

IOT DEVICES AND PLATFORMS

1

5269 物聯網裝置與平台

IOE5114 IOT DEVICES AND PLATFORMS

- Course Outline

- Chapter 0: Class rule
- Chapter 1: IOT devices and sensors introduction
- Chapter 2: Arduino built-in example: Basics
- Chapter 3: Arduino built-in example: Digital
- Chapter 4: Arduino built-in example: Analog
- Chapter 5: Arduino built-in example: Communication
- Chapter 6: Sensor application
- Chapter 7: Arduino wireless networking
- Chapter 8: IOT Cloud platform
- Chapter 9: AI application

WIFI

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WIFI

- Wi-Fi 是什麼意思？

「**wireless fidelity**」的縮寫，也是Wi-Fi聯盟的商標，是由行銷公司建立的品牌名稱。

- Wi-Fi 如何運作？

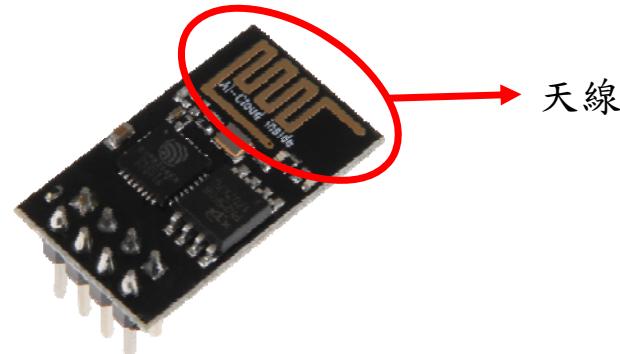
就技術方面而言，**IEEE 802.11** 標準定義了通訊協定，讓無線路由器、無線存取點這類目前已啟用 Wi-Fi 的無線裝置能夠通訊。無線存取點支援不同的 **IEEE** 標準。每項標準都會隨著時間進行修訂與批准。這些標準以不同頻率運作、提供不同頻寬，並支援不同數量的頻道。

- WiFi頻段？

Wi-Fi 訊號可分為 **2.4GHz** 與 **5GHz** 兩種頻段，前者網路收訊範圍廣，但網速慢；後者則是收訊範圍小，但網速高。



ESP8266 WIFI MODULE



■ ESP8266

- 是一款可以作為微控制器使用的成本極低且具有完整TCP/IP協議的Wi-Fi IoT控制晶片
- 是UART(又稱串口)轉WiFi的模組，具有AP(Access Point網路基地台模式)、STA(Station工作站模式)、AP + STA(共存模式)
- ESP8266 family:

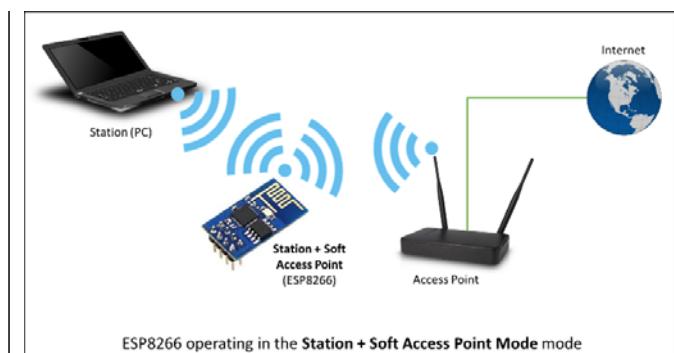
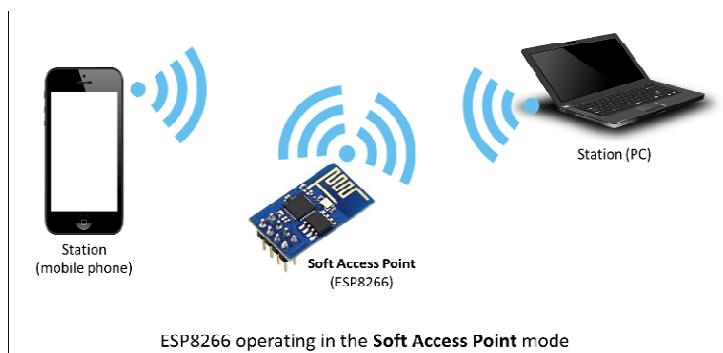
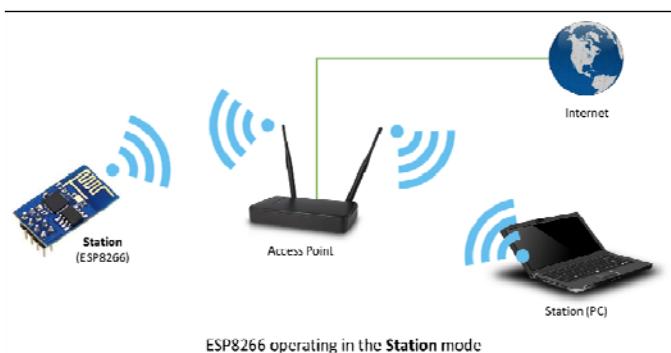


