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古都土城仔綠電創能與智動養殖
之跨界整合永續淨零發展計畫

土壤溼度感測器

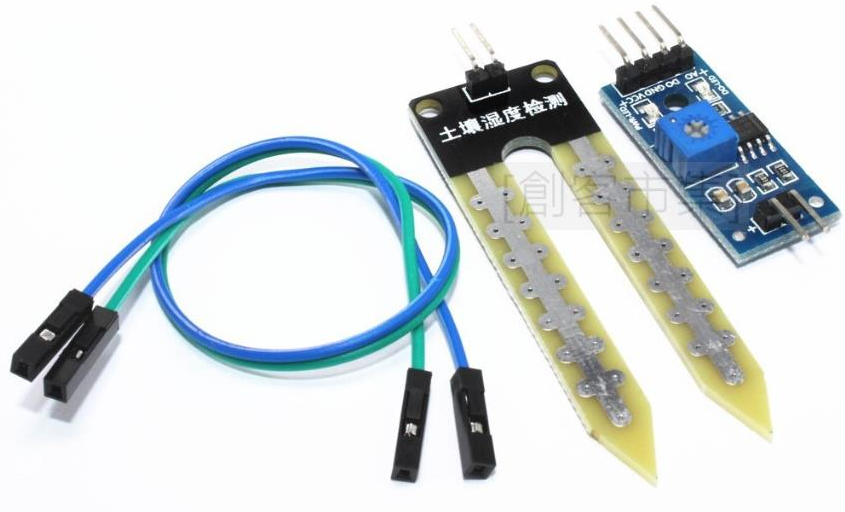
NB-IoT與MQTT連線

目錄

材料

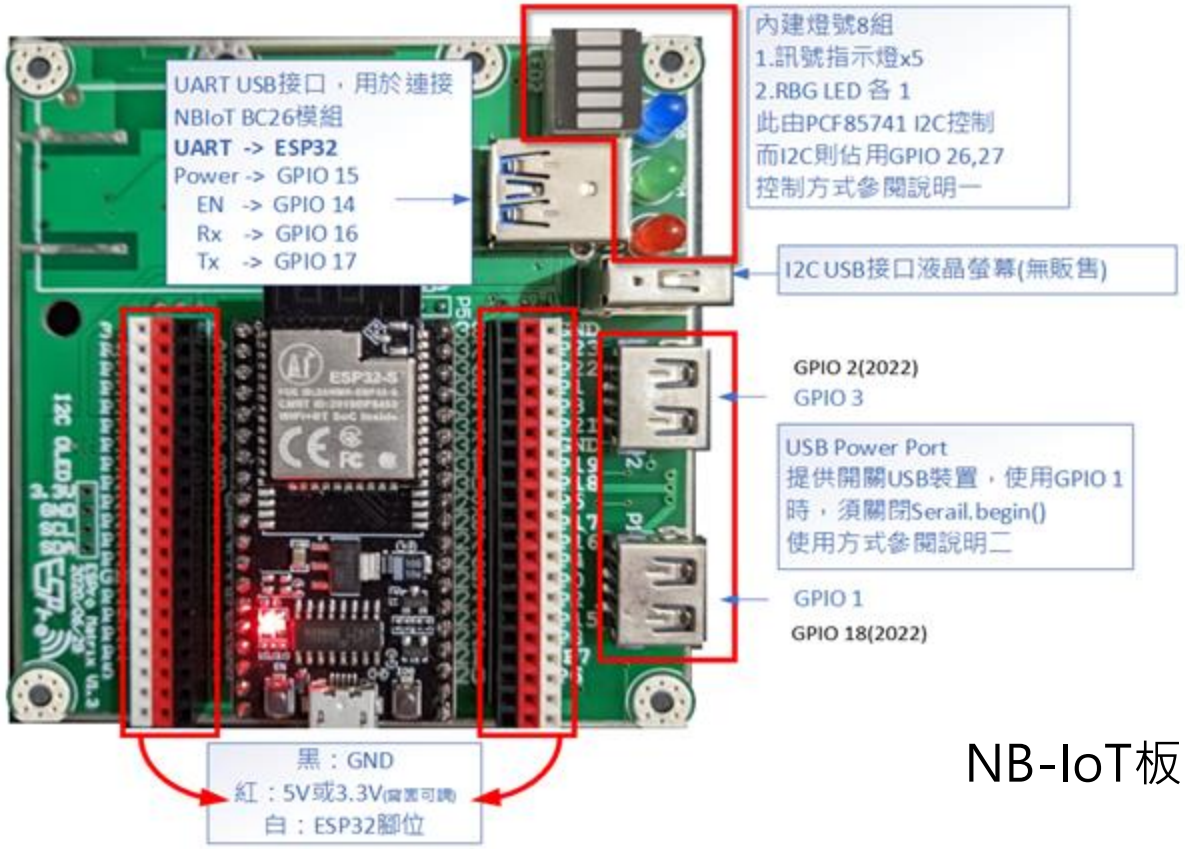
ESP32

數據傳輸線 (MicroUSB)



土壤溼度感測器模組

材料



NB-IoT板

注意事項:

