การควบคุมเครื่องจักรอัจฉริยะโดยใช้การสื่อสารระหว่างเครื่องจักรกับเครื่องจักร
M2M – Intelligence Machine Control

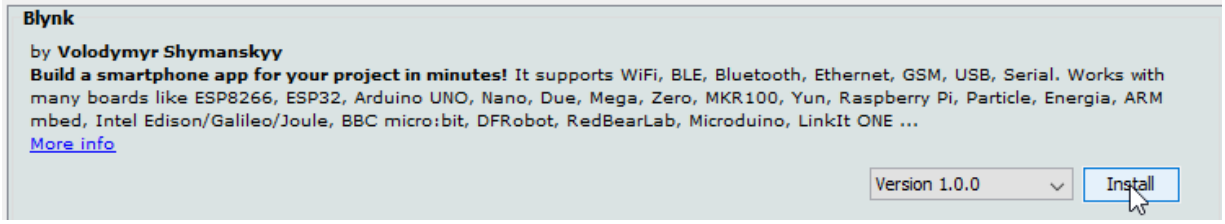
4/4 – Control and Monitor Modbus Device via The IoTs Platform

- การโปรแกรมใช้งาน Blynk เพื่อตรวจสอบ/สั่งงาน อุปกรณ์ Modbus
- การโปรแกรมใช้งาน Ubidots เพื่อตรวจสอบ/สั่งงาน อุปกรณ์ Modbus
- คำถามท้ายบทเพื่อทดสอบความเข้าใจ

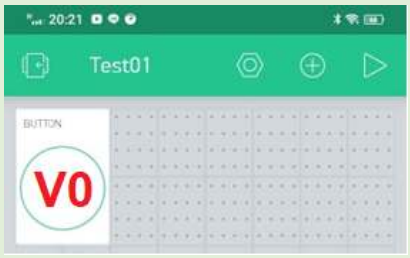
การโปรแกรมใช้งาน Blynk เพื่อตรวจสอบ/สั่งงาน อุปกรณ์ Modbus

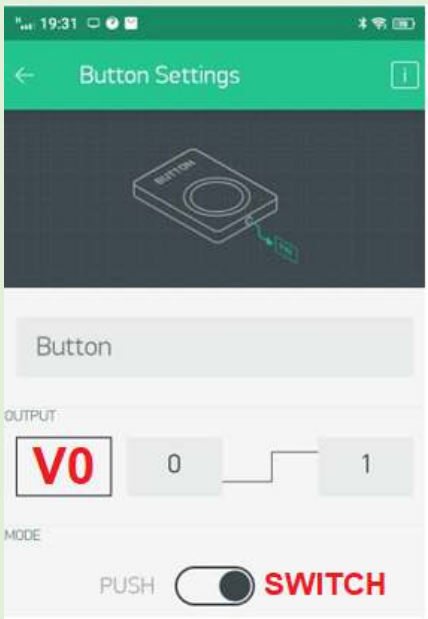
Test 1/6. Remote Control ESP-32 via Blynk

1. ตรวจสอบให้แน่ใจว่ามี Blynk Library เรียบร้อยแล้ว



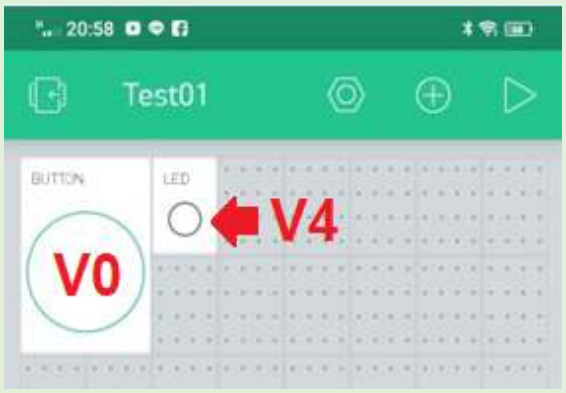
2. ทดสอบการควบคุมผ่าน Blynk ไปยัง Build in LED

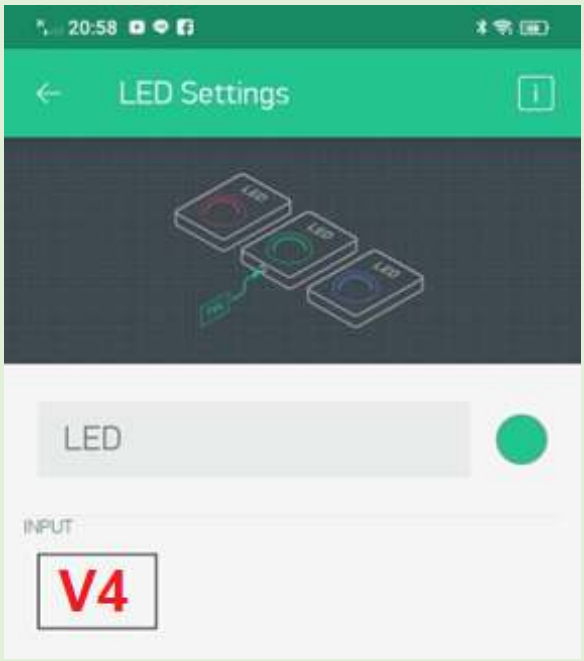





```
#define BLYNK_PRINT Serial
#include <WiFi.h>
#include <WiFiClient.h>
#include <BlynkSimpleEsp32.h>

char auth[] = "YD3FmnLEk5vdhs-BeQlWwrACl8gXNgXK";
char ssid[] = "Mue.Home";
char pass[] = "pk1212312121";

#define testLED 2
#define testSW  0

BLYNK_WRITE(V0) {
  int Value_V0 = param.asInt();
  digitalWrite(testLED,Value_V0);
}

void setup() {
  Serial.begin(115200);
  pinMode(testLED,OUTPUT);
  pinMode(testSW,INPUT_PULLUP);
  Blynk.begin(auth, ssid, pass);
}

void loop() {
  Blynk.run();
  delay(100);
}
```

3. ทดสอบอ่านค่า SW0 และควบคุม D2 พร้อมกันผ่าน Blynk

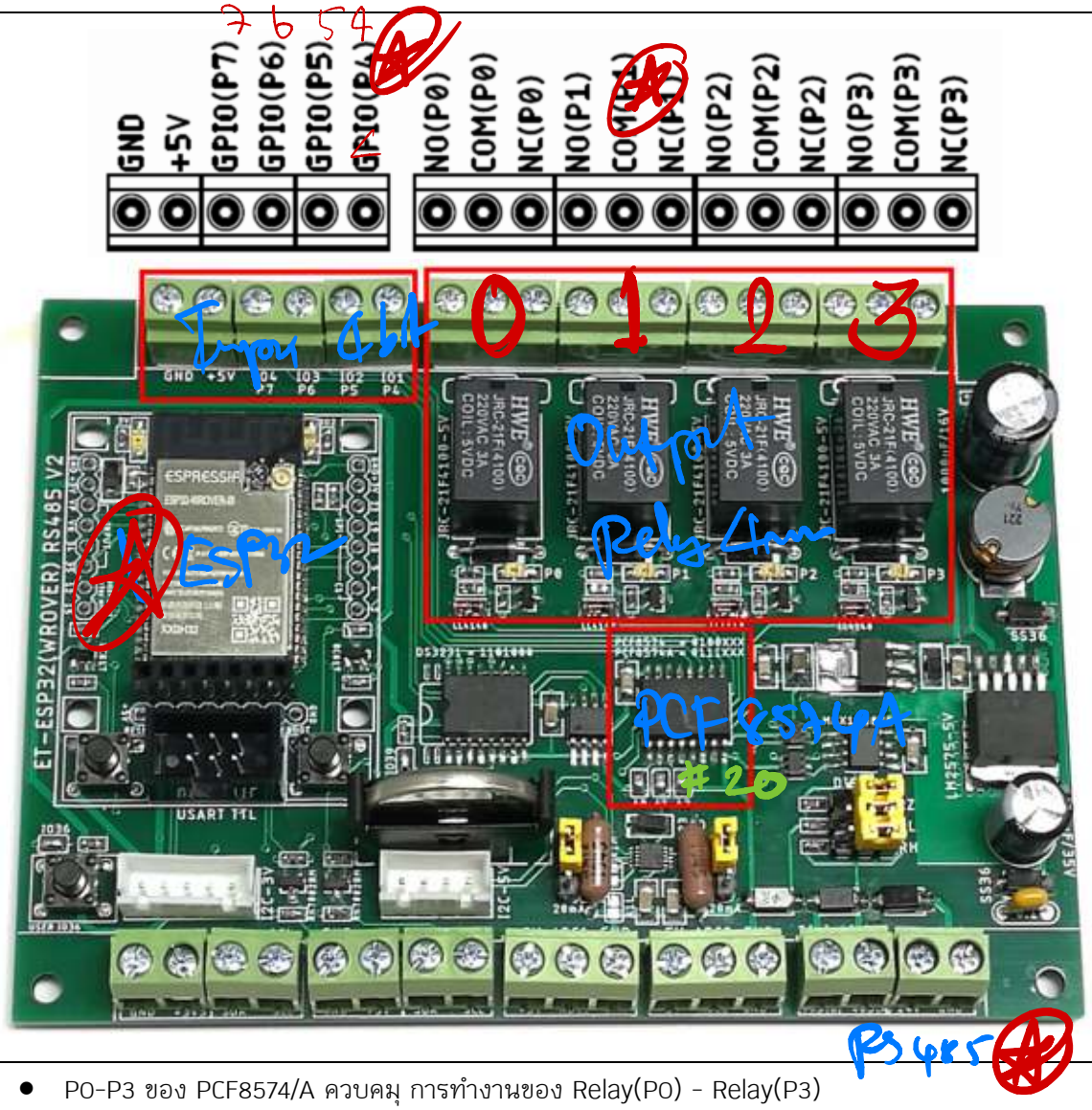





```
#define BLYNK_PRINT Serial
#include <WiFi.h>
#include <WiFiClient.h>
#include <BlynkSimpleEsp32.h>

char auth[] = "YD3FmnLEk5vdhs-BeQlWwrACl8gXNgXK";
char ssid[] = "Mue.Home";
char pass[] = "pk1212312121";

#define testLED 2
#define testSW  0

WidgetLED LED_V4(V4);

BLYNK_WRITE(V0) {
  int Value_V0 = param.asInt();
  digitalWrite(testLED, Value_V0);
}

void setup() {
  Serial.begin(115200);
  pinMode(testLED, OUTPUT);
  pinMode(testSW, INPUT_PULLUP);
  Blynk.begin(auth, ssid, pass);
}

int loopCount = 10;
void loop() {
  Blynk.run();
  if (loopCount < 0) {
    loopCount = 20;
    //int stsTestSW = digitalRead(testSW);
    int stsTestSW = random(2);
    Serial.println("stsTestSW = " + String(stsTestSW));
    if (stsTestSW == 0)
      LED_V4.off();
    else
      LED_V4.on();
  }
  delay(100);
  loopCount--;
}
```

