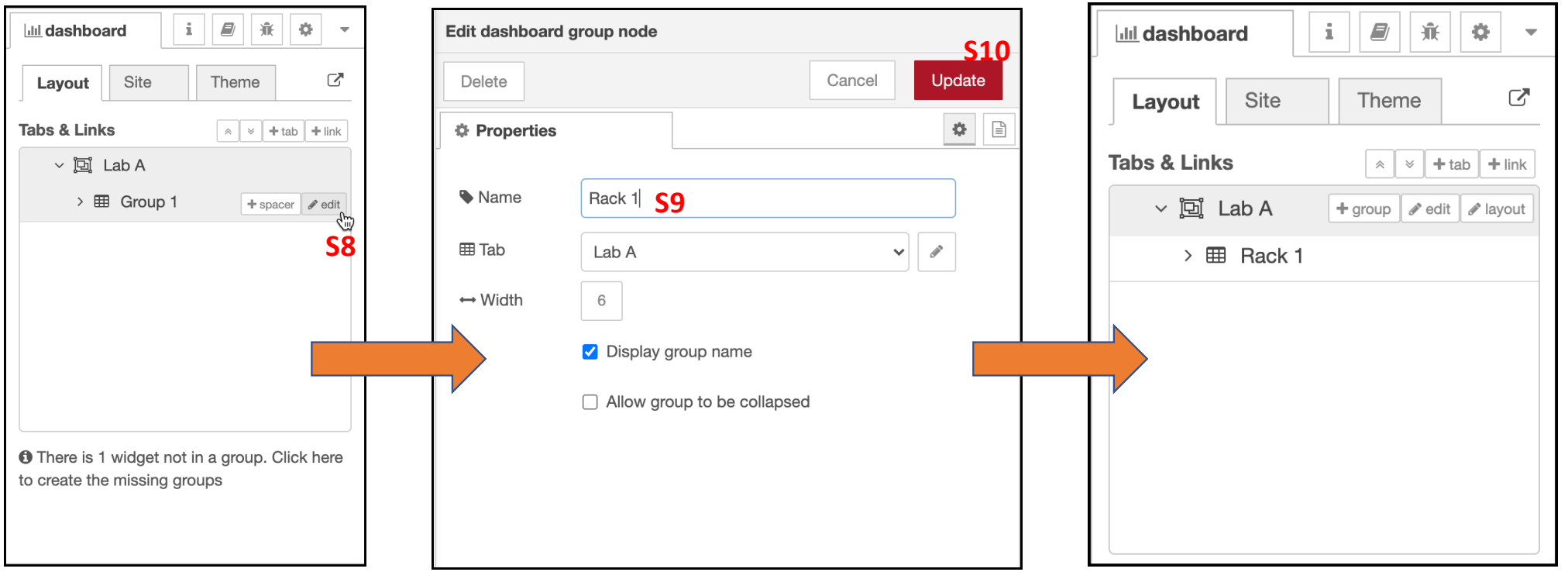






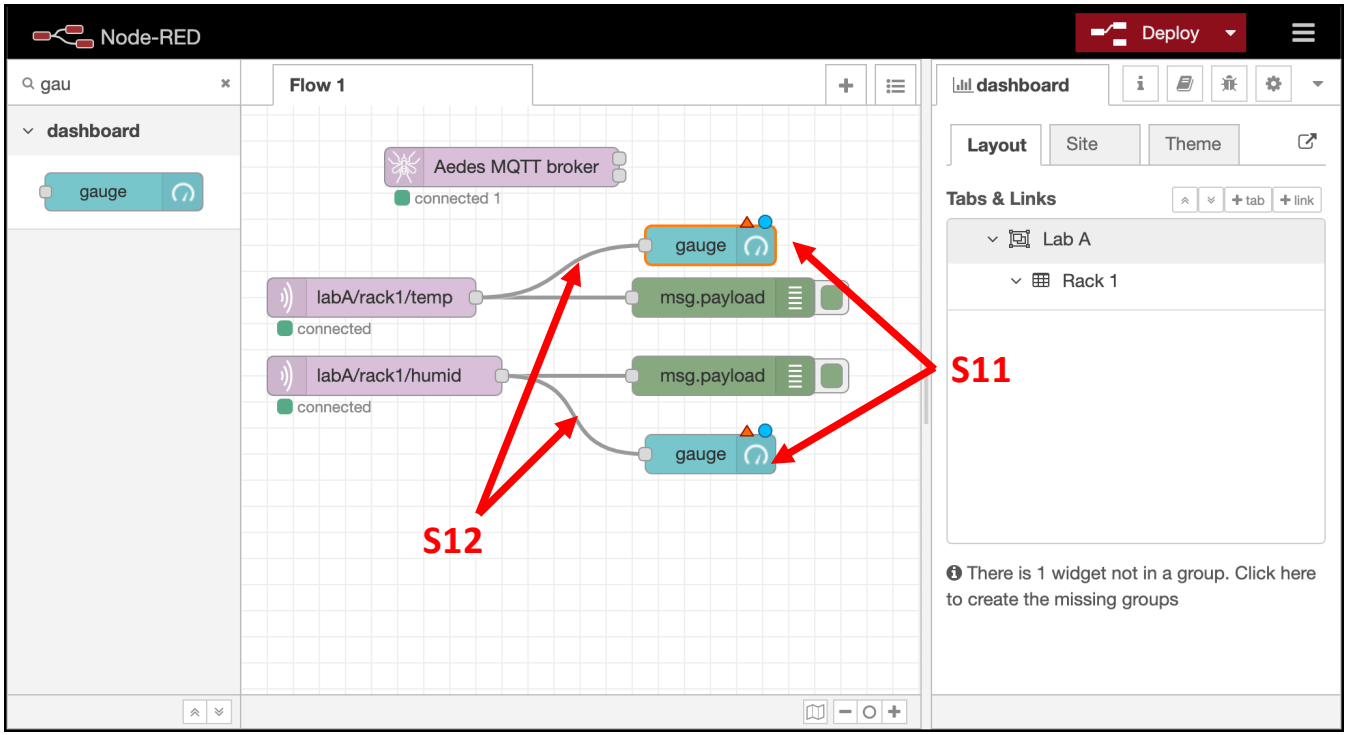
vi. Create Visual Dashboard

- **Step 8**: Click **edit** tab at **Group 1**.
- **Step 9**: Change **Group 1** to **Rack 1.**
- **Step 10**: Click **Update** tab to save the setting..



vi. Create Visual Dashboard

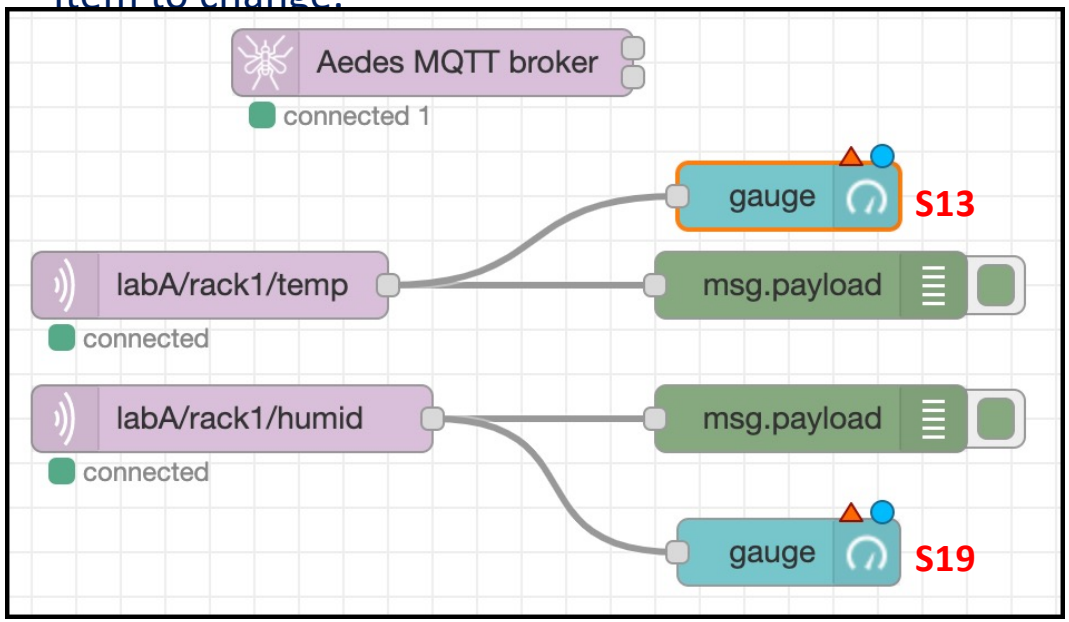
- **Step 11**: Now, add 2 gauges from dashboard palette.
- **Step 12**: Wire each gauge to **labA/rack1/temp** & **labA/rack1/humid** respectively.
- Any of dashboard palette must be configured into its specific tab & group.
- The chances of your node appears in different tab will happen when you mistakenly mapped the groups & tabs.

