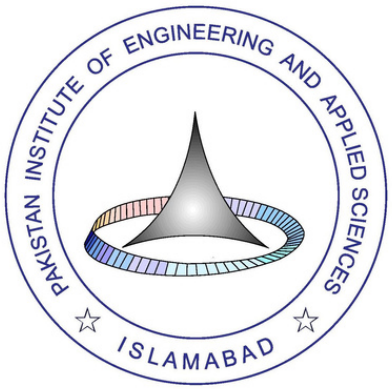


Implementing Leading IoT Cloud Platforms with ESP8266

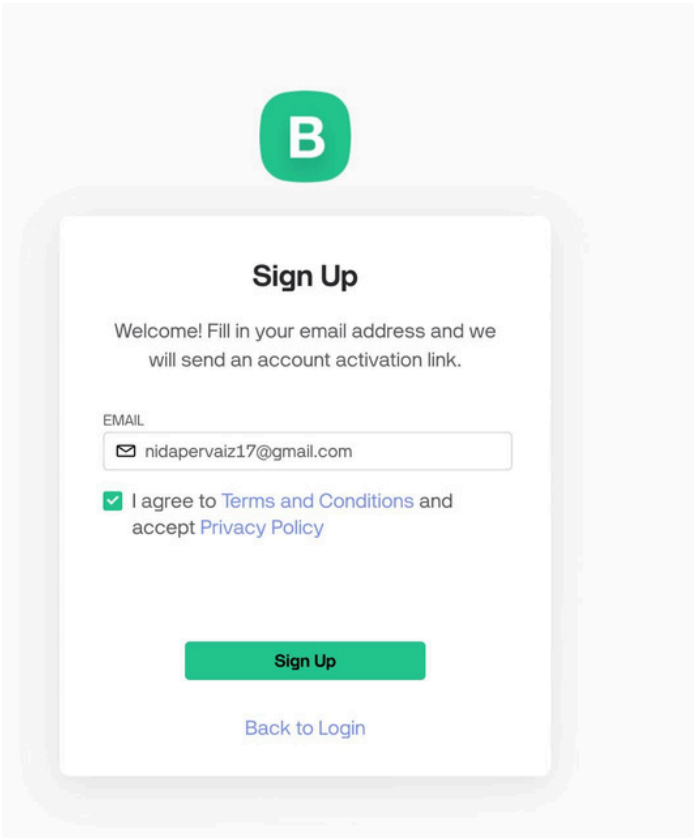
Pakistan Institute of Engineering and Applied Sciences

Blynk

Performed by Nida Pervaiz

Step 1:

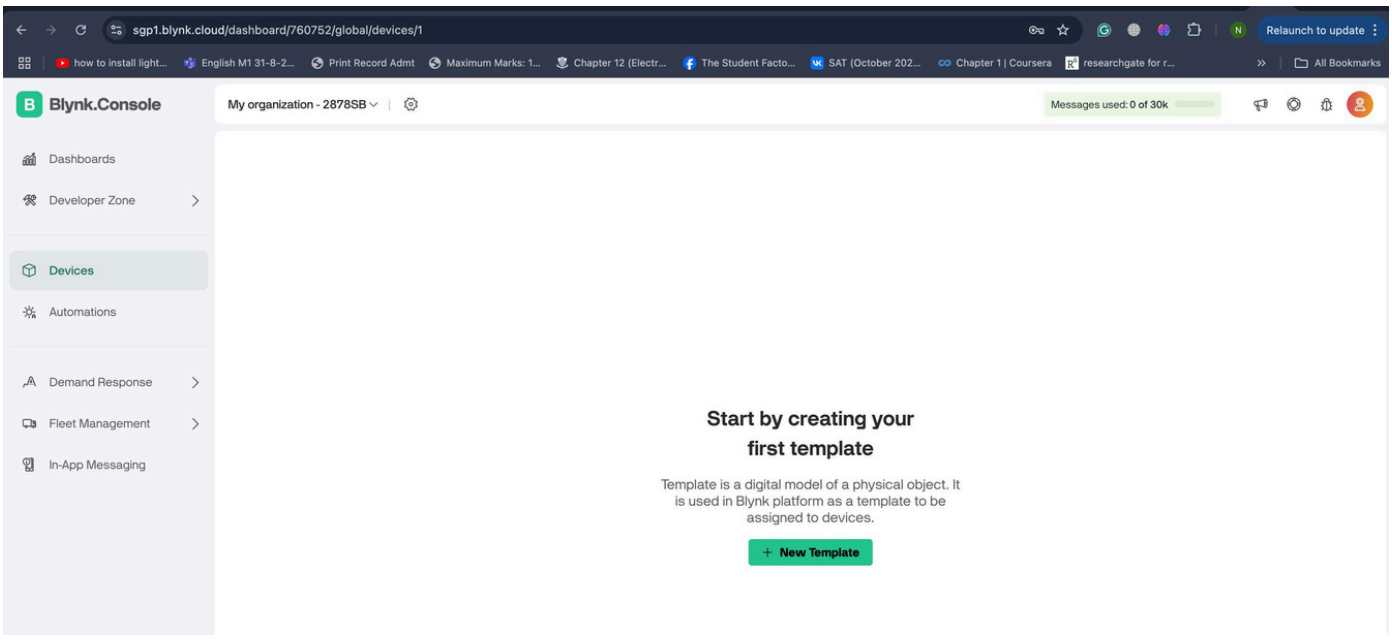
Fisrt i **signed up** on https://blynk.cloud, the official website for Blynk IoT (Blynk 2.0). Following are the sign up steps. Entered my email and verified it through the link that i got in email from Blynk.

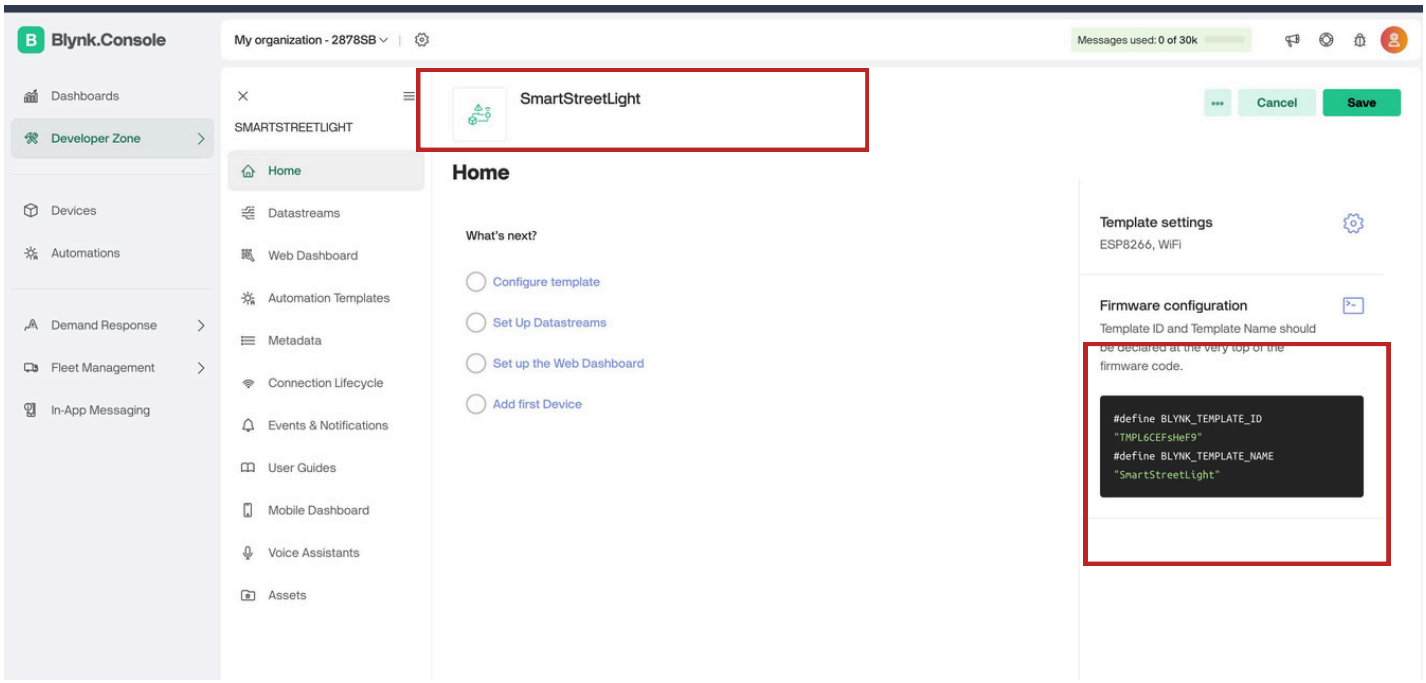


Step 2:

Created **new template** and filled in details

- Name: SmartStreetLight
- Hardware: ESP8266
- Connection Type: WiFi





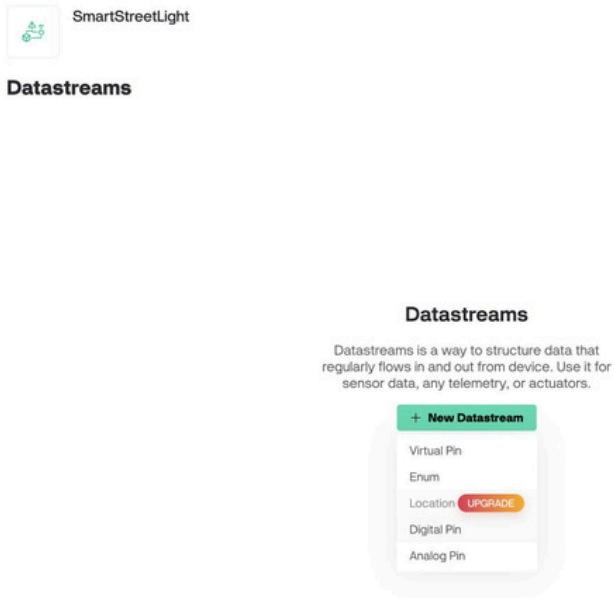
Step 3: Inside the template, went to Datastreams tab.Clicked "+ **New Datastream**" → chose Virtual Pin.

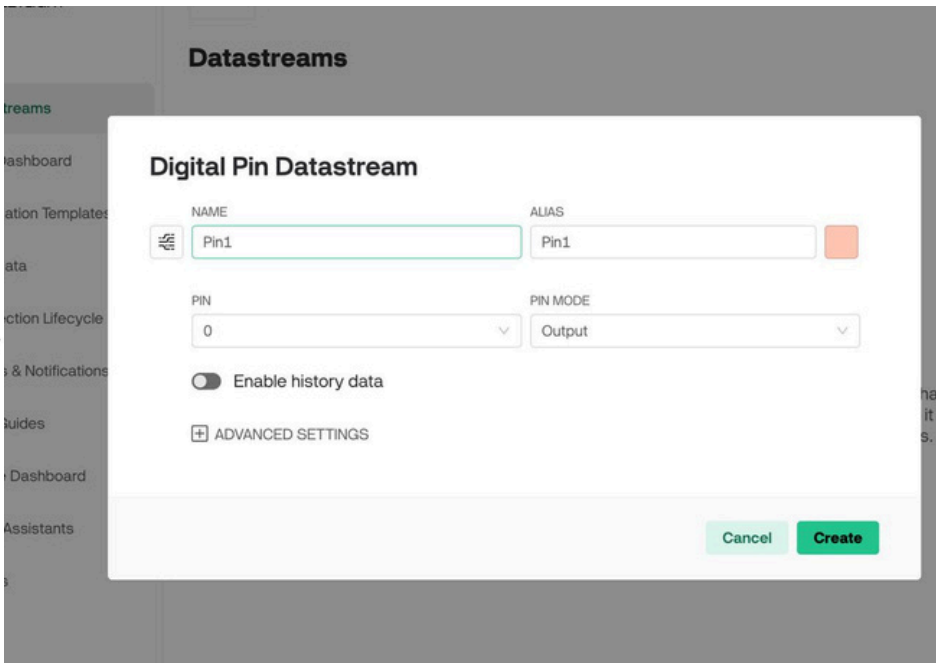
Name: Pin1

Pin: 0

Pin Mode: Output

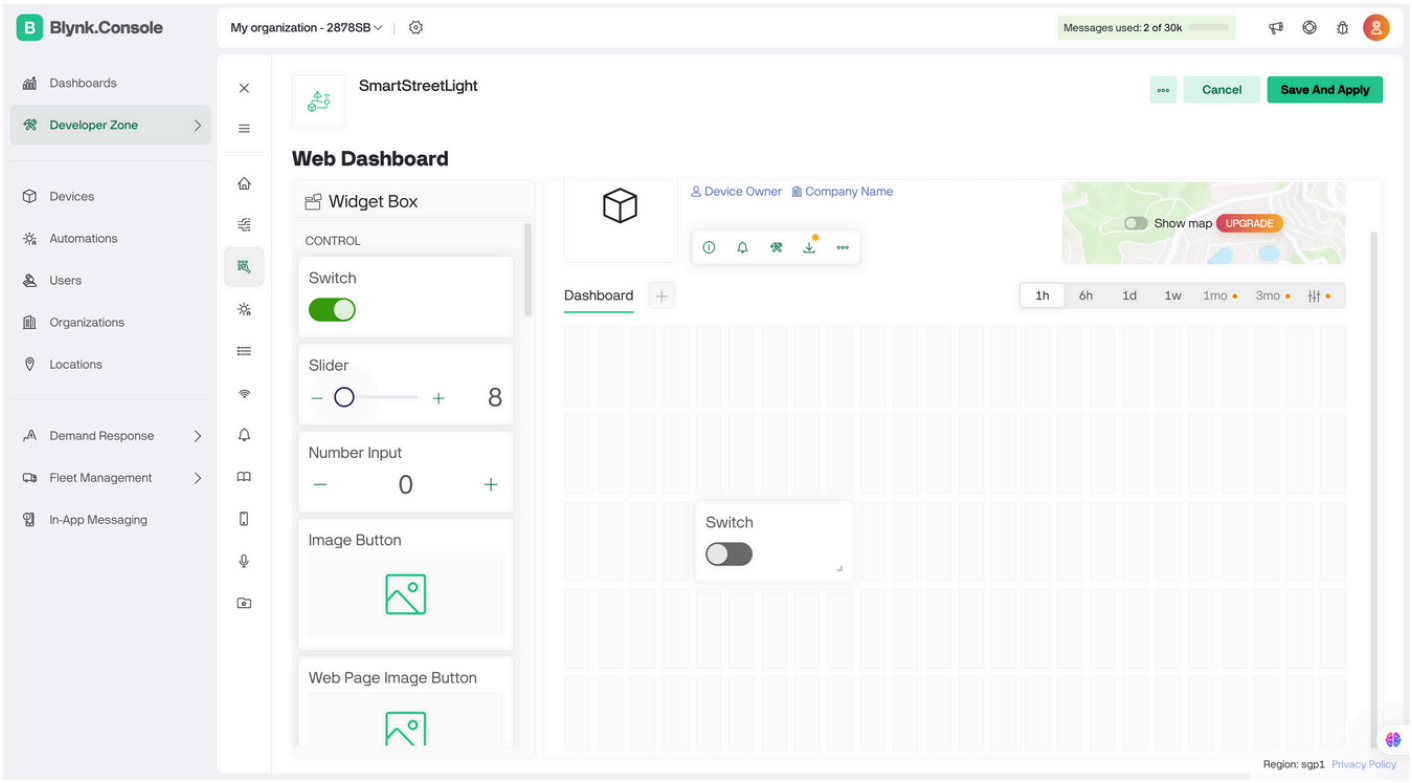
And created it by clicking create.

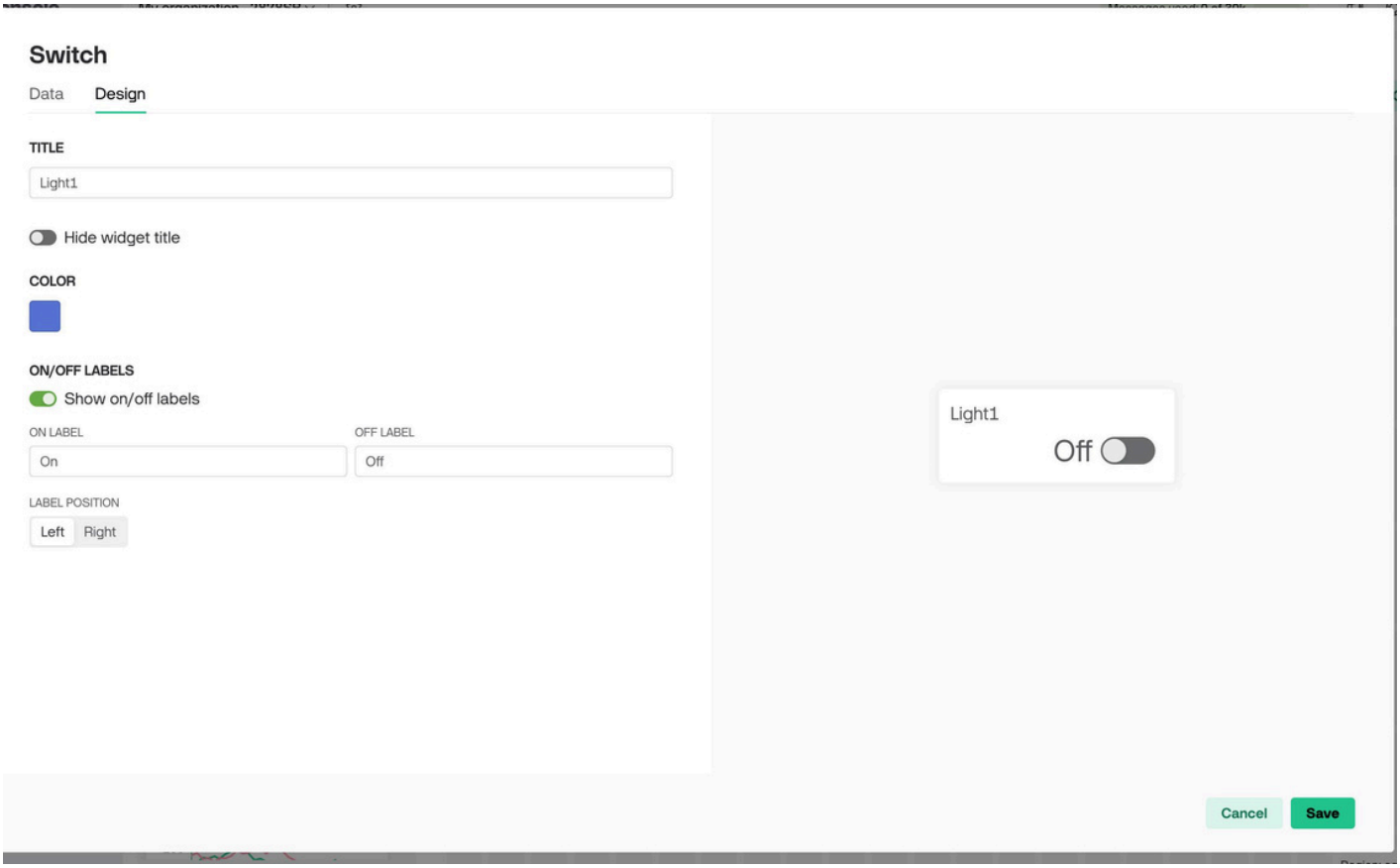


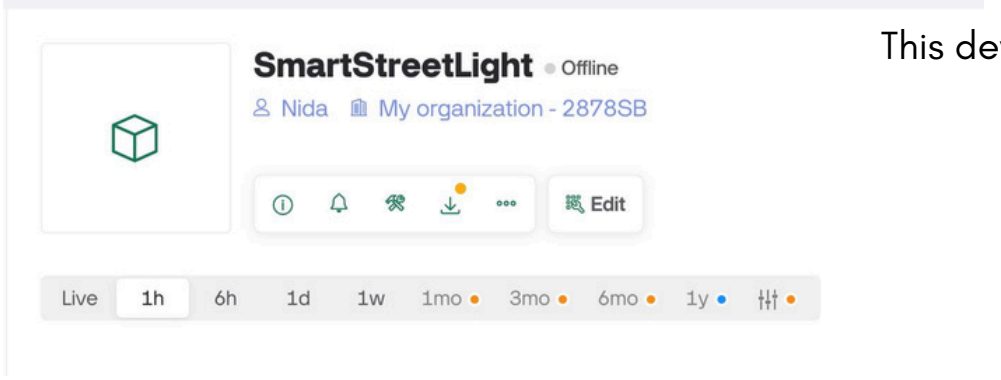


This sets up a channel (pin) to send or receive data like turning an LED on/off..