<https://en.wikipedia.org/wiki/ESP8266>

<https://blog.jmaker.com.tw/esp8266-esp01/>

ESP8266 WIFI MODULE

- AP，也就是無線接入點，是一個無線網路的建立者，是網路的中心節點。一般家庭或辦公室使用的無線路由器就一個AP。
- STA，每一個連線到無線網路中的終端(如筆記型電腦、手機以及其它可以連網的裝置)都可稱為一個站點。



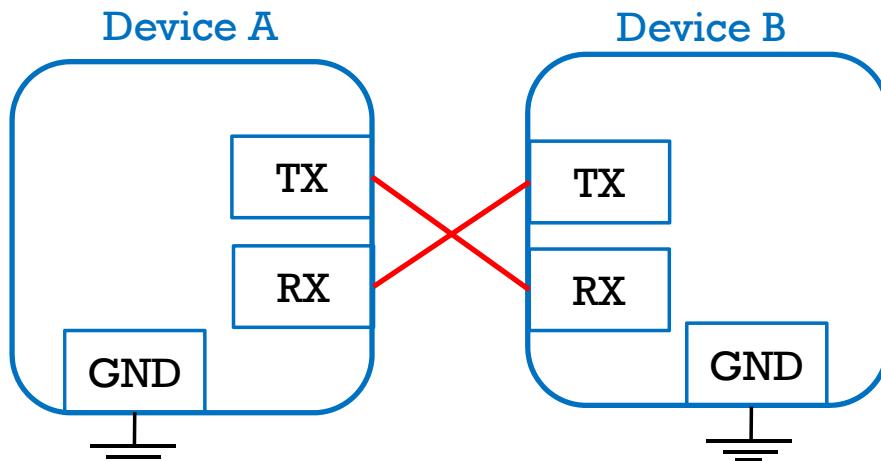
UART

RS232 connector



https://commons.wikimedia.org/wiki/File:RS-232_Series_Port.jpg

- **UART** is an acronym for Universal Asynchronous Receiver Transmitter, including RS232, RS449, RS423, RS422, RS485, etc..
- Protocol for exchanging serial data only using two lines between two devices.
- It can be simplex, half-duplex, or full-duplex



<https://www.youtube.com/watch?v=sTHckUyxwp8>

<https://zh.wikipedia.org/wiki/RS-232>



RS232
adaptor

DE-9 Male (Pin Side)		DE-9 Female (Pin Side)	
腳位	簡寫	意義	說明
Pin1	DCD	Data Carrier Detect	數據機通知電腦有載波被偵測到。
Pin2	RXD	Receiver	接收資料。
Pin3	TXD	Transmit	傳送資料。
Pin4	DTR	Data Terminal Ready	電腦告訴數據機可以進行傳輸。
Pin5	GND	Ground	地線。
Pin6	DSR	Data Set Ready	數據機告訴電腦一切準備就緒。
Pin7	RTS	Request To Send	電腦要求數據機將資料送出。
Pin8	CTS	Clear To Send	數據機通知電腦可以傳資料過來。
Pin9	RI	Ring Indicator	數據機通知電腦有電話進來。

THINGSPEAK

The homepage features a large banner image of a person holding a tablet. The tablet screen shows several MATLAB-based data visualizations for weather monitoring, including line graphs and 3D surface plots. To the left of the tablet, the text "ThingSpeak for IoT Projects" and "Data collection in the cloud with advanced data analysis using MATLAB" is displayed. A red circle highlights the "Get Started For Free" button.

