การใช้งาน ThingsBoard IoTs Platform เพื่อสร้างและจัดการระบบอัฉริยะ ThingsBoard IoTs Platform for smart system

ชื่อ-สกุล : วราสิริ ลิ้มประเสริฐ B6214005

6/6 -- คำถามท้ายบทเพื่อทดสอบความเข้าใจ

Quiz_101 – ThingsBoard Data Monitor

- Mission - 1/4: ให้ส่งข้อมูลค่า Humidity และ Temperatures จากเซ็นเซอร์ DHT-22 ไปยัง Dashboard

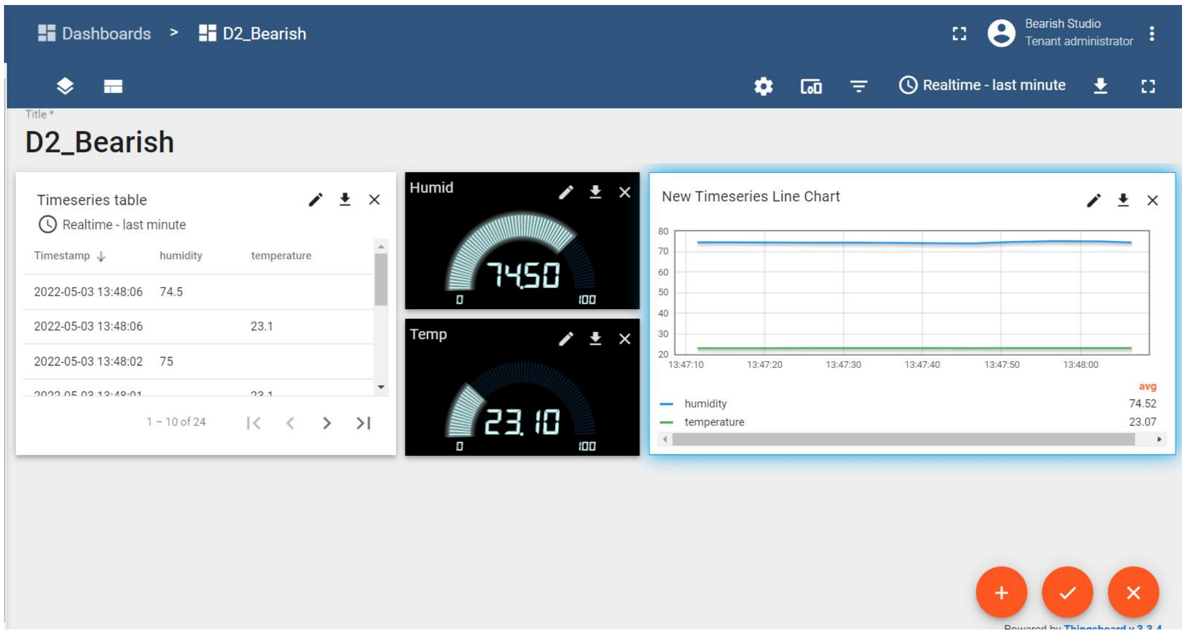
```
#include "ThingsBoard.h"
#include <WiFi.h>
#define WIFI_AP "V2036"
#define WIFI_PASSWORD "fnafchica"
#define TOKEN "wcbt10HzC54MQwRO6DeA"
#define THINGSBOARD_SERVER "demo.thingsboard.io"
#include <Arduino.h>
#define DHT22_Pin 15
#include "DHTesp.h"
DHTesp dht;
// Baud rate for debug serial
#define SERIAL_DEBUG_BAUD 115200
// Initialize ThingsBoard client
WiFiClient espClient;
// Initialize ThingsBoard instance
ThingsBoard tb(espClient);
// the Wifi radio's status
int status = WL_IDLE_STATUS;

void setup() {
  // initialize serial for debugging
  Serial.begin(SERIAL_DEBUG_BAUD);
  WiFi.begin(WIFI_AP, WIFI_PASSWORD);
  InitWiFi();
  dht.setup(DHT22_Pin, DHTesp::DHT22); // Connect DHT sensor to GPIO 15
}

void loop() {
  if (WiFi.status() != WL_CONNECTED) {
    reconnect();
  }
  if (!tb.connected()) {
    // Connect to the ThingsBoard
    Serial.print("Connecting to: ");
    Serial.print(THINGSBOARD_SERVER);
    Serial.print(" with token ");
    Serial.println(TOKEN);
    if (!tb.connect(THINGSBOARD_SERVER, TOKEN)) {
      Serial.println("Failed to connect");
      return;
    }
  }
  Serial.print("Sending data...");
  // Uploads new telemetry to ThingsBoard using MQTT.
  // See https://thingsboard.io/docs/reference/mqtt-api/#telemetry-upload-api
  // for more details
  //tb.sendTelemetryInt("temperature", xTempp);
  //tb.sendTelemetryInt("humidity", xTempp);
  Serial.print(dht.getTemperature() );
  Serial.print(" , ");
  Serial.println(dht.getHumidity());
  tb.sendTelemetryFloat("temperature", dht.getTemperature() );
  tb.sendTelemetryFloat("humidity", dht.getHumidity());
  tb.loop();
  delay(5000);
}

void InitWiFi()
{
  Serial.println("Connecting to AP ...");
  // attempt to connect to WiFi network
  WiFi.begin(WIFI_AP, WIFI_PASSWORD);
  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
  }
  Serial.println("Connected to AP");
}

void reconnect() {
  // Loop until we're reconnected
  status = WiFi.status();
  if ( status != WL_CONNECTED) {
    WiFi.begin(WIFI_AP, WIFI_PASSWORD);
    while (WiFi.status() != WL_CONNECTED) {
      delay(500);
      Serial.print(".");
    }
    Serial.println("Connected to AP");
  }
}
```



Timeseries table

Realtime - last minute

Timestamp ↓	humidity	temperature
2022-05-03 13:48:06	74.5	
2022-05-03 13:48:06		23.1
2022-05-03 13:48:02	75	