Step 4: Create a **New Device** from Template and added a switch to it by drag and drop and then i edited its design etc.

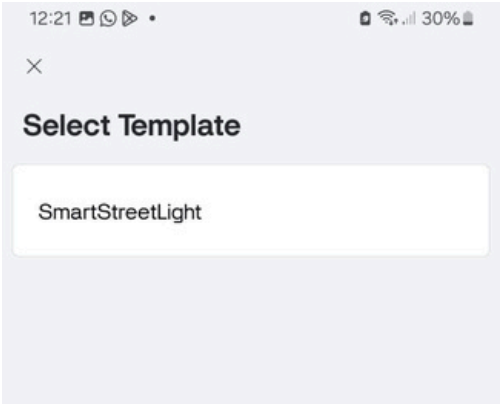


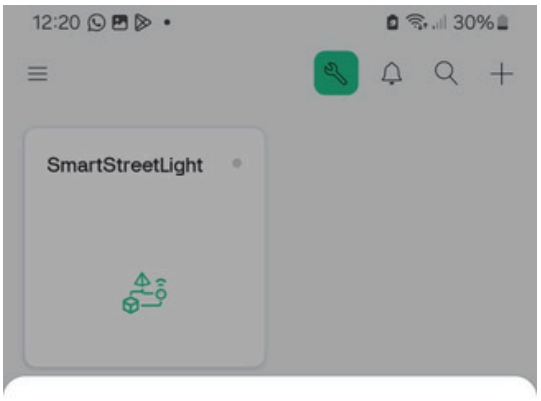




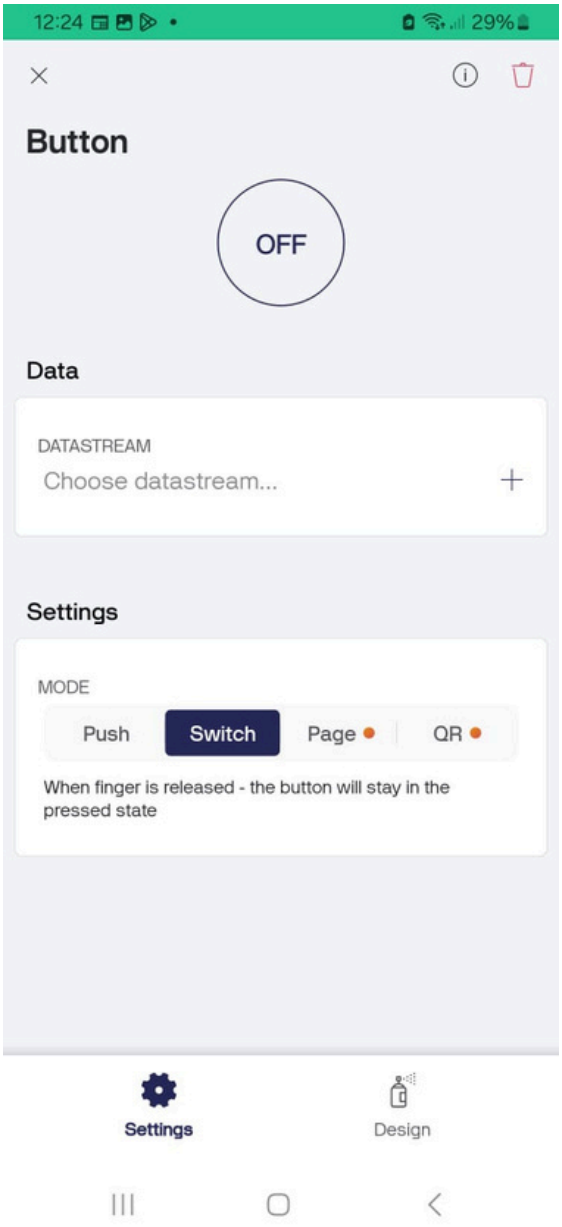
This device has been created.

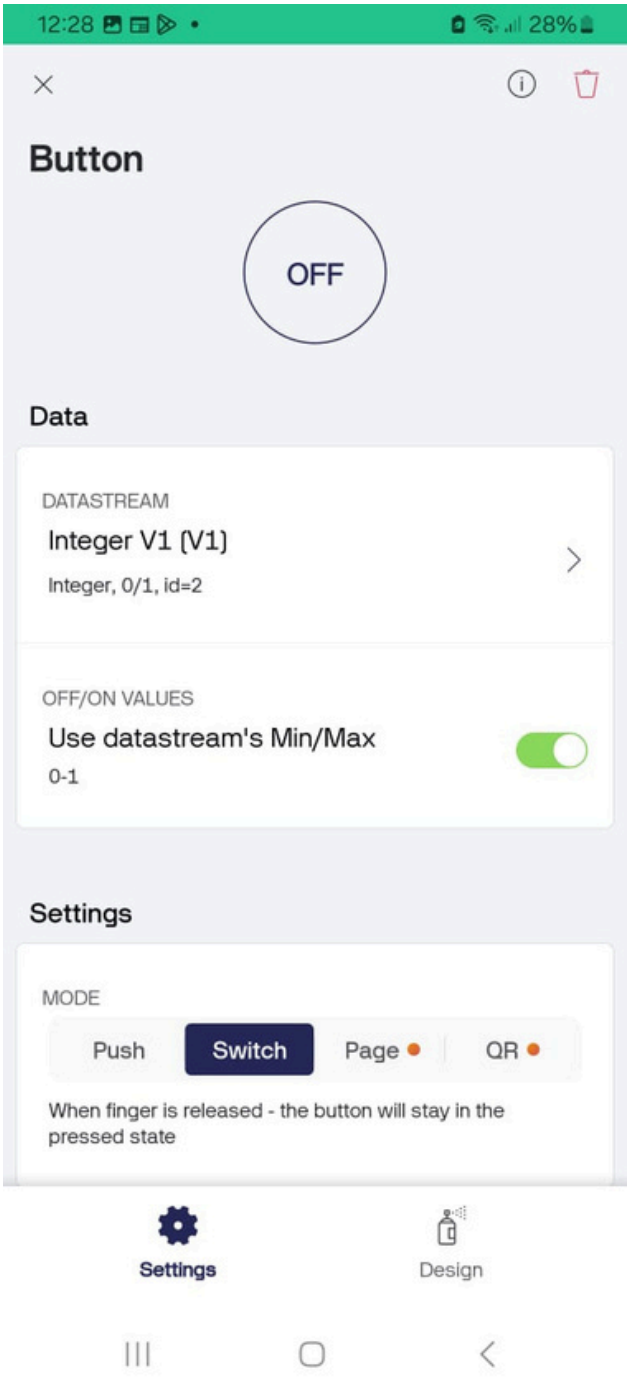
Step 5: Since we already created a template named 'SmartStreetLight' on the Blynk Cloud, we'll now set up the mobile app to control our device using that template."





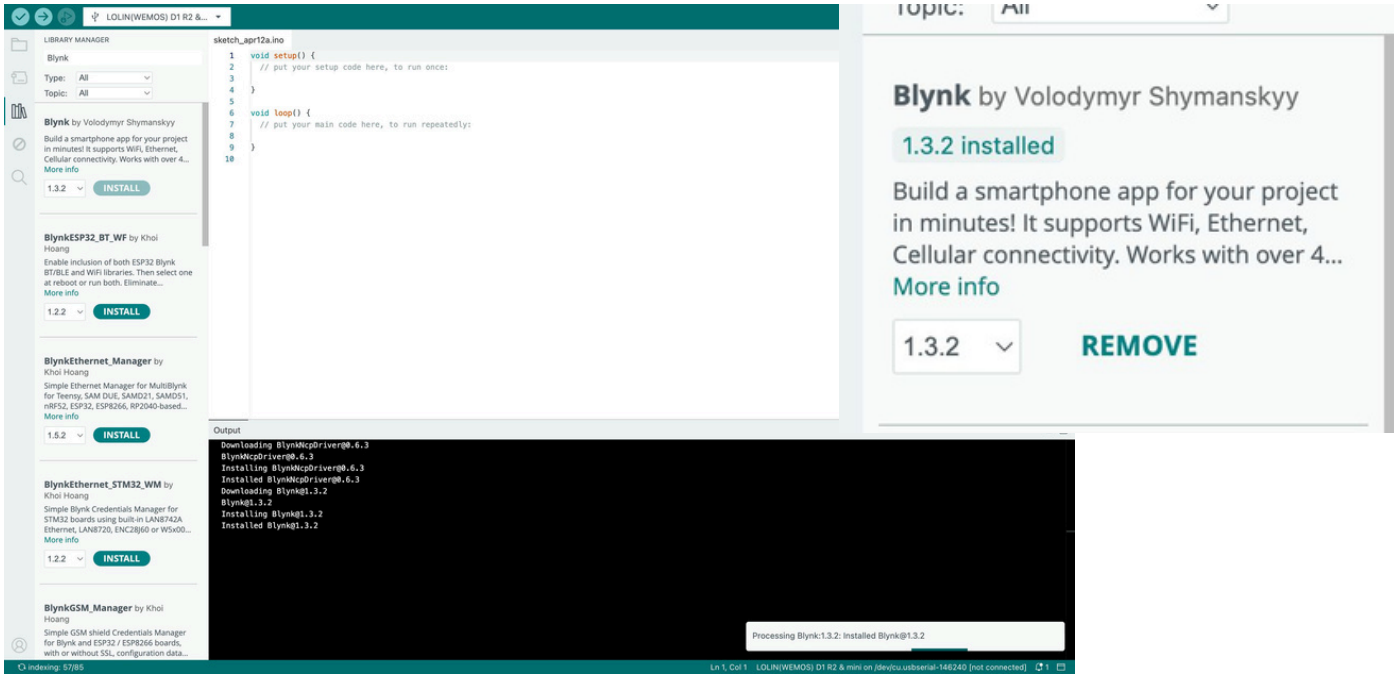
Upon selecting this template it already has a button that we added on blynk cloud in our device SmartStreetLight. I then setup the settings of it like Data stream, off/on values etc.



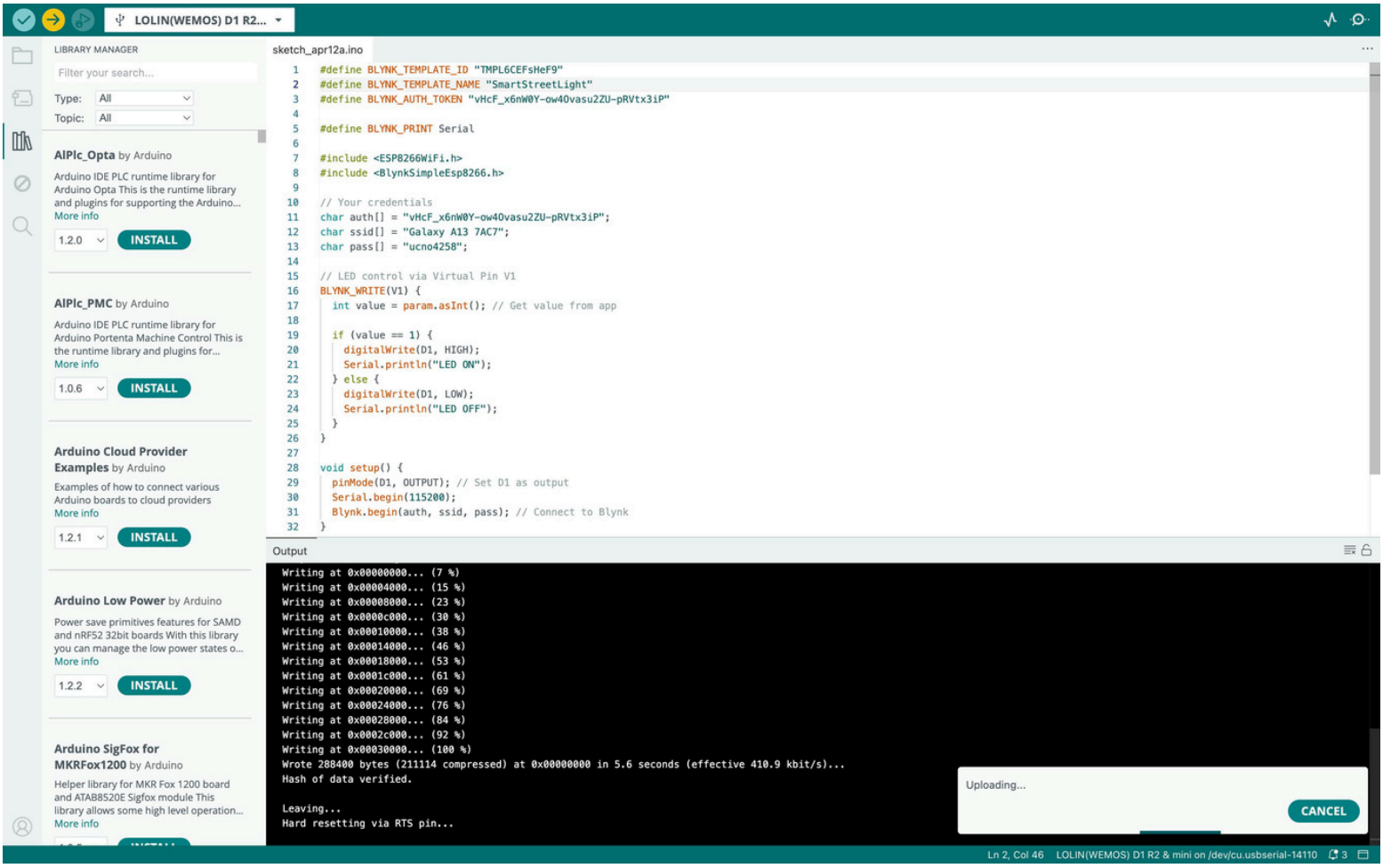


Step 6: Setting up Arduino IDE to program the ESP8266 module for Blynk-based IoT control.

First of all installed the Blynk library.