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<https://thingspeak.com/>

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To send data faster to ThingSpeak or to send more data from more devices, consider the [paid license options](#) for cor

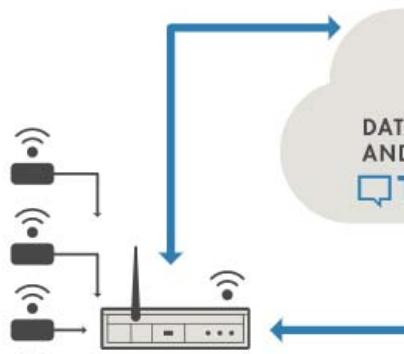


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To send data faster to ThingSpeak or to send more data from more devices, consider the [paid license options](#) for comm

Create MathWorks Account

Email Address

To access your organization's MATLAB license, use your school or work email.

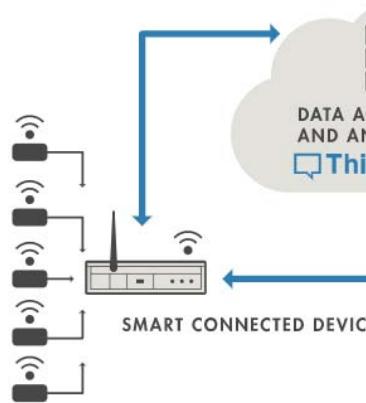
Location

First Name

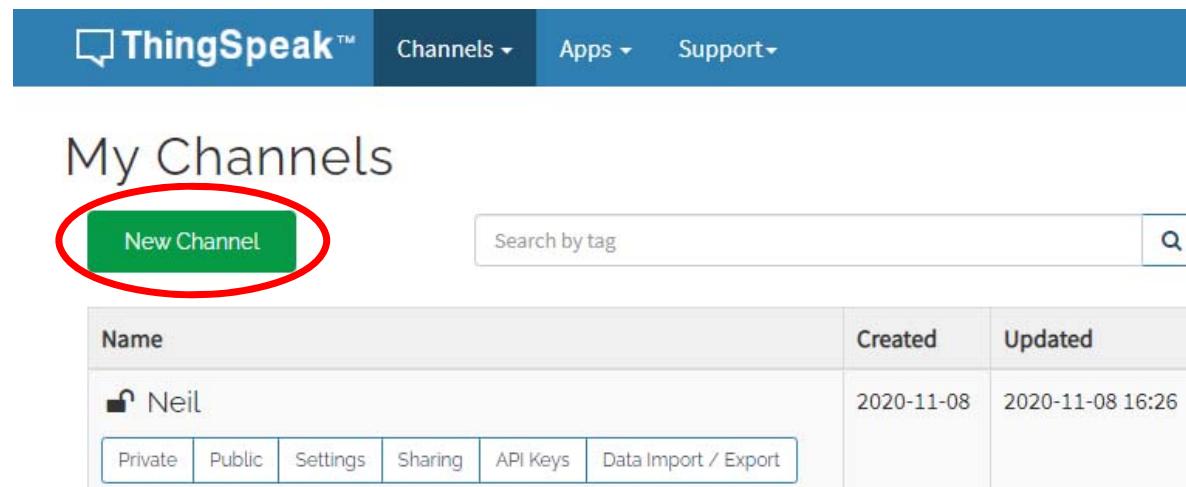
Last Name

Continue

Cancel



THINGSPEAK



The screenshot shows the ThingSpeak interface. At the top, there's a navigation bar with the logo, 'Channels', 'Apps', 'Support', and 'Commercial Use'. Below the navigation bar is the title 'My Channels'. A green button labeled 'New Channel' is highlighted with a red circle. To the right of the button is a search bar with the placeholder 'Search by tag' and a magnifying glass icon. Below the search bar is a table with columns 'Name', 'Created', and 'Updated'. One row in the table is shown, containing the name 'Neil' with a lock icon, creation date '2020-11-08', and update date '2020-11-08 16:26'. Below the table are links for 'Private', 'Public', 'Settings', 'Sharing', 'API Keys', and 'Data Import / Export'.