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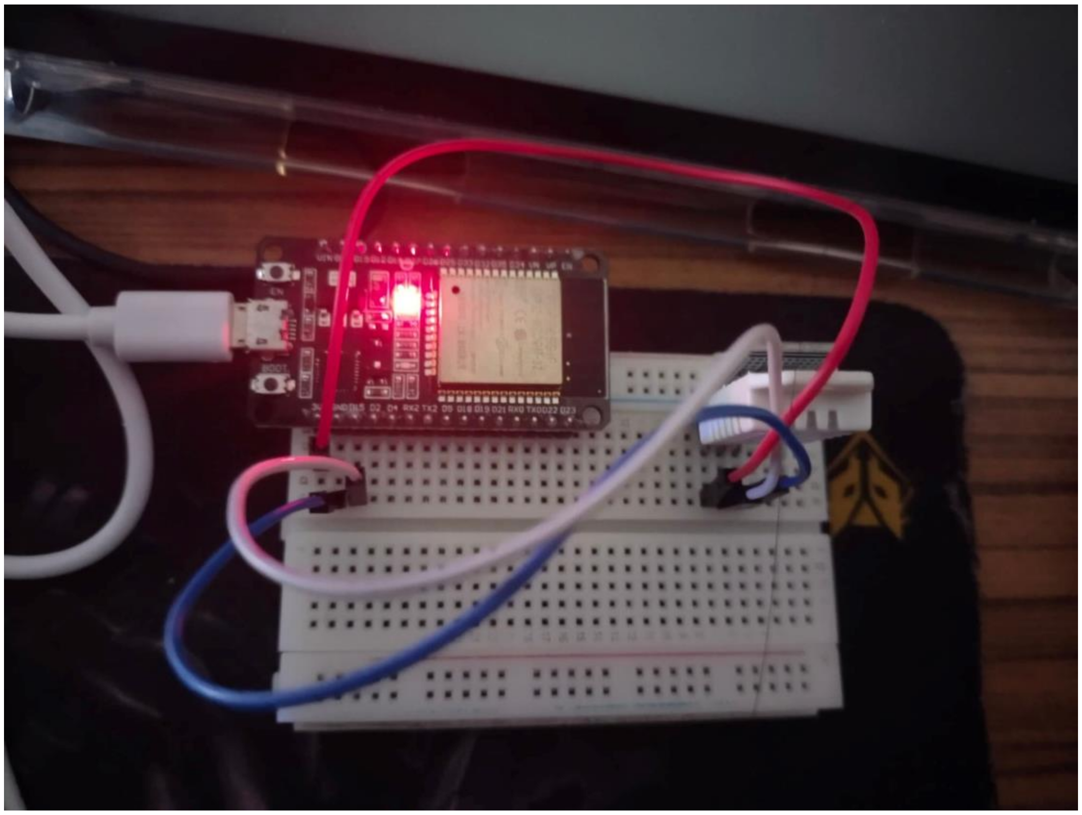
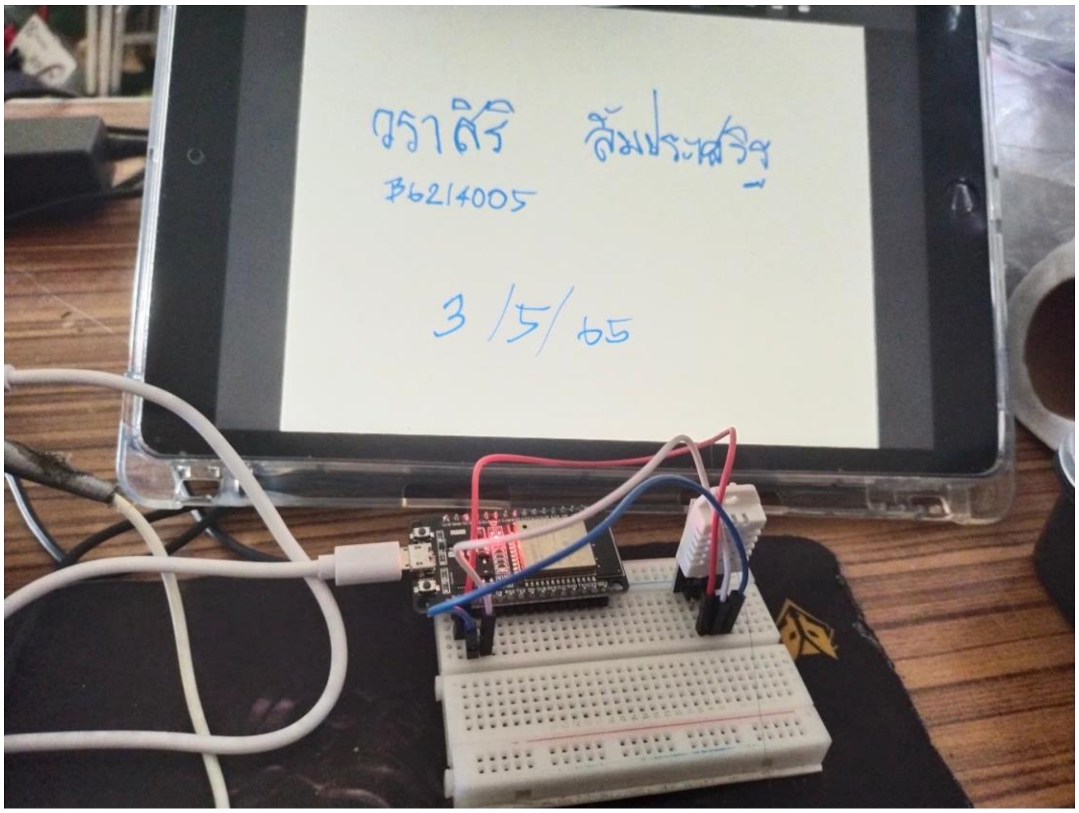
Humid: 74.50

Temp: 23.10

	avg
humidity	74.52
temperature	23.07

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Quiz_102 – ThingsBoard Data Monitor and Control

- Mission 2/4: ให้ส่งข้อมูลค่า Humidity และ Temperatures จากเซ็นเซอร์ DHT-22 ไปยัง ThingsBoard พร้อมทั้งควบคุม On/Off - 4 LED และ Blink Speed สำหรับอีก 1 LED