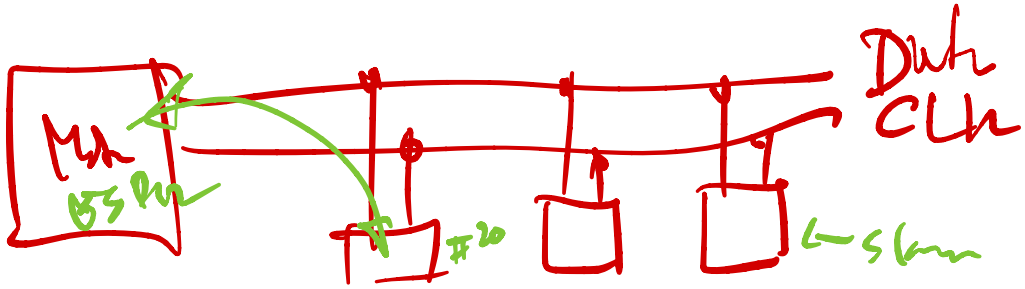
Test 2/6. Remote Control and Monitor ET-ESP32-RS485 V2 Board via Blynk

4. บอร์ด ET-ESP32-RS485 V2 เป็นบอร์ดที่เหมาะในการแปลงการสื่อสารระหว่าง Modbus กับ IoT เนื่องจากมีทั้งช่องทางสื่อสารทำให้เรียกใช้งานได้ทันที



- P0-P3 ของ PCF8574/A ควบคุม การทำงานของ Relay(P0) - Relay(P3)
- P4-P7 ต่อกับ GPIO(P4)- GPIO(P7) สามารถกำหนดเป็น Input/Output ได้อิสระจากโปรแกรม
- PCF8574 Address=0x20, I2C_SCL_Pin D22, I2C_SDA_Pin D21

5. Add WROVER Chip ให้ Arduino IDE (หากกำหนดแล้วให้ข้าม)
   - File → Preference … กำหนด https://dl.espressif.com/dl/package_esp32_index.json
   - Tools → Board → Board Manager … ทำการเพิ่ม esp32 บอร์ด
   - Add WROVER Chip ให้ Arduino IDE (หากกำหนดแล้วให้ข้าม)



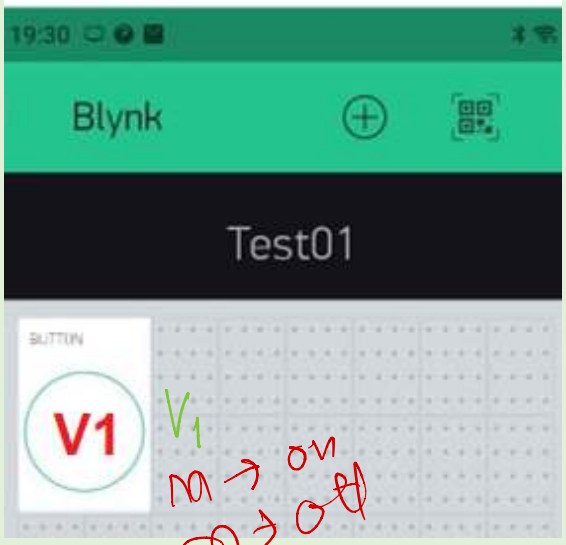
6. เลือกบอร์ดเป็น ESP32 Wrover Module ทดสอบการทำงานด้วย Blink Example Code

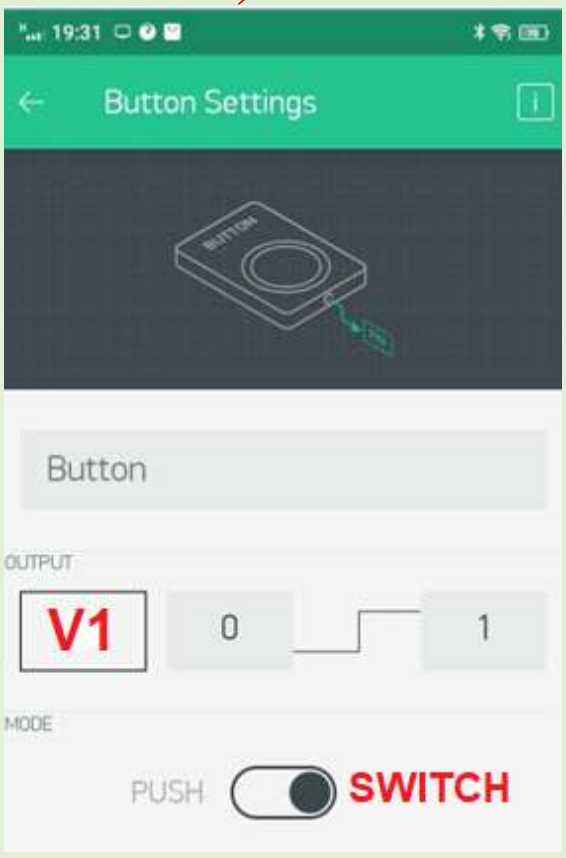
```
#define testLED 2
void setup() {
  pinMode(testLED, OUTPUT);
}

void loop() {
  digitalWrite(testLED, HIGH);  delay(1000);
  digitalWrite(testLED, LOW);   delay(1000);
}
```

7. ควบคุมการทำงานของ Relay

```
#include <Wire.h>

#define PCF8574_Addr 0x20
#define I2C_SCL_Pin 22
#define I2C_SDA_Pin 21
#define testLED      2

void setup() {
  pinMode(testLED, OUTPUT);
  Wire.begin(I2C_SDA_Pin, I2C_SCL_Pin);
}

void loop() {
  digitalWrite(testLED, HIGH);
  Wire.beginTransmission(PCF8574_Addr);
  Wire.write(0xAA);
  Wire.endTransmission();
  delay(1000);

  digitalWrite(testLED, LOW);
  Wire.beginTransmission(PCF8574_Addr);
  Wire.write(0x55);
  Wire.endTransmission();
  delay(1000);
}
```

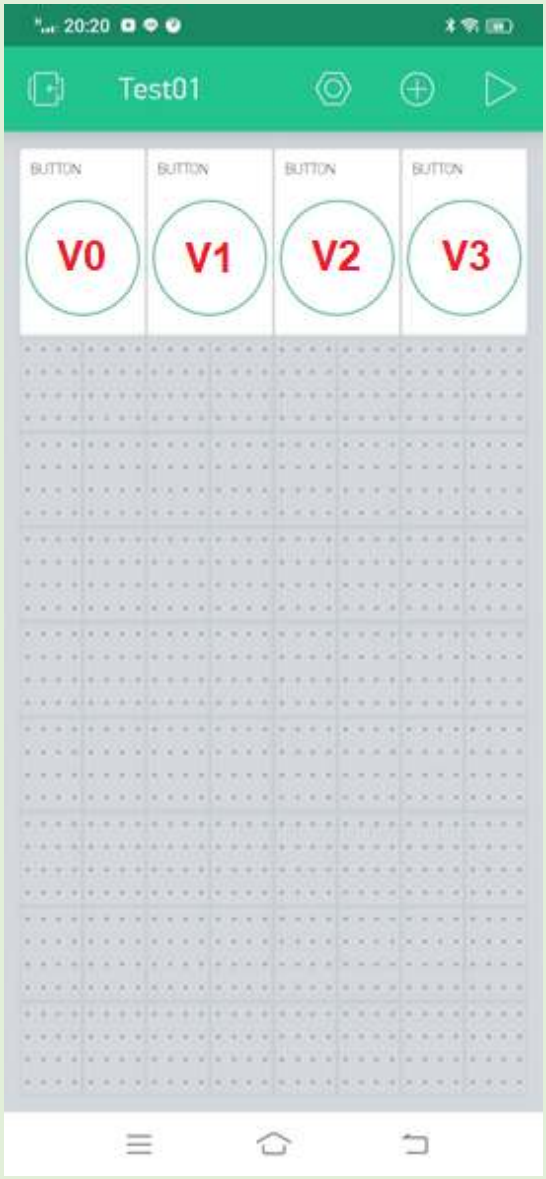
8. ทดสอบการควบคุมผ่าน Blynk ไปยัง PCF8517 Relay_0





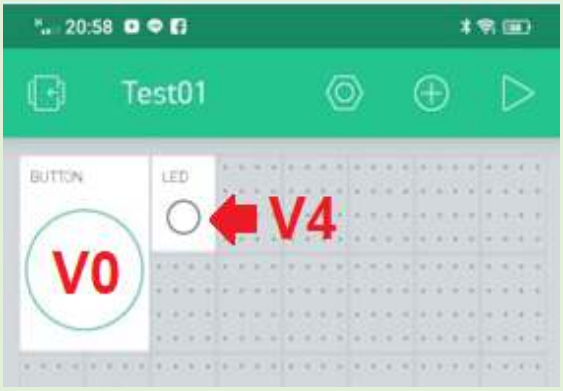

```
#define BLYNK_PRINT Serial

#include <WiFi.h>
#include <WiFiClient.h>
#include <BlynkSimpleEsp32.h>
#include <Wire.h>

#define PCF8574_Addr 0x20
#define I2C_SCL_Pin 22
#define I2C_SDA_Pin 21
#define testLED 2

char auth[] = "GzWPpqdufO2I4WFA4kT4FjTh_AT";          // Token Key
char ssid[] = "Test1234";                             // AP Name
char pass[] = "0816601234";                           // Wifi-Password

byte statusRelay = 0x0ff; // All Off

void RelayUpdate(int idRelay, int stsRelay) {
  byte stsRelayTemp;
  Serial.print("Relay_");
  Serial.print(idRelay);
  if (stsRelay == 1) {
    stsRelayTemp = ~(1 << idRelay);
    statusRelay &= stsRelayTemp;
    Serial.println("Force: On");
  }
  else {
    stsRelayTemp = 1 << idRelay;
    statusRelay |= stsRelayTemp;
    Serial.println("Force: Off");
  }
  Wire.beginTransmission(PCF8574_Addr);
  Wire.write(statusRelay);
  Wire.endTransmission();
}

BLYNK_WRITE (V1) {
  int pinValue = param.asInt();
  RelayUpdate(0, pinValue);
  digitalWrite(testLED, pinValue);
}

void setup() {
  Serial.begin(115200);
  pinMode(testLED, OUTPUT);
  Blynk.begin(auth, ssid, pass);
  Wire.begin(I2C_SDA_Pin, I2C_SCL_Pin);
}

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

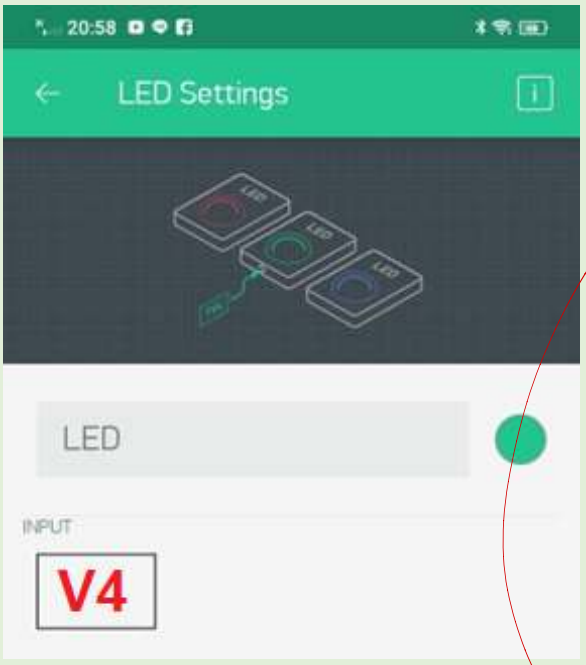
9. ปรับแก้เป็นควบคุม 4-Switch สำหรับ 4-Relay