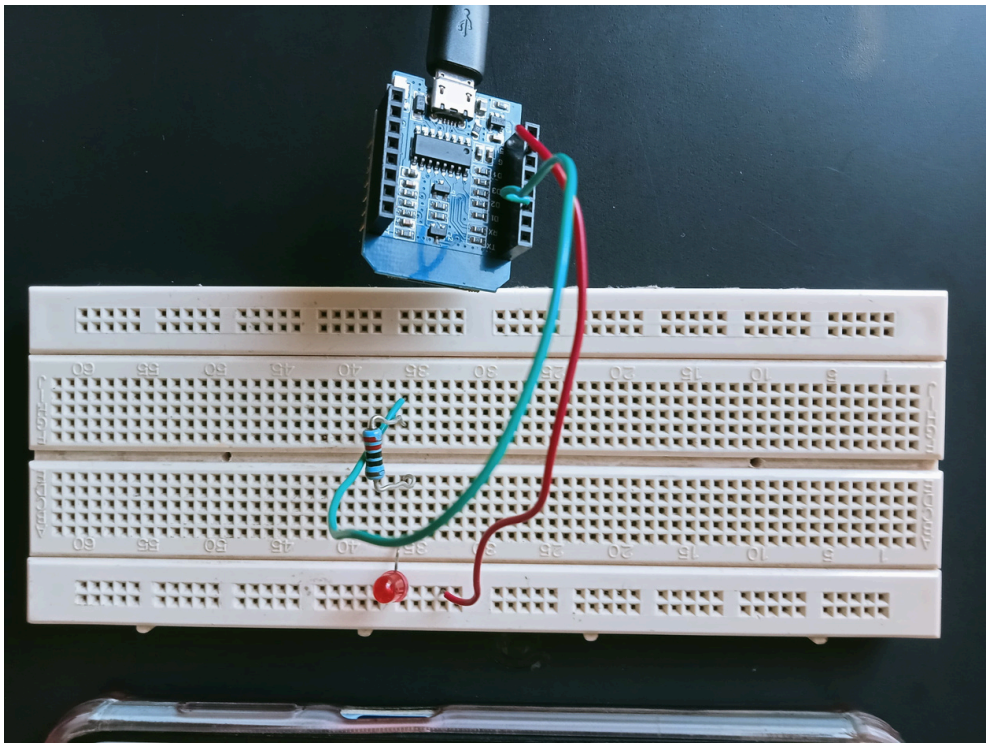


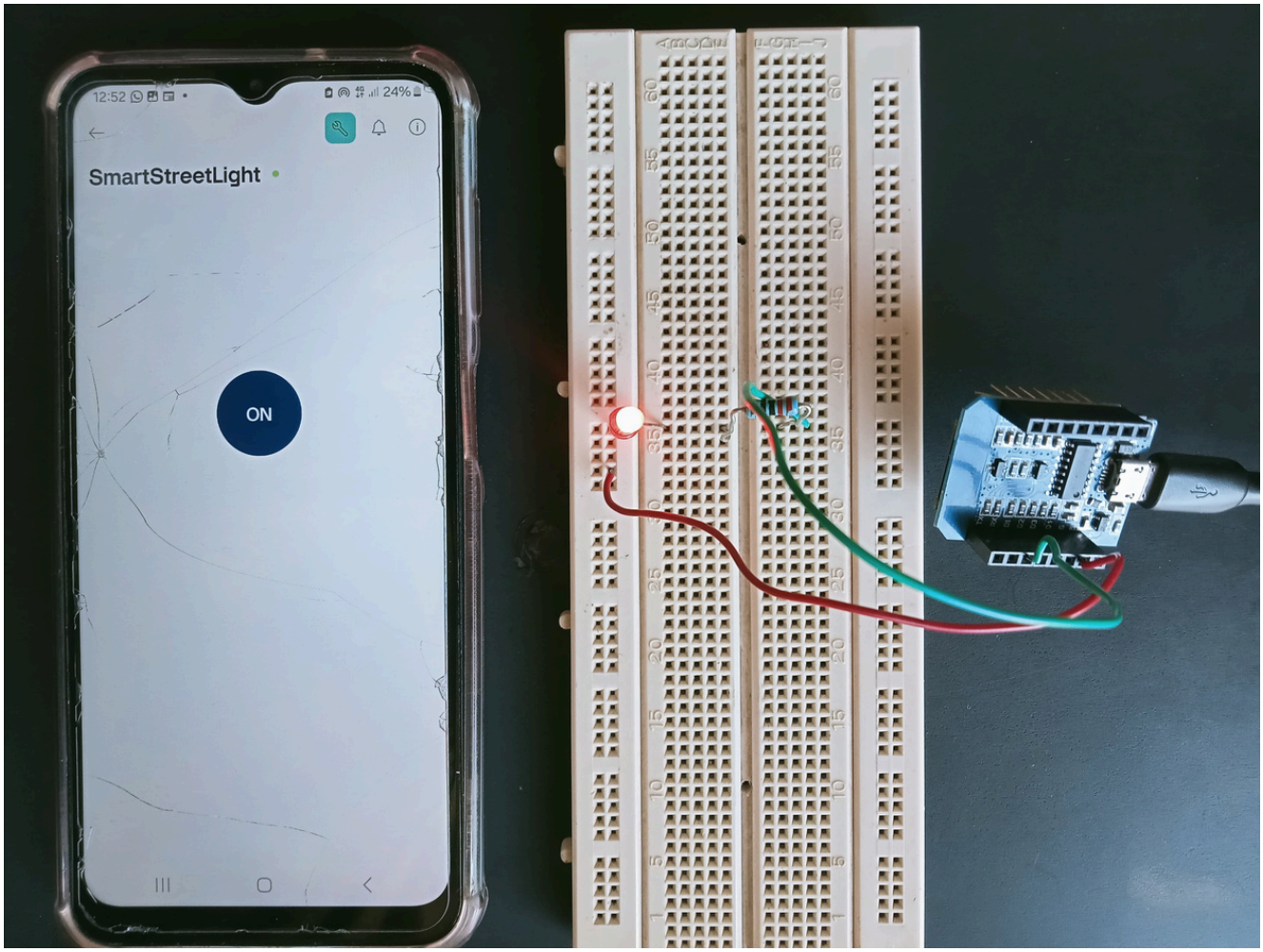
Wrote the code to control and LED. I have attached the screen shot and have also added the code in text form here. In the code i added BLYNK-AUTHENTICATION TOKEN, BLYNK_TEMPLATE_NAME, BLYNK_TEMPLATE_ID, and connected my laptop and esp8266 with my mobile internet and then compiled and uploaded the code.

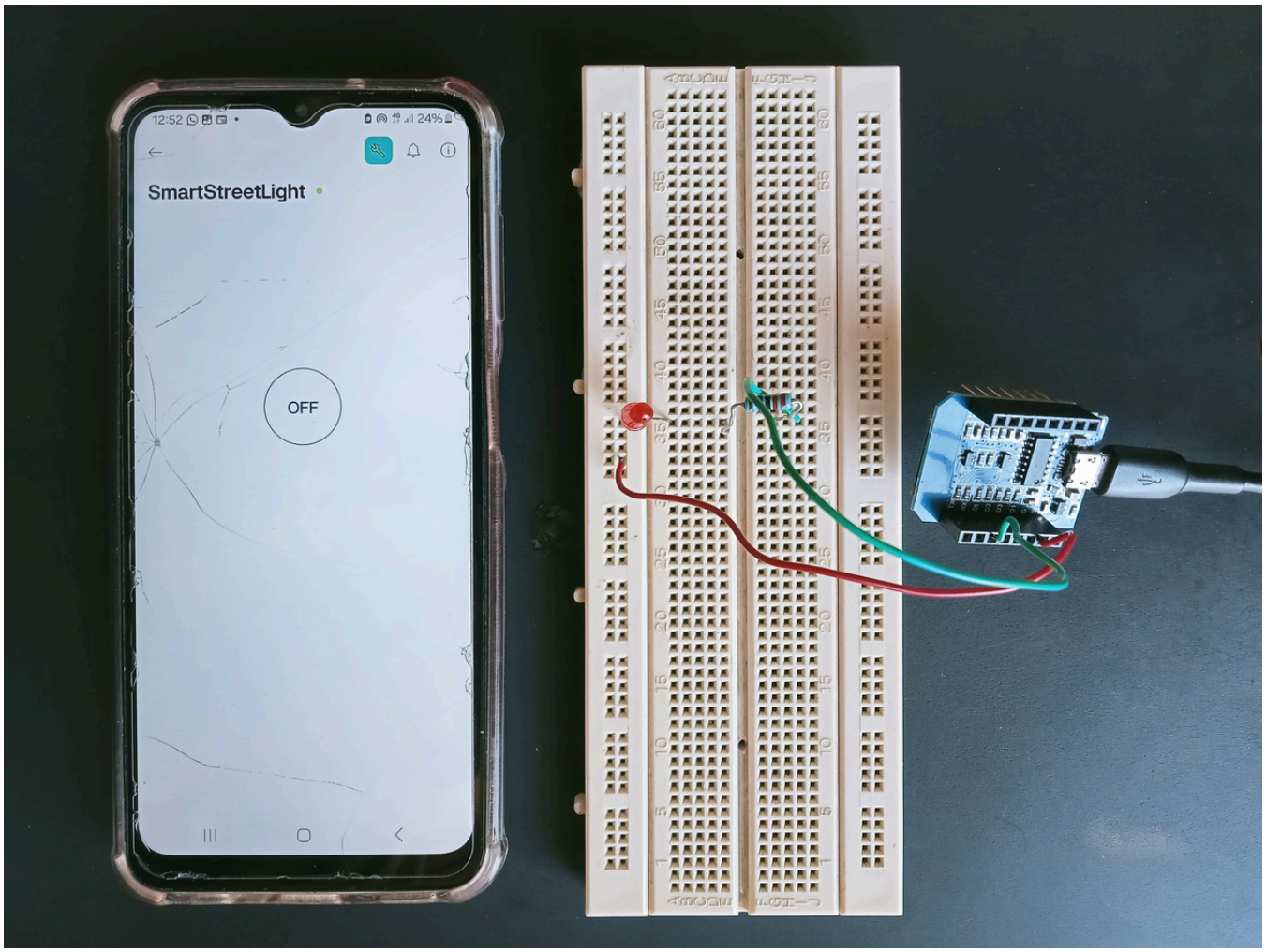


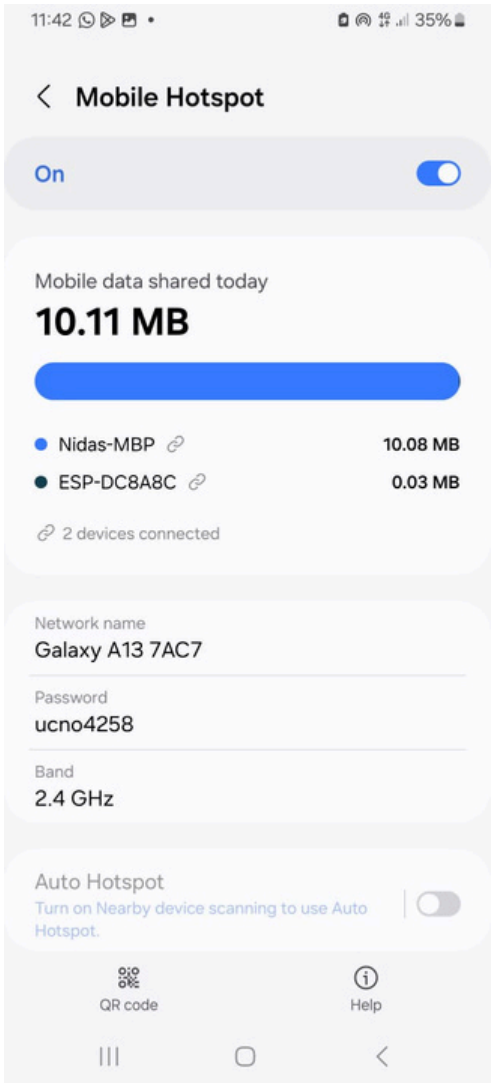
```
#define BLYNK_TEMPLATE_ID "TMPL6CEFsHeF9"
#define BLYNK_TEMPLATE_NAME "SmartStreetLight"
#define BLYNK_AUTH_TOKEN "vHcF_x6nW0Y-ow4Ovasu2ZU-pRVtx3iP"

#define BLYNK_PRINT Serial

#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>

// Your credentials
char auth[] = "vHcF_x6nW0Y-ow4Ovasu2ZU-pRVtx3iP";
char ssid[] = "Galaxy A13 7AC7";
char pass[] = "ucno4258";

// LED control via Virtual Pin V1
BLYNK_WRITE(V1) {
 int value = param.asInt(); // Get value from app

 if (value == 1) {
 digitalWrite(D1, HIGH);
 Serial.println("LED ON");
 } else {
 digitalWrite(D1, LOW);
 Serial.println("LED OFF");
 }
}

void setup() {
 pinMode(D1, OUTPUT); // Set D1 as output
 Serial.begin(115200);
 Blynk.begin(auth, ssid, pass); // Connect to Blynk
}

void loop() {
 Blynk.run();
}
```

Step 7: Following is the circuit that i connected with the esp8266. It shows that ehn i turned the button ON, the LED got ON and when i turned the button OFF, the LED turned OFF.







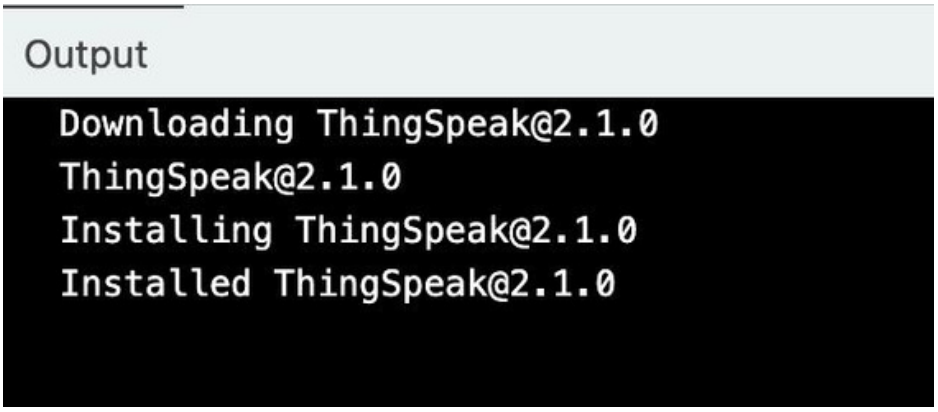


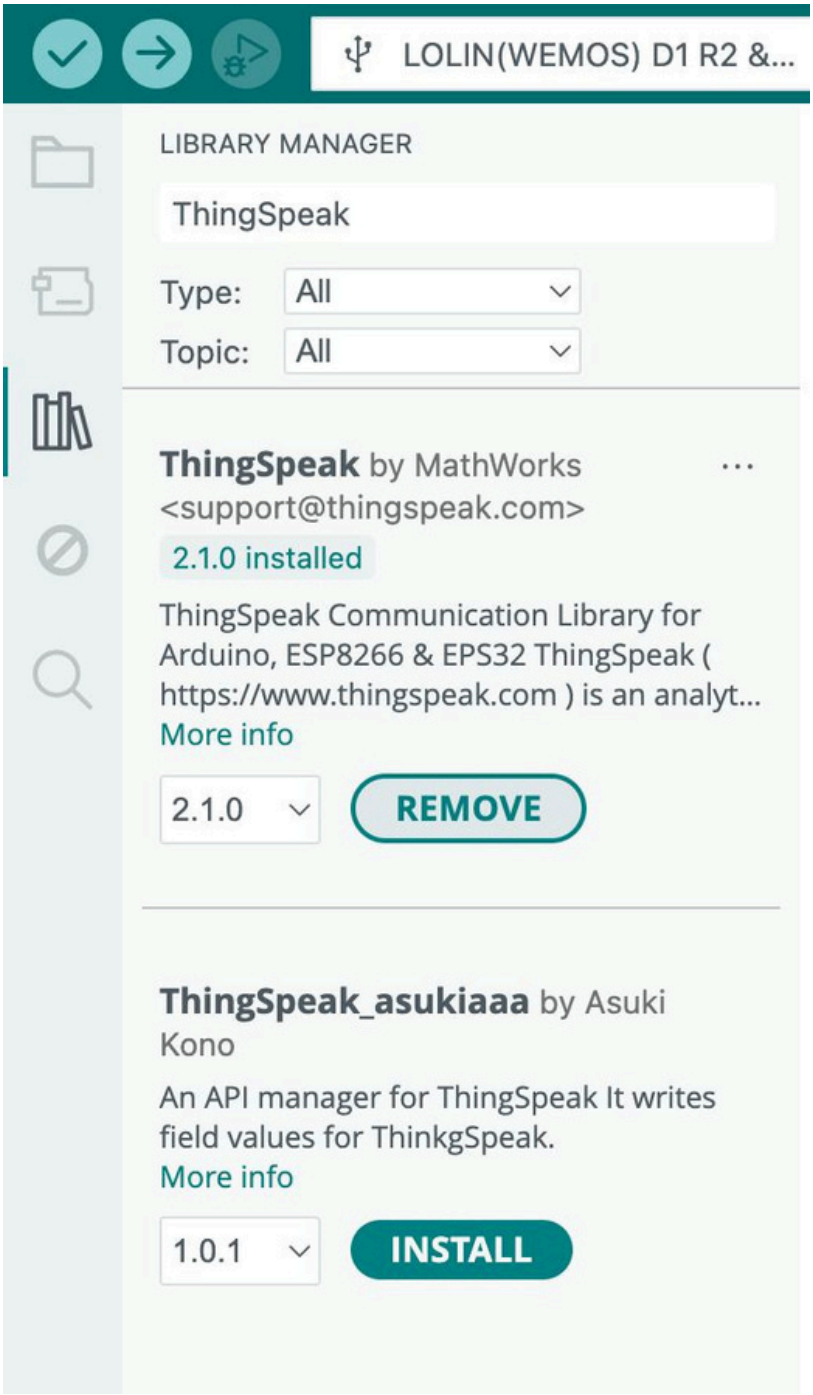
Challenges:

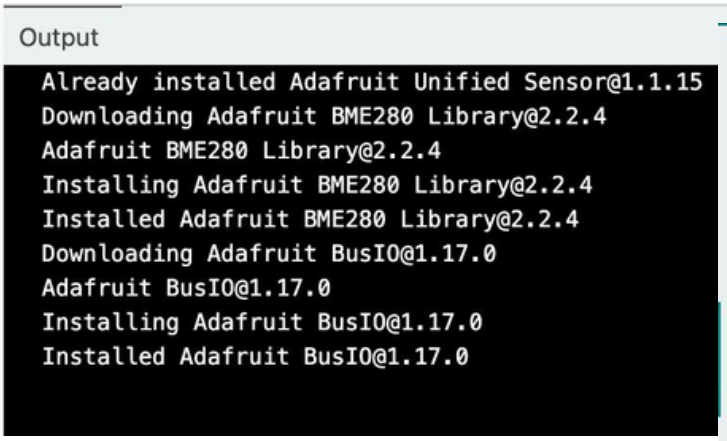
No issues faced. Every step was smooth and easy

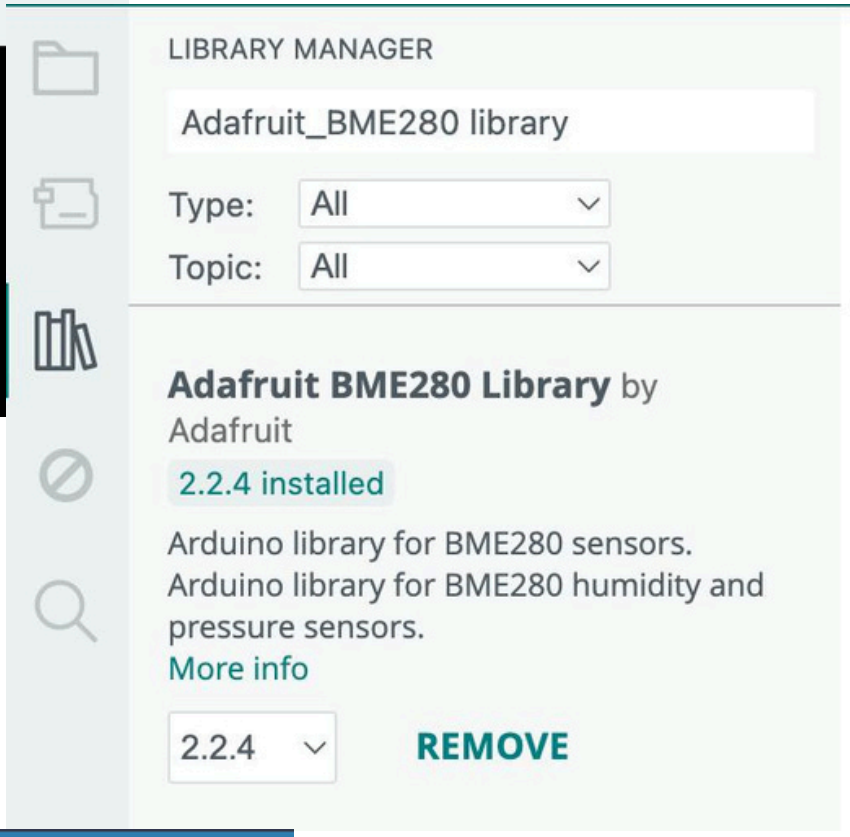
THINGSPEAK Performed by Wajeeha Jahangir

Step 1: Installed the ThingSpeak and Adafruit BME280 (for BME 280 sensor) libraries.



