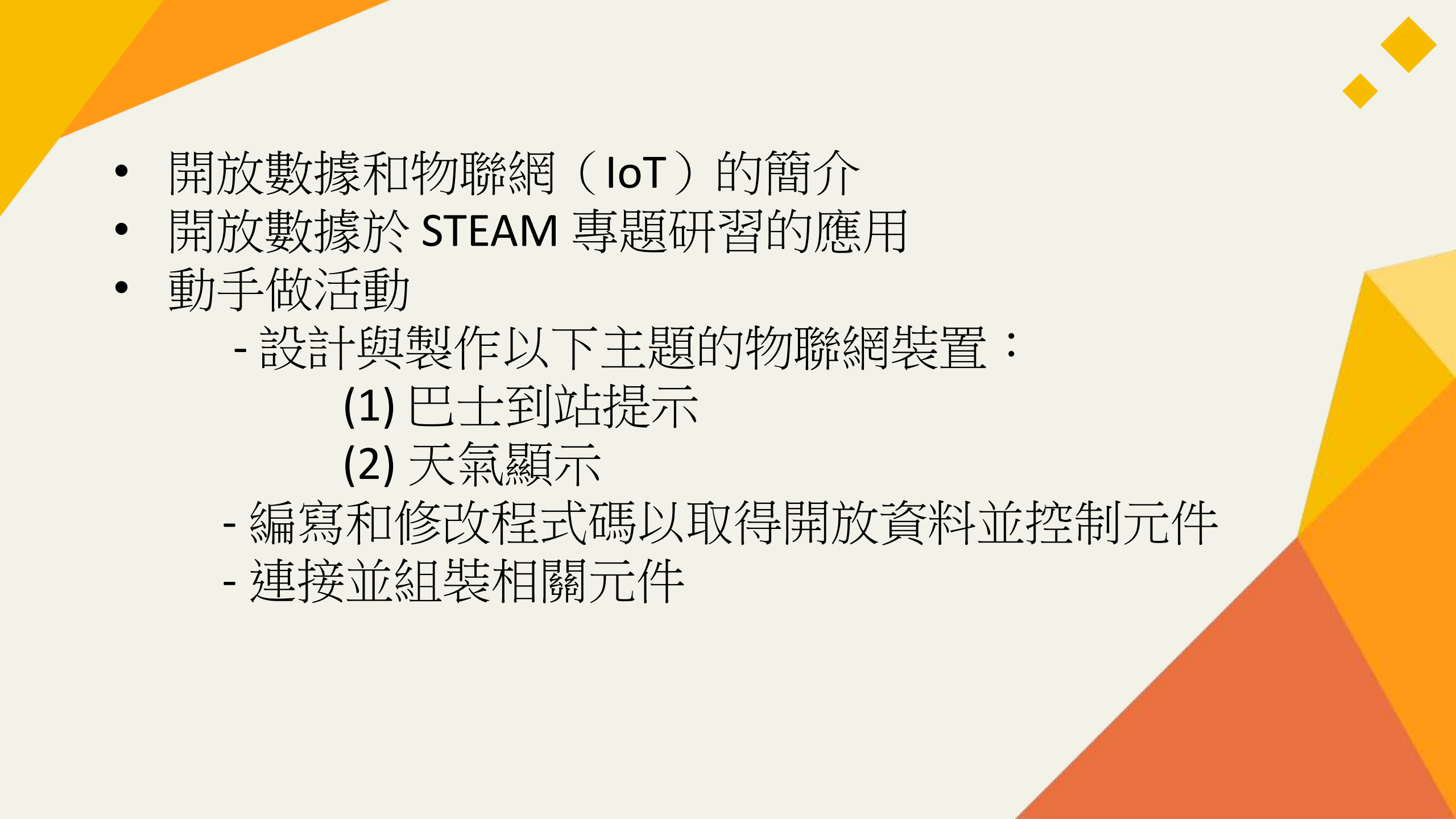




Workshop on Designing and Making of an IoT Device using Open Data

「利用開放數據設計和製作物聯網裝置工作坊」

- 
- 開放數據和物聯網（IoT）的簡介
 - 開放數據於 **STEAM** 專題研習的應用
 - 動手做活動
 - 設計與製作以下主題的物聯網裝置：
 - (1) 巴士到站提示
 - (2) 天氣顯示
 - 編寫和修改程式碼以取得開放資料並控制元件
 - 連接並組裝相關元件

INTERNET OF THINGS EXAMPLES



Smart Home



Smart Agriculture



Smart Cities



Healthcare IoT



Industrial IoT



Retail and
Consumer IoT



Agriculture and
Environment



Transportation
and Automotive
IoT



Retail and
Logistics IoT

Opendata 開放數據

開放是在說什麼？

- 這是一本關於開放資料的手冊 - 但是到底什麼是「開放資料」？在這裡，當我們提到「資料開放」時，我們將使用 [Open Definition](#) 中的定義：
- ***Open data is data that can be freely used, reused and redistributed by anyone - subject only, at most, to the requirement to attribute and sharealike.*** (開放資料指的是資料能**被任何人自由地使用**，重新使用與散佈 - 我們至多只能要求來源標示，與以相同方式分享)
- 關於「開放資料」的定義在 **Open Definition ([full Open Definition](#))** 內有更詳細的說明。在這我們列出其中最重要的幾點：
- **Availability and Access / 可得性與可讀性**：資料必須完整釋出，同時只能依照再製的成本徵收適當的費用。最好能提供網路下載。同時提供的資料格式必須是適用和可被修改的。
- **Re-use and Redistribution / 重新使用與散播**：資料釋出時必須採用允許資料的重新使用和散播的授權聲明。並允許與其他資料混合使用。
- **Universal Participation / 分享的普遍性**：任何人都可使用，重新使用和散佈這些資料 - 不能限制資料使用的範圍，或是使用者的資格。例如，「非商業使用」將禁止資料在所有「商業性質」的使用，或是限制資料只能使用在某個範圍內 (例如，只能作為教育上使用)。這些限制都是不被允許的。