Code

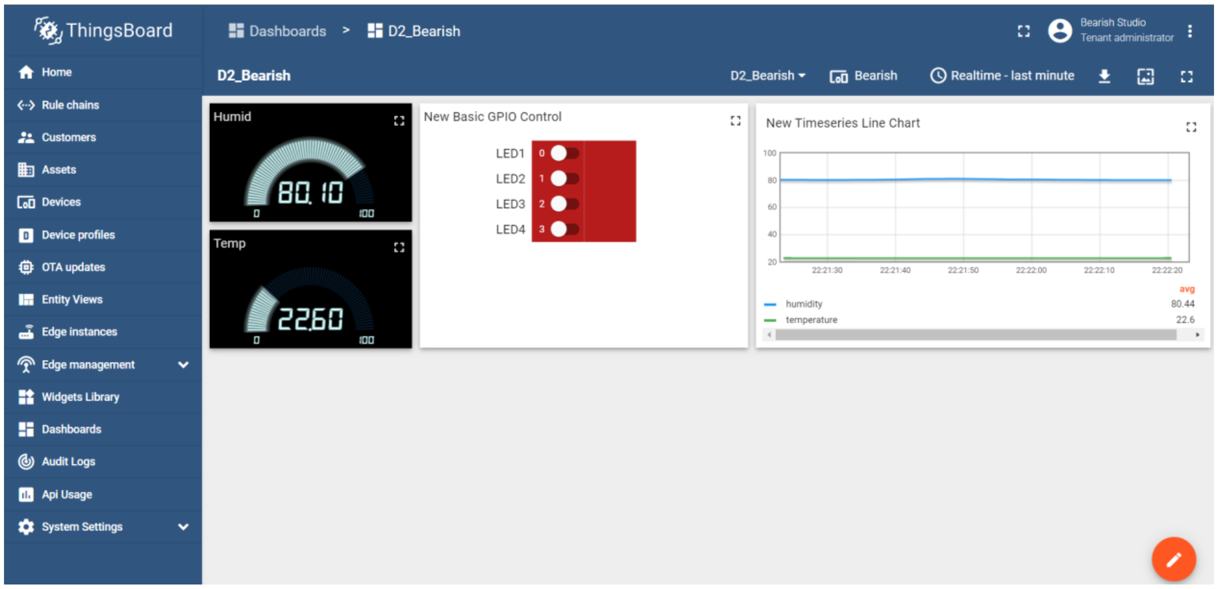
```
#define COUNT_OF(x) ((sizeof(x)/sizeof(0[x])) / ((size_t)(!(sizeof(x) % sizeof(0[x])))))
#include <WiFi.h>
#include <ThingsBoard.h>
#include <Arduino.h>

#define WIFI_AP_NAME "V2036"
#define WIFI_PASSWORD "fnafchica"
#define TOKEN "wcbt10HzC54MQwRO6DeA"
#define THINGSBOARD_SERVER "demo.thingsboard.io"

#define DHT22_Pin 15
#include "DHTesp.h"
DHTesp dht;
#define pinLEDBlink 2

WiFiClient espClient;
ThingsBoard tb(espClient);
int status = WL_IDLE_STATUS;
uint8_t leds_PinControl[] = {18, 19, 22, 23};

int leds_Status[] = { 0, 0, 0, 0 };
char StringEcho[] = "stsLED_1";
int loopDelay = 20; // Main loop delay(ms)
int sendDataDelay = 2000; // Period of Sending Tempp/Humid.
int BlinkLEDDelay = 500; // Initial period of LED cycling.
int Count_BlinkLEDDelay = 0; // Time Counter Blink peroid
int Count_sendDataDelay = 0; // Time Counter Sending Tempp/Humid
bool Subscribed_Status = false; // Subscribed_Status for the RPC messages.
int ststus_BlinkLED = 0; // LED number that is currenlty ON.
#include "_ThingBoardRPC.h"
#include "_ConnectWifi.h"

//=====================================================
void setup() {
  // Initialize serial for debugging
  Serial.begin(115200);
  WiFi.begin(WIFI_AP_NAME, WIFI_PASSWORD);
  WiFi_Initial();
  dht.setup(DHT22_Pin, DHTesp::DHT22); // Connect DHT sensor to GPIO 15
  // Pinconfig
  pinMode(pinLEDBlink, OUTPUT);
  for (size_t i = 0; i < COUNT_OF(leds_PinControl); ++i) {
    pinMode(leds_PinControl[i], OUTPUT);
  }
}
//=====================================================
void loop() {
  // Step0/6 - Loop Delay
  delay(loopDelay);
  Count_BlinkLEDDelay += loopDelay;
  Count_sendDataDelay += loopDelay;
  // Step1/6 - Check if next LED Blink
  if (Count_BlinkLEDDelay > BlinkLEDDelay) {
    digitalWrite(pinLEDBlink, ststus_BlinkLED);
    ststus_BlinkLED = 1 - ststus_BlinkLED;
  Count_BlinkLEDDelay = 0;
}
// Step 2/6 - Reconnect to WiFi, if needed
if (WiFi.status() != WL_CONNECTED) {
    reconnect();
    return;
  }
  // Step 3/6 - Reconnect to ThingsBoard, if needed
  if (!tb.connected()) {
    Subscribed_Status = false;
    // Connect to the ThingsBoard
    Serial.print("Connecting to: "); Serial.print(THINGSBOARD_SERVER);
    Serial.print(" with token "); Serial.println(TOKEN);
    if (!tb.connect(THINGSBOARD_SERVER, TOKEN)) {
      Serial.println("Failed to connect");
      return;
    }
  }
  // Step 4/6 - Subscribe for RPC, if needed
  if (!Subscribed_Status) {
    Serial.println("Subscribing for RPC...");
    // Perform a subscription. All consequent data processing will happen in
    // callbacks as denoted by callbacks[] array. Page 14 of 23
    if (!tb.RPC_Subscribe(callbacks, COUNT_OF(callbacks))) {
      Serial.println("Failed to subscribe for RPC");
      return;
    }
    Serial.println("Subscribe done");
    Subscribed_Status = true;
  }
  // Step 5/6 - Check if it is a time to send Tempp/Humid
  if (Count_sendDataDelay > sendDataDelay) {
    Serial.print("Sending data...");
    float humidity = dht.getHumidity();
    float temperature = dht.getTemperature();
    tb.sendTelemetryFloat("temperature", temperature);
    tb.sendTelemetryFloat("humidity", humidity);
    Serial.print("T=" + String(temperature, 2) + ", ");
    Serial.print("H=" + String(humidity, 2) + ", ");
    Serial.print("LED=");
    for (size_t i = 0; i < COUNT_OF(leds_PinControl); ++i) {
      StringEcho[7] = 0x30 + i; // Set 0 to "0"
      tb.sendTelemetryInt(StringEcho, leds_Status[i]);
      Serial.print(leds_Status[i]);
    }
    Serial.println();
    Count_sendDataDelay = 0;
  }
  // Step 6/6 - Process messages
  tb.loop();
}
```

