PRO-C249

ENVIRONMENTAL MONITOR SYSTEM-2

What is our GOAL for this CLASS?

In this class, we were introduced to interface the BMP180 pressure sensor with ESP32 and we learned to publish and subscription technique used in sending and receiving messages on the cloud server.

What did we ACHIEVE in the class TODAY?

- We were introduced to **Publish & Subscribe**
- We learned how to **Send** data to the server
- We learned how to **Receive** data from the server

Which CONCEPTS/ CODING BLOCKS did we cover today?

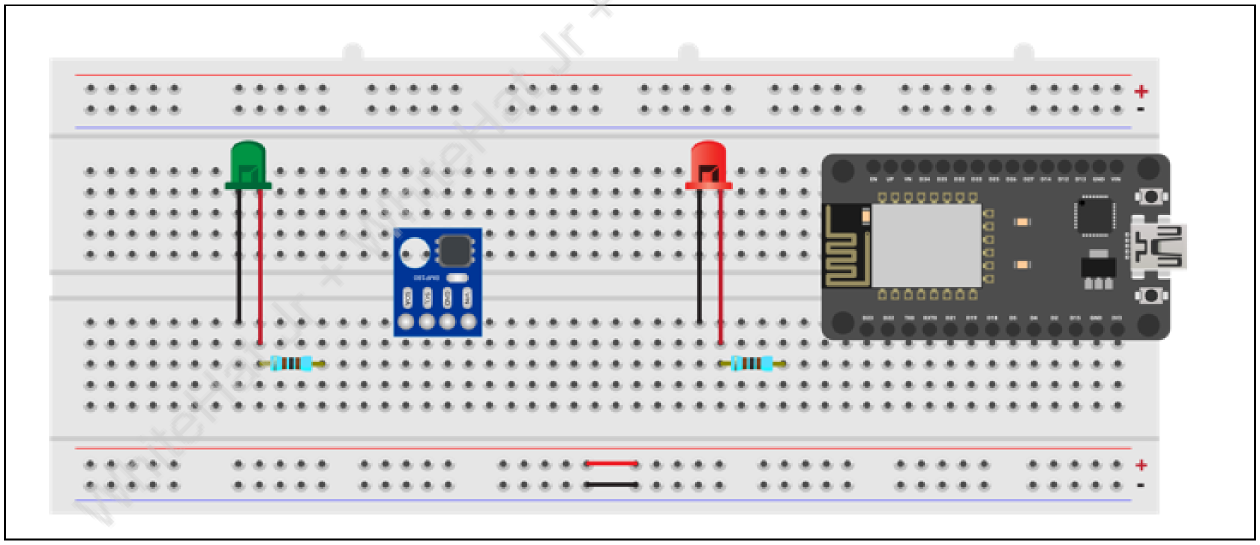
- We learned how to interface sensors and end devices with the cloud server.
- We learned about Publish and Subscribe
  - **Publish** - push data from device to server for example. Sensor Data
  - **Subscribe**- push data from server to device for example. LED Control
- We learned how to publish the sensor data and control the LEDs using an Adafruit server.
- We learned about **readSubscription()**
  - **readSubscription()** will sit and listen for up to 'time' for a message. It will either get a message before the timeout and reply with a pointer to the subscription **or**

it will timeout and return **0.** In this case, it will wait up to 5 seconds for a subscription message.