Name	Created	Updated
Neil	2020-11-08	2020-11-08 16:26

Help

Collect data in a ThingSpeak channel from another channel, or from sensors.

Click **New Channel** to create a new channel.

Click on the column headers to sort entries in that column or click on channels with that tag.

Learn to [create channels](#), [edit channels](#), and [view data](#).

Learn more about [ThingSpeak](#).

Examples

- [Arduino](#)
- [Arduino MKR1000](#)
- [ESP8266](#)
- [Raspberry Pi](#)

THINGSPEAK

ThingSpeak™ [Channels](#) [Apps](#) [Support](#) [Commercial Use](#) [How to Buy](#) [NC](#)

New Channel

Name

Description

Field 1

Field 2

Field 3

Field 4

Field 5

Field 6

Help

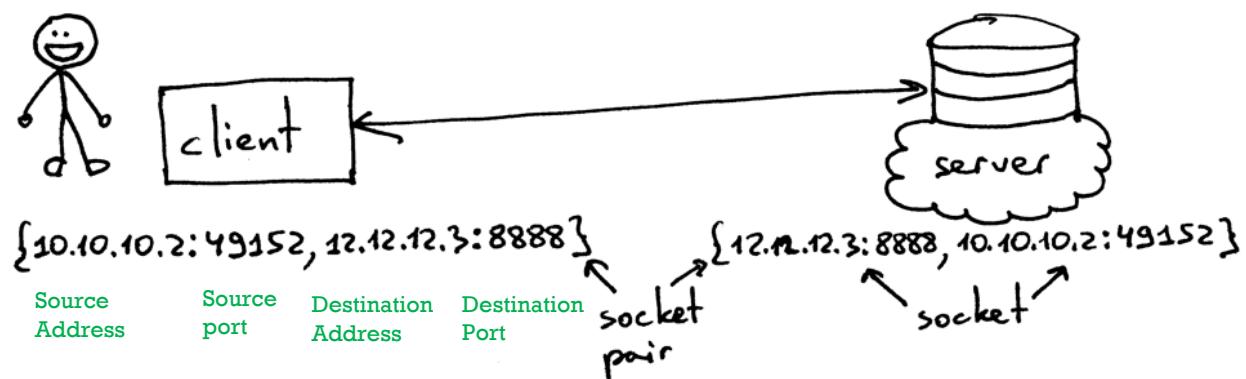
Channels store all the data that a ThingSpeak application collects. Each channel includes eight fields that can hold any type of data, plus three fields for location data and one for status data. Once you collect data in a channel, you can use ThingSpeak apps to analyze and visualize it.

Channel Settings

- **Percentage complete:** Calculated based on data entered into the various fields of a channel. Enter the name, description, location, URL, video, and tags to complete your channel.
- **Channel Name:** Enter a unique name for the ThingSpeak channel.
- **Description:** Enter a description of the ThingSpeak channel.
- **Field#:** Check the box to enable the field, and enter a field name. Each ThingSpeak channel can have up to 8 fields.
- **Metadata:** Enter information about channel data, including JSON, XML, or CSV data.
- **Tags:** Enter keywords that identify the channel. Separate tags with commas.
- **Link to External Site:** If you have a website that contains information about your

TCP

- TCP的全名為 Transmission Control Protocol，是屬於OSI, Open System Interconnection Model，下，「傳輸層」中的一種協定，也是「端點對端點」(End-to-End)的傳輸協定
- TCP也是透過「IP位址」與「TCP Port」形成一個「Socket」，透過此Socket與對方的Socket形成一個「Socket Pair」進行通訊，也就是一條的「連線」(one connection)
- 在建立連線的過程中，Client會向Server發出請求，最基本的請求的方法(語法)有兩種: GET、POST，此課程我們使用GET