移除更換sim卡，請務必關閉電源，否則會短路冒煙損毀

模組腳位說明

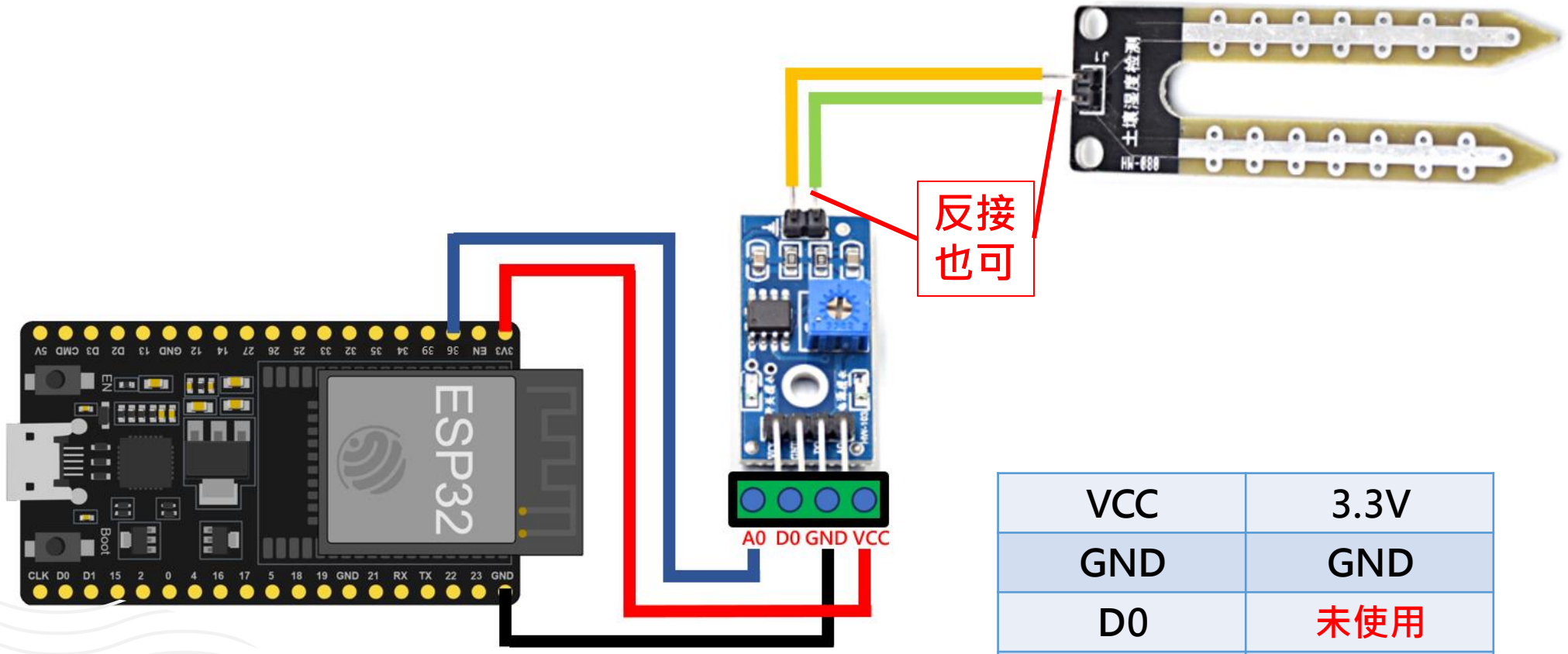
+	對接傳感器
-	對接傳感器

傳感器無正負極之分，與傳感器
對接時可不必注意正負極！

靈敏度調整鈕，用於調整D0開關訊號的靈敏度

VCC	3.3V~5V(+)
GND	GND(-)
D0	開關訊號腳位
A0	模擬訊號腳位

接線說明



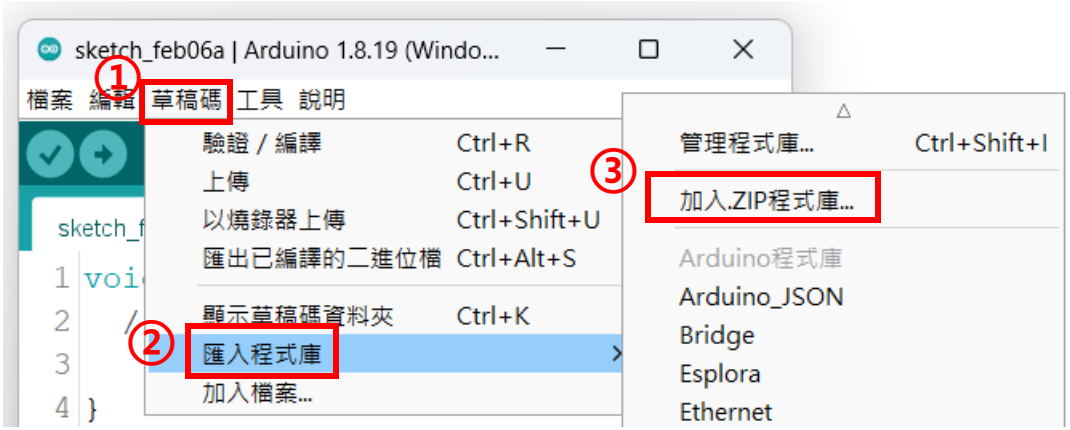
VCC	3.3V
GND	GND
D0	未使用
A0	GPIO36

匯入程式庫

➢ 先下載MatrixInt程式庫

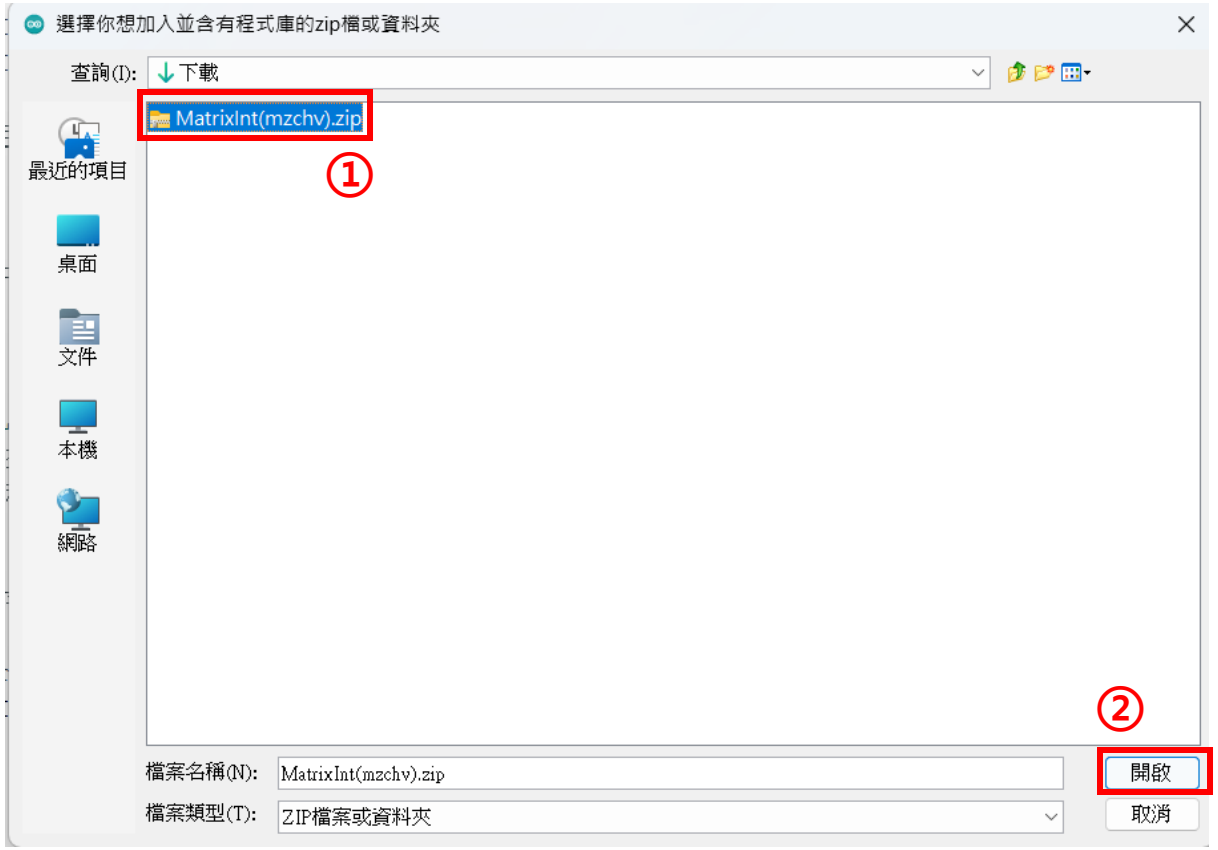
下載連結：[MatrixInt(mzchv).zip - Google 雲端硬碟]