```
#define BLYNK_PRINT Serial

#include <WiFi.h>
#include <WiFiClient.h>
#include <BlynkSimpleEsp32.h>
#include <Wire.h>

#define PCF8574_Addr 0x20
#define I2C_SCL_Pin 22
#define I2C_SDA_Pin 21
#define testLED 2

char auth[] = "GzWPpqdufO2I4WFA4kT4FjTh_AT";          // Token Key
char ssid[] = "Test1234";                             // AP Name
char pass[] = "0816601234";                           // Wifi-Password

byte statusRelay = 0x0ff; // All Off

void RelayUpdate(int idRelay, int stsRelay) {
  byte stsRelayTemp;
  Serial.print("Relay_");
  Serial.print(idRelay);
  if (stsRelay == 1) {
    stsRelayTemp = ~(1 << idRelay);
    statusRelay &= stsRelayTemp;
    Serial.println("Force: On");
  }
  else {
    stsRelayTemp = 1 << idRelay;
    statusRelay |= stsRelayTemp;
    Serial.println("Force: Off");
  }
  Wire.beginTransmission(PCF8574_Addr);
  Wire.write(statusRelay);
  Wire.endTransmission();
}

BLYNK_WRITE (V0) {
  int pinValue = param.asInt();
  RelayUpdate(0, pinValue);
  digitalWrite(testLED, pinValue);
}

BLYNK_WRITE (V1) {
  int pinValue = param.asInt();
  RelayUpdate(1, pinValue);
}

BLYNK_WRITE (V2) {
  int pinValue = param.asInt();
  RelayUpdate(2, pinValue);
}

BLYNK_WRITE (V3) {
  int pinValue = param.asInt();
  RelayUpdate(3, pinValue);
}


void setup() {
  Serial.begin(115200);
  pinMode(testLED, OUTPUT);
  Blynk.begin(auth, ssid, pass);
  Wire.begin(I2C_SDA_Pin, I2C_SCL_Pin);
}

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

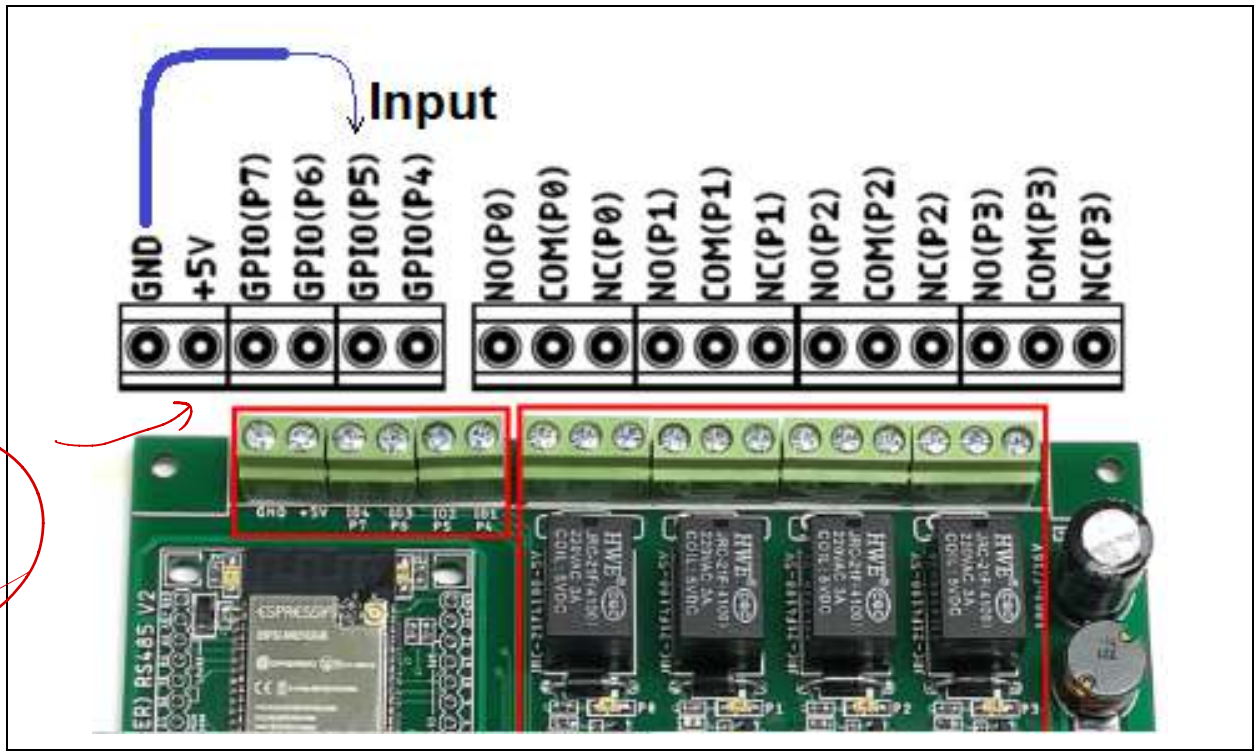
10. ทดสอบอ่านค่า GPIO(P4) และควบคุม Relay-0 พร้อมกันผ่าน Blynk