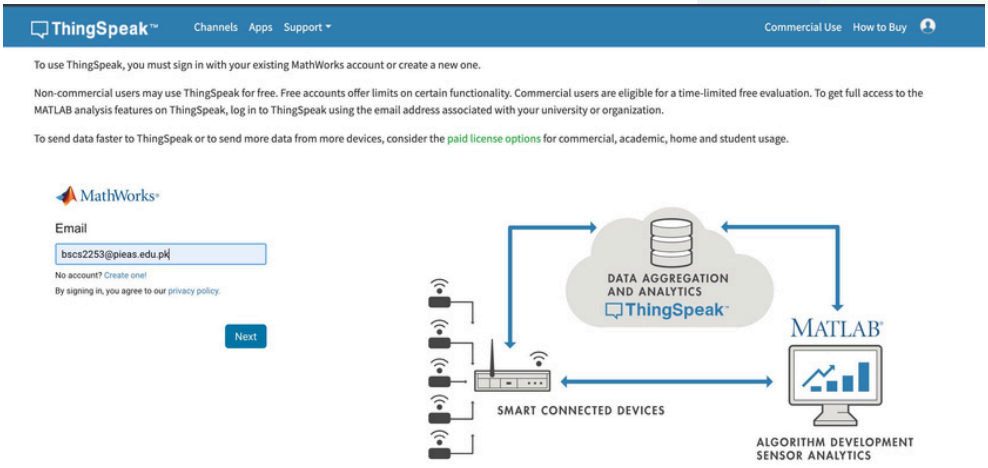


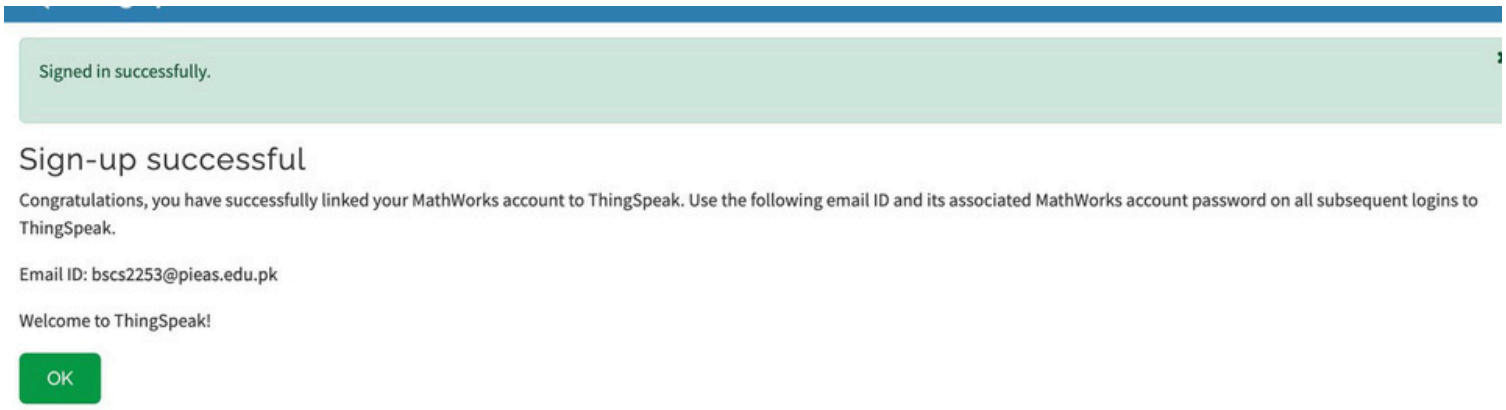




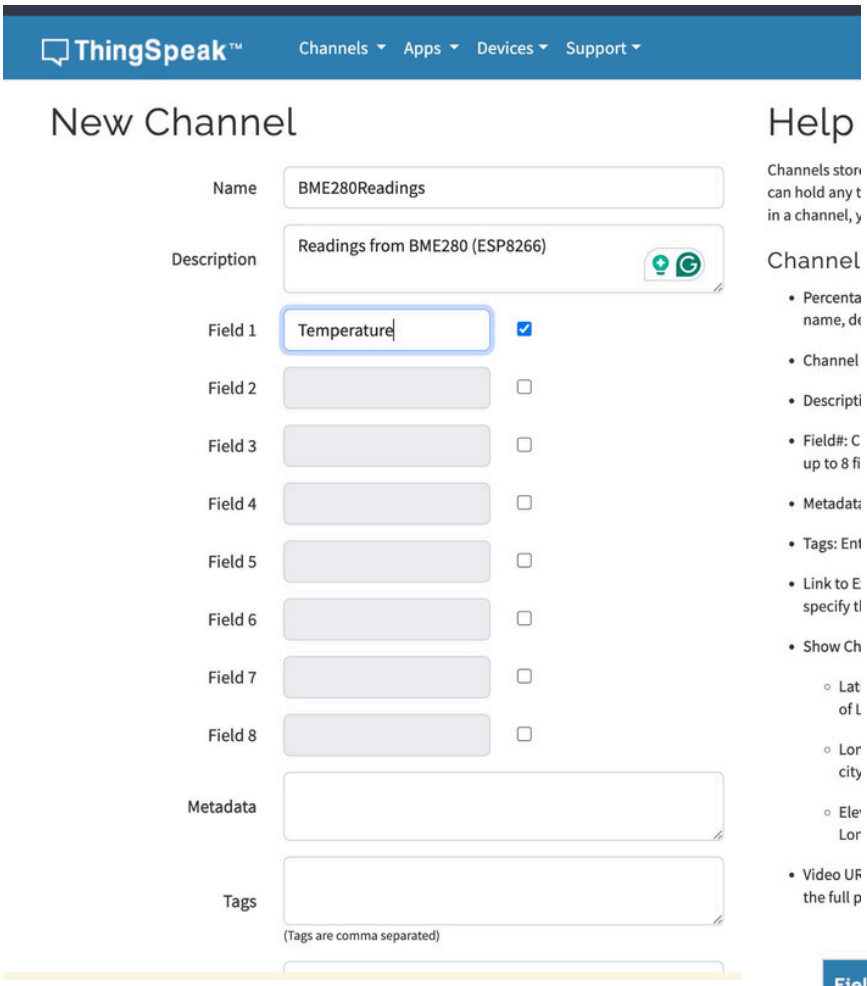
Step 2:

Logged-in ThingSpeak using MathWorks account.

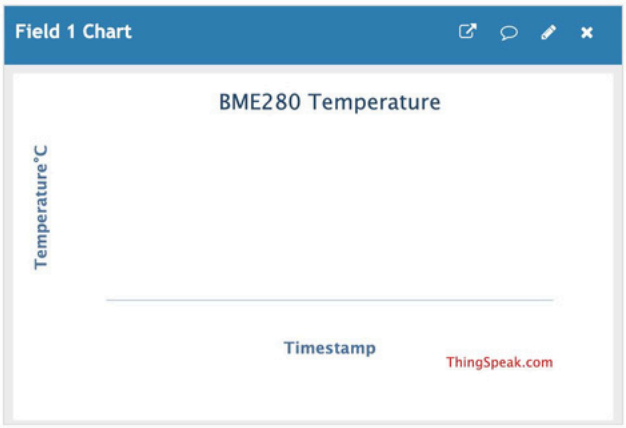




Step 3: Then created a new channel, entered its name and description etc. As the channel was supposed to get data from the BME 280 sensor so named it so. But we didn't have any sensor available so i hardcoded the temperature value (a single field for now).



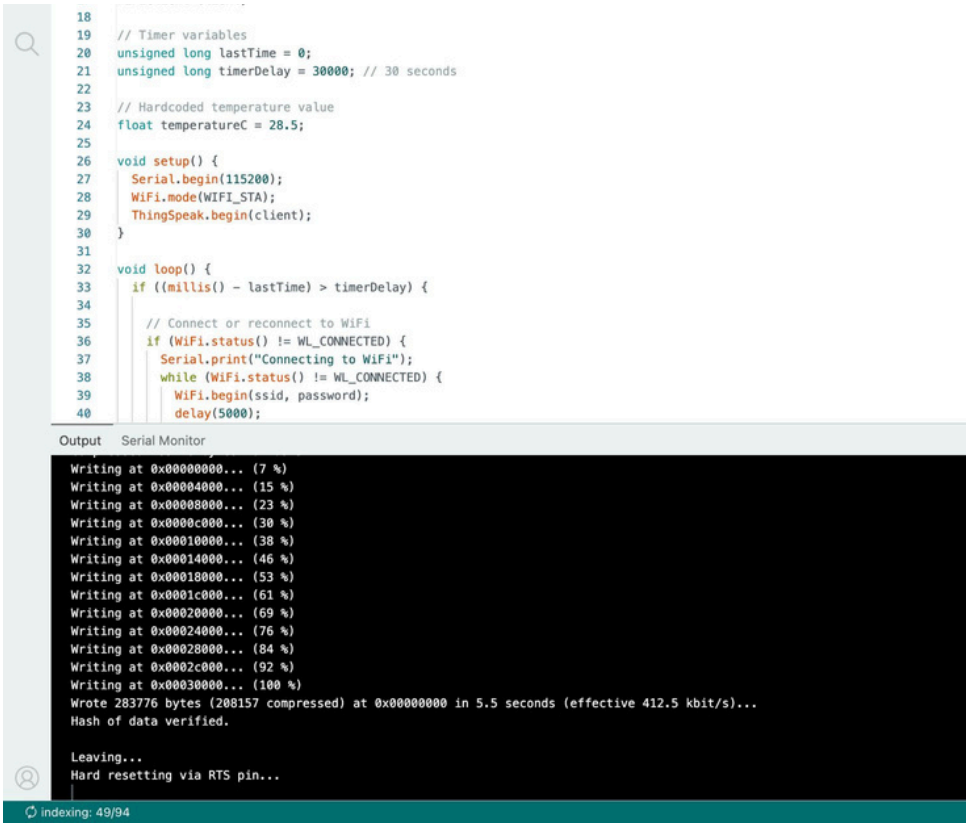
Edited the chart's x and y-axis titles.



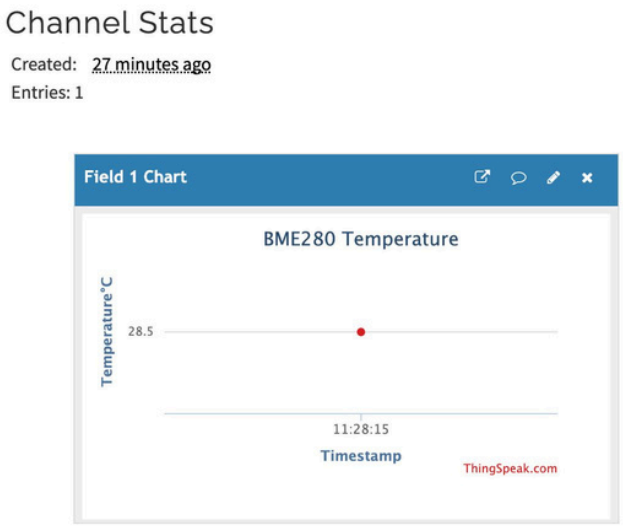
Step 4: Wrote code in Arduino to publish the temperature. Following is the code.

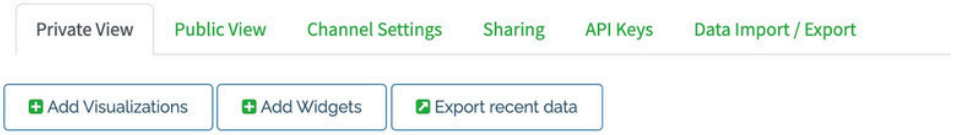
```
/*
Based on Random Nerd Tutorials example
*/

#include <ESP8266WiFi.h>
#include "ThingSpeak.h"

// WiFi credentials
const char* ssid = "WajeehaPhone";
const char* password = "987684";

// ThingSpeak settings
unsigned long myChannelNumber = 1;
const char* myWriteAPIKey = "68LKDJ8K6FW5DNNN
";

WiFiClient client;

// Timer variables
unsigned long lastTime = 0;
unsigned long timerDelay = 30000; // 30 seconds

// Hardcoded temperature value
float temperatureC = 28.5;

void setup() {
  Serial.begin(115200);
  WiFi.mode(WIFI_STA);
  ThingSpeak.begin(client);
}

void loop() {
  if ((millis() - lastTime) > timerDelay) {
```

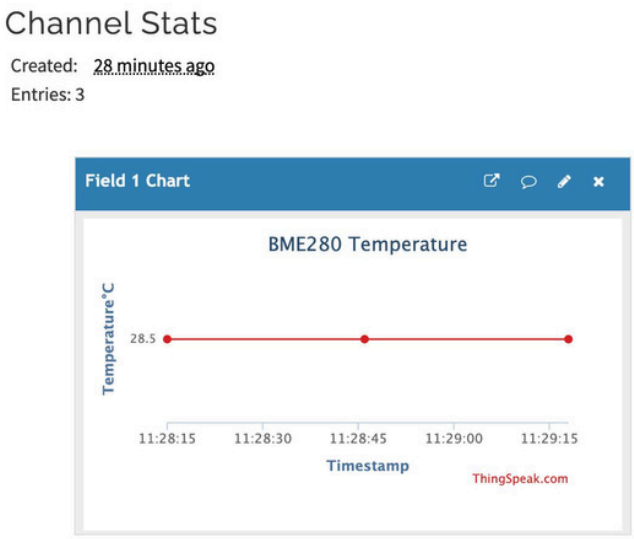
```
// Connect or reconnect to WiFi
if (WiFi.status() != WL_CONNECTED) {
Serial.print("Connecting to WiFi");
while (WiFi.status() != WL_CONNECTED) {
WiFi.begin(ssid, password);
delay(5000);
Serial.print(".");
}
Serial.println("\nWiFi connected");
}
// Display and send hardcoded temperature
Serial.print("Sending hardcoded temperature (°C): ");
Serial.println(temperatureC);
int x = ThingSpeak.writeField(myChannelNumber, 1, temperatureC, myWriteAPIKey);
if (x == 200) {
Serial.println("Channel update successful.");
} else {
Serial.println("Problem updating channel. HTTP error code " + String(x));
}
lastTime = millis();
}
}
```



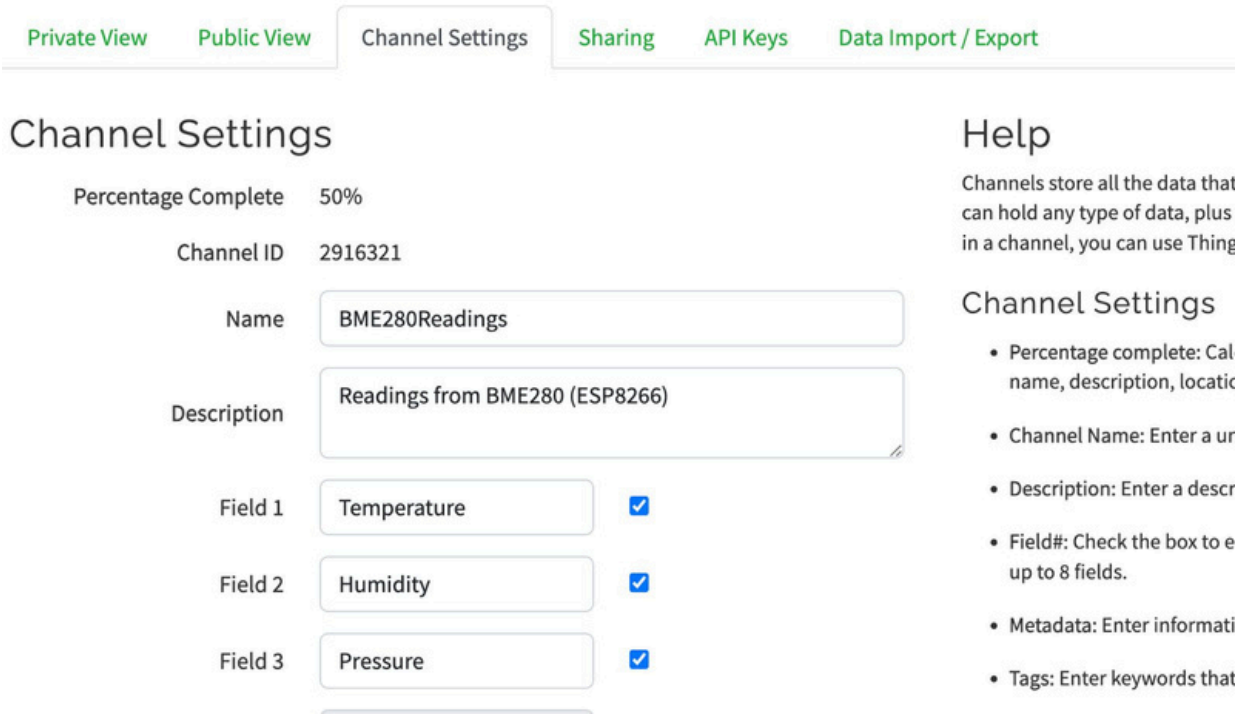
Step 5: We can now see the published values on the ThingSpeak platform. to our created channel. One value and then i waited for some time so that more values get published