➢ 下載後進行安裝，到Arduino IDE的草稿碼/匯入程式庫/加入ZIP程式庫



匯入程式庫

➢ 找到剛剛下載的檔案，選擇開啟，即完成安裝步驟



程式撰寫步驟(1/10)

➢ 開啟記事本
「範例程式 土壤濕度感測器 NB-IoT.txt 」

➢ 複製內容並貼上Arduino IDE視窗中

程式撰寫步驟(2/10)

```
#include <WiFi.h>
#include <Wire.h>
#include "MatrixInt.h" //請先安裝

long WNB303Timeout = 10000; //返回0=Timeout
int soil_sensor = 36; //土壤濕度感測器AO信號腳 連接到ESP32 GPIO36
//使用小霸王Matrix板
int WNB303ResetPIN = 14;     //  設定 WNB303 重置腳位為輸出腳位
int WNB303PowerPIN = 15;     //  設定 WNB303 電源控制腳位為輸出腳位
```

程式撰寫步驟(3/10)

➢ 更改MQTTPubTopic，避免與他人重複

```
// ------ 以下修改成你MQTT設定 ------
String MQTTServer = "mqttgo.io";//免註冊MQTT伺服器
String MQTTPort = "1883";//MQTT Port
String MQTTUser = "";//不須帳密
String MQTTPassword = " " ;//不須帳密更改路徑，例如：TEST/class402/SoilWater
String MQTTPubTopic = "YourTopic/class402/SoilWater";//推播主題:推播土壤濕度
long MQTTLastPublishTime = 0;//此變數用來記錄推播時間
long MQTTPublishInterval = 5000;//每5秒推撥一次
```

程式撰寫步驟(4/10)

```
void setup() {
 Serial.begin(115200);      // 設定序列埠監控視窗的鮑率
 Serial2.begin(115200);     // 設定 WNB303 的鮑率
 Wire.begin(26, 27);        // Matrix I2C
 for (int i = 0; i <= 7; ++i) MatrixInt(i, 0);//關閉所有燈號
 pinMode(soil_sensor,INPUT); //定義土壤濕度感測器接口為輸入接口。
 pinMode(WNB303ResetPIN, OUTPUT);       // 設定 WNB303 電源控制腳位為輸出腳位
 pinMode(WNB303PowerPIN, OUTPUT);       // 設定 WNB303 重置腳位為輸出腳位
 delay(1000);

 Serial.println("\r\n\r\n====================\r\nSystem Starting....");
 String result = "";
 // 開啟 Modem 的電源，開啟關閉之間須間隔10秒(延時電路)
 WNB303Restart(10);
 //檢查網路註冊狀態，5分鐘內無法註冊，則重新啟動WNB303
 int tryCount = 0;
 while (1) {
  boolean resultb = WNB303CheckReg();
  Serial.print("WNB303CheckNetReg result="); Serial.println(resultb);
  if (resultb == false) {
   Serial.println("時間內無法註冊網路(" + String(tryCount) + ")");
   delay(10000);
  }
  else break;
  if (tryCount++ >= 30) { //無法註冊已經超過5分鐘
   tryCount = 0;
   WNB303Restart(30);
  }
 }
 //檢查網路訊號品質
 result = WNB303CheckRSSI();
 Serial.print("WNB303CheckRSSI result="); Serial.println(result);
 delay(10000);
}
```

程式撰寫步驟(5/10)

```
void loop() {

 //檢查時間，傳輸步驟：檢查網路、讀取距離、MQTT連線、推播、關閉
 if ((millis() - MQTTLastPublishTime) >= MQTTPublishInterval ) {
  MatrixInt(7, 1);
  //沒有網路，則重新啟動WNB303
  String result = "";
  //檢查網路狀態
  if (!(WNB303CheckReg())) {
    WNB303Restart(60); //60秒後重新檢測網路
    return;
  }else result = WNB303CheckRSSI();

  //連線mqtt
  result = mqttConnect(MQTTServer, MQTTPort, MQTTUser, MQTTPassword);
  if (result == "OK") Serial.println("MQTT Connected");
```

程式撰寫步驟(6/10)

```
int val= analogRead(soil_sensor); //土壤濕度值給val
 Serial.print(val);//序列埠視窗顯示val值
 Serial.println(" val");
    String payload = String((int)val);//推播val值
   //推播訊息
   result = mqttPublish(MQTTPubTopic, "0", "0", "0", payload);
   if (result == "OK") Serial.println("Data:\"" + payload + "\" Published to " + MQTTPubTopic);
   //關閉mqtt
   result = mqttDisconnect();
   if (result == "OK") Serial.println("MQTT Disconnected");
   MQTTLastPublishTime = millis(); //更新最後傳輸時間
   MatrixInt(7, 0);
  }
 delay(1000);
}
```