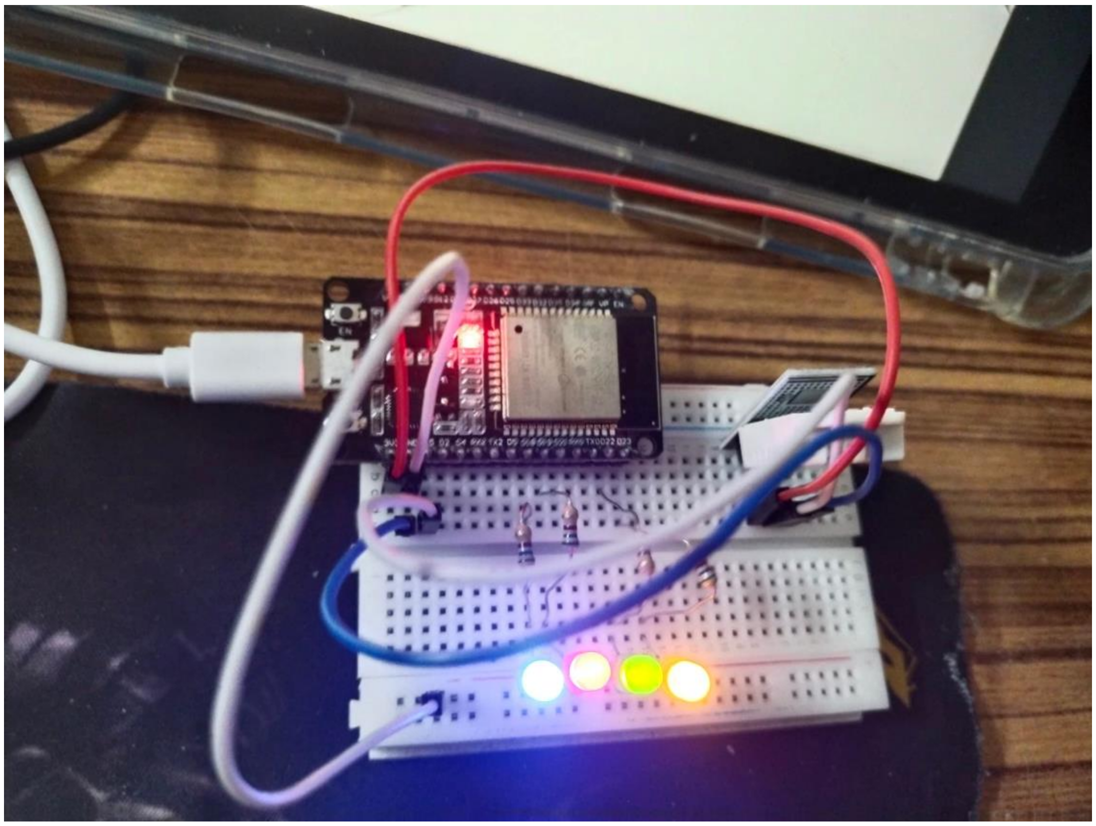
_ConnectWifi.h

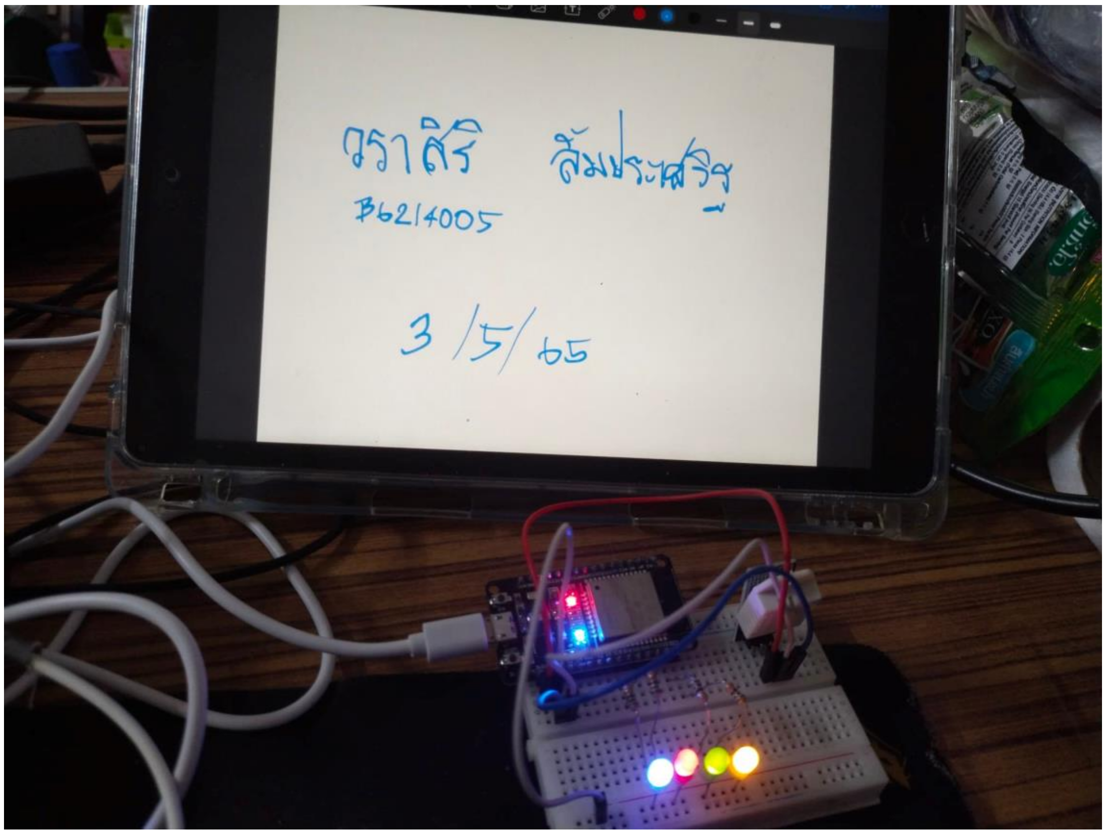
```
//_ConnectWifi.h
//=====================================================
void WiFi_Initial() {
  Serial.println("Connecting to AP ..."); // attempt to connect to WiFi network
  WiFi.begin(WIFI_AP_NAME, WIFI_PASSWORD);
  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
  }
  Serial.println("\nConnected to AP");
  Serial.print("Local IP = ");
  Serial.println(WiFi.localIP());
}
//=====================================================
void reconnect() {
  status = WiFi.status(); // Loop until we're reconnected
  if ( status != WL_CONNECTED) {
    WiFi.begin(WIFI_AP_NAME, WIFI_PASSWORD);
    while (WiFi.status() != WL_CONNECTED) {
      delay(500);
      Serial.print(".");
    }
    Serial.println("\nConnected to AP");
    Serial.print("Local IP = ");
    Serial.println(WiFi.localIP());
  }
}
```