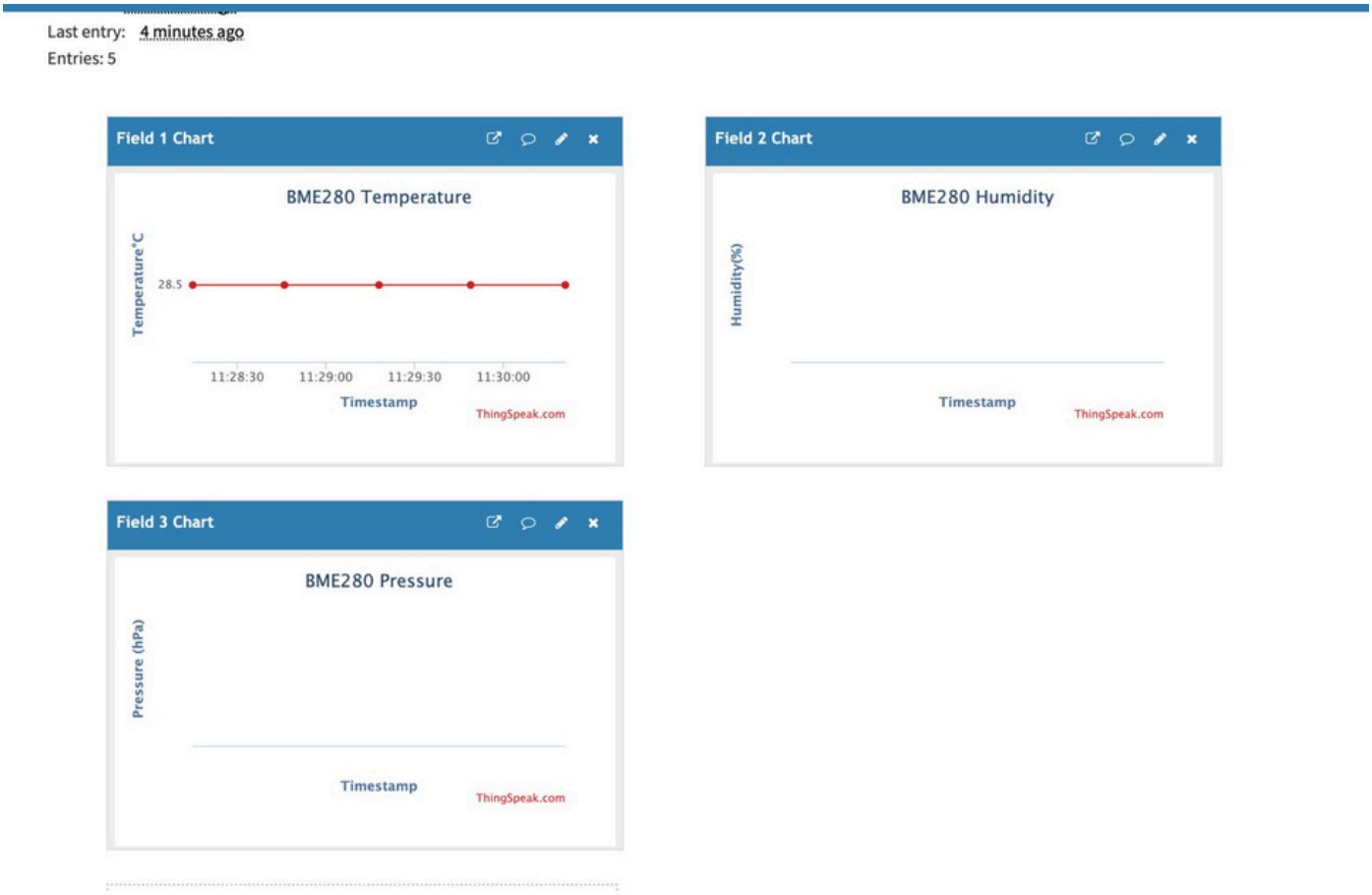




Step 6: Modifying it for multiple fields (temperature, pressure, humidity). This time i used the random function to generate random values of these three variables and published it to ThingSpeak channel.



Changed the names of x and y-axis according to my variables.



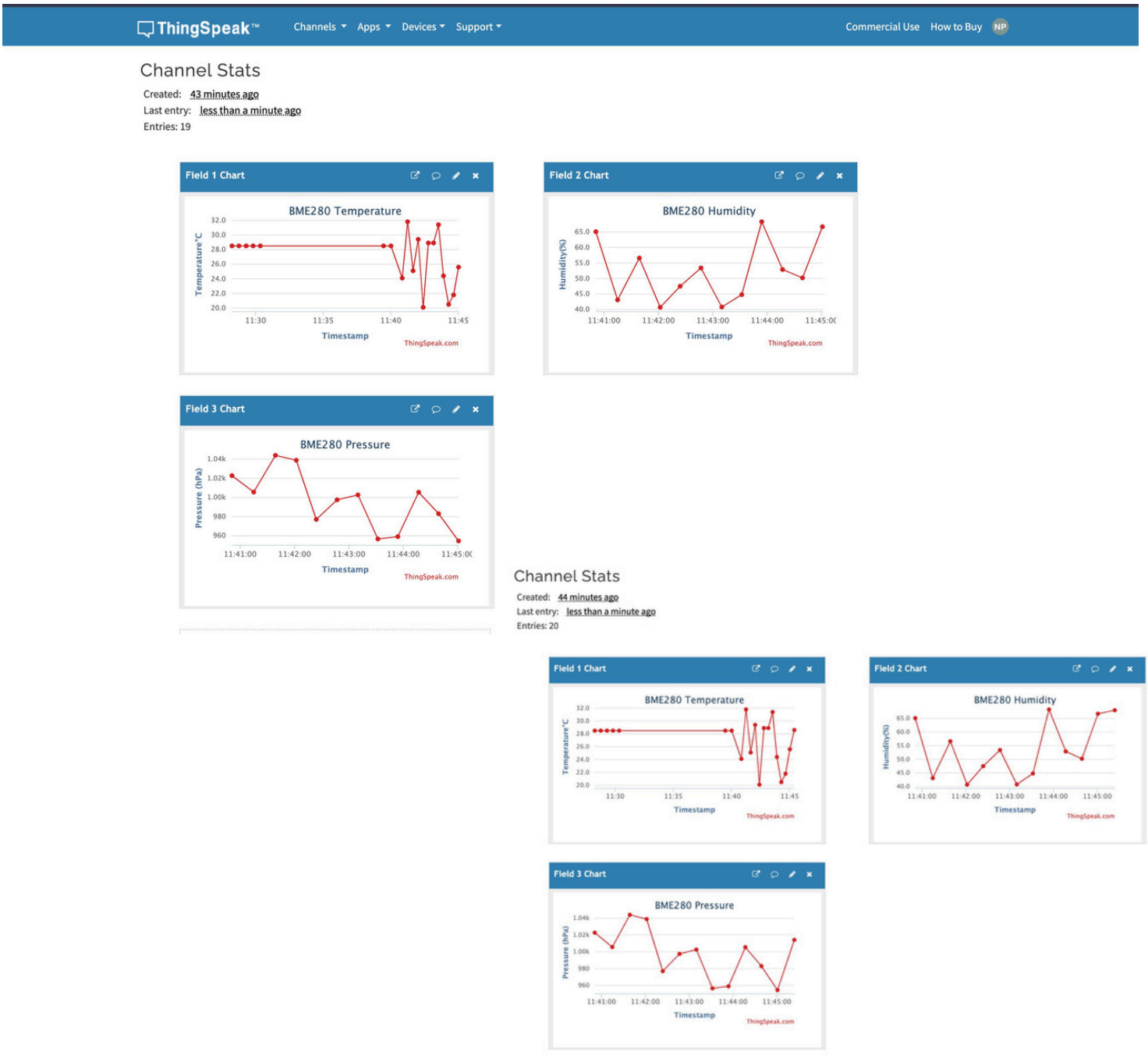
Step 7: Next in the arduino IDE i wrote the following code for 3 fields.

```
#include <ESP8266WiFi.h>
#include "ThingSpeak.h"

// WiFi credentials
const char* ssid = "WajeehaPhone";
const char* password = "987684";

// ThingSpeak settings
unsigned long myChannelNumber = 1;
const char* myWriteAPIKey = "68LKDJ8K6FW5DNNN";

WiFiClient client;

// Timer
unsigned long lastTime = 0;
unsigned long timerDelay = 10000; // 10 seconds

void setup() {
  Serial.begin(115200);
  WiFi.mode(WIFI_STA);
  ThingSpeak.begin(client);
  randomSeed(analogRead(A0)); // Seed random number generator
}

void loop() {
  if ((millis() - lastTime) > timerDelay) {
```

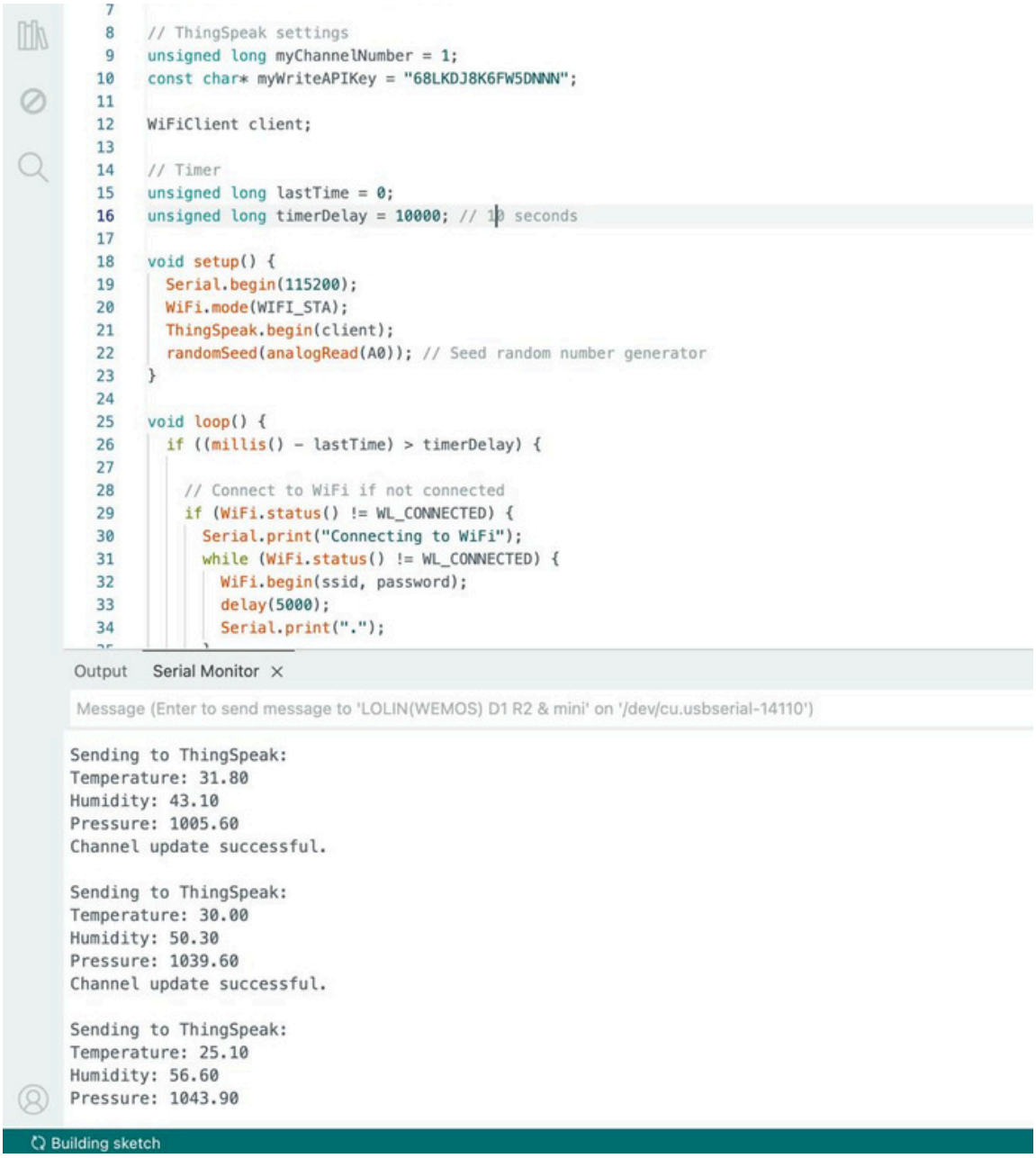
```
// Connect to WiFi if not connected
if (WiFi.status() != WL_CONNECTED) {
Serial.print("Connecting to WiFi");
while (WiFi.status() != WL_CONNECTED) {
WiFi.begin(ssid, password);
delay(5000);
Serial.print(".");
}
Serial.println("\nConnected to WiFi");
}
// Generate random values
float temperature = random(200, 350) / 10.0; // 20.0 to 35.0 °C
float humidity = random(400, 700) / 10.0; // 40.0 to 70.0 %
float pressure = random(9500, 10500) / 10.0; // 950.0 to 1050.0 hPa
// Log to Serial
Serial.println("Sending to ThingSpeak:");
Serial.print("Temperature: "); Serial.println(temperature);
Serial.print("Humidity: "); Serial.println(humidity);
Serial.print("Pressure: "); Serial.println(pressure);
// Send values to corresponding fields
ThingSpeak.setField(1, temperature);
ThingSpeak.setField(2, humidity);
ThingSpeak.setField(3, pressure);
int x = ThingSpeak.writeFields(myChannelNumber, myWriteAPIKey);
if (x == 200) {
Serial.println("Channel update successful.\n");
} else {
Serial.println("Problem updating channel. HTTP error code " + String(x) + "\n");
}
lastTime = millis();
}
}
```

```
Output
Writing at 0x00000000... (7 %)
Writing at 0x00004000... (15 %)
Writing at 0x00008000... (23 %)
Writing at 0x0000c000... (30 %)
Writing at 0x00010000... (38 %)
Writing at 0x00014000... (46 %)
Writing at 0x00018000... (53 %)
Writing at 0x0001c000... (61 %)
Writing at 0x00020000... (69 %)
Writing at 0x00024000... (76 %)
Writing at 0x00028000... (84 %)
Writing at 0x0002c000... (92 %)
Writing at 0x00030000... (100 %)
Wrote 285232 bytes (209161 compressed) at 0x00000000 in 5.5 seconds (effective 414.3 kbit/s)...
Hash of data verified.

Leaving...
Hard resetting via RTS pin...
```

After some time, multiple values have been published to channel, which are shown here.

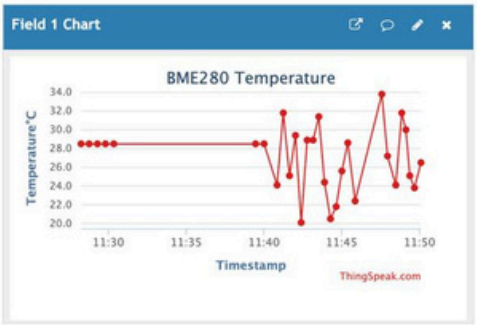


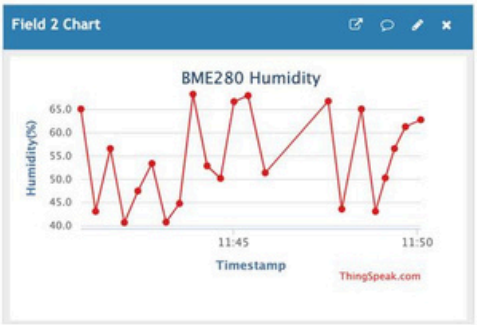
Serail Monitor:

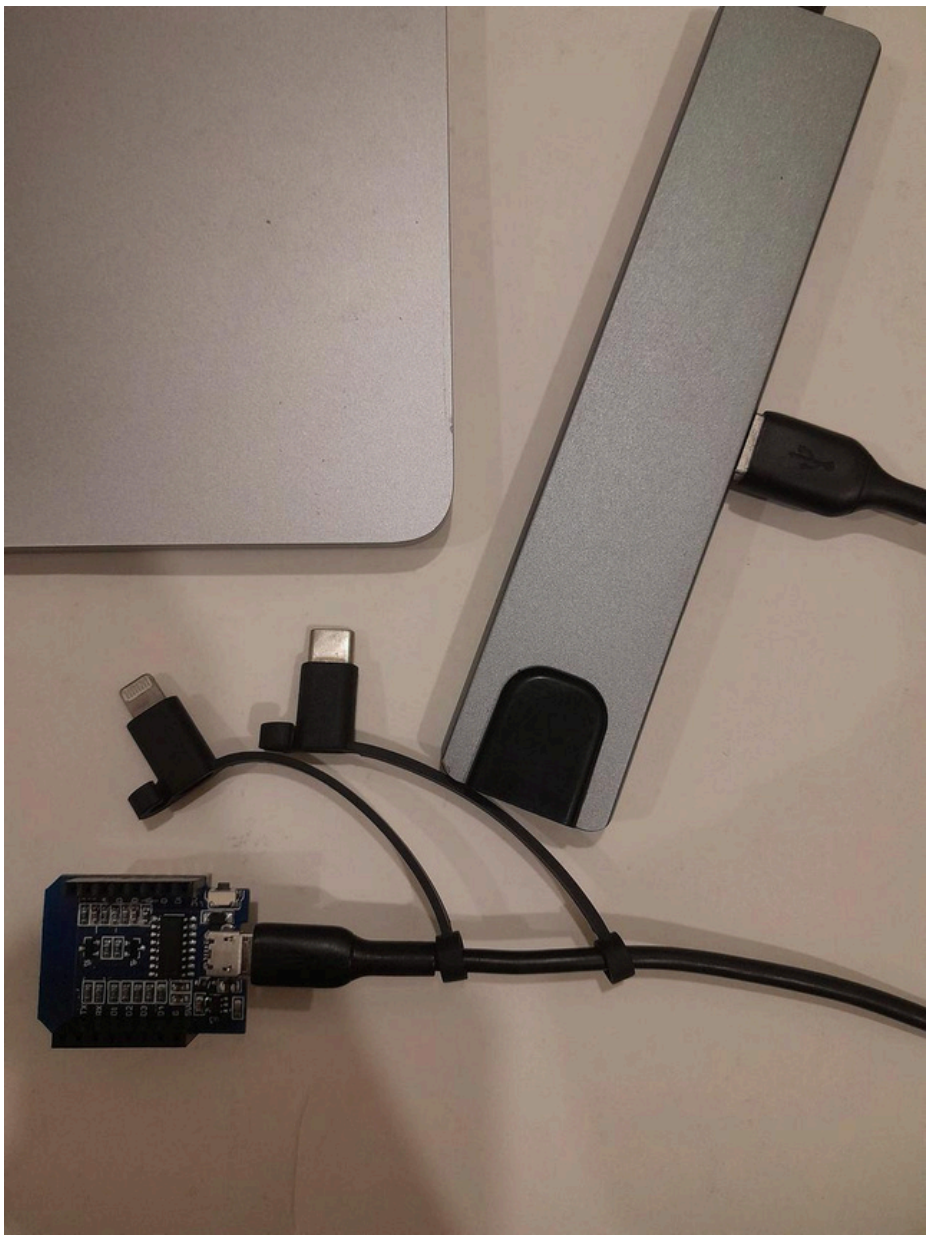


Channel Stats

Created: about an hour ago
Last entry: less than a minute ago
Entries: 28







Challenges:

All the lab steps were performed without any difficulty.