程式撰寫步驟(7/10)

```
//連線mqtt
String mqttConnect(String Host, String Port, String MQTTUser, String MQTTPassword) {
 //1.取得IP
 String result = "" ;
 String IP = AT2WNB303("AT+EDNS=\"" + Host + "\"", "+EDNS:");
 IP.trim(); IP = split( IP, ':', 1);
 if (IP.length() <= 7) return "Error: Can't Get IP";
 //2.建立連線
 result = AT2WNB303("AT+EMQNEW=\"" + IP + "\",\"" + Port + "\"" + "," + 60000  + "," + 1024, "+EMQNEW:");
 String mqttid = split( result, ':', 1);
 //Serial.print("MQTTCreate result="); Serial.println(mqttid);
 //以亂數為ClientID
 String  MQTTClientid = "NBIoT-" + String(random(1000000, 9999999));
 result = AT2WNB303("AT+EMQCON=" + mqttid + ",3,\"" + MQTTClientid + "\"" + "," + 60000  + ",0,0,\"" +
MQTTUser + "\",\"" + MQTTPassword + "\"", "OK");
 //Serial.print("MQTTConnect result="); Serial.println(result);
 return result;
}

//推播訊息
String mqttPublish(String Topic, String QoS, String retained, String dup , String Payload) {
 String result = "" ;
 String hexPayload = Str2Hex(Payload);
 String lenHexPayload = String(hexPayload.length());
 result = AT2WNB303("AT+EMQPUB=0," + Topic + "," + QoS + "," + retained + "," + dup + "," + lenHexPayload + ","
+ hexPayload, "OK");
 return result;
}
```

```
//關閉mqtt連線
String mqttDisconnect() {
 String result = "" ;
 result = AT2WNB303("AT+EMQDISCON=0", "OK");
 return result;
}

//檢查網路註冊狀態 return true or false
boolean WNB303CheckReg() {
 String result = "";
 boolean CEREG = false;
 result = AT2WNB303("AT+CEREG?", "+CEREG:");
 if (result.indexOf("0,1") >= 0 || result.indexOf("1,1") >= 0) { //註冊成功
  MatrixInt(5, 0);//亮紅燈
  MatrixInt(6, 1);//亮綠燈
  CEREG = true;
 }
 else {
  MatrixInt(5, 1);//亮紅燈
  MatrixInt(6, 0);//亮綠燈
  CEREG = false;
 }
 return CEREG;
}
```

程式撰寫步驟(8/10)

```
//檢查網路訊號品質 return RSSI，當RSSI=0或99代表沒訊號
int WNB303CheckRSSI() {
 String result = "";
 int RSSI = 0;
 result = AT2WNB303("AT+CESQ", "+CESQ:");
 //處理+CESQ:
 if (!(result == "-1")) {
  int CESQ = split(split(result, ':', 1), ',', 0).toInt();
  RSSI = CESQ - 111;
 }
 if (RSSI == -111 || RSSI == 210) RSSI = 0;
 MatrixLEDrssi(RSSI);
 return RSSI;
}

//重新啟動WNB303(單位為秒)
void WNB303Restart(int dalayTime) {
 AT2WNB303("POWEROFF", "");
 delay(5000);
 AT2WNB303("POWERON", "");
 delay(dalayTime * 1000) ;
}
```

```
//HTTP GET
String HTTPGET(String Protocol, String Host, String port, String Url) {
 //例如 http://x.x.x.x/update?api_key=xxxxx&field1=60
 //拆解成Protocol="http" host="x.x.x.x" port="80" Url="/update?api_key=CxxxxxxJ&field1=60"
 //1.轉換網址IP
 String result = "" ;
 String IP = AT2WNB303("AT+EDNS=\"" + Host + "\"", "+EDNS:");
 IP.trim(); IP = split( IP, ':', 1);
 if (IP.length() <= 7) return "Error: Can't Get IP";
 //2.建立連線
 String PIP = Protocol + "://" + IP + ":" + port + "/";
 int PIPlen = PIP.length();
 //Serial.println("PIP=" + PIP + ",len=" + String(PIPlen));
 result = AT2WNB303("AT+EHTTPCREATE=0," + String(PIPlen) + "," + String(PIPlen) + ",\"" + PIP + "\"",
"+EHTTPCREAT");
 result.trim(); String clientid = split(result, ':', 1);
 if (result == "") return "Error: Can't Create Connection";
 else {
  //3.開啟連線
  result = AT2WNB303("AT+EHTTPCON=" + clientid, "OK");
  result.trim();
  if (!(result == "OK")) result = "Error: Can't Connect to Server";
  //4.組成網址並傳送
  int LenUrl = Url.length();
  Url = clientid + ",0," + String(LenUrl) + "," + Url + ",0,,0,,0,";
  Url = "0," + String(Url.length()) + "," + String(Url.length()) + "," + Url;
  result = AT2WNB303("AT+EHTTPSEND=" + Url, "OK");
  if (!(result == "OK")) result = "Error: Can't Send to Server";
 }
 delay(1000);
```

程式撰寫步驟(9/10)

```
  //關閉連線
  AT2WNB303("AT+EHTTPDISCON=" + clientid, "OK");
  //Serial.println(result);
  delay(1000);
  AT2WNB303("AT+EHTTPDESTROY=" + clientid, "OK");
  //Serial.println(result);
  delay(1000);
  return result;
}

//HTTP POST
String HTTPPOST(String Protocol, String Host, String port, String Url , String contType , String Data) {
  //1.轉換網址IP
  String result = "" ;
  String IP = AT2WNB303("AT+EDNS=\"" + Host + "\"", "+EDNS:");
  IP.trim(); IP = split( IP, ':', 1);
  if (IP.length() <= 7) return "Error: Can't Get IP";
  //2.建立連線
  String PIP = Protocol + "://" + IP + ":" + port + "/";
  int PIPlen = PIP.length();
  //Serial.println("PIP=" + PIP + ",len=" + String(PIPlen));
  result = AT2WNB303("AT+EHTTPCREATE=0," + String(PIPlen) + "," + String(PIPlen) + ",\"" + PIP + "\"", "+EHTTPCREAT");
  result.trim(); String clientid = split(result, ':', 1);
  if (result == "") return "Error: Can't Create Connection";
  else {
   //3.開啟連線
   result = AT2WNB303("AT+EHTTPCON=" + clientid, "OK");
   result.trim();
   if (!(result == "OK")) result = "Error: Can't Connect to Server";
   //4.組成網址並傳送
   int i = 0;
   String PostCommand[10];
   PostCommand[i++] = clientid + ",1," + Url.length() + "," + Url + ",0,," + contType.length() + "," + contType + ",";
   //Serial.println("command1=" + PostCommand[i - 1]);
   String hexData = Str2Hex(Data);
   int lenHexData = hexData.length();
   PostCommand[i++] = String(lenHexData) + ",";
   //Serial.println("command2=" + PostCommand[i - 1]);
   int num = 30;
   for (int n = 0; n < lenHexData; n = n + num) {
    String DataSend = "";
    if (n + num < lenHexData) {
     //切割字串
     DataSend = hexData.substring(n, n + num);
    }
else if (lenHexData % num > 0) {
      int remainder = lenHexData % num;
      //切割字串
      DataSend = hexData.substring(n, n + remainder);
    }
    PostCommand[i++] = DataSend;
    //Serial.println("command2=" + PostCommand[i - 1]);
   }
   //求出每條命令長度
   int totalLenHexData = 0;
   for (int j = 0; j <= i - 1; j++) {
    totalLenHexData = totalLenHexData + PostCommand[j].length();
    PostCommand[j] = String(PostCommand[j].length()) + "," + PostCommand[j];
   }
   //完成命令組合
   for (int j = 0; j <= i - 1; j++) {
    if (j == 1) PostCommand[j] = "AT+EHTTPSEND=1," + String(totalLenHexData) + "," + PostCommand[j];
    else if (j == i - 1) PostCommand[j] = "AT+EHTTPSEND=0," + String(totalLenHexData) + "," + PostCommand[j];
    else PostCommand[j] = "AT+EHTTPSEND=1," + String(totalLenHexData) + "," + PostCommand[j];
    result = AT2WNB303(PostCommand[j], "OK");
    //Serial.println("POST" + String(j) + +":" + result);
   }

  }
  delay(1000);
  //關閉連線
  AT2WNB303("AT+EHTTPDISCON=" + clientid, "OK");
  //Serial.println(result);
  delay(1000);
  AT2WNB303("AT+EHTTPDESTROY=" + clientid, "OK");
  //Serial.println(result);
  delay(1000);
  return result;
}
```