_ThingBoardRPC.h

```
//##############################################################
// Processes function for RPC call "setValue"
// RPC_Data is a JSON variant, that can be queried using operator[]
// See https://arduinojson.org/v5/api/jsonvariant/subscript/ for more details
//==============================================================
RPC_Response processDelayChange(const RPC_Data &data)
{ Serial.println("Received the set delay RPC method");
  BlinkLEDDelay = data;
  Serial.print("Set new delay: ");
  Serial.println(BlinkLEDDelay);
  return RPC_Response(NULL, BlinkLEDDelay);
}
//##############################################################
// Processes function for RPC call "getValue"
// RPC_Data is a JSON variant, that can be queried using operator[]
// See https://arduinojson.org/v5/api/jsonvariant/subscript/ for more details
//==============================================================
RPC_Response processGetDelay(const RPC_Data &data) {
  Serial.println("Received the get value method");
  return RPC_Response(NULL, BlinkLEDDelay);
}
//##############################################################
// Processes function for RPC call "setGpioStatus"
// RPC_Data is a JSON variant, that can be queried using operator[]
// See https://arduinojson.org/v5/api/jsonvariant/subscript/ for more details
//==============================================================
RPC_Response processSetGpioState(const RPC_Data &data) {
  Serial.println("Received the set GPIO RPC method");
  int pin = data["pin"];
  bool enabled = data["enabled"];
  if (pin < COUNT_OF(leds_PinControl)) {
    Serial.print("Setting LED ");
    Serial.print(pin);
    Serial.print(" to state ");
    Serial.println(leds_Status[pin]);
    leds_Status[pin] = 1 - leds_Status[pin];
    digitalWrite(leds_PinControl[pin], leds_Status[pin]);
  }
  return RPC_Response(data["pin"], (bool)data["enabled"]);
}
//##############################################################
// RPC handlers
//==============================================================
RPC_Callback callbacks[] = {
  { "setValue", processDelayChange },
  { "getValue", processGetDelay },
  { "setGpioStatus", processSetGpioState },
};
```



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Quiz_103 – ThingsBoard Data Monitor and control with MQTT Protocol

- Mission 3/4: ให้ใช้ MQTT กับ ThingsBoard
  - ปรับปรุงเพื่อให้ทำงานควบคุมการ On/Off - 4 LED
  - เพิ่มเติม คือ ทดสอบส่งข้อมูล 1 ค่าแบบสุ่มระหว่าง 00 – 50 ไปแสดงที่ Dashboard ด้วย ได้หรือไม่ ทำอย่างไรบ้างให้อธิบาย {Read https://thingsboard.io/docs/user-guide/device-profiles/ }

Code

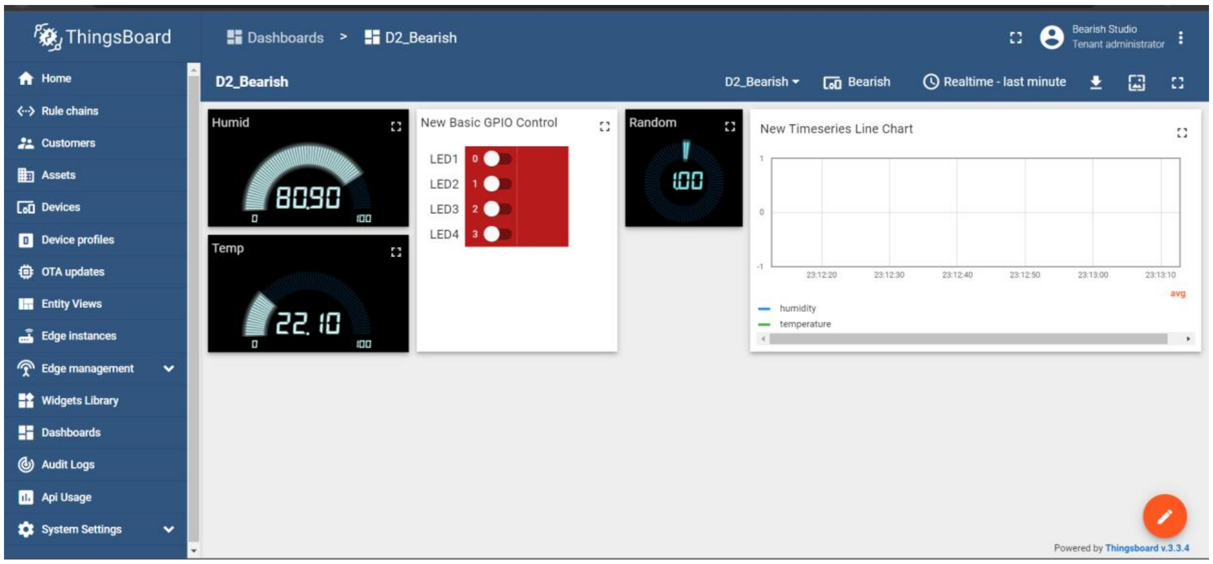
```
#include <WiFi.h>
#include <ArduinoJson.h> // by Benoit Blanchon >> Ver 5.8.0
#include <PubSubClient.h> // by Nick O'Leary. >> Ver 2.6 and Update PubSubClient.h

#define WIFI_AP_NAME "V2036"
#define WIFI_PASSWORD "fnafchica"
#define Device_Name "Bearish"
#define Device_Token "wcbt10HzC54MQwRO6DeA"
#define THINGSBOARD_SERVER "demo.thingsboard.io"
#define GPIO1_ESP32Pin 18
#define GPIO2_ESP32Pin 19
#define GPIO3_ESP32Pin 22
#define GPIO4_ESP32Pin 23

#define Rand "random"
boolean gpioState[] = {false, false, false, false};
int status = WL_IDLE_STATUS;

int Stepupdate;
int Random;
WiFiClient wifiClient;
PubSubClient client(wifiClient);
#include "_HandOnMQTT.h"
#include "_WifiConnect.h"
void setup() {
  Serial.begin(115200);
  // Set output mode for all GPIO pins
  pinMode(GPIO1_ESP32Pin, OUTPUT);
  pinMode(GPIO2_ESP32Pin, OUTPUT);
  pinMode(GPIO3_ESP32Pin , OUTPUT);
  pinMode(GPIO4_ESP32Pin , OUTPUT);
  delay(10);
  InitialWiFi();
  client.setServer( THINGSBOARD_SERVER, 1883 );
  client.setCallback(on_message);
}
void loop() {
  delay(20);
  Stepupdate += 20;
  if (Stepupdate > 5000) {
    Random = random(00 , 50);
    client.publish("v1/devices/me/telemetry", get_gpio_status().c_str());
    Stepupdate = 0;
  }
  if ( !client.connected() ) {
    reconnect();
  }
  client.loop();
}
```