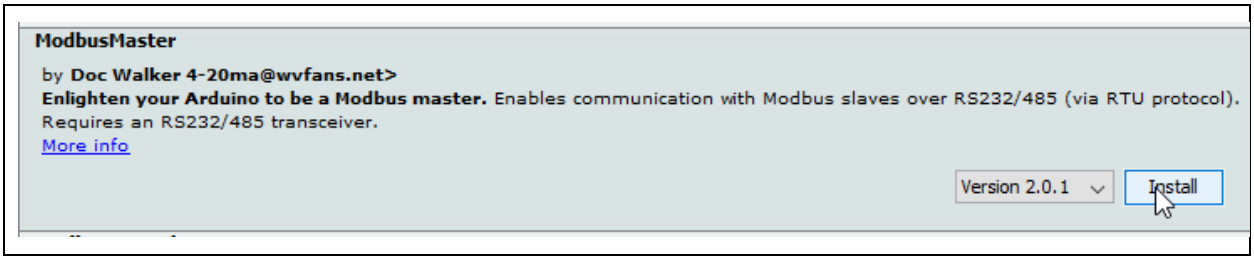

```
#define BLYNK_PRINT Serial

#include <WiFi.h>
#include <WiFiClient.h>
#include <BlynkSimpleEsp32.h>
#include <Wire.h>

#define PCF8574_Addr 0x20
#define I2C_SCL_Pin 22
#define I2C_SDA_Pin 21
#define testLED 2

char auth[] = "GzWPpqdufO2I4WFA4kT4FjTh_AT";          // Token Key
char ssid[] = "Test1234";                             // AP Name
char pass[] = "0816601234";                           // Wifi-Password

byte statusRelay = 0x0ff; // All Off

WidgetLED Input4(V4);
BlynkTimer timer;

//-------------------------------------------
void expanderWrite(byte _data ) {
  Wire.beginTransmission(PCF8574_Addr);
  Wire.write(_data);
  Wire.endTransmission();
}
//-------------------------------------------
byte expanderRead() {
  byte _data;
  Wire.requestFrom(PCF8574_Addr, 1);
  if (Wire.available()) {
    _data = Wire.read();
  }
  return _data;
}
//-------------------------------------------
void RelayUpdate(int idRelay, int stsRelay) {
  byte stsRelayTemp;
  Serial.print("Relay_");
  Serial.print(idRelay);
  if (stsRelay == 1) {
    stsRelayTemp = ~(1 << idRelay);
    statusRelay &= stsRelayTemp;
    Serial.println("Force: On");
  }
  else {
    stsRelayTemp = 1 << idRelay;
    statusRelay |= stsRelayTemp;
    Serial.println("Force: Off");
  }
  expanderWrite(statusRelay);
}
//-------------------------------------------
BLYNK_WRITE (V0) {
  int pinValue = param.asInt();
  RelayUpdate(0, pinValue);
  digitalWrite(testLED, pinValue);
}
//-------------------------------------------
void loopReadInput()
{ byte stsRead = expanderRead();
  if ((stsRead >> 4) &1){
    Input4.off();   Serial.println("Input V4: off");
  } else {
    Input4.on();   Serial.println("Input V4: on");
  }
}
//===========================================
void setup() {
  Serial.begin(115200);
  pinMode(testLED, OUTPUT);
  Blynk.begin(auth, ssid, pass);
  Wire.begin(I2C_SDA_Pin, I2C_SCL_Pin);
  timer.setInterval(1000L, loopReadInput);
}

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

11. การอ่านค่าจาก Input Connector



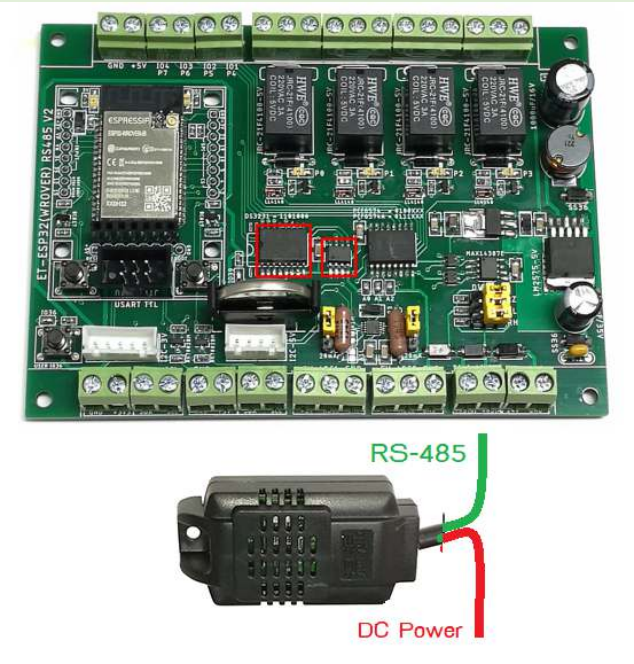
Test 3/7. Remote monitor and control Modbus RTU device via Blynk

12. ให้แน่ใจว่าติดตั้ง ModbusMaster V 2.0.1 ของ Doc Walker



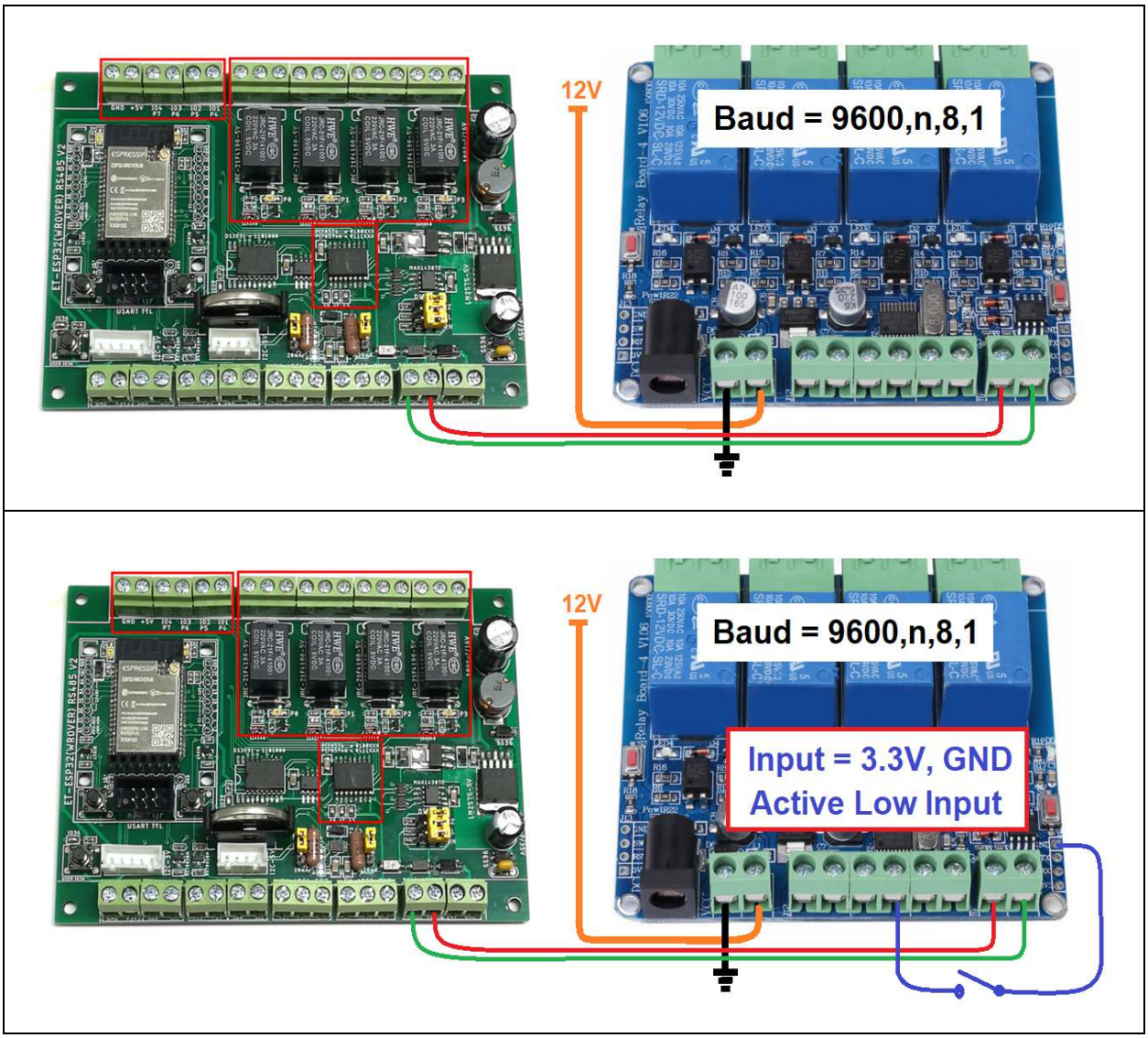
13. ทดสอบอ่าน **MODBUS RTU SENSOR H/T**

```
// ET-ESP32(WROVER).RS485.V2
// Read MODBUS RTU SENSOR H/T

#include <ModbusMaster.h>
#define Rx2_Pin  26
#define Tx2_Pin  27

#define ModbusID  1
#define StartAdd  0
#define nWordRead 2

ModbusMaster node;

void setup() {
 Serial.begin(115200);
 Serial2.begin(9600, SERIAL_8N1, Rx2_Pin, Tx2_Pin);
 node.begin(ModbusID, Serial2);
}

void loop() {
 uint16_t data[6];
 int result = node.readHoldingRegisters(StartAdd, nWordRead);
 if (result == node.ku8MBSuccess) {
  for (int j = 0; j < nWordRead; j++)
   data[j] = node.getResponseBuffer(j);
  float Tempp =  data[0] / 10.0;
  float Humid =  data[1] / 10.0;
  Serial.println();
  Serial.println("Tempp = " + String(Tempp, 1) + "'C");
  Serial.println("Humid = " + String(Humid, 1) + "%");
 }
 delay(10000);
}
```




```
Tempp = 28.9'C
Humid = 58.9%

Tempp = 28.9'C
Humid = 58.6%
```

14. วงจรทดสอบการควบคุม และวงจรการอ่านค่า กับ Modbus Device “MODBUS RTU RELAY4/IN4”



15. ทดสอบการควบคุม Modbus Device แบบ Direct Code ไม่ใช้ Library และแบบใช้ Modbus Master Lib.

```
// ET-ESP32(WROVER).RS485.V2
// Control MODBUS RTU RELAY4/IN4

#include <ModbusMaster.h>
#define Rx2_Pin   26
#define Tx2_Pin   27

#define HTSensor_ID 1
#define R4I4Brd_ID  5
#define HTStartAdd  0
#define HTnWordRead 2

ModbusMaster nodeHT;
ModbusMaster nodeR4I4;

float Tempp, Humid;
int state = 1;

void Read_HT_Sensor() {
 uint16_t data[6];
 int result = nodeHT.readHoldingRegisters(HTStartAdd, HTnWordRead);
 if (result == nodeHT.ku8MBSuccess) {
  for (int j = 0; j < HTnWordRead; j++)
    data[j] = nodeHT.getResponseBuffer(j);
  Tempp =  data[0] / 10.0;
  Humid =  data[1] / 10.0;
 }
}


void setup() {
 Serial.begin(115200);
 Serial2.begin(9600, SERIAL_8N1, Rx2_Pin, Tx2_Pin);
 nodeHT.begin(HTSensor_ID, Serial2);
 nodeR4I4.begin(R4I4Brd_ID, Serial2);
}


void loop() {
 Read_HT_Sensor();
 Serial.println();
 Serial.println("Tempp = " + String(Tempp, 1) + "'C");
 Serial.println("Humid = " + String(Humid, 1) + "%");
 for (int i = 0; i <= 3; i++) {
  nodeR4I4.writeSingleCoil(i, state);
  Serial.println("Addr-" + (String)(i) + " >> " + (String)(state));
  delay(2000);
 }
 state = 1 - state;
}
```

```
Tempp = 28.7'C
Humid = 56.8%
Addr-0 >> 1
Addr-1 >> 1
Addr-2 >> 1
Addr-3 >> 1

Tempp = 28.7'C
Humid = 56.9%
Addr-0 >> 0
Addr-1 >> 0
```

16. วงจรทดสอบ การควบคุมและวงจรการอ่านค่า กับ Modbus Device

```
// ET-ESP32(WROVER).RS485.V2
// Control MODBUS RTU RELAY4/IN4

#include <ModbusMaster.h>
#define Rx2_Pin   26
#define Tx2_Pin   27

#define HTSensor_ID 1
#define R4I4Brd_ID  5
#define HTStartAdd  0
#define HTnWordRead 2

ModbusMaster nodeHT;
ModbusMaster nodeR4I4;

float Tempp, Humid;
int DataIn4, coilState = 1, IO_State = 1;

void Read_HT_Sensor() {
  uint16_t data[6];
  int result = nodeHT.readHoldingRegisters(HTStartAdd, HTnWordRead);
  if (result == nodeHT.ku8MBSuccess) {
    for (int j = 0; j < HTnWordRead; j++)
      data[j] = nodeHT.getResponseBuffer(j);
    Tempp =  data[0] / 10.0;
    Humid =  data[1] / 10.0;
  }
}

void Read_R4I4_Board() {
  int result;
  uint16_t data[6];
  // Toggle the coil at address (Manual Load Control)
  result = nodeR4I4.writeSingleCoil(R4I4Brd_ID, coilState);
  coilState = 1 - coilState;
  result = nodeR4I4.readDiscreteInputs(0, 4); // Start=0, nByte=4
  if (result == nodeR4I4.ku8MBSuccess)
    DataIn4 = nodeR4I4.getResponseBuffer(0);
}

void setup() {
  Serial.begin(115200);
  Serial2.begin(9600, SERIAL_8N1, Rx2_Pin, Tx2_Pin);
  nodeHT.begin(HTSensor_ID, Serial2);
  nodeR4I4.begin(R4I4Brd_ID, Serial2);
}

void loop() {
  Serial.println();

  Read_HT_Sensor();
  Serial.println("Tempp = " + String(Tempp, 1) + "'C");
  Serial.println("Humid = " + String(Humid, 1) + "%");