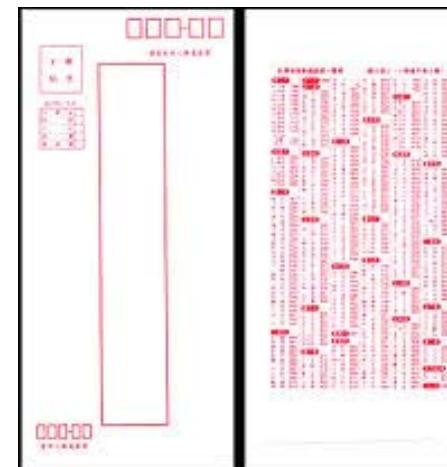
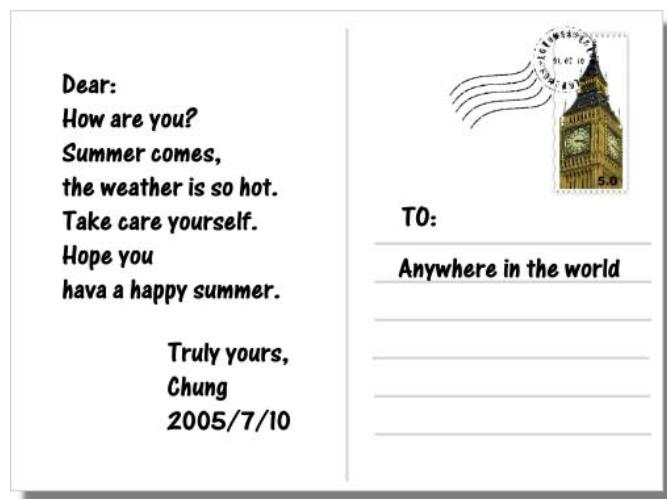


圖片來源<https://ruslanspivak.com/lsbaws-part3/>

GET AND POST

<https://www.wibibi.com/info.php?tid=235>

	GET	POST
網址差異	網址會帶有 HTML Form 表單的參數與資料。	資料傳遞時，網址並不會改變。
資料傳遞量	由於是透過 URL 帶資料，所以有長度限制。	由於不透過 URL 帶參數，所以不受限於 URL 長度限制。
安全性	表單參數與填寫內容可在 URL 看到。	透過 HTTP Request 方式，故參數與填寫內容不會顯示於 URL。

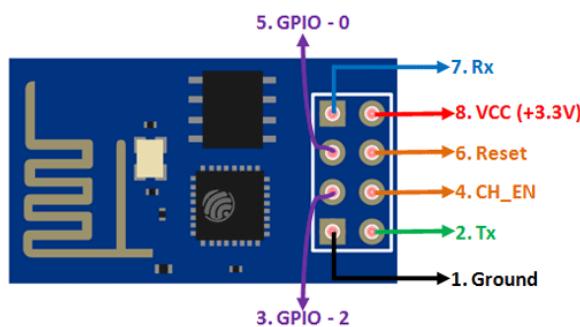
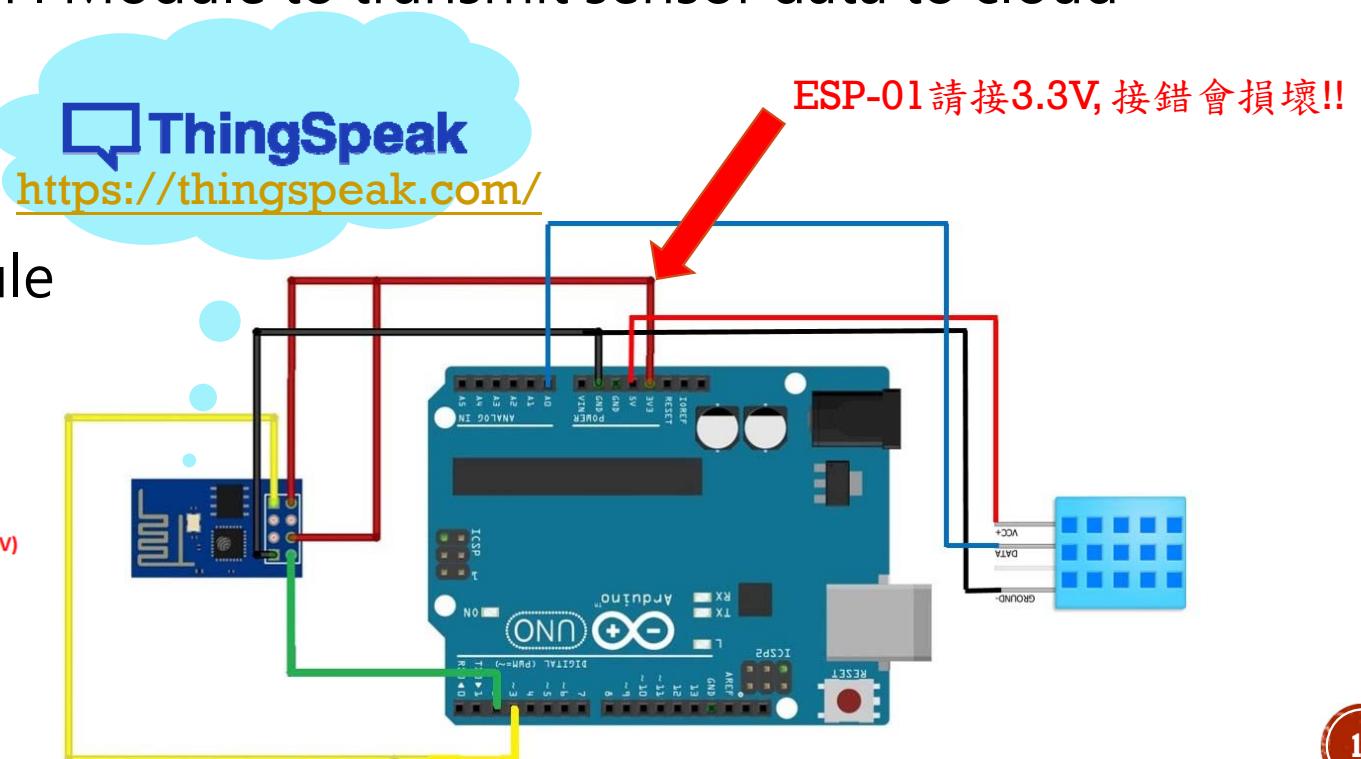