程式撰寫步驟(10/10)

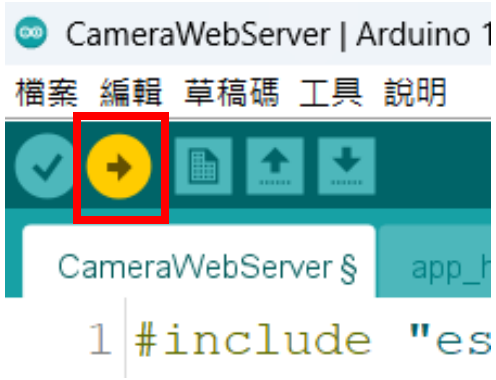
```
//將訊息傳到WNB303，並讀取回傳訊息 0代表timeout
String AT2WNB303(String ATdata, String StartWith) {
 Serial.println("你的命令是:" + ATdata);
 if (ATdata.length() > 0) {//送出AT命令
  ATdata.trim();
  String command = ATdata;
  command.toUpperCase();

  if (command == "RESET") { //重置 WNB303
   digitalWrite(WNB303ResetPIN, HIGH);
   delay(10000);
   digitalWrite(WNB303ResetPIN, LOW);
   return "RESET OK";
  }
  else if (command == "POWERON") { //開啟 WNB303 的電源
   digitalWrite(WNB303PowerPIN, HIGH);
   return "POWERON OK";
  }
  else if (command == "POWEROFF") { //關閉 WNB303 的電源
   digitalWrite(WNB303PowerPIN, LOW);
   return "POWEROFF OK";
  }
  else { //送出AT命令
   Serial2.println(ATdata);
  }
 }
 else return "";
 String result = "";
 //等候回應資料
 long StartTime = millis();
 while (1) {
  result = "";
  while (Serial2.available()) { //WNB303有資料回傳
   char c = Serial2.read();  //從WNB303讀取一個位元組
   result += c;          //將讀到的字元 c 加進字串 Xfer
   if (c == '\n') break;
  }
  result.trim();
  if (result.startsWith(StartWith)) break; //結尾OK返回
  if ((millis() - StartTime) >= WNB303Timeout ) { //Timeout返回
   result = "0";
   break;
  }
 }
 return result;
}

//字串轉HEX
String Str2Hex(String msg) {
 String a = "";
 for (int i = 0; i < msg.length(); i++) {
  a = a + String(msg.charAt(i), HEX);
 }
 return a;
}

//HEX轉字串
String Hex2Str(String msg) {
 char input[msg.length() + 1];
 msg.toCharArray(input, msg.length() + 1);
 char c[sizeof(input)];
 String a = "";
 for (int i = 0; i < sizeof(input) - 1; i += 2) {
  char temp[3];
  temp[0] = input[i];
  temp[1] = input[i + 1];
  int val = ASCIIHexToInt(temp[0]) * 16 + ASCIIHexToInt(temp[1]);
  c[i] = toascii(val);
  a = a + String(c[i]);
 }
 return a;
}

//ASC轉INT
int ASCIIHexToInt(char c) {
 int ret = 0;
 if ((c >= '0') && (c <= '9')) ret = (ret << 4) + c - '0';
 else ret = (ret << 4) + toupper(c) - 'A' + 10;
 return ret;
}
```

```
//split拆解，範例：String a1=split(“aa,bb,cc”,’,’,0);
String split(String data, char separator, int index) {
 int found = 0;
 int strIndex[] = { 0, -1 };
 int maxIndex = data.length() - 1;
 for (int i = 0; i <= maxIndex && found <= index; i++) {
  if (data.charAt(i) == separator || i == maxIndex) {
   found++;
   strIndex[0] = strIndex[1] + 1;
   strIndex[1] = (i == maxIndex) ? i + 1 : i;
  }
 }
 return found > index ? data.substring(strIndex[0], strIndex[1]) : "";
}
```