  Read_R4I4_Board();
  Serial.print("DataInput = ");
  Serial.print(DataIn4 >> 3 & 1);  Serial.print(DataIn4 >> 2 & 1);
  Serial.print(DataIn4 >> 1 & 1);  Serial.print(DataIn4 >> 0 & 1);

  for (int i = 0; i <= 3; i++) {
    nodeR4I4.writeSingleCoil(i, IO_State);
    Serial.print("\n Addr-" + (String)(i) + " >> " + (String)(IO_State));
    delay(2000);
  }
  IO_State = 1 - IO_State;
}
```

```
Tempp = 28.7'C
Humid = 57.0%
DataInput = 1100
 Addr-0 >> 0
 Addr-1 >> 0
 Addr-2 >> 0
 Addr-3 >> 0
Tempp = 28.7'C
Humid = 57.1%
DataInput = 1100
 Addr-0 >> 1
```

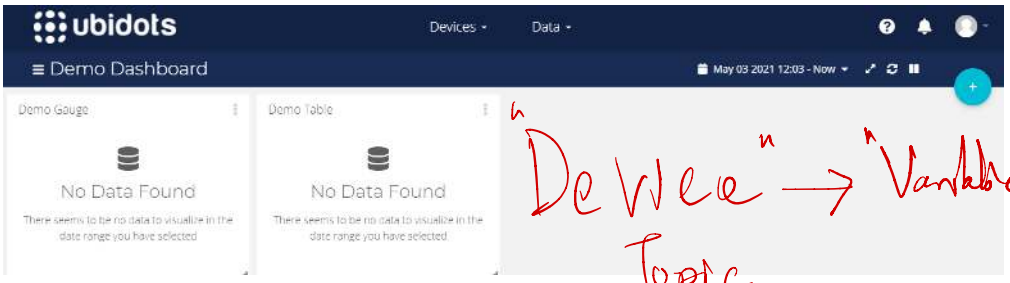
การโปรแกรมใช้งาน Ubidots เพื่อตรวจสอบ/สั่งงาน อุปกรณ์ Modbus

Test 5/6. Remote Control and Monitor via Ubidots IoTs Platform

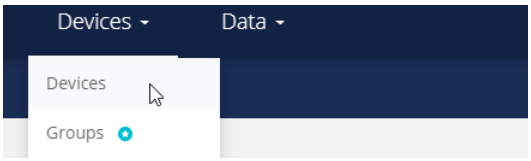
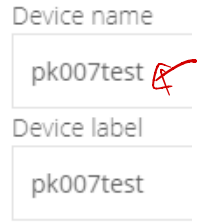
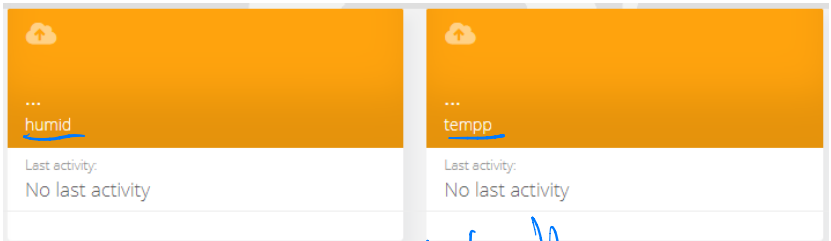
1. Ubidots -- https://ubidots.com/

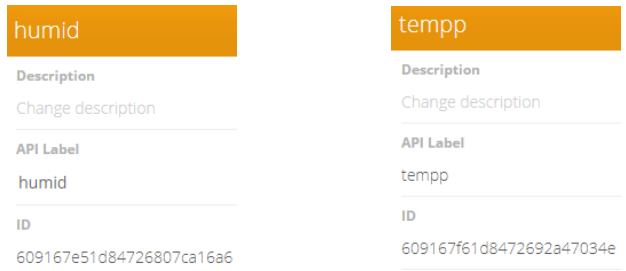
IoT platform →

2. Signed Up (or Signed In) -- https://industrial.ubidots.com/accounts/signin/



3. Create Device and Variable

	Device -→ Device
	Create Device Blank Device Device Name = pk007test Device Label = pk007test <all lowercase alphabet>
	Click pk007test Device Add Variable → raw humid tempp <all lowercase alphabet>



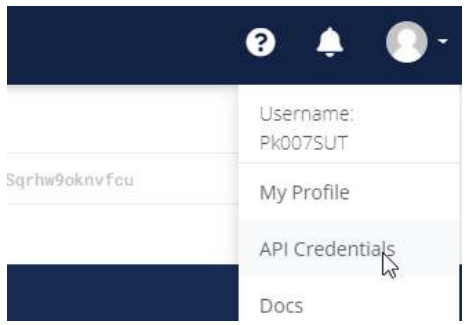
Click …

Set API Label = humid

Set API Label = tempp

<all lowercase alphabet>

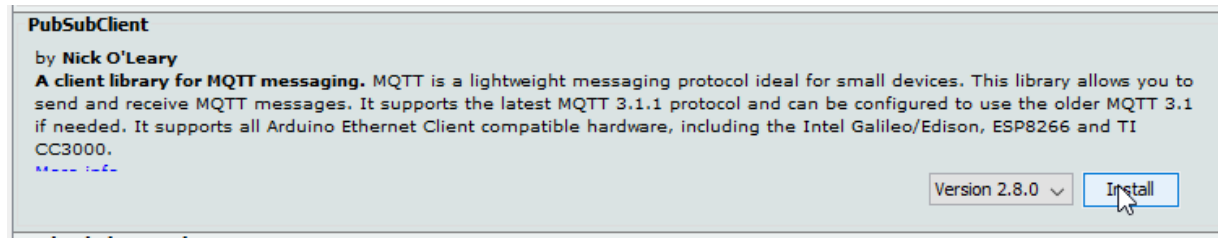
4. Get Tokens Key



API Credentials

Get Tokens Key

5. ตรวจสอบว่าติดตั้ง PubSubClient by Nick O'Leary – V2.8.0

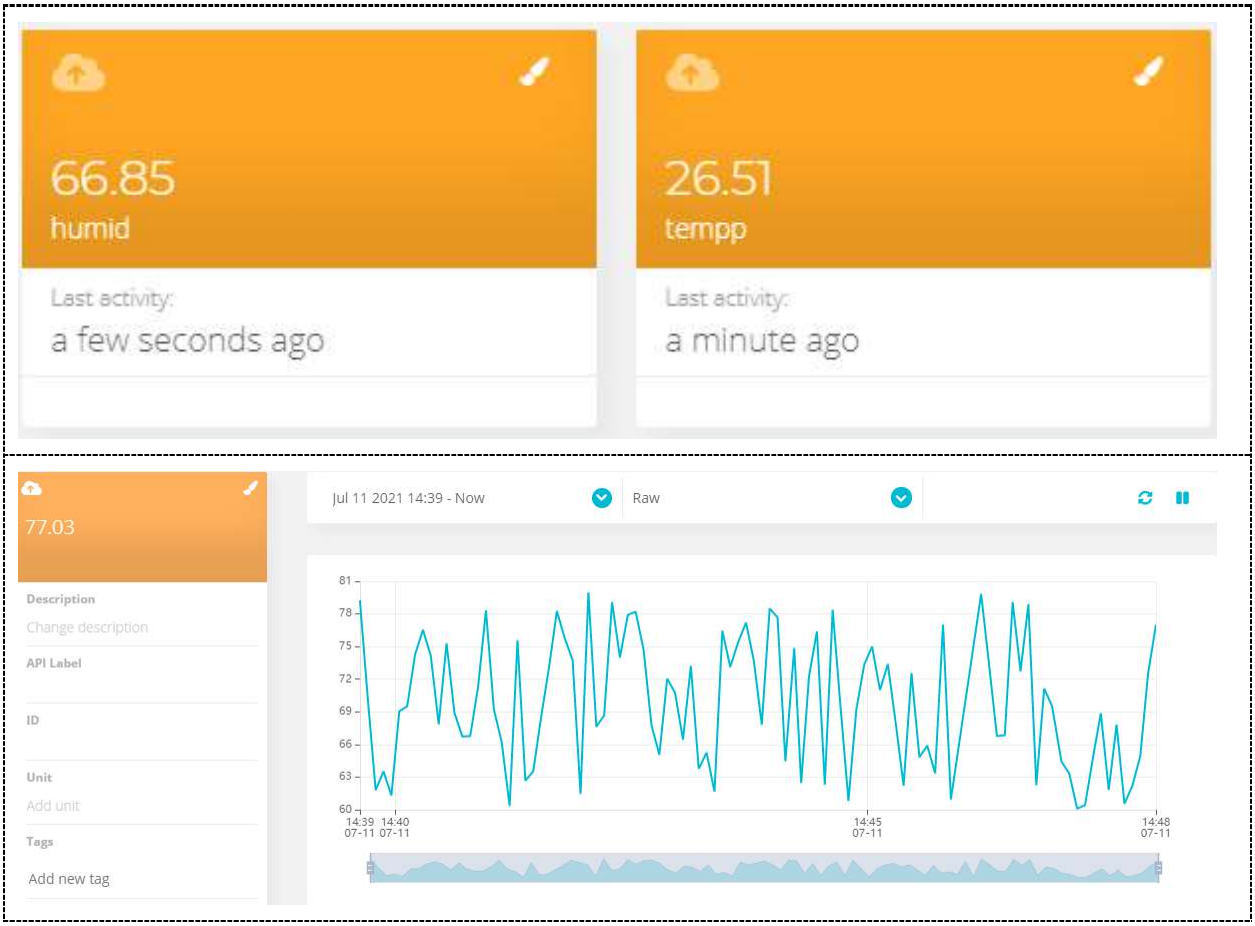


6. Coding Send Random Data to Ubidots

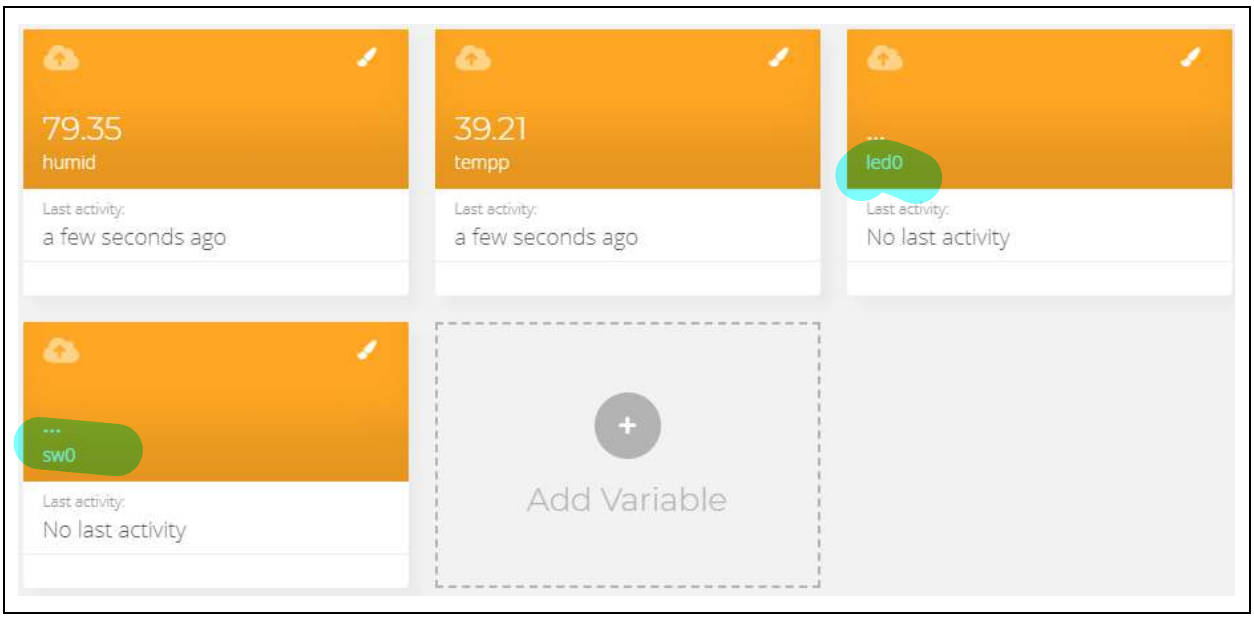
```
#include <WiFi.h>
#include <PubSubClient.h>