TUT. 1 ESP-01 WIFI MODULE

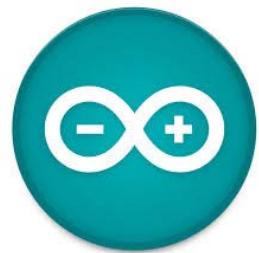
- Goal: Use ESP-01 WIFI Module to transmit sensor data to cloud platform

- Hardware Required

- Arduino UNO
- ESP-01 WIFI module
- DHT-11 sensor



TUT. 1 ESP-01 WIFI MODULE



Arduino

- Download the code from new E3
- Open the code

TUT. 1 ESP-01 WIFI MODULE

- 確定Wi-Fi模組可以正常工作 (AT指令)
- 將Wi-Fi模組設定至單連線模式 (AT指令)
- 將連線至外網的Wi-Fi模組設定為STA (Station工作站模式)
- 將Wi-Fi模組連上可連至外網的Wi-Fi AP (AT指令+手機無線網路分享的名稱&密碼)
- 將Wi-Fi模組與雲端平台建立TCP連線 (AT指令+IP+PORT+API Key)
- 將Arduino上的資料透過Wi-Fi模組傳至雲端平台 (AT指令+Sensor data+特定格式)

ESP8266 AT 指令

<https://iottalk.vip/static/iottalk/01/ESP8266UsersGuide.pdf>

TUT. 1 ESP-01 WIFI MODULE

```
#include <SoftwareSerial.h>
#define WiFi_TX 2
#define WiFi_RX 3
SoftwareSerial WiFi_Serial(WiFi_TX,WiFi_RX);
int flag = 0;

// 請輸入自己WiFi熱點的名稱
#define SSID "Neil_2"

// 請輸入自己WiFi熱點的密碼
#define PASS "09121021"

#define IP "api.thingspeak.com"
// GET /update?key=[THINGSPEAK_KEY]&field1=[data 1]&field2=[data 2]...
String GET = "GET /update?key=U5RQ8FIUOS89J7RK"; // 請將key=之後的16碼改為自己的API key
```