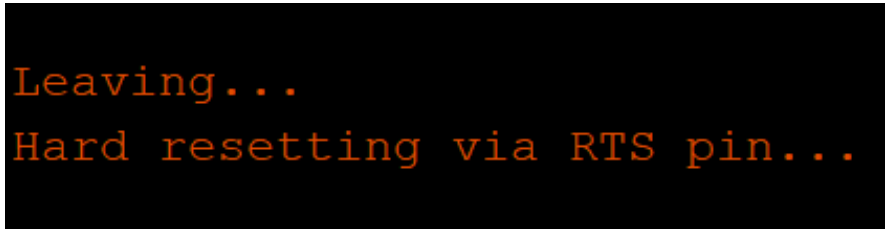
寫入程式步驟

➢ 1.確定工具欄位下的選項有正確選擇

➢ 2.確認後點擊上傳

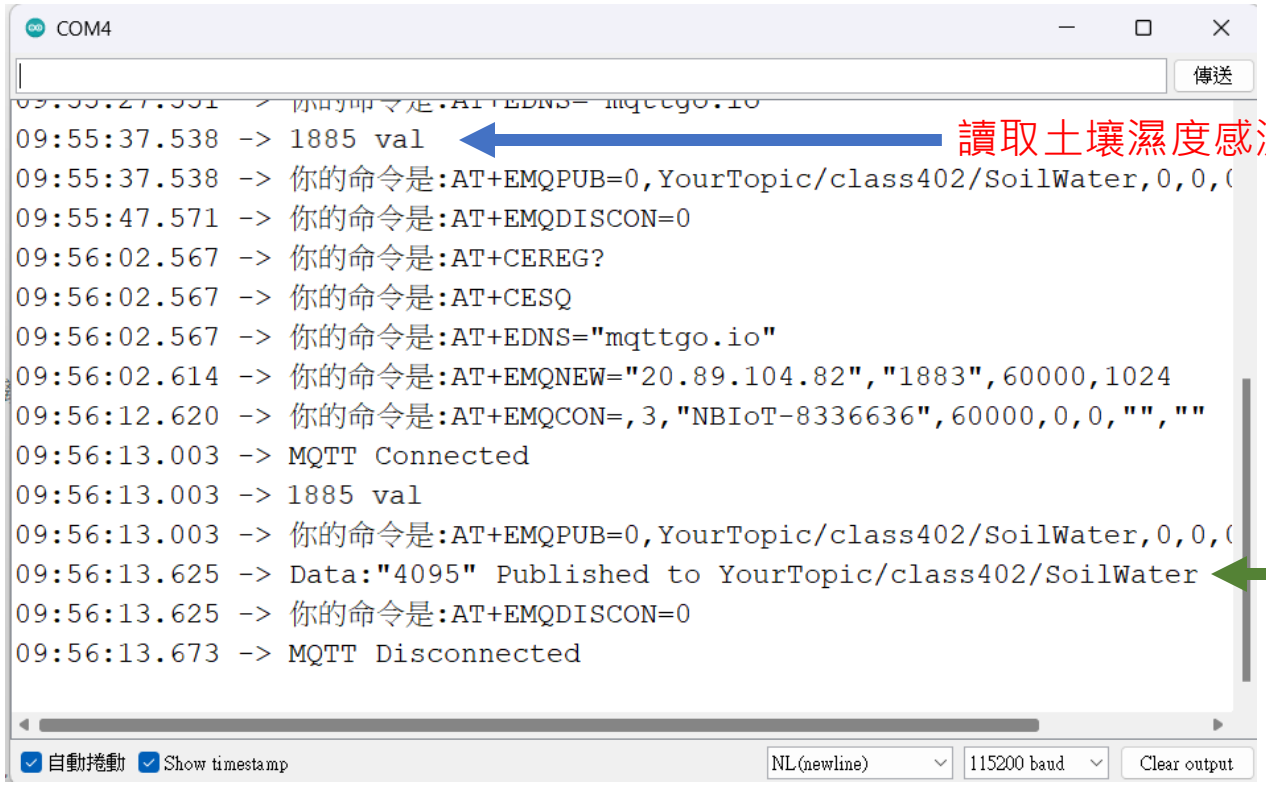


➢ 3.等待底下出現此字串即成功



查看資訊

➢ 開啟右上角序列埠監控視窗即可查看土壤濕度資訊



查看資訊

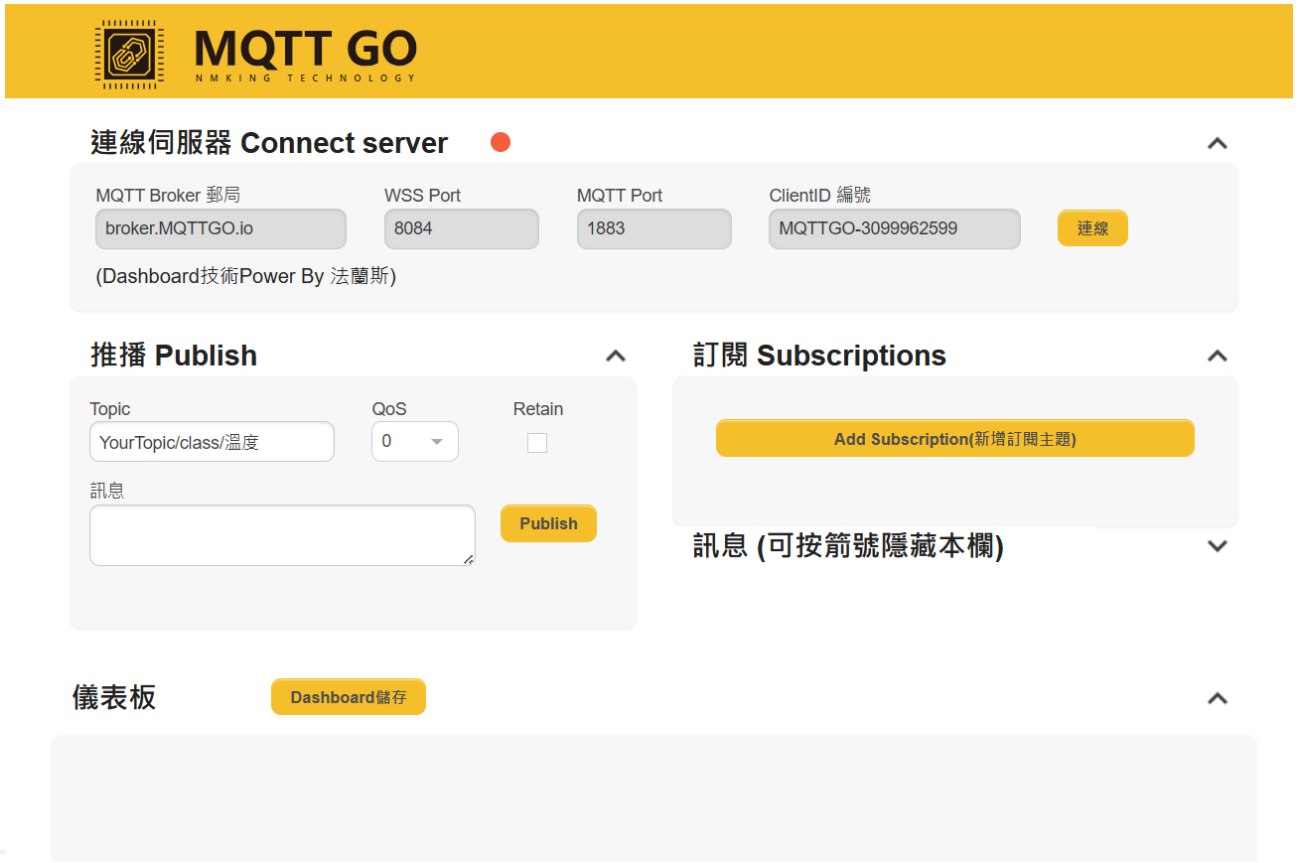
- 土壤濕度偵測計的偵測原理是透過「導電度」，即透過金屬探針之間的導電度回傳類比訊號。