const char  *My_SSID = "Test1234";
const char  *My_Pass = "0816601929";
const char  *MQTT_Server = "things.ubidots.com";
const char  *MQTT_User = "BBFF-YgcQcuqoAiO9g46ehWh12TxVwyTjCx";
const char  *MQTT_Pass = "BBFF-YgcQcuqoAiO9g46ehWh12TxVwyTjCx";
const char  *PTopic1 = "/v2.0/devices/pk007test";
const char  *STopic1 = "/v2.0/devices/pk007test/humid";
const char  *STopic2 = "/v2.0/devices/pk007test/tempp";

#define MQTT_Port 1883

WiFiClient espClient;
PubSubClient client(espClient);
long lastMsg = 0;
char msg[50];

void Setup_Wifi() {
```

```
  delay(10);   Serial.println();
  Serial.print("Connecting to ");
  Serial.println(My_SSID);
  WiFi.begin(My_SSID, My_Pass);
  while (WiFi.status() != WL_CONNECTED) {
   delay(500);   Serial.print(".");
  }
  randomSeed(micros());
  Serial.println("");   Serial.println("WiFi connected");
  Serial.println("IP address: "); Serial.println(WiFi.localIP());
 }

 void reconnect()
 { while (!client.connected())                // Loop until we're reconnected
  { Serial.print("Attempting MQTT connection...");
    String clientId = "ESP32 Client-";
    clientId += String(random(0xffff), HEX);       // Create a random client ID
    if (client.connect(clientId.c_str(), MQTT_User, MQTT_Pass)) // Attempt to connect
    { Serial.println("connected");              // Once connected, publish an announcement...
      client.subscribe(STopic1);
      client.subscribe(STopic2);
    } else
    { Serial.print("failed, rc=");
      Serial.print(client.state());
      Serial.println(" try again in 5 seconds");
      delay(5000);
    }
  }
 }

 void callback(char* topic, byte* payload, unsigned int length)
 { Serial.print("Message arrived [");
  Serial.print(topic);
  Serial.print("] ");
  for (int i = 0; i < length; i++)
  { Serial.print((char)payload[i]);
  }
  Serial.println();
 }

 void setup()
 { Serial.begin(115200);
  Setup_Wifi();
  client.setServer(MQTT_Server, MQTT_Port);
  client.setCallback(callback);
 }

 void loop()
 { if (!client.connected())  reconnect();
  client.loop();
  long now = millis();
  if (now - lastMsg > 5000)
  { lastMsg = now;
    float xTempp = random(2000, 4000) / 100.0;
    float xHumid = random(6000, 8000) / 100.0;
    snprintf (msg, 75, "{ \"humid\" : %5.2f, \"tempp\": %5.2f}", xHumid, xTempp);
    Serial.print("Publish message: ");
    Serial.println(msg);
    client.publish(PTopic1, msg);
  }
 }
```

```
Connecting to Test1234
.....
WiFi connected
IP address:
192.168.1.22
Attempting MQTT connection...connected
Message arrived [/v2.0/devices/pk007test/humid] {"value": 69.53, "timestamp": 1625989
Message arrived [/v2.0/devices/pk007test/tempp] {"value": 32.73, "timestamp": 1625989
Publish message: { "humid" : 64.44, "tempp": 30.80}
Message arrived [/v2.0/devices/pk007test/humid] {"value": 64.44, "timestamp": 1625989
Message arrived [/v2.0/devices/pk007test/tempp] {"value": 30.8, "timestamp": 16259896
Publish message: { "humid" : 63.31, "tempp": 34.42}
```



7. Update Code for monitor and control via Ubidots
8. Add 2 Variable → ledo and swo {ตัวเล็กเท่านั้น}

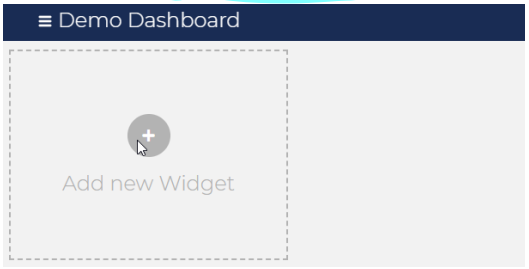
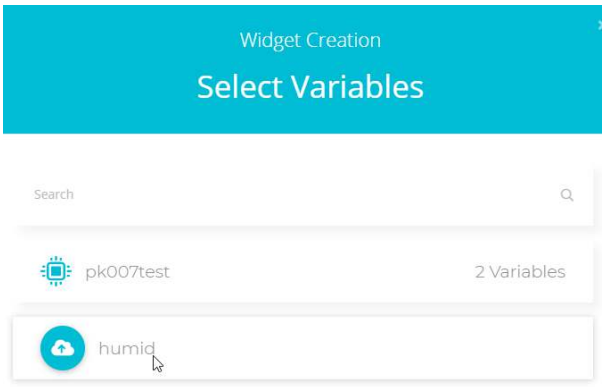


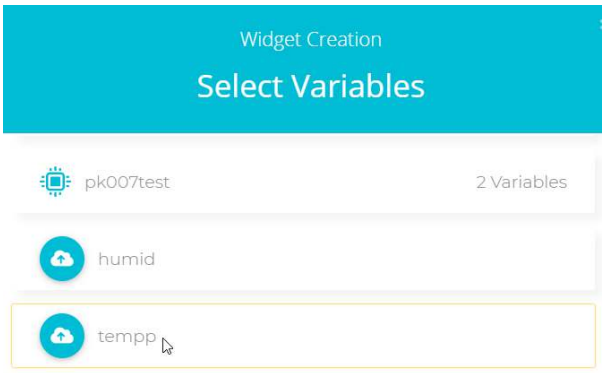
```
Message arrived [/v2.0/devices/pk007test/tempp] {"value": 32.01, "timestamp": 16259904134(
Message arrived [/v2.0/devices/pk007test/sw0] {"value": 1.0, "timestamp": 1625990413404, '
Publish message: { "humid" : 72.10, "tempp": 24.22, "sw0": 0}
Message arrived [/v2.0/devices/pk007test/sw0] {"value": 0.0, "timestamp": 1625990418408, '
Message arrived [/v2.0/devices/pk007test/tempp] {"value": 24.22, "timestamp": 16259904184(
Message arrived [/v2.0/devices/pk007test/humid] {"value": 72.1, "timestamp": 1625990418408
Publish message: { "humid" : 74.82, "tempp": 31.04, "sw0": 1}
Message arrived [/v2.0/devices/pk007test/sw0] {"value": 1.0, "timestamp": 1625990423400, '
Message arrived [/v2.0/devices/pk007test/humid] {"value": 74.82, "timestamp": 16259904234(
Message arrived [/v2.0/devices/pk007test/tempp] {"value": 31.04, "timestamp": 16259904234(
```

```
#include <WiFi.h>
#include <PubSubClient.h>

const char  *My_SSID = "Test1234";
const char  *My_Pass = "0816601929";
const char  *MQTT_Server = "things.ubidots.com";
const char  *MQTT_User = "BBFF-YgcQcuqoAiO9g46ehWh12TxVwyTjCx";
const char  *MQTT_Pass = "BBFF-YgcQcuqoAiO9g46ehWh12TxVwyTjCx";
const char  *PTopic1 = "/v2.0/devices/pk007test";
const char  *STopic1 = "/v2.0/devices/pk007test/humid";
const char  *STopic2 = "/v2.0/devices/pk007test/tempp";
const char  *STopic3 = "/v2.0/devices/pk007test/led0";
const char  *STopic4 = "/v2.0/devices/pk007test/sw0";