TUT. 1 ESP-01 WIFI MODULE

```
void setup() {  
    Serial.begin(9600);  
    WiFi_Serial.begin(115200);  
    while(flag == 0){  
        WiFi_Send("AT"); //測試指令-AT  
        delay(1000);  
        if(WiFi_Serial.find("OK")){  
            Serial.println("RECEIVED: OK");  
            WiFi_Send("AT+CIPMUX=0"); //設定為單連線型態  
            delay(1000);  
            if(WiFi_Serial.find("OK")){  
                Serial.println("RECEIVED: OK");  
            }  
        }  
        while(!connectWiFi()); //將Wi-Fi模組連上可連至外網的Wi-Fi AP  
        flag = 1;  
    }  
    else{  
        Serial.println("NO RESPONSE!");  
    }  
}
```

Serial.find() 可以從串列埠緩衝區讀取資料，並且找到目標字串。假如有找到目標字串，則回傳 **true**，一段時間內沒找到目標字串，則回傳 **false**。

TUT. 1 ESP-01 WIFI MODULE

```
void loop() {  
    double Hum = 66; //濕度  
    double Temp = 20.5; //溫度  
    if (isnan(Hum) || isnan(Temp)){ //確定溫濕度值存在  
        Serial.println("Failed to read from DHT sensor!");  
        return;  
    }  
  
    else{  
        String HH,TT;  
        HH=String(Hum); //將濕度值轉換成字串型態的資料  
        TT=String(Temp); //將溫度值轉換成字串型態的資料  
  
        updateDHT11(TT,HH); //將溫濕度資料傳至雲端平台  
  
        Serial.print("Humidity: ");  
        Serial.print( HH );  
        Serial.print(" %\t");  
        Serial.print("Temperature: ");  
        Serial.print( TT );  
        Serial.println(" *C\t");  
    }  
    delay(5000);  
}
```

Demo時請改為DHT11實際量測的值

TUT. 1 ESP-01 WIFI MODULE

```
void updateDHT11(String T, String H){  
    String cmd = "AT+CIPSTART=\"TCP\",\""; //建立TCP連線  
    cmd += IP;  
    cmd += "\",80";      AT+CIPSTART="TCP",IP",80  
    WiFi_Send(cmd);  
    delay(1000);  
    if(WiFi_Serial.find("ERROR")){  
        Serial.println("RECEIVED: TCP Connect Error");  
        return;  
    }  
    cmd = GET + "&field1=" + T + "&field2=" + H +"\r\n";  
    WiFi_Serial.print("AT+CIPSEND="); //傳送資料的指令  
    WiFi_Serial.println(cmd.length()); //資料的長度  
    if(WiFi_Serial.find(">")){ //確定WiFi模組有接收到指令  
        Serial.print(">");  
        Serial.print(cmd);  
        WiFi_Serial.print(cmd); //傳送資料  
        delay(1000);  
        if(WiFi_Serial.find("OK")){  
            Serial.println("RECEIVED: SEND OK");  
        }  
        else{  
            Serial.println("RECEIVED: SEND Error_2");  
        }  
    }  
    else{  
        Serial.println("RECEIVED: SEND Error");  
    }  
}
```

AT+CIPSEND=<length>

Wi-Fi模組收到指令後會回傳">"，然後才開始接收串列埠資料

當資料長度符合length時才傳送資料

```
void WiFi_Send(String cmd){  
    Serial.print("SEND: ");  
    WiFi_Serial.println(cmd);  
    Serial.println(cmd);  
}  
  
boolean connectWiFi(){  
    WiFi_Serial.println("AT+CWMODE=1"); //WiFi 應用型態為Station型態  
    delay(1000);  
    String cmd="AT+CWJAP=\""; //加入接入點(與WiFi AP連線)  
    cmd+=SSID;  
    cmd+="\",\"";  
    cmd+=PASS;  
    cmd+="\"";  
    WiFi_Send(cmd);  
    delay(1000);  
    if(WiFi_Serial.find("OK")){  
        Serial.println("RECEIVED: OK");  
        return true;  
    }  
    else{  
        Serial.println("RECEIVED: Error");  
        return false;  
    }  
}
```

TUT. 1 ESP-01 WIFI MODULE

The figure shows the ThingSpeak channel interface. At the top, there are tabs for Private View, Public View, Channel Settings, Sharing, API Keys, and Data Import / Export. Below these are buttons for Add Visualizations, Add Widgets, and Export recent data. To the right are buttons for MATLAB Analysis and MATLAB Visualization. The main area displays Channel Stats with creation and entry times, and entry count. Two line charts are shown: Field 1 Chart (Temperature) and Field 2 Chart (Humidity), both showing constant values over time.