AWS IoT Core

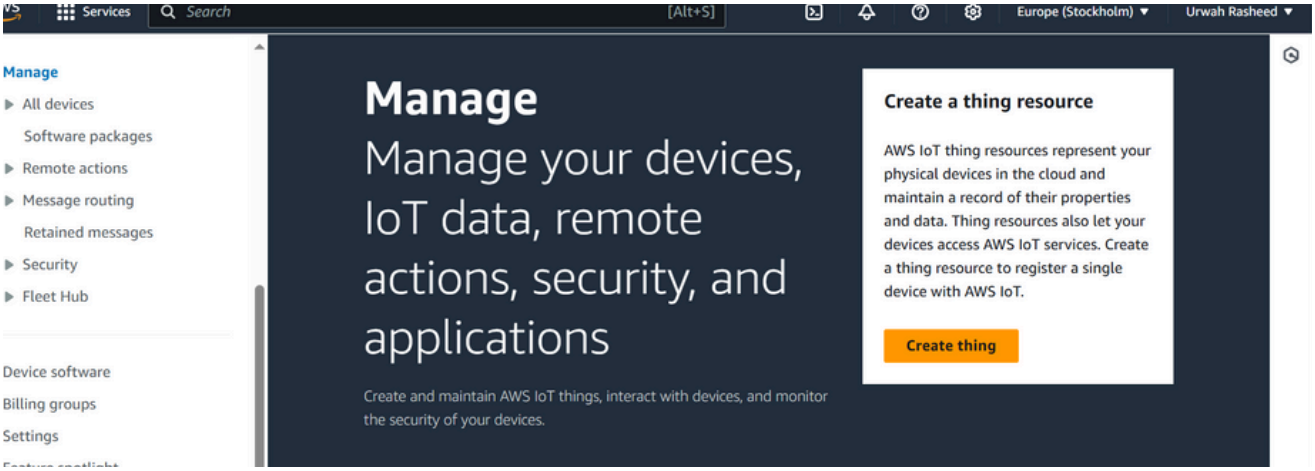
Overview:

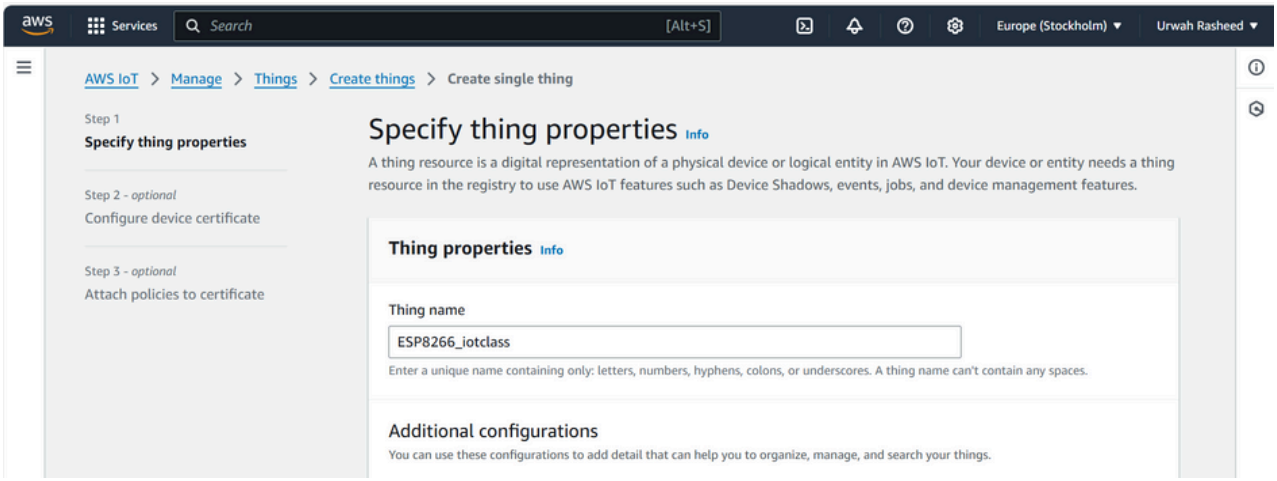
- Creating a Thing in the AWS, generating a certificate and attaching a policy to it.
- Installing ESP8266 sketch data upload tool in Arduino IDE.
- Modifications in the Arduino sketch according to the thing.
- Uploading AWS certificates & code to the NodeMCU ESP8266.
- Testing/Subscription of thing on Amazon Web Services (AWS).

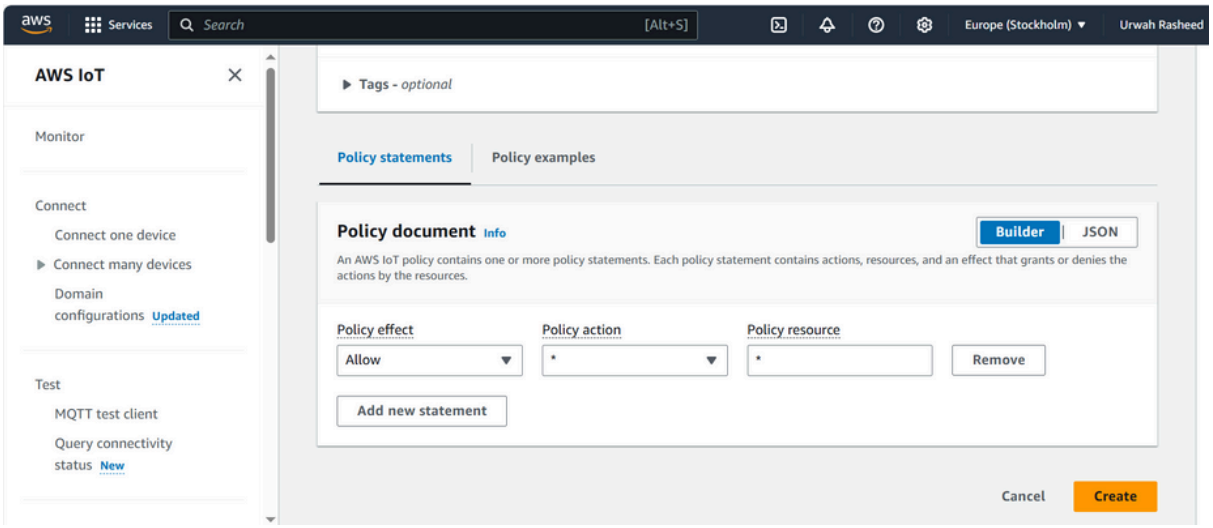
Step 1:

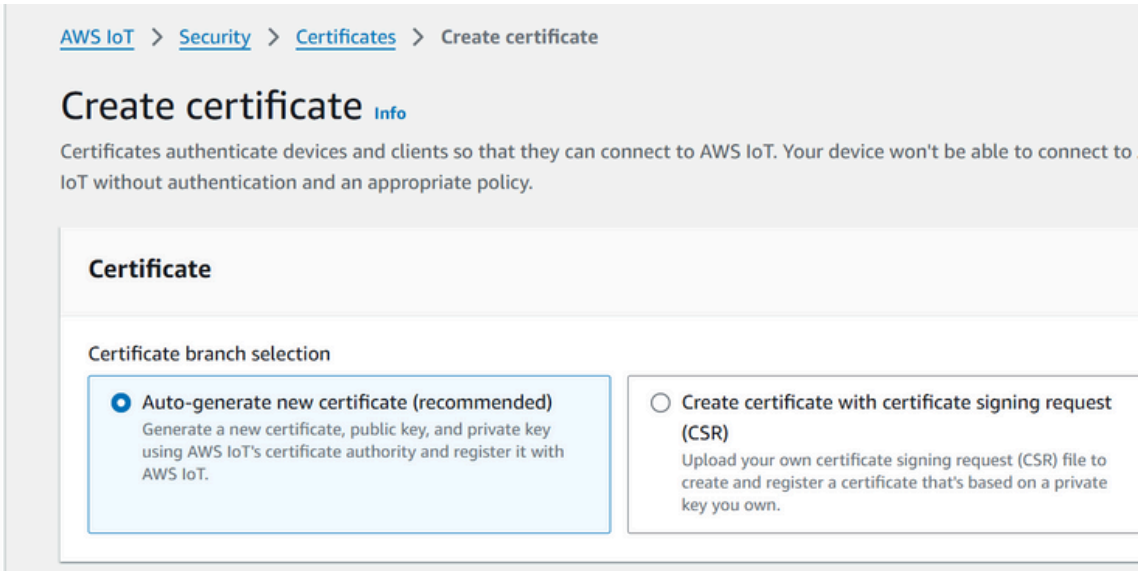
Creating a Thing in the AWS, generating a certificate and attaching a policy to it.

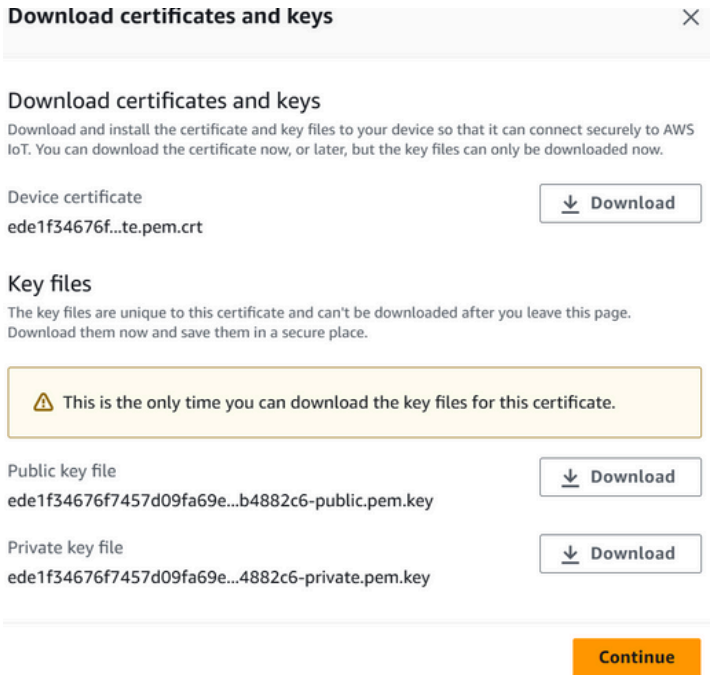
Open browser and enter AWS console to visit AWS management console page.First you need to signup.
Search for IoT core in find services search bar.
Click on the IoT core that will redirect to the Amazon IoT console page. On the left navigation page click on manage tab.
Go for register a thing. Click on create a single thing. Set a name for the thing and click next.Click on create certificate. Once a certificate is created successfully download certificate, private key and root CA certificate. It will redirect to another tab where you will have to choose RSA 2048 bit key to download the certificate.
Come back to the AWS IoT page and click on activate and done.Certificate is created successfuly.
Now go for secure tab and click on policy section and then click on create. Set a policy name and for action and resourse section enter * to allow device to perform all aws actions on all aws resources. For effect choose allow and then click on create.
Once policy is created successfully click on the certificate tab and click on 3 dots of certificate file and go for attach policy.A popup will show you all the policies choose the right policy and then click on attach.
Thus we have created a thing and attached a policy and certificate to it successfully.

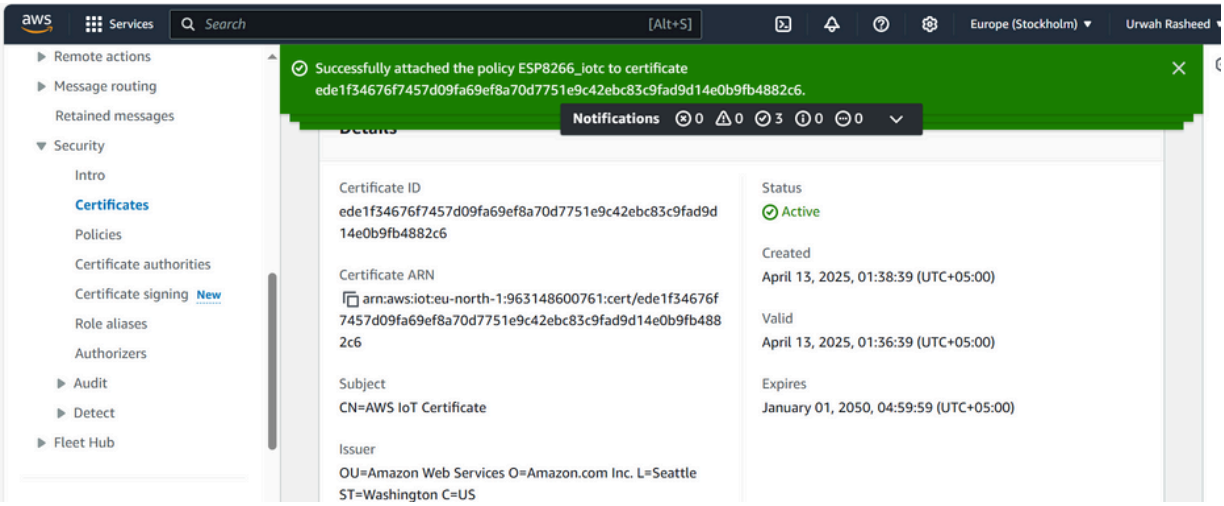

Services
Search
[Alt+S]
Europe (Stockholm)
Urwah Rasheed
Manage
All devices
Software packages
Remote actions
Message routing
Retained messages
Security
Fleet Hub
Device software
Billing groups
Settings
Manage
Manage your devices, IoT data, remote actions, security, and applications
Create and maintain AWS IoT things, interact with devices, and monitor the security of your devices.
Create a thing resource
AWS IoT thing resources represent your physical devices in the cloud and maintain a record of their properties and data. Thing resources also let your devices access AWS IoT services. Create a thing resource to register a single device with AWS IoT.
Create thing


aws
Services
Search
[Alt+S]
Europe (Stockholm)
Urwah Rasheed
AWS IoT > Manage > Things > Create things > Create single thing
Step 1
Specify thing properties
Step 2 - optional
Configure device certificate
Step 3 - optional
Attach policies to certificate
Specify thing properties Info
A thing resource is a digital representation of a physical device or logical entity in AWS IoT. Your device or entity needs a thing resource in the registry to use AWS IoT features such as Device Shadows, events, jobs, and device management features.
Thing properties Info
Thing name
ESP8266_iotclass
Enter a unique name containing only: letters, numbers, hyphens, colons, or underscores. A thing name can't contain any spaces.
Additional configurations
You can use these configurations to add detail that can help you to organize, manage, and search your things.


aws
Services
Search
[Alt+S]
Europe (Stockholm)
Urwah Rasheed
AWS IoT
Monitor
Connect
Connect one device
Connect many devices
Domain configurations Updated
Test
MQTT test client
Query connectivity status New
Tags - optional
Policy statements
Policy examples
Policy document Info
Builder
JSON
An AWS IoT policy contains one or more policy statements. Each policy statement contains actions, resources, and an effect that grants or denies the actions by the resources.
Policy effect
Policy action
Policy resource
Allow
*
*
Remove
Add new statement
Cancel
Create


AWS IoT > Security > Certificates > Create certificate
Create certificate Info
Certificates authenticate devices and clients so that they can connect to AWS IoT. Your device won't be able to connect to IoT without authentication and an appropriate policy.
Certificate
Certificate branch selection
Auto-generate new certificate (recommended)
Generate a new certificate, public key, and private key using AWS IoT's certificate authority and register it with AWS IoT.
Create certificate with certificate signing request (CSR)
Upload your own certificate signing request (CSR) file to create and register a certificate that's based on a private key you own.