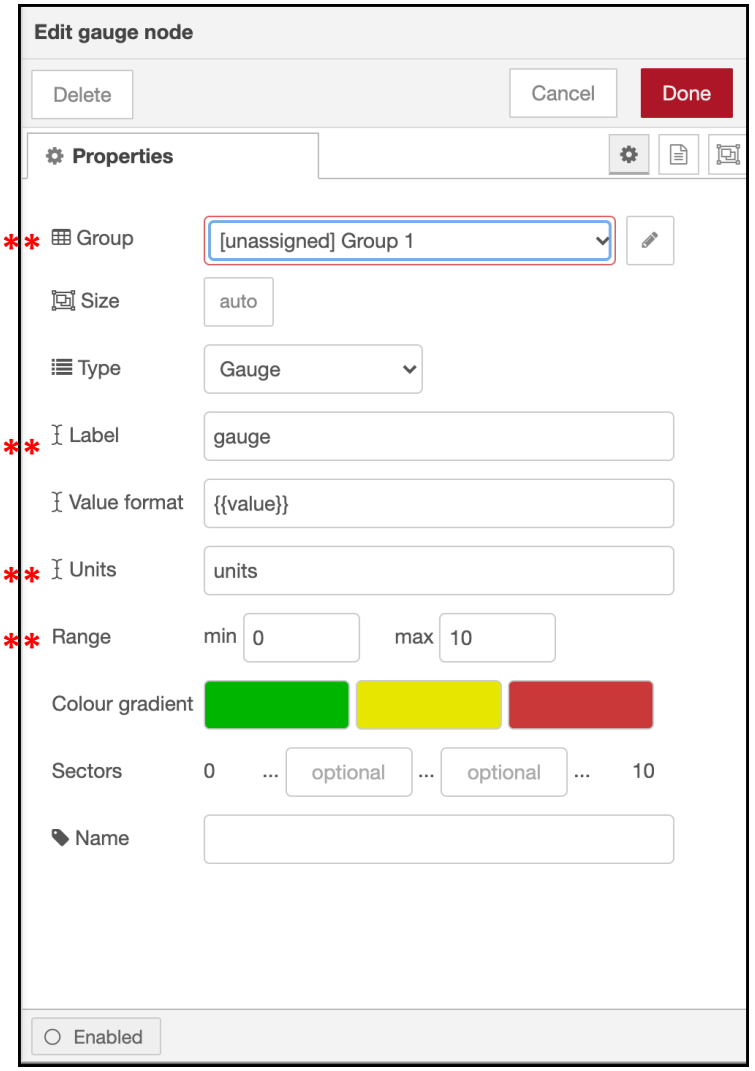


vi. Create Visual Dashboard

Configuration of Gauges.

- **Step 13**: Double click gauge connected to **labA/rack1/temp**.
- **Step 19**: Double click gauge connected to **labA/rack1/humid**.
- **Item to change.