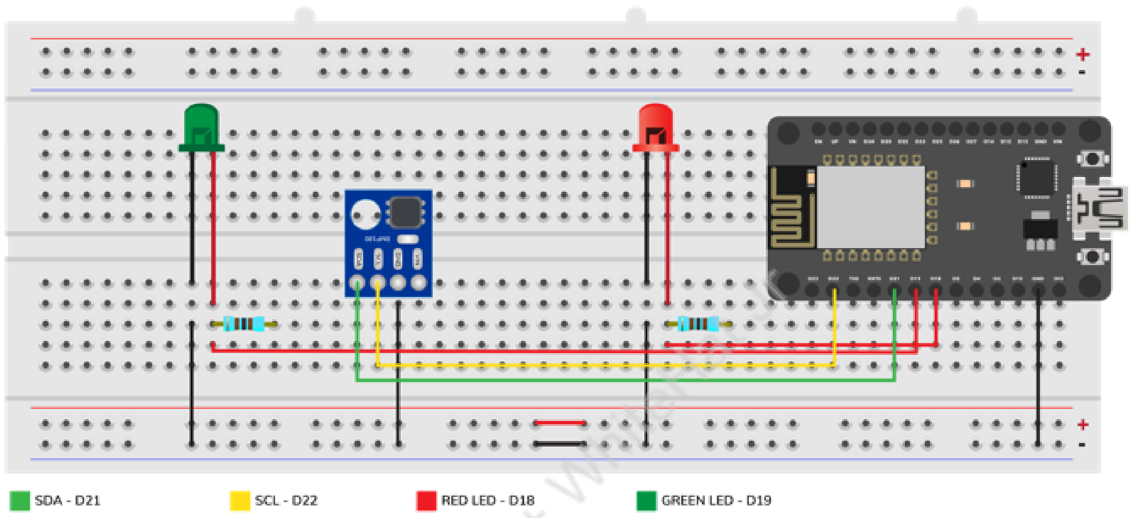
How did we DO the activities?

1. Gather the material from the IoT kit:
   - 1 x ESP32
   - 1 x USB Cable
   - 1 x Breadboard
   - 4 x Jumper wires
   - 1 x BMP180
   - 2 x LED
   - 2 x Resistors

2. Mount the components



3. Connections for **Circuit** Diagram
   - **BMP180 VCC pin**: Connect with 3V3 PIN of the ESP32
   - **BMP180 GND pin**: Connect with GND of the ESP32
   - **BMP180 SCL pin**: Connect with GPIO PIN 22
   - **BMP180 SDA pin**: Connect with GPIO PIN 21
   - **LED Connections:** Connect positive leg of **LED** with a resistor and negative with **GND(0V).**
   - Other end of the resistor with **GPIO pin 18.**
   - Do the same connection for the second **LED**, but this time connect with **GPIO pin 19**



4. write a code for barometric sensors:
    - Define the libraries
        - **include keyword** is used to import libraries in embedded language as we used to import in python language
        - **WiFi.h:** WiFi library will be able to answer all HTTP request
        - **Adafruit BMP085.h** Adafruit **BMP085** is used to connect the BMP180 sensor with the Adafruit dashboard**.**
        - Adafruit supports a protocol called **MQTT**, or **message queue telemetry transport**, for communication with devices. To send and receive feed data,
        - **Adafruit_MQTT** header file tells about sending and receiving packets.
        - **Adafruit_MQTT_Client** allows you to publish to a feed.

```
#include <WiFi.h>
#include <Adafruit_BMP085.h>
#include "Adafruit_MQTT.h"
#include "Adafruit_MQTT_Client.h"
```

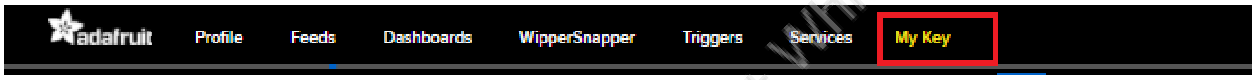
- Connect with ESP32 with the WiFi. For that use SSID(Wi-Fi credentials i.e WiFi name and WiFi Password)
- **WLAN_SSID, WLAN_PASS** are the variables that are used to save WiFi credentials. Set the **SSID** and **password**
- Use your actual WIFi Credentials
  .

```
#define WLAN_SSID       "WR3005N3-757E"
#define WLAN_PASS       "70029949"
```