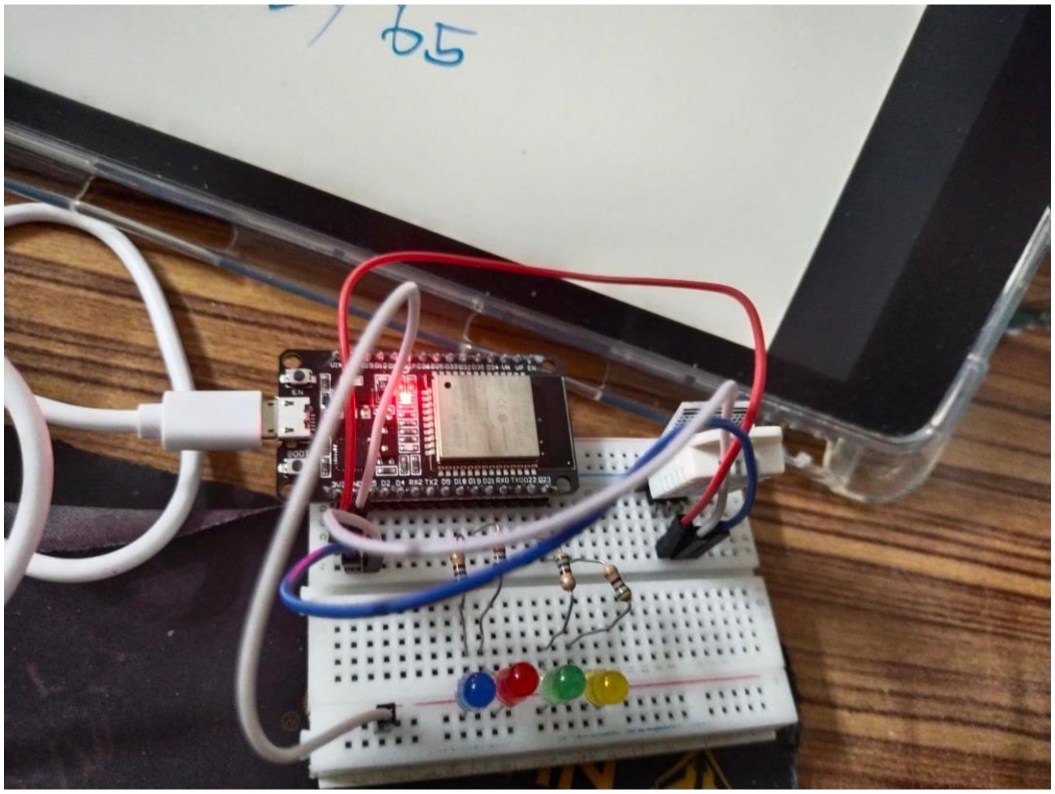
_HandOnMQTT.h

```
// File 2 of 3
// _HandOnMQTT.h
//=========================================================
//=========================================================
String get_gpio_status() {
  // Prepare gpios JSON payload string
  StaticJsonBuffer<200> jsonBuffer;
  JsonObject & data = jsonBuffer.createObject();
  data[String(GPIO1_ESP32Pin)] = gpioState[0];
  data[String(GPIO2_ESP32Pin)] = gpioState[1];
  data[String(GPIO3_ESP32Pin)] = gpioState[2];
  data[String(GPIO4_ESP32Pin)] = gpioState[3];
  char payload[256];
  data.printTo(payload, sizeof(payload));
  String strPayload = String(payload);
  Serial.print("Get GPIO Status: ");
  Serial.println(strPayload);
  return strPayload;
}
//=========================================================
//=========================================================
void set_gpio_status(int pin, boolean enabled) {
  if (pin == GPIO1_ESP32Pin) {
    gpioState[0] = 1 - gpioState[0];
    digitalWrite(GPIO1_ESP32Pin, gpioState[0]);
  }
  if (pin == GPIO2_ESP32Pin) {
    gpioState[1] = 1 - gpioState[1];
    digitalWrite(GPIO2_ESP32Pin, gpioState[1]);
  }
  if (pin == GPIO3_ESP32Pin) {
    gpioState[2] = 1 - gpioState[2];
    digitalWrite(GPIO3_ESP32Pin, gpioState[2]);
  }
  if (pin == GPIO4_ESP32Pin) {
    gpioState[3] = 1 - gpioState[3];
    digitalWrite(GPIO4_ESP32Pin, gpioState[3]);
  }
}
//=====================================================
//=====================================================
// The callback for when a PUBLISH message is received from the server.
void on_message(const char* topic, byte* payload, unsigned int length) {
  Serial.println("\nOn message");
  char json[length + 1];
  strncpy (json, (char*)payload, length);
  json[length] = '\0';
  Serial.print("Topic: "); Serial.println(topic);
  Serial.print("Message: "); Serial.println(json);
  // Decode JSON request
  StaticJsonBuffer<200> jsonBuffer;
  JsonObject& data = jsonBuffer.parseObject((char*)json);
  if (!data.success()) {
    Serial.println("parseObject() failed");
    return;
  }
  // Check request method
  String methodName = String((const char*)data["method"]);
  // If Reply with GPIO status
  if (methodName.equals("getGpioStatus")) {
    String responseTopic = String(topic);
    responseTopic.replace("request", "response");
    client.publish(responseTopic.c_str(), get_gpio_status().c_str());
  }
  // If Update GPIO status and reply
  if (methodName.equals("setGpioStatus")) {
    set_gpio_status(data["params"]["pin"], data["params"]["enabled"]);
    String responseTopic = String(topic);
    responseTopic.replace("request", "response");
    client.publish(responseTopic.c_str(), get_gpio_status().c_str());
    client.publish("v1/devices/me/attributes", get_gpio_status().c_str());
  }
}
```