Channel Stats

Created: 23 days ago
Last entry: less than a minute ago
Entries: 715

Field 1 Chart

Temperature

Time: 04:06 to 04:08

ThingSpeak.com

Field 2 Chart

Humidity

Time: 04:06 to 04:08

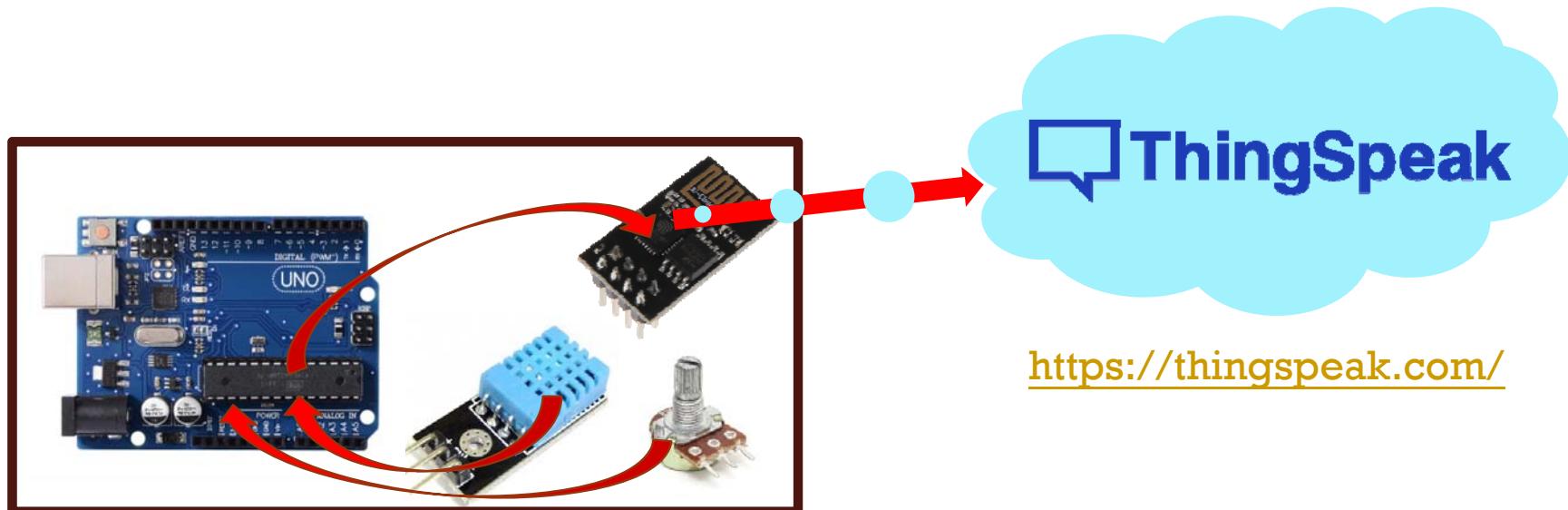
ThingSpeak.com

TUT. 1 ESP-01 WIFI MODULE

- **Syntax**
 - Serial.find(target)
 - Serial.find(target, length)
- **Description**
 - Serial.find() reads data from the serial buffer until the target is found. The function returns true if target is found, false if it times out.
- **Parameters**
 - target: the string to search for. Allowed data types: char.
 - length: length of the target. Allowed data types: size_t.
- **Returns**
 - Data type: bool.
- **Example**
 - Serial.find("OK");

LAB: DEMO 1

- 實際接上溫濕度感測器
- 雲端平台新增Field 3
- Arduino接上可變電阻，偵測可變電阻的數值(0~255)
- 將當下的溫濕度數值以及可變電阻的數值傳送至ThingSpeak雲端平台
- Field 1儲存溫度值、Field 2儲存濕度值、Field 3儲存可變電阻值



SUMMARY

- Practice TUT. 1
- Write code for Demo 1, then demonstrate it to TAs
 - If you can not finish today, remember to tell TA before you leave.
(record your attendance)
 - If you demonstrate quiz in next week, the score is multiply by 0.8
(ex: 100 -> 80)