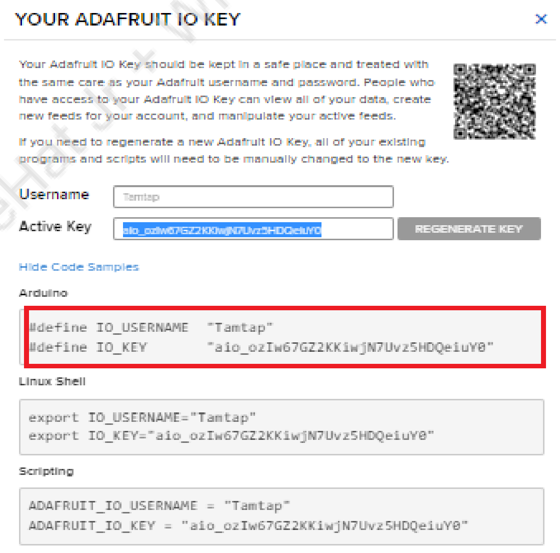
5. Adafruit Setup and Authentication
   - Set the Adafruiit **AIO_SERVER , AIO_SERVERPORT, AIO_USERNAME, AIO_KEY**

```
#define AIO_SERVER      "io.adafruit.com"
#define AIO_SERVERPORT  1883                   // use 8883 for SSL
#define AIO_USERNAME  "Tamtap"
#define AIO_KEY        "aio_ozIw67GZ2KKiwjN7Uvz5HDQeiuY0"
```

   - To get **AIO_USERNAME** & **AIO_KEY go to adafruit,** Click on **My Key**



   - After clicking on **My Key**, the following window will appear.
   - Note down **IO_USERNAME** & **IO_KEY,** paste the same in the program where **AIO_USERNAME** & **AIO_KEY is mentioned.**
   - Connect the Adafruit server with ESP32.



YOUR ADAFRUIT IO KEY

Your Adafruit IO Key should be kept in a safe place and treated with the same care as your Adafruit username and password. People who have access to your Adafruit IO Key can view all of your data, create new feeds for your account, and manipulate your active feeds.

If you need to regenerate a new Adafruit IO Key, all of your existing programs and scripts will need to be manually changed to the new key.

Username: Tamtap

Active Key: aio_ozIw67GZ2KKiwjN7Uvz5HDQeiuY0

REGENERATE KEY

Hide Code Samples

Arduino

```
#define IO_USERNAME  "Tamtap"
#define IO_KEY       "aio_ozIw67GZ2KKiwjN7Uvz5HDQeiuY0"
```

Linux Shell

```
export IO_USERNAME="Tamtap"
export IO_KEY="aio_ozIw67GZ2KKiwjN7Uvz5HDQeiuY0"
```

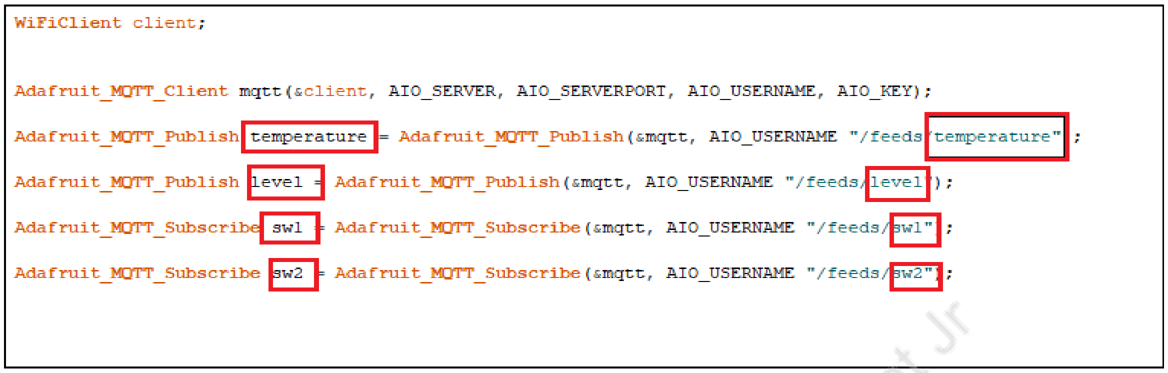
Scripting

```
ADAFRUIT_IO_USERNAME = "Tamtap"
ADAFRUIT_IO_KEY = "aio_ozIw67GZ2KKiwjN7Uvz5HDQeiuY0"
```

6. Publish & Subscribe
   - Setup the MQTT client class by passing is Adafruit server set up details like **AIO_SERVER, AIO_SERVERPORT, AIO_USERNAME, AIO_KEY**
   - BMP180 is used to sense temperature and pressure will use **Adafruit_MQTT_Publish** publish data, and to control LED from the server use