_WifiConnect.h

```
// File 3 of 3
// _WifiConnect.h
//=========================================================
//=========================================================
void InitialWiFi() {
  Serial.println("Connecting to AP ...");
  WiFi.begin(WIFI_AP_NAME, WIFI_PASSWORD);
  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
  }
  Serial.println("Connected to AP");
}
//=========================================================
//=========================================================
void reconnect() {
  // Loop until we're reconnected
  while (!client.connected()) {
    status = WiFi.status();
    if ( status != WL_CONNECTED) {
      InitialWiFi();
    }
    Serial.print("Connecting to ThingsBoard node ...");
    // Attempt to connect (clientId, username, password)
    if ( client.connect(Device_Name, Device_Token, NULL) ) {
      Serial.println( "[DONE]" );
      // Subscribing to receive RPC requests
      client.subscribe("v1/devices/me/rpc/request/+");
      // Sending current GPIO status
      Serial.println("Sending current GPIO status ...");
      client.publish("v1/devices/me/attributes", get_gpio_status().c_str());
    } else {
      Serial.print( "[FAILED] [ rc = " );
      Serial.print( client.state() );
      Serial.println( " : retrying in 5 seconds]" );
      delay( 5000 ); // Wait 5 seconds before retrying
    }
  }
}
```


ThingsBoard
Dashboards > D2_Bearish
Bearish Studio
Tenant administrator
Home
Rule chains
Customers
Assets
Devices
Device profiles
OTA updates
Entity Views
Edge instances
Edge management
Widgets Library
Dashboards
Audit Logs
Api Usage
System Settings
D2_Bearish
D2_Bearish
Bearish
Realtime - last minute
Humid
80.90
0
100
Temp
22.10
New Basic GPIO Control
LED1 0
LED2 1
LED3 2
LED4 3
Random
1.00
New Timeseries Line Chart
23:12:20
23:12:30
23:12:40
23:12:50
23:13:00
23:13:10
avg
humidity
temperature
Powered by Thingsboard v.3.3.4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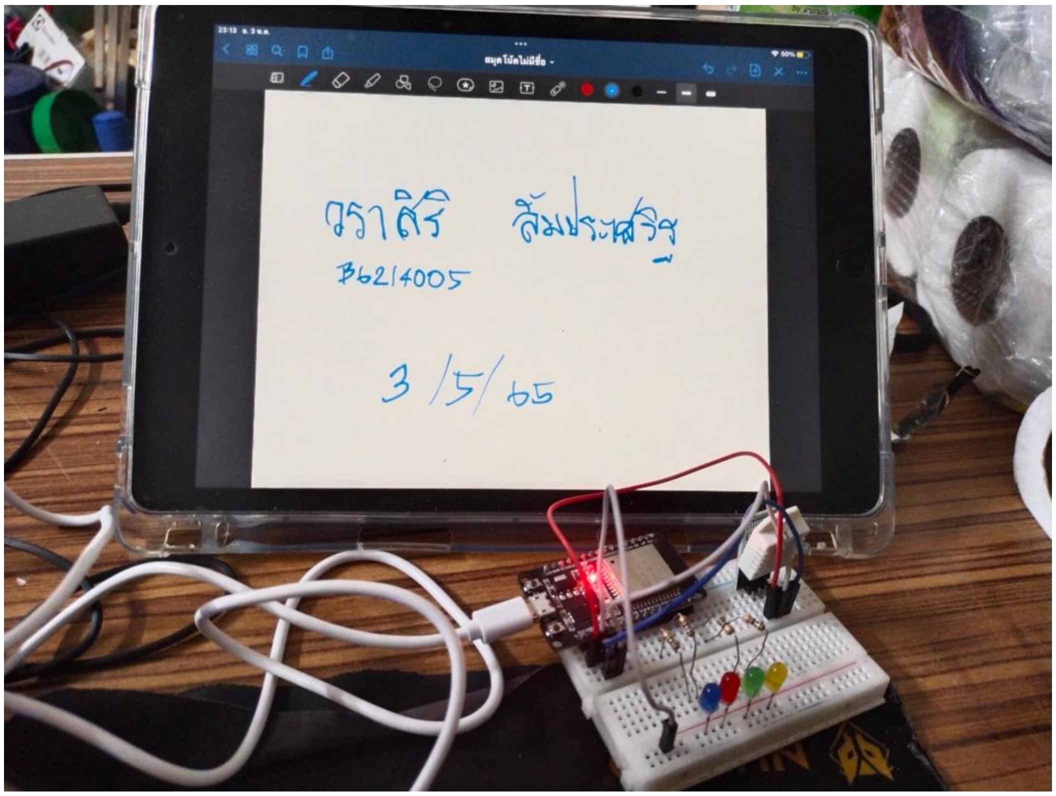
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Quiz_104 – Web Control 4 LED and Monitor Humid/Temperature

- Mission 4/4: การตรวจสอบและควบคุม อุณหภูมิ-ความชื้น ของโรงเรือนเลี้ยงไก่
  - ให้ใช้ ESP32 ส่งข้อมูลแบบสุ่มสองจำนวน คือ
    - Tempp_A สุ่มระหว่าง 20-40
    - Hudmid_A สุ่มระหว่าง 60-80
  - ข้อมูลทั้งสองค่าจะนำมาแสดงที่ Dashboard
  - สร้าง Alarm โดย หาก Tempp_A > 35 หรือ Hudmid_A > 70 ให้ Alarm
  - ศึกษาการตั้ง Alarm - https://thingsboard.io/docs/user-guide/alarms/
  - กำหนดรอบการตรวจสอบทุกๆ 20 วินาที
  - แชร์ Dashboard ไปให้ผู้ใช้งาน