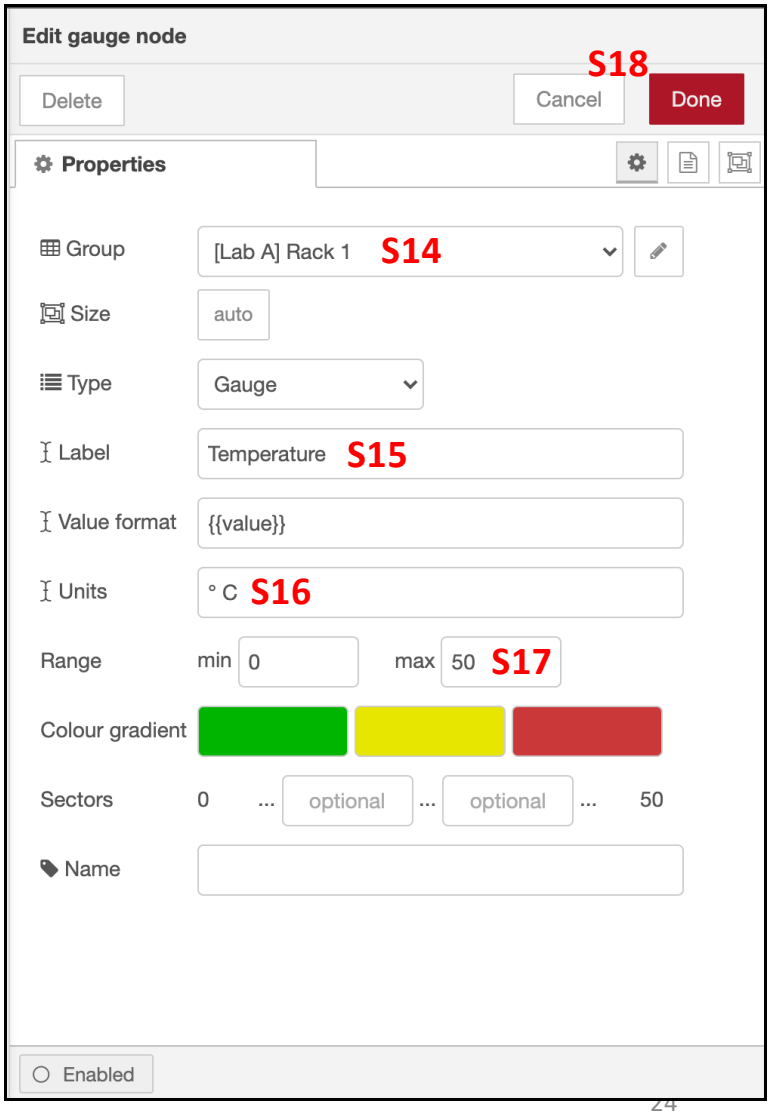


vi. Create Visual Dashboard

Update Temperature Gauge Properties.

- **Step 14**: Click textbox at Group . Change **[unassigned] Group 1** to select **[Lab A] Rack 1**.

- **Step 15**: Change text **gauge** to **Temperature** at .
- **Step 16**: Replace **units** with **° C** (you may copy **°** here).
- **Step 17**: Replace maximum range **10** with **50**
- DHT11's range is between **0° C to 50° C**.
- **Step 18**: Click Done upon completion. **Item to change.



vi. Create Visual Dashboard

Update Humidity Gauge Properties.

- **Step 20**: Click textbox at Group . Change **[unassigned] Group 1** to select **[Lab A] Rack 1**.