Adafruit_MQTT_Subscribe

- **AIO_USERNAME/feeds/temperature** is feed name

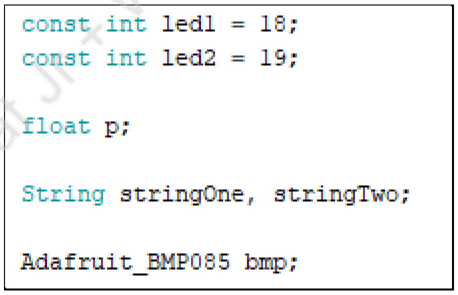


```
WiFiClient client;

Adafruit_MQTT_Client mqtt(&client, AIO_SERVER, AIO_SERVERPORT, AIO_USERNAME, AIO_KEY);
Adafruit_MQTT_Publish temperature = Adafruit_MQTT_Publish(&mqtt, AIO_USERNAME "/feeds/temperature");
Adafruit_MQTT_Publish level = Adafruit_MQTT_Publish(&mqtt, AIO_USERNAME "/feeds/level");
Adafruit_MQTT_Subscribe sw1 = Adafruit_MQTT_Subscribe(&mqtt, AIO_USERNAME "/feeds/sw1");
Adafruit_MQTT_Subscribe sw2 = Adafruit_MQTT_Subscribe(&mqtt, AIO_USERNAME "/feeds/sw2");
```

- **MQTT_ connect** will establish a connection of ESp32 with cloud server

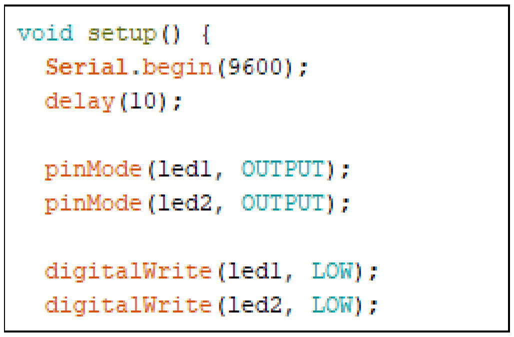
```
void MQTT_connect();
```

7. Define **GPIO pins**
   - **Define LED's pin** along with data type **int**
   - Define Variable **p** with datatype **float**
   - Define **String** variable to store value
   - Define **bmp** object for **Adafruit_BMP085**



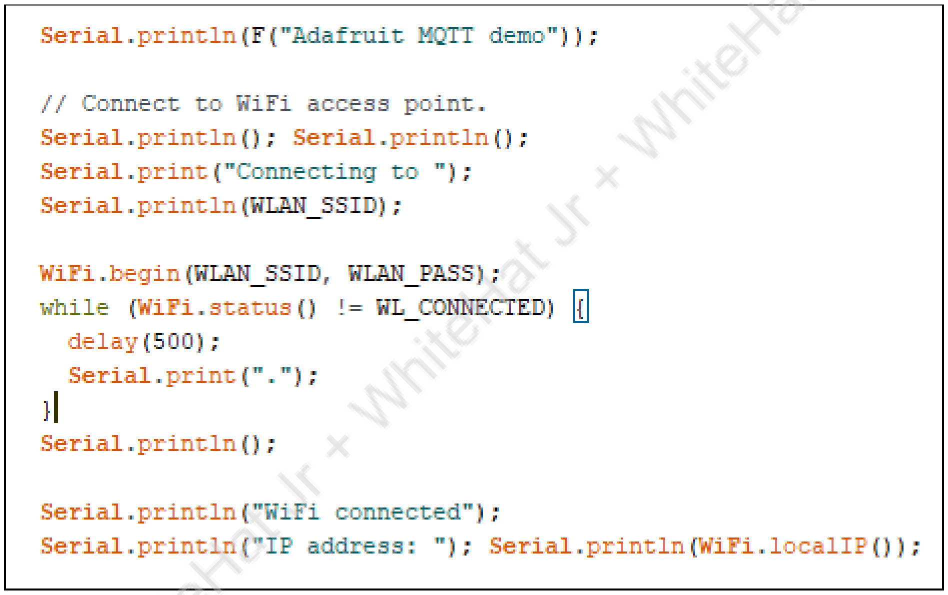
```
const int led1 = 18;
const int led2 = 19;

float p;

String stringOne, stringTwo;

Adafruit_BMP085 bmp;
```