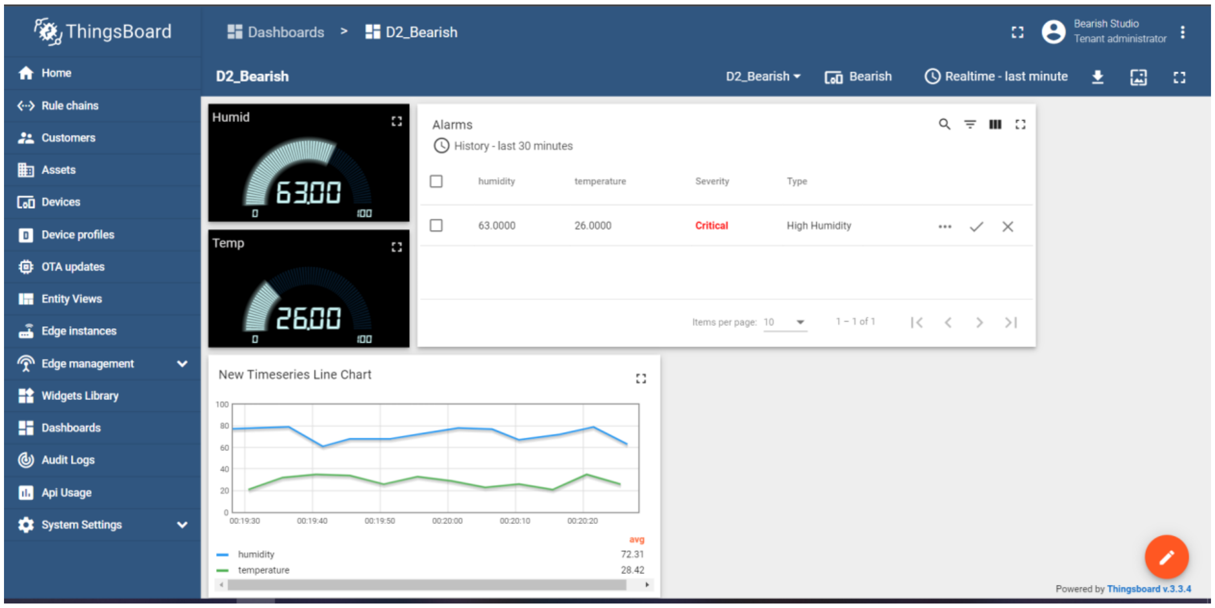
```
#include "ThingsBoard.h"
#include <WiFi.h>
#define WIFI_AP "V2036"
#define WIFI_PASSWORD "fnafchica"
#define TOKEN "wcbt10HzC54MQwRO6DeA"
#define THINGSBOARD_SERVER "demo.thingsboard.io"
#include <Arduino.h>
#include "ArduinoJson.h"

#define SERIAL_DEBUG_BAUD 115200
WiFiClient espClient;
ThingsBoard tb(espClient);
int status = WL_IDLE_STATUS;

void setup() {
  // initialize serial for debugging
  Serial.begin(SERIAL_DEBUG_BAUD);
  WiFi.begin(WIFI_AP, WIFI_PASSWORD);
  InitWiFi();
}

void loop() {
  if (WiFi.status() != WL_CONNECTED) {
    reconnect();
  }
  if (!tb.connected()) {
    // Connect to the ThingsBoard
    Serial.print("Connecting to: "); Serial.print(THINGSBOARD_SERVER);
    Serial.print(" with token "); Serial.println(TOKEN);
    if (!tb.connect(THINGSBOARD_SERVER, TOKEN)) {
      Serial.println("Failed to connect"); return;
    }
  }
  Serial.print("Sending data...");
  // Uploads new telemetry to ThingsBoard using MQTT.
  // See https://thingsboard.io/docs/reference/mqtt-api/#telemetry-upload-api
  // for more details
  float xTempp = random(20, 40);
  float xHdmid = random(60, 80);
  Serial.print(xTempp, 2);
  Serial.print(","); Serial.print(xHdmid, 2); Serial.println();
  tb.sendTelemetryFloat("temperature", xTempp);
  tb.sendTelemetryFloat("humidity", xHdmid);
  tb.loop(); delay(5000);
}

void InitWiFi() {
  Serial.println("Connecting to AP ...");
  // attempt to connect to WiFi network
  WiFi.begin(WIFI_AP, WIFI_PASSWORD);
  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
  }
  Serial.println("Connected to AP");
}
void reconnect() {
  // Loop until we're reconnected
  status = WiFi.status();
  if ( status != WL_CONNECTED) {
    WiFi.begin(WIFI_AP, WIFI_PASSWORD);
    while (WiFi.status() != WL_CONNECTED) {
      delay(500);
      Serial.print(".");
    }
    Serial.println("Connected to AP");
  }
}
```



Alarms
History - last 30 minutes

humidity	temperature	Severity	Type
63.0000	26.0000	Critical	High Humidity

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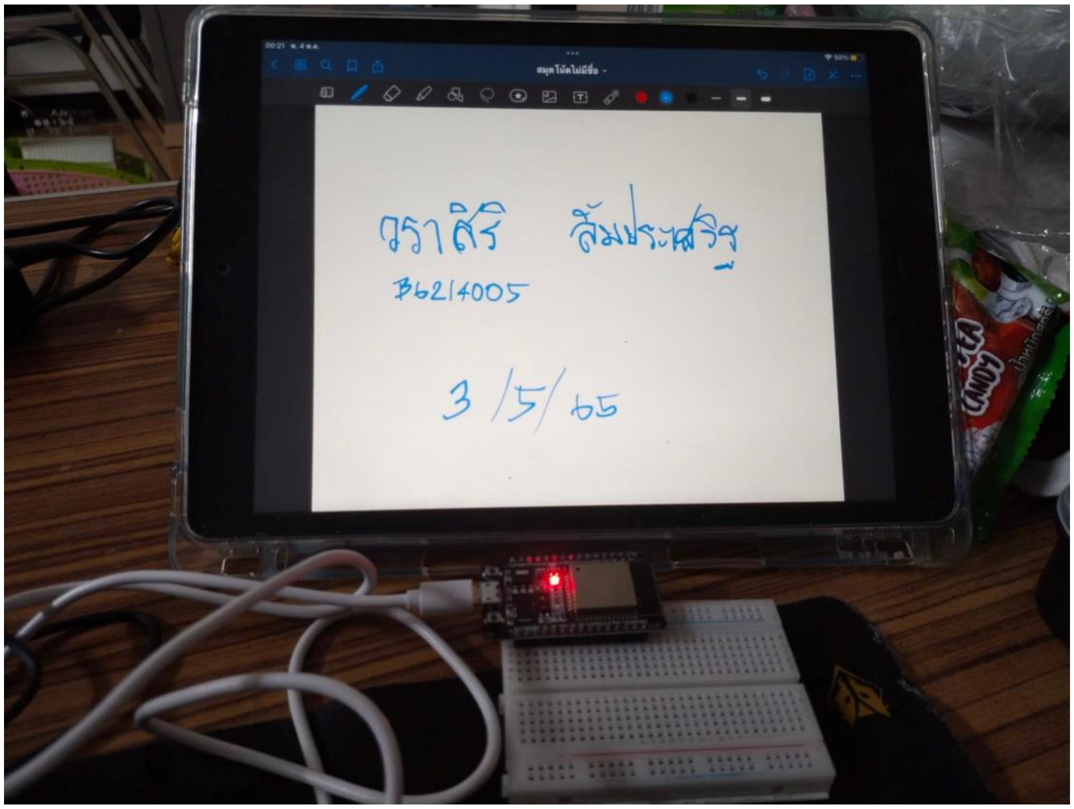
	avg
humidity	72.31
temperature	28.42



ลิงค์ Dashboard :

https://demo.thingsboard.io/dashboard/01e00640-caab-11ec-9a68-6b50da95566e?publicId=7fa73190-c037-11eb-8f11-41ff5faa9969