查看資訊

- ESP32類比訊號解析度為4096，即0~4095
- val值判斷方式

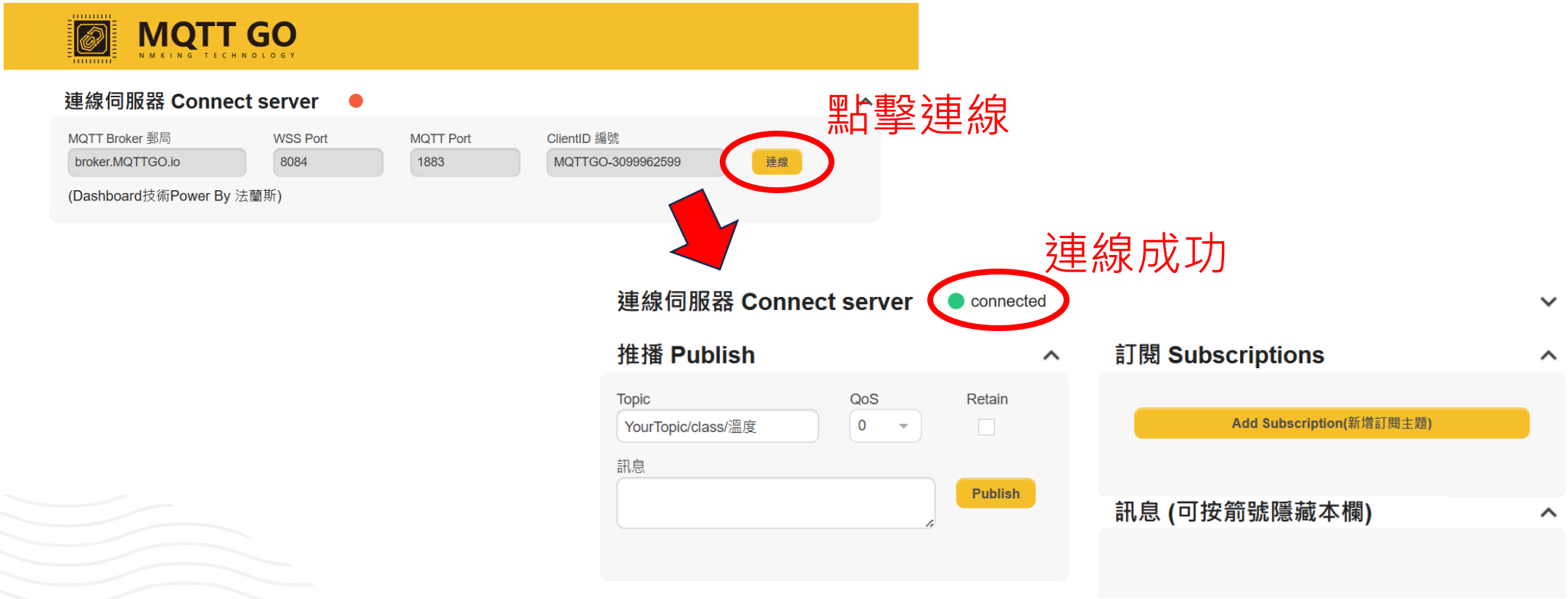
MQTT查看資訊

➢ 於瀏覽器開啟網站：https://broker.mqttgo.io/



MQTT查看資訊

➢ 點擊連線，待燈號亮綠燈顯示connected即連線成功



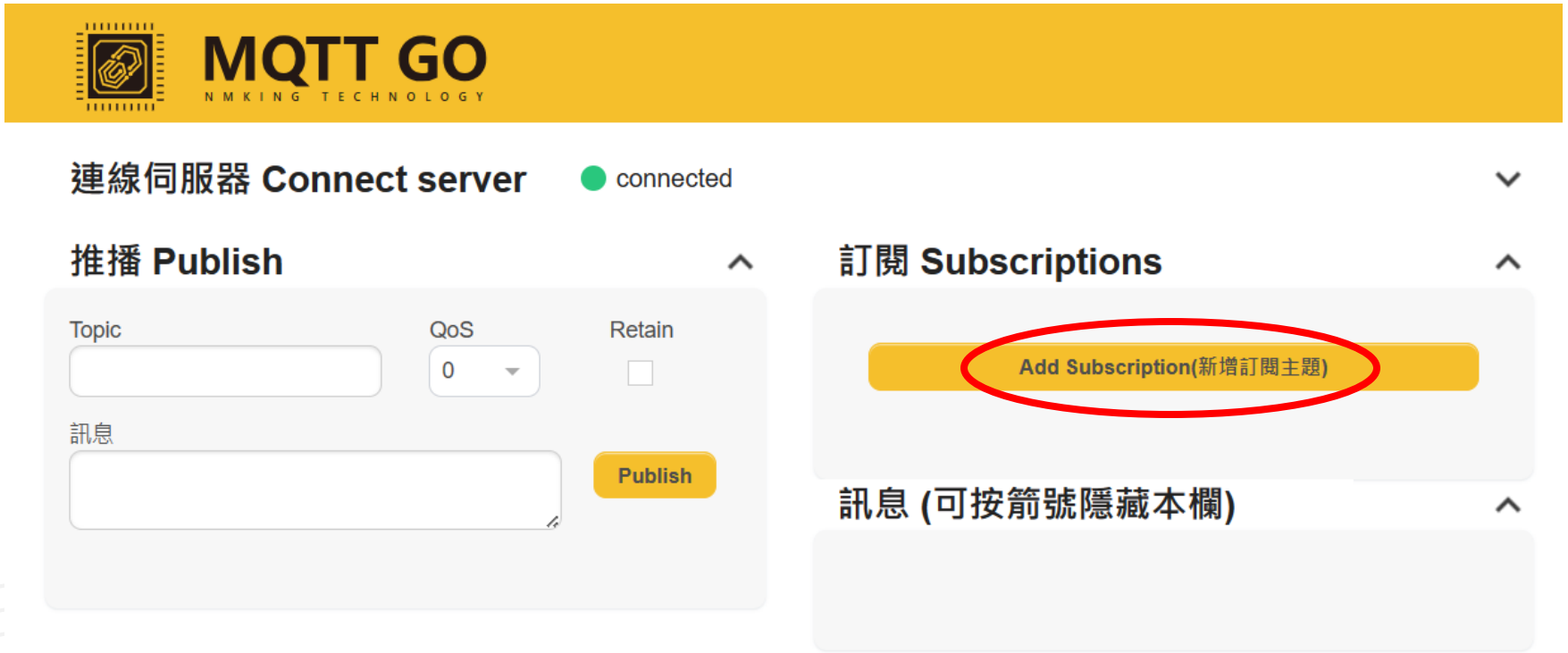
MQTT查看資訊

➢ 回到程式碼，將以下框中Topic文字複製下來

```
//推播主題1:推播土壤濕度                    複製
char* MQTTPubTopic1 =  "YourTopic/class402/SoilWater";
long MQTTLastPublishTime;//此變數用來記錄推播時間
long MQTTPublishInterval = 1000;//每1秒推撥一次
WiFiClient WifiClient;
PubSubClient MQTTClient(WifiClient);
```