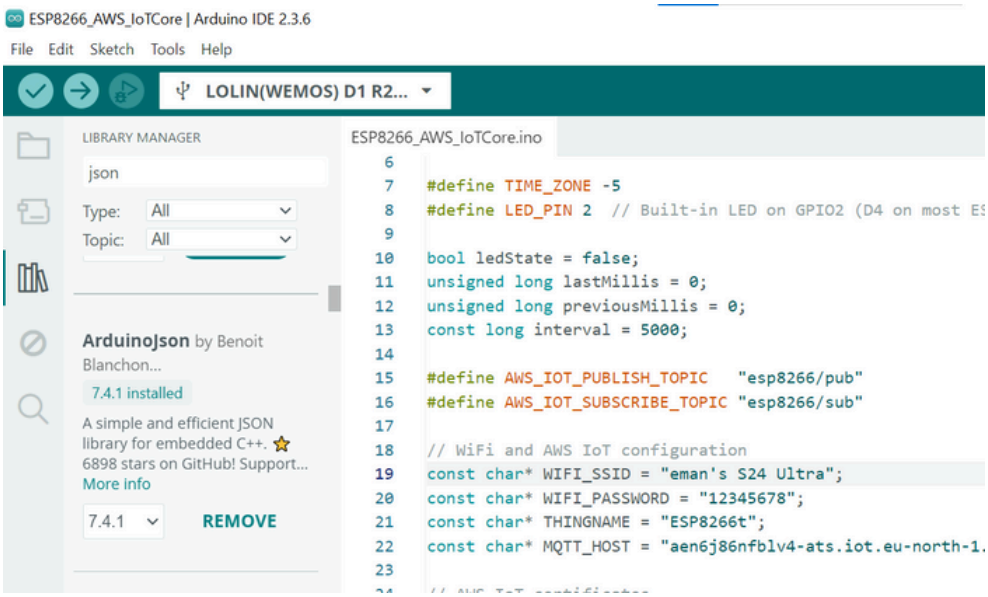




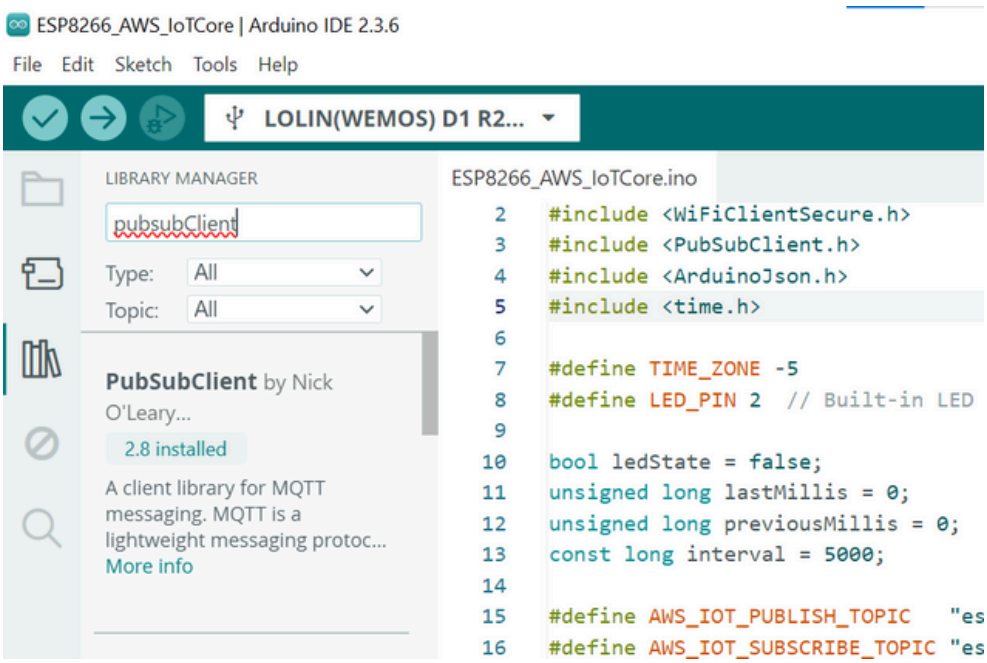
Step 3:

Installing Necessary Arduino Libraries

So first go to the library manager and search for “JSON” & install the library as shown in the figure below.



Again go to the library manager and search for “PubSubClient” & install the library from Nick O’Leary.



Source Code/Program for connecting AWS IoT Core with ESP8266

```
#include <ESP8266WiFi.h>
#include <WiFiClientSecure.h>
#include <PubSubClient.h>
#include <ArduinoJson.h>
#include <time.h>

#define TIME_ZONE -5
#define LED_PIN 2 // Built-in LED on GPIO2 (D4 on most ESP8266 boards)

bool ledState = false;
unsigned long lastMillis = 0;
unsigned long previousMillis = 0;
const long interval = 5000;

#define AWS_IOT_PUBLISH_TOPIC "esp8266/pub"
#define AWS_IOT_SUBSCRIBE_TOPIC "esp8266/sub"

// WiFi and AWS IoT configuration
const char* WIFI_SSID = "eman's S24 Ultra";
const char* WIFI_PASSWORD = "12345678";
const char* THINGNAME = "ESP8266t";
const char* MQTT_HOST = "aen6j86nfblv4-ats.iot.eu-north-1.amazonaws.com";
// AWS IoT certificates
static const char cacert[] PROGMEM = R"EOF(
```

-----BEGIN CERTIFICATE-----
MIIDQTCCAimgAwIBAgITBmyfz5m/jAo54vB4ikPmljZbyjANBgkqhkiG9w0BAQsF
ADA5MQswCQYDVQQGEwJVUzEPMA0GA1UEChMGQW1hem9uMRkwFwYDVQQDExBBbWF6
b24gUm9vdCBDQSAxMB4XDTE1MDUyNjAwMDAwMFoXDTM4MDExNzAwMDAwMFowOTEL
MAkGA1UEBhMCVVMxDzANBgNVBAoTBkFtYXpvbjEZMBcGA1UEAxMQQW1hem9uIFJv
b3QgQ0EgMTCCASIwDQYJKoZIhvcNAQEBBQADggEPADCCAQoCggEBALJ4gHHKeNXj
ca9HgFB0fW7Y14h29Jlo91ghYPl0hAEvrAIthtOgQ3pOsqTQNroBvo3bSMgHFzZM
9O6II8c+6zf1tRn4SWiw3te5djgdYZ6k/oI2peVKVuRF4fn9tBb6dNqcmzU5L/qw
IFAGbHrQgLKm+a/sRxmPUDgH3KKHOVj4utWp+UhnMJbulHheb4mjUcAwhmahRWa6
VOujw5H5SNz/0egwLX0tdHA114gk957EWW67c4cX8jJGKLhD+rcdqsq08p8kDi1L
93FcXmn/6pUCyziKrlA4b9v7LWIbxcceVOF34GfID5yHI9Y/QCB/IIDEgEw+OyQm
jgSubJrIqg0CAwEAAaNCMEAwDwYDVR0TAQH/BAUwAwEB/zAOBgNVHQ8BAf8EBAMC
AYYwHQYDVR0OBBYEFIQYzIU07LwMlJQuCFmcx7IQTgoIMA0GCSqGSIb3DQEBCwUA
A4IBAQCY8jdaQZChGsV2USggNiMOruYou6r4lK5IpDB/G/wkjUu0yKGX9rbxenDI
U5PMCCjjmCXPI6T53iHTfIUJrU6adTrCC2qJeHZERxhlbI1Bjjt/msv0tadQ1wUs
N+gDS63pYaACbvXy8MWy7Vu33PqUXHeeE6V/Uq2V8viTO96LXFvKWlJbYK8U90vv
o/ufQJVtMVT8QtPHRh8jrdkPSHCa2XV4cdFyQzR1bldZwgJcJmApzyMZFo6IQ6XU
5MsI+yMRQ+hDKXJioaldXgjUkK642M4UwtBV8ob2xJNDd2ZhwLnoQdeXeGADbkpy
rqXRfboQnoZsG4q5WTP468SQvvG5
-----END CERTIFICATE-----
)EOF";

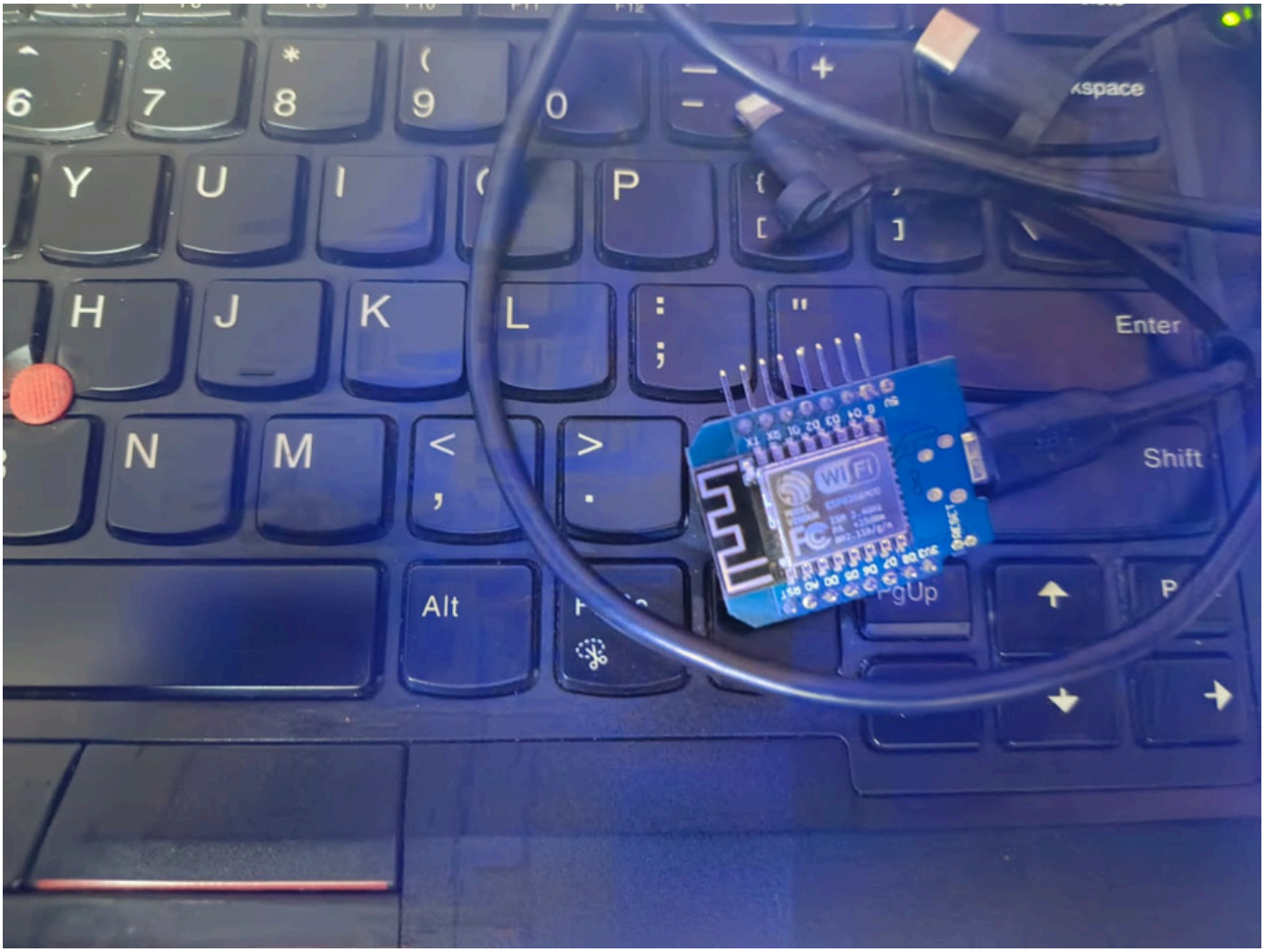
static const char client_cert[] PROGMEM = R"KEY(
-----BEGIN CERTIFICATE-----
MIIDWjCCAkKgAwIBAgIVAMIhSbr7KpTZFgHt8EEuoDfDghswMA0GCSqGSIb3DQEB
CwUAME0xSzBJBgNVBAsMQkFtYXpvbiBXZWIgU2VydmljZXMgTz1BbWF6b24uY29t
IEluYy4gTD1TZWF0dGxlIFNUPVdhc2hpbmd0b24gQz1VUzAeFw0yNTA0MTMxNzI3
MDdaFw00OTEyMzEyMzU5NTlaMB4xHDAaBgNVBAMME0FXUyBJb1QgQ2VydGlmaWNh
dGUwggEiMA0GCSqGSIb3DQEBAQUAA4IBDwAwggEKAoIBAQCzmdl6GwE81pqwFqH1
R9FLywuLbq4WQWX/9ZYnVVA60wRgvwVElDePFu/hIJJDKG/57/ob7HB5t+pGYGmX
iMdQRQbdb1T8wf7B8bvYMcm0+PhxaGP1viBf4mGfQnNzLcNDJMrAB5VfpHj6hAZC
+i2uytMzQIF8Om6qpVW6DwtXv5ZaLLc78rtqnmilL7jgEeH6fSyHs46ftsatnhKQ
LQiLvejw36aV5L60Zvb9aT6rJgc2Y15eLCZc3dNeB1yHBrSPofVEf3UZLjWArEJS
F5G/OWtta0Gh7K9CAlYM0UWPa4ZQxlRvXBgu8K/iHUOJquloBUYj/2UMDoxAptB1
89UxAgMBAAGjYDBeMB8GA1UdIwQYMBaAFHuMMXtITnRFQGSk1aa4QrwFQGQjMB0G
A1UdDgQWBBTv1kRe5RqSfoZC9/UKhQ5VHfxF1DAMBgNVHRMBAf8EAjAAMA4GA1Ud
DwEB/wQEAwIHgDANBgkqhkiG9w0BAQsFAAOCAQEAOA3TyymVPqpPO1KFTJbiCm3f
w+dupstEmyC01PPDZsn1yzyXRs1ukubdIKeTRTGlHPA+y/0lAFov7//Fy2yvIVGU
dQEm7nqRtKD8aG8T7fwdP8u0mS5mmuiP+iHWxEWj4fhfV9i+FdPNaZV+UfX0lWxk
6xBC9T/WY9lIJxi5GHt2BOgu3Lza4Bzjp4LVRzn3Z8tMmLFxHbpqJWyyym8oPc+V
UPugdFLaqzChP0HCdTmucE/QAb1mcxFoogQmwXskyNwMDExau2DyiC5QFUECnfTw
h/1knVJTYCjVZ9V6aMGSGZg5yanCz1D6N+bGU9RIBDDZ9dqNEiNOSt7wVnB5iA==
-----END CERTIFICATE-----
)KEY";