#define MQTT_Port 1883

#define Test_LED0 2
#define Test_SW00 0

WiFiClient espClient;
PubSubClient client(espClient);
long lastMsg = 0;
char msg[50];

void Setup_Wifi() {
 delay(10);   Serial.println();
 Serial.print("Connecting to ");
 Serial.println(My_SSID);
 WiFi.begin(My_SSID, My_Pass);
 while (WiFi.status() != WL_CONNECTED) {
  delay(500);  Serial.print(".");
 }
 randomSeed(micros());
 Serial.println("");  Serial.println("WiFi connected");
 Serial.println("IP address: "); Serial.println(WiFi.localIP());
}

void reconnect()
{ while (!client.connected())                // Loop until we're reconnected
  { Serial.print("Attempting MQTT connection...");
   String clientId = "ESP32 Client-";
   clientId += String(random(0xffff), HEX);      // Create a random client ID
   if (client.connect(clientId.c_str(), MQTT_User, MQTT_Pass)) // Attempt to connect
   { Serial.println("connected");              // Once connected, publish an announcement...
    client.subscribe(STopic1);
    client.subscribe(STopic2);
    client.subscribe(STopic3);
    client.subscribe(STopic4);
   } else
   { Serial.print("failed, rc=");
    Serial.print(client.state());
    Serial.println(" try again in 5 seconds");
    delay(5000);
   }
  }
}

void callback(char *topic, byte *payload, unsigned int length)
{ Serial.print("Message arrived [");
 Serial.print(topic);
 Serial.print("] ");
 for (int i = 0; i < length; i++)
 { Serial.print((char)payload[i]);
 }
 if (topic[24] == STopic3[24]) {
  Serial.print(" -LED1->> ");
  Serial.print((char)payload[10]);
  if (payload[10] == '1')
   digitalWrite(Test_LED0, HIGH);
  else
```

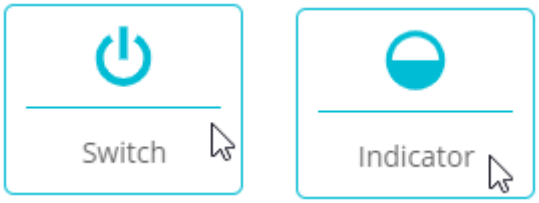
```
    digitalWrite(Test_LED0, LOW);
  }
  Serial.println();
}


void setup()
{ pinMode(Test_LED0,OUTPUT);
  pinMode(Test_SW00,INPUT_PULLUP);
  Serial.begin(115200);
  Setup_Wifi();
  client.setServer(MQTT_Server, MQTT_Port);
  client.setCallback(callback);
}

void loop()
{ if (!client.connected())  reconnect();
  client.loop();
  long now = millis();
  if (now - lastMsg > 5000)
  { lastMsg = now;
    float xTempp = random(2000, 4000) / 100.0;
    float xHumid = random(6000, 8000) / 100.0;
    int stsSW = digitalRead(Test_SW00);
    snprintf (msg, 75, "{ \"humid\" : %5.2f, \"tempp\": %5.2f, \"sw0\": %d}", xHumid, xTempp, stsSW);
    Serial.print("Publish message: ");
    Serial.println(msg);
    client.publish(PTopic1, msg);
  }
}
```

8. Create Dashboard

	Data Dashboard Add New Dashboard Add new Widget
	Line chart
	Add Value → humid

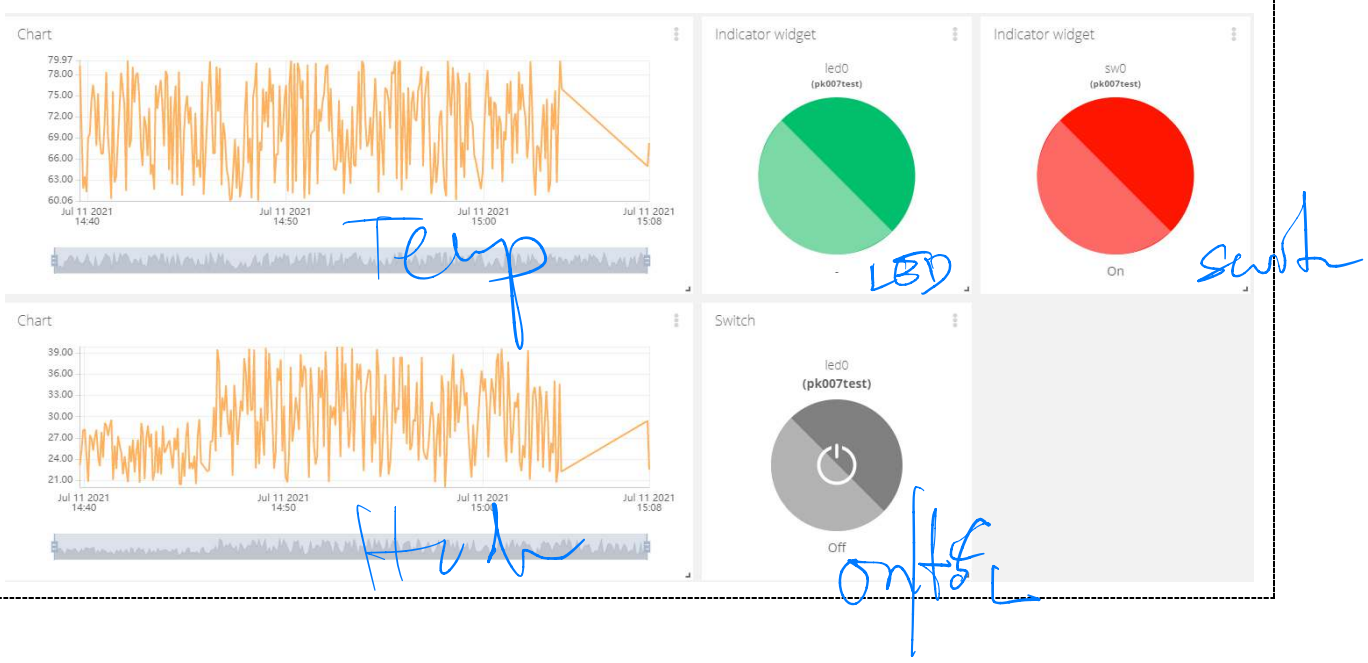


Line chart
Add Value → tempp

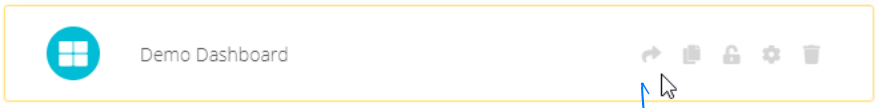


Switch
Add Value → led0

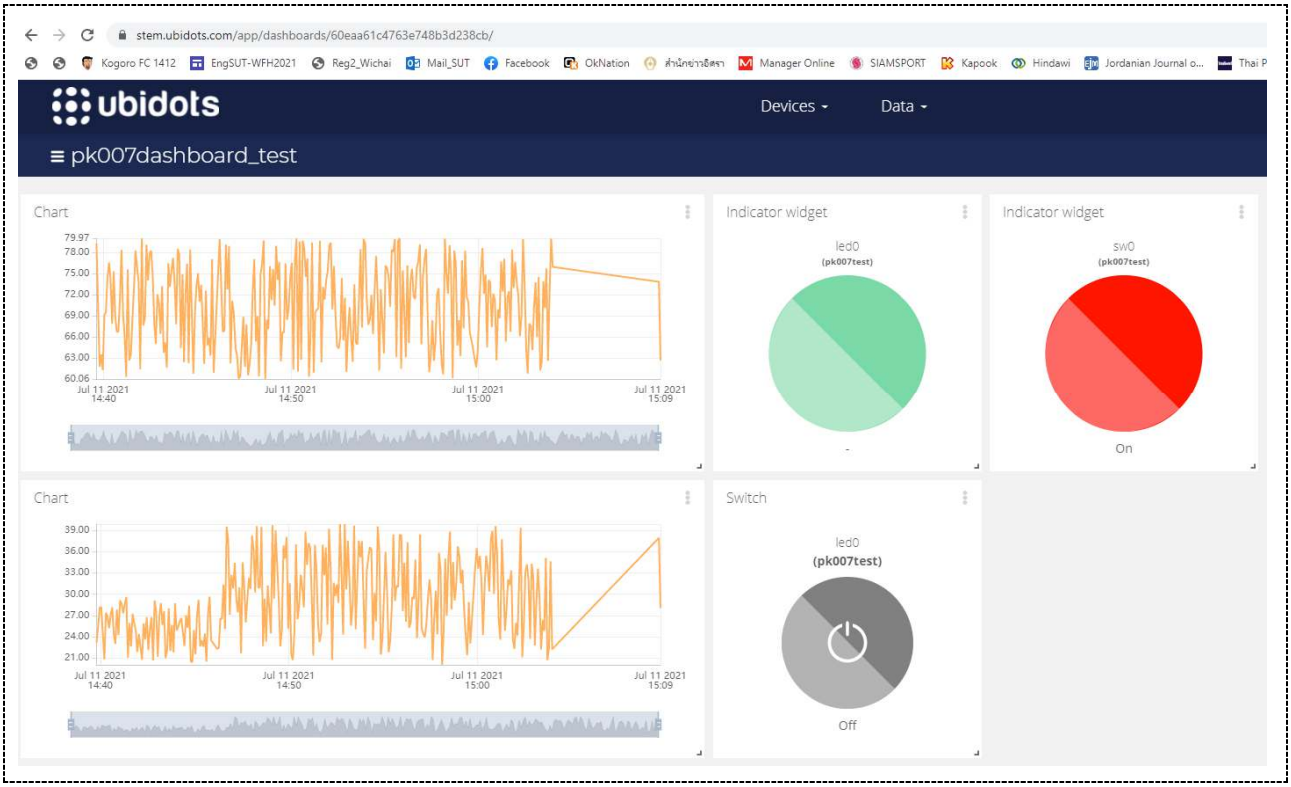
Indicator
Add Value → led0
Add Value → sw0



9. Test Dashboard and Create Share Dashboard Link

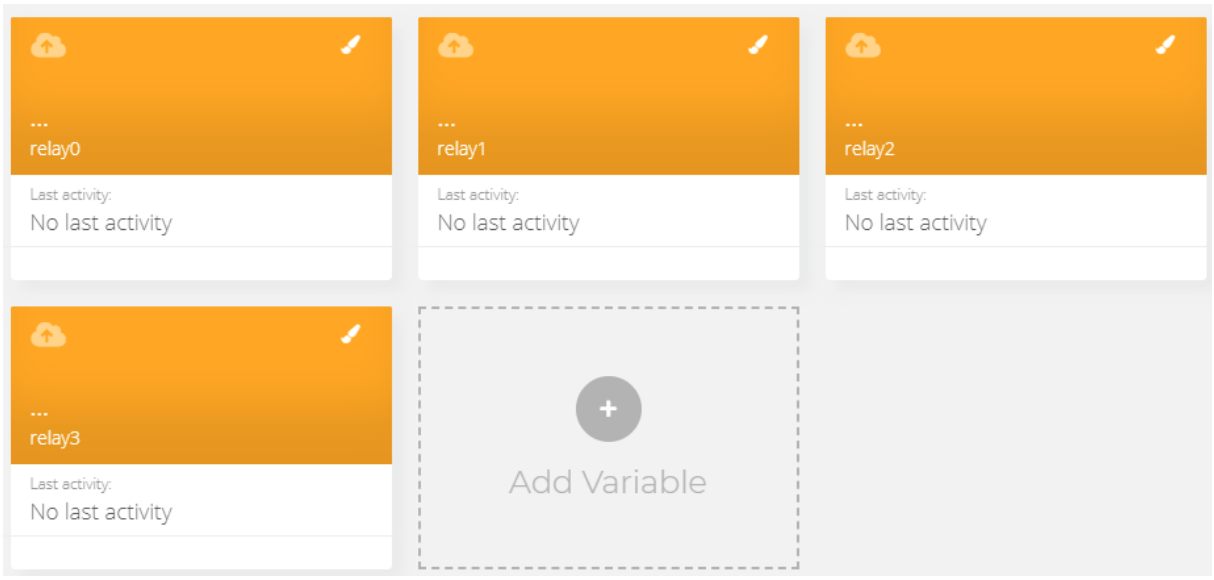
	Click Demo Dashboard
	Click Share Create Link

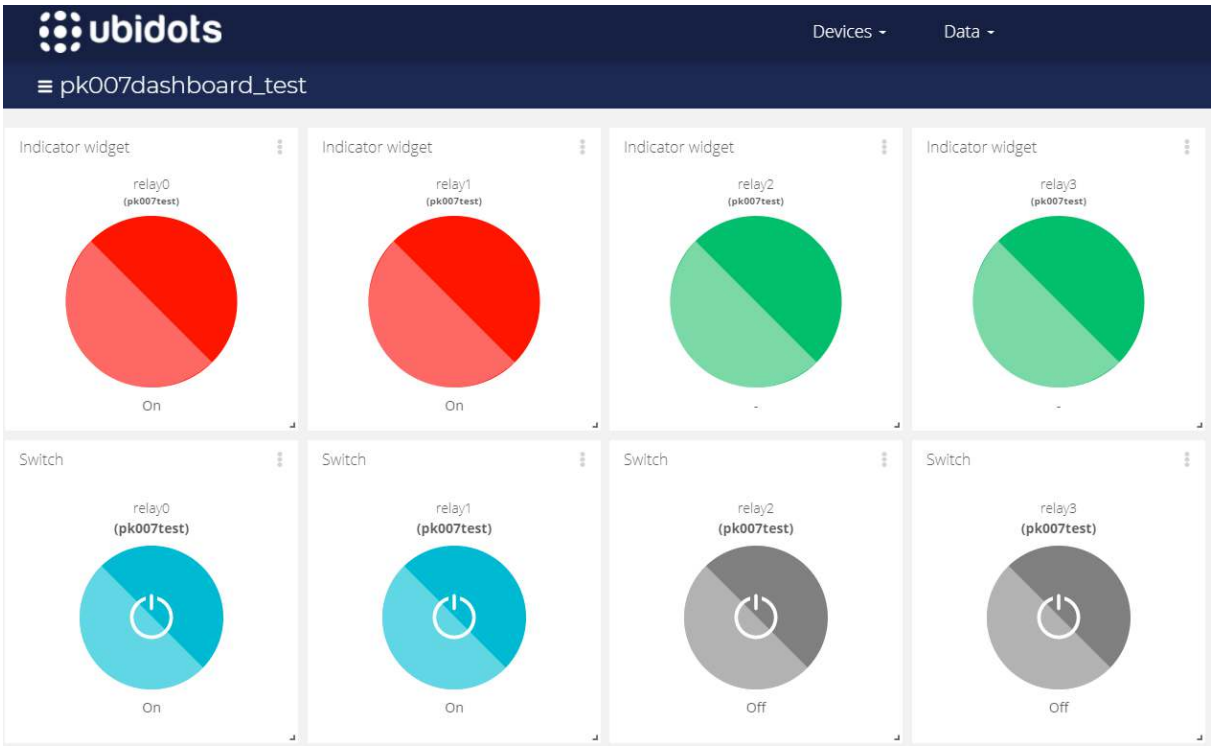
10. Test with Browser



Test 6/6. Remote monitor and control Modbus RTU device via Ubidots

9. Create Device → Variable {relay0, relay1, relay2, relay3}→ dashboard on Ubidots





10. Test This Code for Relay Control