MQTT查看資訊

➢ 回到MQTT GO，點選新增訂閱主題

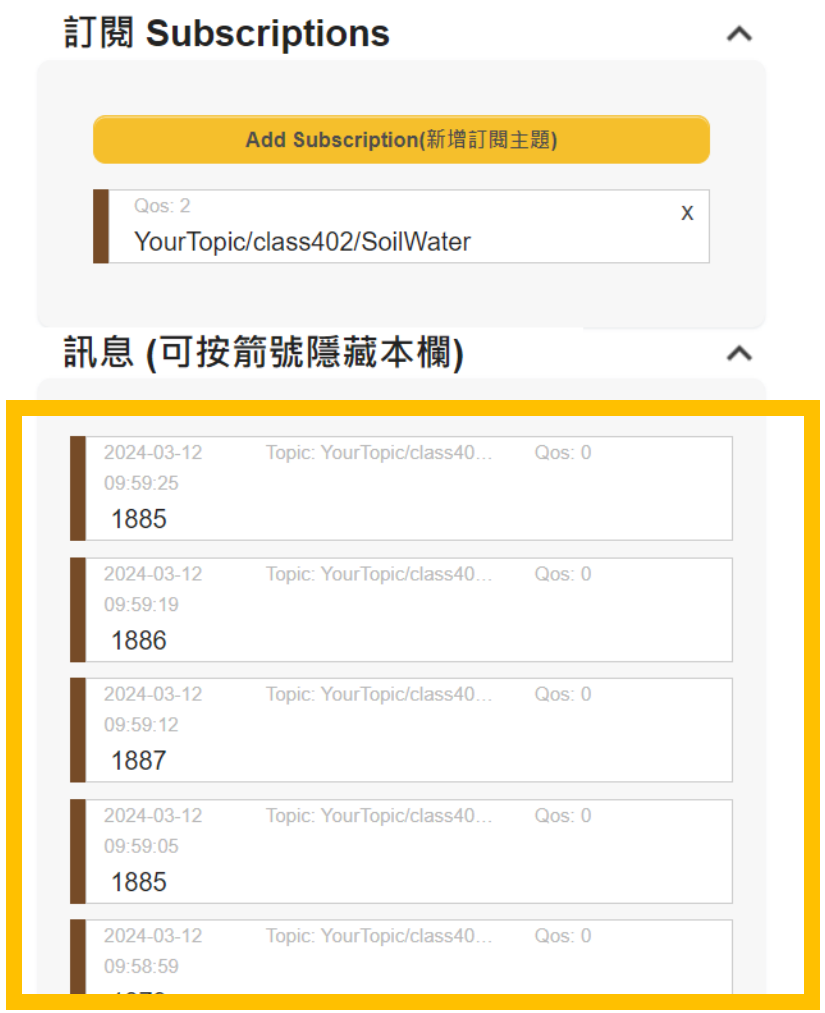


MQTT查看資訊

➢ 將剛剛複製的路徑貼到Topic，按步驟修改完成後點擊Subscribe

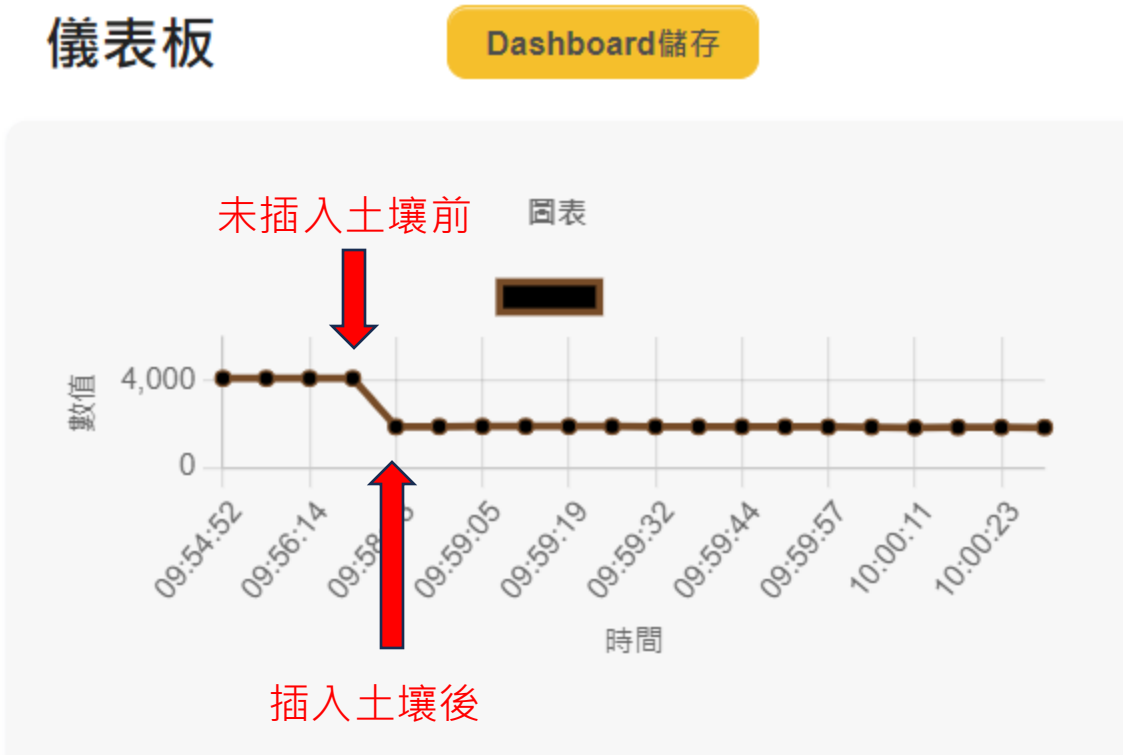
MQTT查看資訊

➢ 訊息欄可看到接收到的資訊



MQTT查看資訊

➢ 在下方儀表板也可清楚以圖示的方式得知資訊



減碳蘊福

古都土城仔綠電創能與智動養殖
之跨界整合永續淨零發展計畫

感謝聆聽
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