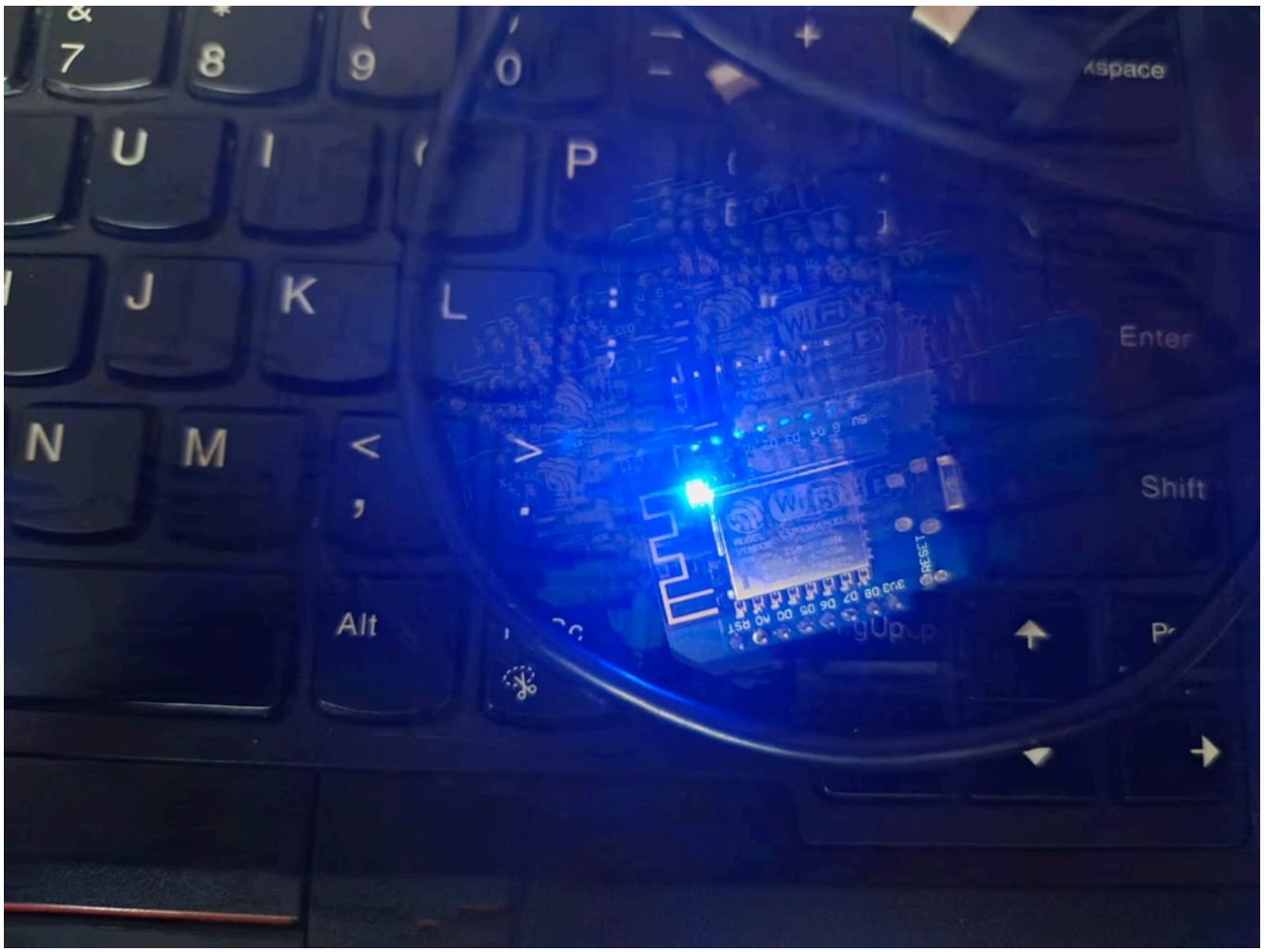
```
static const char privkey[] PROGMEM = R"KEY(
-----BEGIN RSA PRIVATE KEY-----
MIIEogIBAAKCAQEAs5nZehsBPNaasBah9UfRS8sLi26uFkFl//WWJ1VQOtMEYL8F
RJQ3jxbv4SCSQyhv+e/6G+xwebfqRmBpl4jHUEUG3W9U/MH+wfG72DHJtPj4cWhj
9b4gX+Jhn0Jzcy3DQyTKwAeVX6R4+oQGQvotrsrTM0CBfDpuqqVVug8LV7+WWiy3
O/K7ap5opS+44BHh+n0sh7OOn7bGrZ4SkC0Ii73o8N+mleS+tGb2/Wk+qyYHNmNe
XiwmXN3TXgdchwa0j6H1RH91GS41gKxCUheRvzlrbWtBoeyvQgJWDNFFj2uGUMZU
b1wYLvCv4h1DiarpaAVGI/9lDA6MQKbQdfPVMQIDAQABAoIBAEz+NGQLNaGellxA
p5ed/RRv6/gPL6QszwxGfONJylYfNi4/VYPLwnGeFKG/M9SEflR4UxErcCBN/qnC
5SFoKoG3xbSh6J4ekBcWiT+qQF1Lqj370XZk1j4kr1L1ysZipOWg3SYrWhbRTGeg
t4p486KOlrJDAf9+kTiofjKwBl3L9U/1nnVVSlYU7siUXm8pa3BkUxCgUAOUMiPL
VbTiL3aQ4KzlE6S1A9XoeFyZ2GG8ZVbCk3v82WWpqfZfJqteICpgx03HLwLo5/3T
VzZq0Z456tK4FfbcG5Indi1fcq+ox0uBTD9VIVFlhyyVSpMELZcrDtZgGib1AJdV
yjiqJp0CgYEA1+9jpt8fUTtAD9YH7UvwPlblLaKYH94bRrjYZBp1c6vwKQRj6A7T
B2MJzFFX3hvjIcuqBRgr6Yz7iD+HnhWNqErAz74V6sbiMbpLFrUv/+XBmfHQbVXP
P5T/6WcIfiWORqI/U/u+sL3vCI3jkxxWGwEe1EKo0guHnnoPYfFCA+8CgYEA1Oyj
63pXfmIEhcpJzQXJN/JGJ2OM1YM7+QkkZUL5RDC0neTN5MW8MhDEP2RdN033mCoY
Aq1yHXZZdnuH6Gh7MYhFm8+q90pTIc9xY6dPZA/C33a/vEwF8RTLT/b3S316YCB1
Ka/AD1n7Y3ZWEklZuJ8Kw9aT2OPeXKySzpAsGN8CgYACdu0APpOw7agxhhPZFYDM
cA1g1/Y8huBw0jNGETc99rxq+23YfDLUZsD54APMuSzCefyaykfWBpHoYDFAEKbp
QNEqjdTaNSLnxmSNAcxmc0zeYPAsD0qqQx0YoOBr8CnLjJaEct8eTUypIFV0nGIv
NLgRXCFpJFCL8oCycXp7aQKBgHzXyzzUXNyTaAdyFleJ3vNYsF2D9x1xdwaLn7Vn
0XN0A1lYxwguECxivE5W8Hju1A96Dt3zCIfRzp6zy3ovWJwwRHAZESsxfxDB6r/9
Z4VJ4H7Zx44GHS2/fX4DVfgDOG+IWGn6zGez4LvutITAUUT4q30slT/4S3aXEPTg
f5qNAoGAeNsnNb9lbPx9GrsjMPtwiGpX+AwG2CBvURA5zdfYoIWWCgimqOwkXrDz
Ce5A1b+48LP0Pl0ndn7bS+58YRZeUEdget7tUX9cxwiKFxMSrB4xQThHOWf+1dMQ
zP7lV/gDl48g2UfyL3WnTKkB/aRLvDlOcmWAuTHZdQJT9AcARPE=
-----END RSA PRIVATE KEY-----
)KEY";
WiFiClientSecure net;
BearSSL::X509List cert(cacert);
BearSSL::X509List client_crt(client_cert);
BearSSL::PrivateKey key(privkey);
PubSubClient client(net);

time_t now;
time_t nowish = 1510592825;

void NTPConnect(void) {
 Serial.print("Setting time using SNTP");
 configTime(TIME_ZONE * 3600, 0 * 3600, "pool.ntp.org", "time.nist.gov");
 now = time(nullptr);
```

```
while (now < nowish) {
  delay(500);
  Serial.print(".");
  now = time(nullptr);
 }
 Serial.println("done!");
 struct tm timeinfo;
 gmtime_r(&now, &timeinfo);
 Serial.print("Current time: ");
 Serial.print(asctime(&timeinfo));
}
void messageReceived(char *topic, byte *payload, unsigned int length) {
 Serial.print("Received [");
 Serial.print(topic);
 Serial.print("]: ");
 for (int i = 0; i < length; i++) {
  Serial.print((char)payload[i]);
 }
 Serial.println();

 // Optional: Add code here to handle incoming messages if needed
}
void connectAWS() {
 delay(3000);
 WiFi.mode(WIFI_STA);
 WiFi.begin(WIFI_SSID, WIFI_PASSWORD);

 Serial.println(String("Attempting to connect to SSID: ") + String(WIFI_SSID));

 while (WiFi.status() != WL_CONNECTED) {
  Serial.print(".");
  delay(1000);
 }
NTPConnect();
net.setTrustAnchors(&cert);
 net.setClientRSACert(&client_crt, &key);
 client.setServer(MQTT_HOST, 8883);
 client.setCallback(messageReceived);
 Serial.println("Connecting to AWS IOT");
 while (!client.connect(THINGNAME)) {
 Serial.print(".");
 delay(1000);
 }
```

```
 if (!client.connected()) {
 Serial.println("AWS IoT Timeout!");
 return;
 }

 client.subscribe(AWS_IOT_SUBSCRIBE_TOPIC);
 Serial.println("AWS IoT Connected!");
}
void publishMessage() {
 StaticJsonDocument<200> doc;
 doc["time"] = millis();
 doc["led_state"] = ledState ? "ON" : "OFF";
 doc["message"] = "LED status update";
```

Circuit/Connected ESP8266- didn't have sensors avaialble.





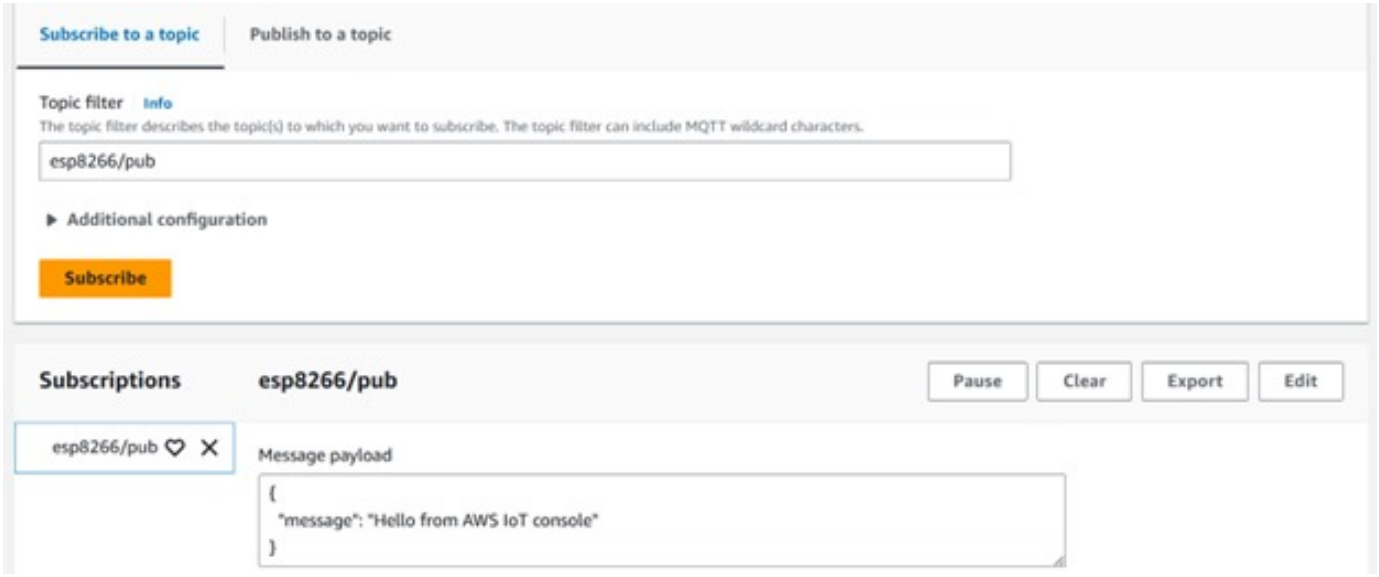
Serail Monitor:

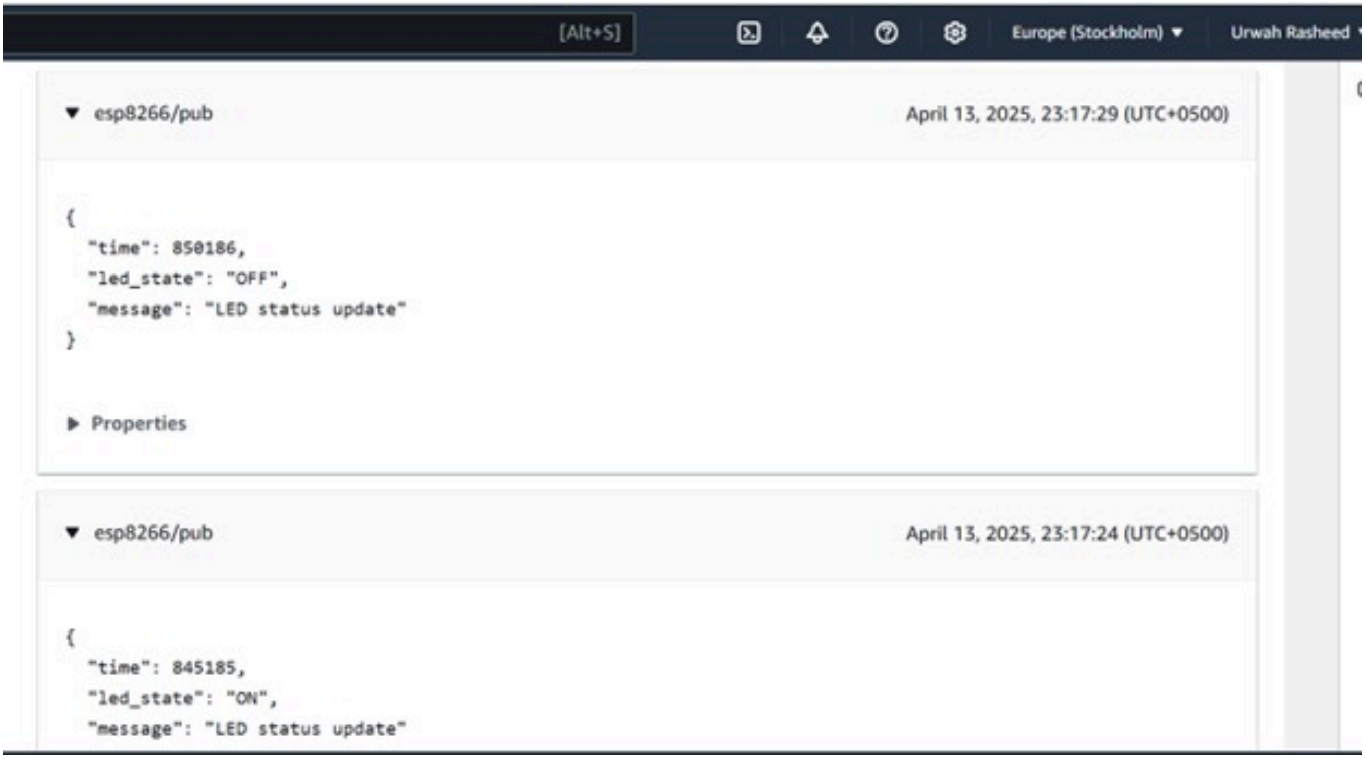
```
Attempting to connect to SSID: eman's S24 Ultra
.........Setting time using SNTP.............................done!
Current time: Sun Apr 13 18:39:23 2025
Connecting to AWS IOT
AWS IoT Connected!
LED is now ON
```

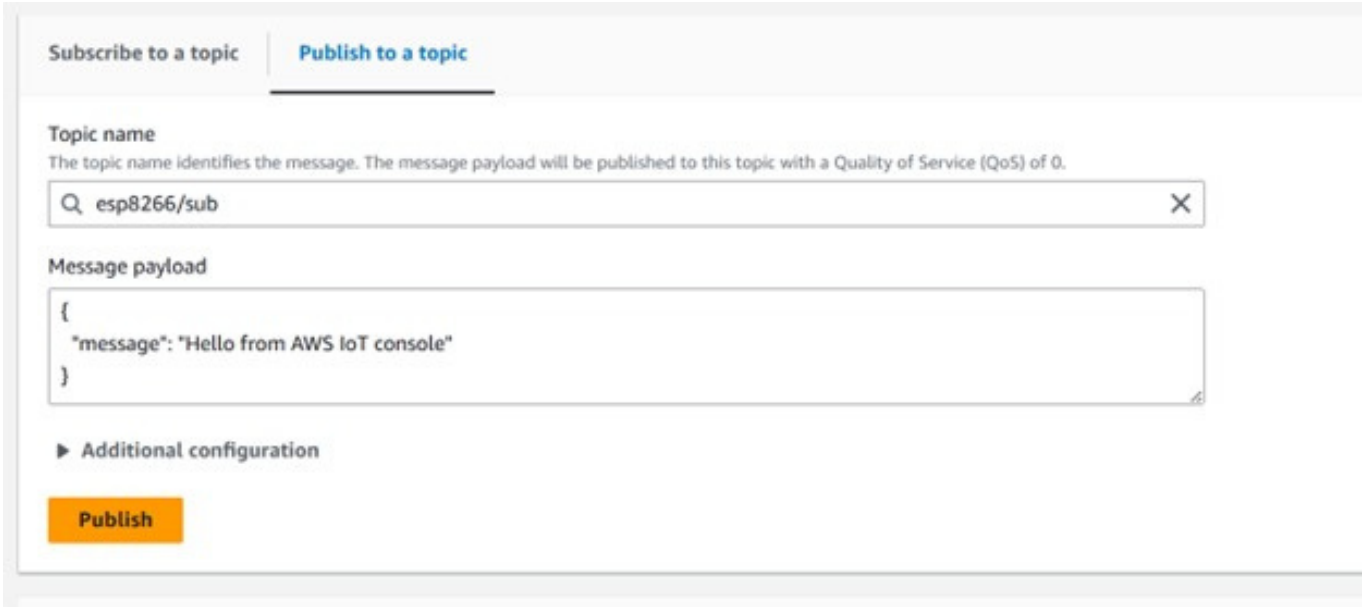
```
LED is now ON
Published LED status to AWS IoT
LED is now OFF
LED is now ON
LED is now OFF
LED is now ON
```

```
LED is now ON
Published LED status to AWS IoT
Received [esp8266/sub]: {
  "message": "Hello from AWS IoT console"
}
LED is now OFF
```

AWS IoT Platform: Values getting published







Critical Analysis and Comparison of Platforms:

By Areeb Ur Rehman

In this project, we have discussed three Internet of Things (IoT) platforms—Blynk, ThingSpeak, and AWS IoT Core. Each of them has unique strengths and weaknesses.

1. Blynk (Blynk 2.0):

Blynk is a platform designed to make IoT development easier, especially for people who are new to the field. It allows users to create mobile applications that can control microcontrollers like the ESP8266 or ESP32 over the internet.

Pros:

- **Very Beginner-Friendly:** Blynk is known for its simple drag-and-drop interface, especially on its mobile app. You don't need to write much code to create a working app to control your IoT device.
- **Fast Setup:** You can get a project running in minutes. Creating templates, adding widgets like switches or buttons, and linking them to your device is fast and smooth.
- **Mobile Control:** The platform shines when it comes to controlling IoT devices through your phone. The app interface is clean and highly responsive.
- **Virtual Pins:** These let you link the app interface directly to your code logic—like controlling an LED with a virtual switch.

Cons:

- **Restricted Free Tier:** Free accounts come with less functionality, fewer devices, and fewer templates. For more sophisticated features, a premium plan is required.
- **Unsuitable for Big Projects:** Blynk works well for prototypes but struggles to scale for intricate multi-device systems.
- **Basic Security:** Advanced security features like encryption keys and rules are not supported, despite the fact that it makes use of authentication tokens.
- **Strongly Connected to the Blynk Ecosystem:** Projects mostly depend on cloud services provided by Blynk. Very little can be done offline.

2. ThingSpeak:

ThingSpeak is an open-source IoT platform that focuses on collecting, storing, and visualizing data from devices. It's especially popular in educational and research settings.

Pros:

- **Great for Data Logging:** ThingSpeak is excellent if your project involves collecting sensor data and plotting it over time.
- **Built-in MATLAB Integration:** A powerful feature that allows you to analyze data directly in the cloud using MATLAB code.
- **Simple Dashboard Tools:** To keep an eye on data in real time, you can configure widgets, gauges, and charts.
- **Easy-to-Use API:** Using HTTP to upload data is straightforward and well-documented. There are numerous Arduino examples available.

Cons:

- **Old-School Interface:** The user interface can feel awkward and is out of date. Not very user-friendly for novices.
- **Requires MathWorks Account:** This is an additional step that may be perplexing, particularly if you are only doing a class project or doing an experiment.
- **Basic Control Features:** Unlike Blynk, ThingSpeak isn't really made for controlling devices—it's more about monitoring and analytics.
- **Limited Customization of UI Elements:** You can't build complex or interactive dashboards easily.

3. AWS IoT Core:

AWS IoT Core is Amazon's cloud-based platform for managing and communicating with IoT devices. It's a professional-grade service designed for real-world, large-scale deployments.

Pros:

- **Highly Scalable:** AWS IoT Core is built for serious business and industrial applications. It can handle thousands—even millions—of devices.
- **Advanced Security:** Assures safe connection between devices and the cloud by utilizing policies, private keys, and certificates.

- **Strong Integration Options:** AWS IoT Core can be connected to other services such as SNS (for notifications), DynamoDB (for data storage), and AWS Lambda (for automation).
- **Supports Standard Protocols:** Supports Standard Protocols: It is adaptable to a variety of devices due to its strong support for MQTT and HTTPS.

Cons:

- **Not for Beginners:** The platform is very technical and assumes a strong understanding of networking, security, and cloud architecture.
- **Complex Setup Process:** Even for something as simple as sending a message, there are numerous processes involved in creating a "Thing," adding a certificate, and converting keys to DER format.
- **Requires External Tools:** You may need to use tools like OpenSSL, the AWS CLI, and Arduino IDE plugins just to get everything working.
- **Costs Add Up:** While AWS has a free tier, when your device count or data usage increases, costs can increase.

END