8. **Initialize the setup()**
   - **Serial. begin(9600)** is used for data exchange speed. speed parameters. This tells the Arduino to get ready to exchange messages with the Serial Monitor at a data rate of 9600 bits per second. That's 9600 binary ones or zeros per second and is commonly called a baud rate.
   - Set a **delay** of **10** ms
   - **PinMode()** configures the specified pin to behave either as an input or an output. As we want to act as output we are writing **OUTPUT** here. Set the pinMode for both **Led1, Led2**
   - **digitalWrite()** function helps to change the state of LED from **HIGH to LOW** or vice versa



```
void setup() {
  Serial.begin(9600);
  delay(10);

  pinMode(led1, OUTPUT);
  pinMode(led2, OUTPUT);

  digitalWrite(led1, LOW);
  digitalWrite(led2, LOW);
```

- **Serial. println** is used to print the statement



```
Serial.println(F("Adafruit MQTT demo"));

// Connect to WiFi access point.
Serial.println(); Serial.println();
Serial.print("Connecting to ");
Serial.println(WLAN_SSID);

WiFi.begin(WLAN_SSID, WLAN_PASS);
while (WiFi.status() != WL_CONNECTED) {
  delay(500);
  Serial.print(".");
}
Serial.println();

Serial.println("WiFi connected");
Serial.println("IP address: "); Serial.println(WiFi.localIP());
```

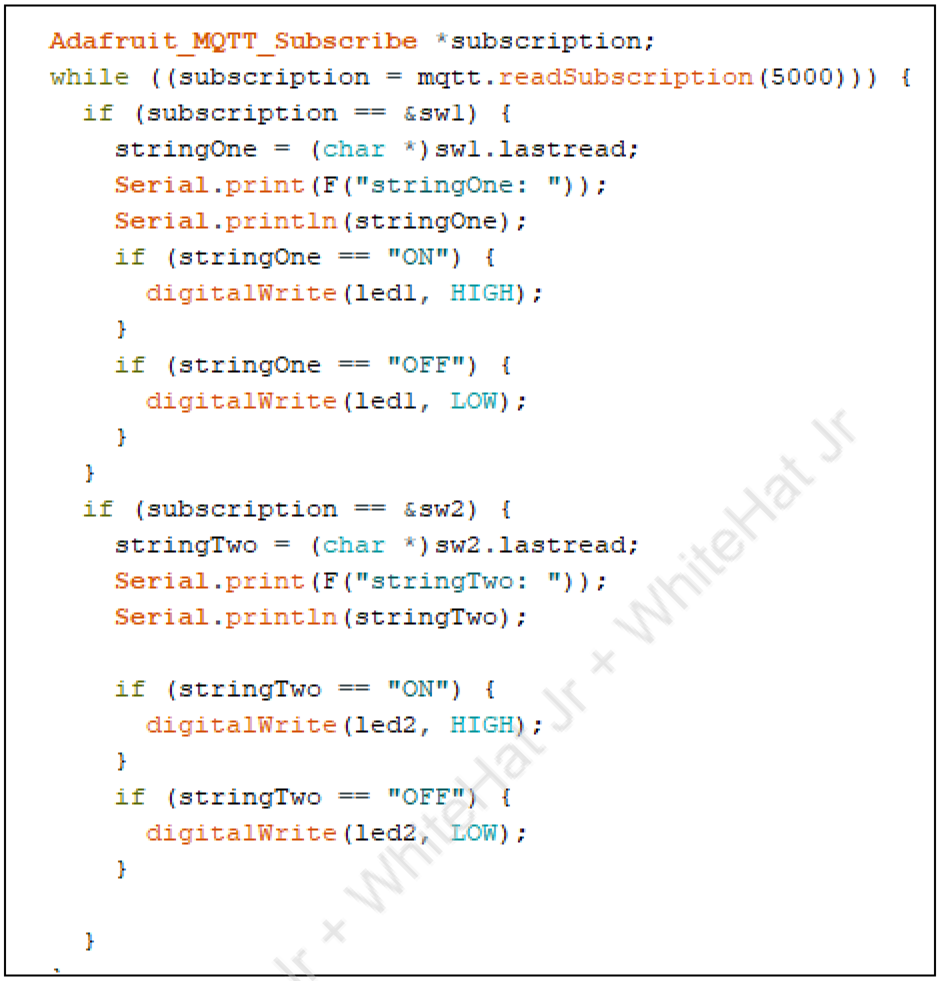
- Setup MQTT subscriptions for **led1, led2** i.e. **sw1,sw2. sw1 and sw2** are the feed names that is entered at the very first step of naming the feed.
- **bmp. begin()** is used to start the process.
- Print **"Could not found",** if the sensor fail to start the process

```
  mqtt.subscribe(&sw1);
  mqtt.subscribe(&sw2);


  if (!bmp.begin()) {
    Serial.println("BMP180 Sensor not found ! ! !");
    while (1) {}
  }
}
```