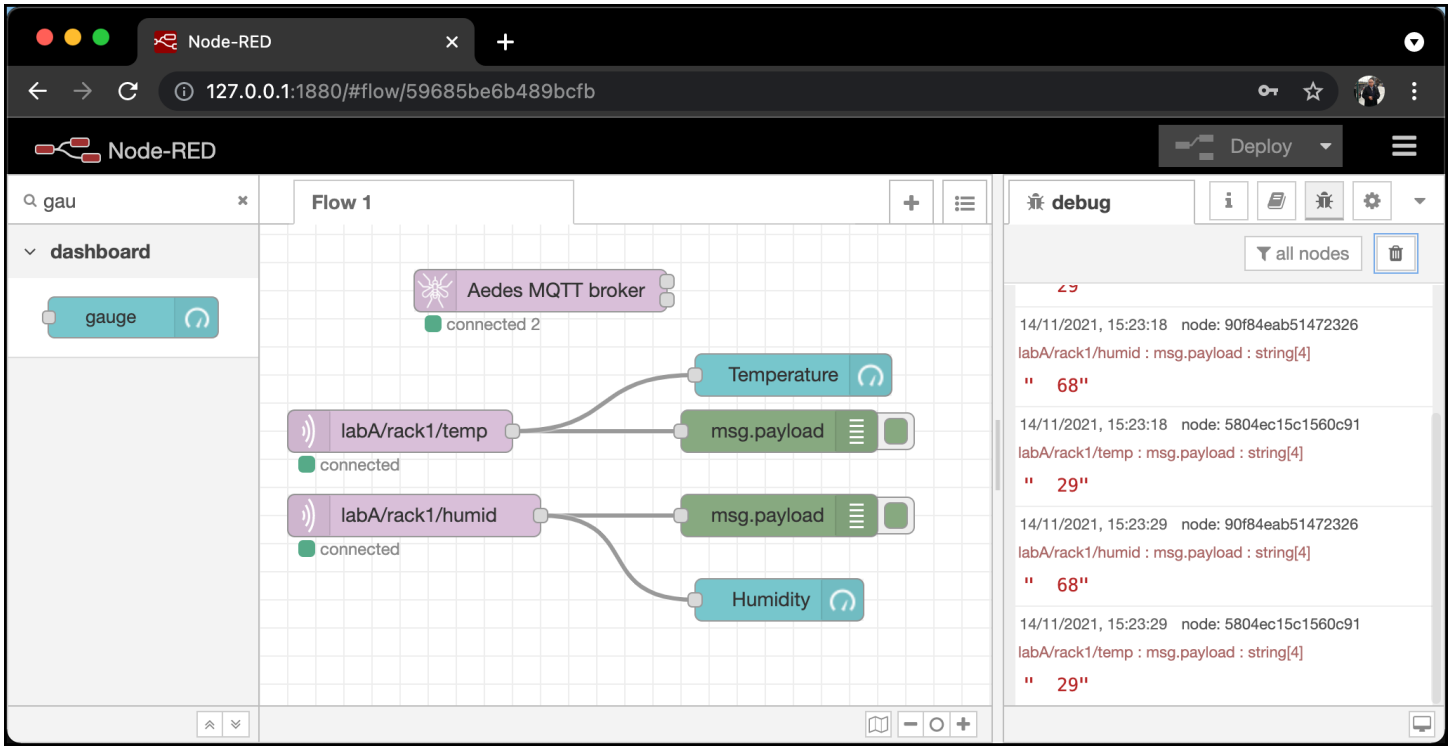
- **Step 21**: Change text **gauge** to **Temperature** at .
- **Step 22**: Replace **units** with **° C** (you may copy **°** here).
- **Step 23**: Replace maximum range **10** with **50**
- Humidity range is between **0° C to 100° C**.
- **Step 24**: Click Done upon completion.
- **Step 25**: Node-RED offers a few interactive visual for metering.

You may go to **Type** & select the output that suit with your needs.

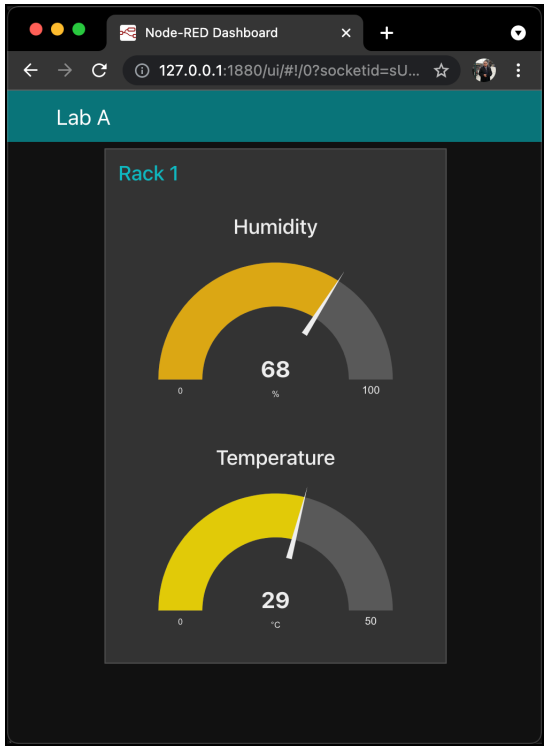
Do not forget to click **Deploy** button.

vi. Create Visual Dashboard

- Download the file working file from https://bit.ly/3DfNfsI.



Node-RED Flow Editor



Node-RED Dashboard

vi. Create Visual Dashboard

Adding More Racks.

- In order to add more rack, means you have to add more sensors.
- You have to consider the topic at ESP32 and also at broker side.
- Assume you want to add Rack 2, Lab A. Open arduino sketch (https://bit.ly/31WQUhn) and change:
  labA/rack1/humid at line number **133** to **labA/rack2/humid**, and **also ,**
  labA/rack1/temp at line number **134** to **labA/rack2/temp**.

```
133   client.publish("labA/rack1/humid", humidValue); /// send char
134   client.publish("labA/rack1/temp", tempValue); /// send char
```

- Next, at Node-RED flow editor, add 2 **mqtt in**, set IP address similar with steps, label the topic as **labA/rack2/humid and labA/rack2/temp.**

QUESTIONS

END