```
#include <WiFi.h>
#include <PubSubClient.h>
#include <ModbusMaster.h>

#define MAX485_Monitor 2
#define MAX485_Ctrl 5 // Pin Ctrl 1=Tx and 0=Rx_NEG
#define MAX485_Rx 16  // Pin RXD2 16
#define MAX485_Tx 17  // Pin TXD2 17
#define Slave_ID 5     // Slave ID
ModbusMaster node;  // instantiate ModbusMaster object

const char  *My_SSID = "Test1234";
const char  *My_Pass = "0816601929";
const char  *MQTT_Server = "things.ubidots.com";
const char  *MQTT_User = "BBFF-YgcQcuqoAiO9g46ehWh12TxVwyTjCx";
const char  *MQTT_Pass = "BBFF-YgcQcuqoAiO9g46ehWh12TxVwyTjCx";
const char  *PTopic1 = "/v2.0/devices/pk007test";
const char  *STopic1 = "/v2.0/devices/pk007test/relay0";
const char  *STopic2 = "/v2.0/devices/pk007test/relay1";
const char  *STopic3 = "/v2.0/devices/pk007test/relay2";
const char  *STopic4 = "/v2.0/devices/pk007test/relay3";
#define MQTT_Port 1883
#define testLED   2
int stsLED = 0;

WiFiClient espClient;
PubSubClient client(espClient);
long lastMsg = 0;
char msg[50];

void Setup_Wifi() {
 delay(10);    Serial.println();
 Serial.print("Connecting to ");
 Serial.println(My_SSID);
 WiFi.begin(My_SSID, My_Pass);
 while (WiFi.status() != WL_CONNECTED) {
  delay(500);   Serial.print(".");
 }
 randomSeed(micros());
 Serial.println("");   Serial.println("WiFi connected");
 Serial.println("IP address: "); Serial.println(WiFi.localIP());
}

void reconnect()
{ while (!client.connected())                  // Loop until we're reconnected
  { Serial.print("Attempting MQTT connection...");
    String clientId = "ESP32 Client-";
    clientId += String(random(0xffff), HEX);       // Create a random client ID
    if (client.connect(clientId.c_str(), MQTT_User, MQTT_Pass)) // Attempt to connect
    { Serial.println("connected");               // Once connected, publish an announcement...
      client.subscribe(STopic1);
      client.subscribe(STopic2);
      client.subscribe(STopic3);
      client.subscribe(STopic4);
    } else
    { Serial.print("failed, rc=");
      Serial.print(client.state());
      Serial.println(" try again in 5 seconds");
      delay(5000);
    }
  }
}

void callback(char *topic, byte *payload, unsigned int length)
{ Serial.print("Message arrived [");
  Serial.print(topic);
  Serial.print("] ");
  for (int i = 0; i < length; i++)
  { Serial.print((char)payload[i]);
  }
  int RlyID  = (int)topic[29] - 0x30;  // '0'
  int RlySts = (int)payload[10] - 0x30; // '0'
  Serial.println("\nRlyID-" + (String)(RlyID) + " >> RlyStatus-" + (String)(RlySts));
  node.writeSingleCoil(RlyID, RlySts);
}

void preTransmission() {
  digitalWrite(MAX485_Monitor, 1);
  digitalWrite(MAX485_Ctrl, 1);
}

void postTransmission() {
  digitalWrite(MAX485_Monitor, 0);
  digitalWrite(MAX485_Ctrl, 0);
}
```

```
void setup()
{ pinMode(testLED, OUTPUT);

 pinMode(MAX485_Monitor, OUTPUT);
 pinMode(MAX485_Ctrl, OUTPUT);
 postTransmission(); // Init in receive mode
 Serial.begin(115200);
 Serial2.begin(9600, SERIAL_8N1, MAX485_Rx, MAX485_Tx);
 node.begin(Slave_ID, Serial2); // Modbus slave ID Setting
 // Callbacks allow us to configure the RS485 transceiver correctly
 node.preTransmission(preTransmission);
 node.postTransmission(postTransmission);

 Setup_Wifi();
 client.setServer(MQTT_Server, MQTT_Port);
 client.setCallback(callback);
}

void loop()
{ if (!client.connected()) reconnect();
 client.loop();
 long now = millis();
 if (now - lastMsg > 5000)
 { lastMsg = now;
  digitalWrite(testLED, stsLED);
  stsLED = 1 - stsLED;
 }
}
```

```
Connecting to Test1234
.....
WiFi connected
IP address:
192.168.1.22
Attempting MQTT connection...connected
Message arrived [/v2.0/devices/pk007test/relay0] {"value": 1.0, "timestamp": 162599406757
RlyID-0 >> RlyStatus-1
Message arrived [/v2.0/devices/pk007test/relay2] {"value": 1.0, "timestamp": 162599407163
RlyID-2 >> RlyStatus-1
Message arrived [/v2.0/devices/pk007test/relay1] {"value": 1.0, "timestamp": 162599406918
RlyID-1 >> RlyStatus-1
Message arrived [/v2.0/devices/pk007test/relay3] {"value": 1.0, "timestamp": 162599407315
RlyID-3 >> RlyStatus-1
```

11. Test Control and Monitor Modbus Device

Test 7/7. Remote monitor and control Modbus RTU/ASCII/TCP device via Ubidots

12. Test Control and Monitor Modbus Device

< ลองปรับโปรแกรมด้วยตัวท่านเอง >

การควบคุมเครื่องจักรอัจฉริยะโดยใช้การสื่อสารระหว่างเครื่องจักรกับเครื่องจักร M2M - Intelligence Machine Control
ชื่อ-สกุล :

4/4: -- คำถามท้ายบทเพื่อทดสอบความเข้าใจ

Quiz_401 – test Blynk

< รูปอุปกรณ์ที่ใช้ทดสอบ ขณะทำการทดสอบ >
< รูปอุปกรณ์ที่ใช้ทดสอบ ขณะทำการทดสอบ >
< รูปหน้าจอ Blynk >
รายยละเอียดการทดสอบ
< โปรแกรมทดสอบ >
< ผลการทดสอบ >

Quiz_402 – test Ubidot with ESP32

< รูปอุปกรณ์ที่ใช้ทดสอบ ขณะทำการทดสอบ >
< รูปอุปกรณ์ที่ใช้ทดสอบ ขณะทำการทดสอบ >
< รูปหน้าจอ Ubidots >
รายยละเอียดการทดสอบ
< โปรแกรมทดสอบ >
< ผลการทดสอบ >

Quiz_403 – Modbus RTU/ASCII/TCP with Ubidots IoTs Platform

< รูปอุปกรณ์ที่ใช้ทดสอบ ขณะทำการทดสอบ >
< รูปอุปกรณ์ที่ใช้ทดสอบ ขณะทำการทดสอบ >
< รูปหน้าจอ Ubidots >
รายยละเอียดการทดสอบ
< โปรแกรมทดสอบ >
< ผลการทดสอบ >

Quiz_404 – Application

< อธิบายแนวคิด การนำไปใช้เกี่ยวกับงานที่รับผิดชอบ >