- The unsigned uint32_t data type works on 32-bit numbers.
- To execute the main process write the **void loop()**
- The **readPressure()** function will read the pressure around us
- The **readTemperature ()** function will read the pressure around us
- Store the sensor's pressure value into variable p
- Set a delay of **100** ms
- **MQTT_connect** function instructs the library to start connecting to the server. This will ensure that the connection to the MQTT server is alive.

```
p = bmp.readPressure();
q = bmp.readTemperature();
Serial.println(p);
Serial.println(q);
delay(100);

MQTT_connect();
```

- After the connection check, the server waits for subscriptions to come in. Send data from server to LED's
- To send data from server to end devices(LEDs) use the **Subscribe** function.
- Create the **Adafruit_MQTT_Subscribe** object **subscription**, using object subscription it is used to determine which subscription was received.
- Compare the latest feed to the **sw1** feed. If they match, read the last message using **lastread**
- If the read times out, the while loop will fail
- Prints the received data but also compares the data to determine whether the string received is **ON** or **OFF**
- adafruit.io publishes the data as a string, use **string. stringOne, stringTwo** will save LED's ON or OFF
- **digitalWrite()** will change the state of LED using **HIGH** or **LOW**
- If it is **ON** then make it **HIGH,** otherwise make it **LOW**



```
Adafruit_MQTT_Subscribe *subscription;
while ((subscription = mqtt.readSubscription(5000))) {
  if (subscription == &sw1) {
    stringOne = (char *)sw1.lastread;
    Serial.print(F("stringOne: "));
    Serial.println(stringOne);
    if (stringOne == "ON") {
      digitalWrite(led1, HIGH);
    }
    if (stringOne == "OFF") {
      digitalWrite(led1, LOW);
    }
  }
  if (subscription == &sw2) {
    stringTwo = (char *)sw2.lastread;
    Serial.print(F("stringTwo: "));
    Serial.println(stringTwo);

    if (stringTwo == "ON") {
      digitalWrite(led2, HIGH);
    }
    if (stringTwo == "OFF") {
      digitalWrite(led2, LOW);
    }

  }
```

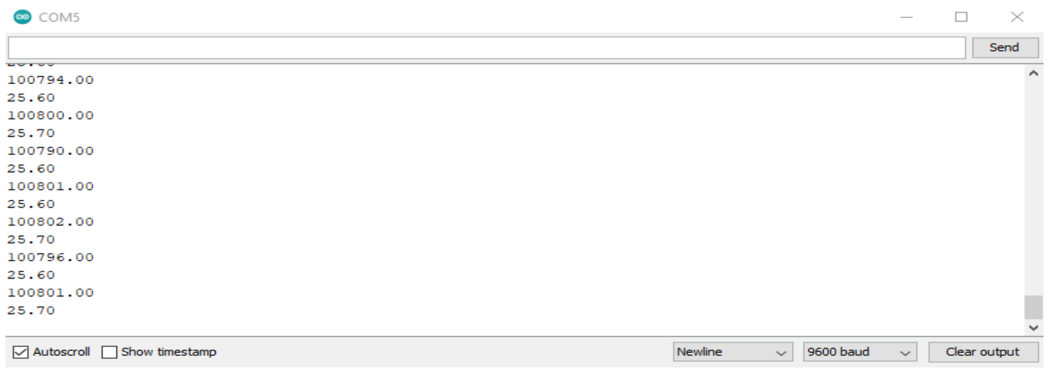
9. Publish the **BMP180** data, publish Pressure and Temperature
   - BMP180 can measure temperature and pressure
   - Publish the temperature and subtract that temperature from temperature_sens_read and then convert it into Fahrenheit.
   - Convert raw temperature in Fahrenheit to Celsius degrees using the formula **F= 32+1.8C**
   - Check for success or failure of publication by using the **Serial.print** function.

```
if (! temperature.publish(((temprature_sens_read() - 32 ) / 1.8))) {
} else {
  //Serial.println(F("Teamp OK!"));
}

if (! level.publish(p)) {
  //Serial.println(F(pressure Level Failed"));
} else {
  //Serial.println(F("pressure Level OK!"));
}
```

- Function to connect and reconnect as necessary to the MQTT server alive.
- It should be called in the loop function and it will take care of connecting.
- If gets disconnected then try to connect it again.
- ret is a variable which will save temporary return value in datatype int

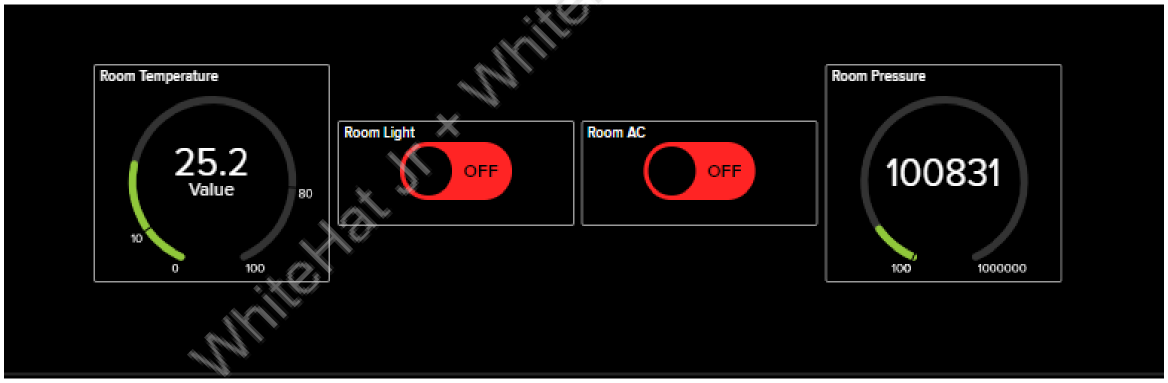
```
void MQTT_connect() {
  int8_t ret;
  if (mqtt.connected()) {
    return;
  }

  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) {
      while (1);
    }
  }
}
```

10. Compile and upload the program to ESP32 board using Arduino IDE
    - Verify the program by clicking the Tick option
    - Upload the program by clicking the arrow option
    - If the port is not selected, insert the USB cable in Computer's port and select the port
    - Go to Tools and select Serial Monitor



```
100794.00
25.60
100800.00
25.70
100790.00
25.60
100801.00
25.60
100802.00
25.70
100796.00
25.60
100801.00
25.70
```

- **Error Message:** If an error message comes like no such file or directory then use the below method to resolve this error
    - Go to Tools
        - Click on Manage Libraries
        - Write the component name which needs to install
        - Click on Install
- Go to Tools and select **Serial Monitor**
    - See the Pressure and Temperature value
    - Open your Adafruit server and check the live values of Pressure and Temperature. Click the Toggle buttons to turn ON and OFF your LED's



- So, Today we made an arrangement where we saw the exact readings of the pressure and temperature around us using a **BMP180** sensor and we learned how to publish and subscribe data

What's NEXT?

In the next class, we will learn **about Relays.**

Expand Your Knowledge

To know more about **BMP180 pressure sensor** click here.