<https://data.gov.hk/>



「開放數據平台」以**機器可讀格式**提供開放數據，供商業或非商業目的免費重複使用，以促進網絡和移動應用程序和解決方案的開發，以及學術研究和分析。

瀏覽 數據集



人口



工商業



社區及社會福利



法律及保安



房屋



城市管理及公共設施



科技及廣播



食物



氣象



財經



旅遊



教育



康樂、體育及文化



就業及勞工



發展、地理及土地資訊



運輸



選舉及立法機關



衛生



環境



其他



書籤



下載列



提出意見



回到頂部



31 個應用程式

以下資訊由開發者提供。



蚊患風險地圖

蚊患風險地圖是根據蚊患風險指數 (MRI) 識別多蚊位置的地圖。該地圖是以可視化方式呈現GeoAI 模型的結果，以便有興趣的各方及公眾可...



Busio - 精準即時地鐵巴士

告別盲目等待！由實時車輛定位到多模式路線規劃，重新定義高效巴士出行體驗，為您提供毫秒級精準預測服務。...



香港電動車充電器

該應用程式旨在幫助您輕鬆找到和定位香港各地的電動車充電器。



我的九龍東

起動九龍東辦事處與地政總署共同開發的「我的九龍東」手機應用程式旨在促進及推廣智慧城市措施，以九龍東作試點建立互動創新平...



香港公眾假期

提供香港公眾假期資訊，多種顯示方式：月曆、年曆、列表。明亮或深色模式。自動檢查更新，無須每年重新下載新App。離線時亦可隨...



個人化實時空氣污染風險信息系統

PRAISE-HK 代表「個人化實時空氣污染風險信息系統」。功能包括：
- 全港街道空氣質量地圖
- 實時及未來48小時預測...



城巴

城巴App提供巴士及小巴路線的抵站時間、城巴路線資訊及智能點對點路線搜尋。



政府拍賣資料庫

想執平嘢？用《政府拍賣資料庫》瀏覽物流服務署的公開拍賣物品，小至數碼相機，大至消防車都可以搵得到！...



開放數據於STEAM 專題研習的應用

上屆比賽得獎作品題材廣泛，呈現出獨到創新思維與實際應用潛力。初中組冠軍作品《全城走塑、智能共享》透過空間數據分析商業區內環保餐具借還設施的最佳佈局，以減少即棄餐具的使用量。參賽同學表示，由時事、政府政策及全球趨勢中發掘主題，藉此學習如何以數據解決現實挑戰。

上屆高小組冠軍提出《城門花之道》，靈感來自學校鄰近的城門河，透過展示沿岸的花卉分布及人流趨勢。得獎同學提到，從地理空間實驗室學習分析人流趨勢，掌握如何運用空間數據，「盼望透過作品推廣城門河的美景。」



城門花之道

占 ...

[賞花之旅](#)[城門花之道](#)[賞花旅行的禮儀](#)[賞花旅行的準備](#)[城門花之道的春夏秋冬線](#)[城門花之道的花色路線](#)[我們的花之道](#)[我的花之道](#)[城門花之道的實體模型](#)[城門花之道的立體圖](#)[城門花之道的人流預測圖](#)[城門花之道的感想](#)

城門花之道的春夏路線

城門花之道的花期都集中於春天及夏天，就讓我們介紹比大家知
啦。

路線： 春夏「花之道」

以下路線顯示花期為春天及夏天的花卉位置。



公交無障礙小助手

「農圃小隊」助視障人士出行

農圃道官立小學
馮健恒主任

農圃道官立小學三位學生組成「農圃小隊」，構建「公交無障礙小助手」計劃書，為視障人士規劃最佳出行路線。作品奪得「開放數據應用比賽2023」二等獎，有望在社區落實。

「農圃小隊」在老師指導下，構建「公交無障礙小助手」計劃書，當中的應用程式通過整合交通和地圖數據，提供詳細的語音導航，內容涵蓋路口、轉彎、交通燈等資訊，讓視障人士輕鬆掌握前進方向。

當視障人士抵達車站，語音系統會發出提示，並預報巴士的到站時間和位置，除了可消除他們候車的困擾和焦慮，還可提醒其他候車人士發揮關愛精神，主動協助有需要人士。巴士車長亦可使用應用程式，知悉車站有視障人士，及時提供協助。小隊的創新思維獲得比賽評委一致讚賞，以及政府部門和資訊科技行業人士的認可。

「公交無障礙小助手」於香港國際創科展展出，其間不少業界人士向小隊了解作品理念，並分享寶貴的開發經驗。小隊意識到計劃書尚有不足之處，例如未有考慮產品電量、收發數據頻率等，著手改善設計。計劃書現已提交民政事務處，讓有關部門進一步探討可行性，有望在社區落實，為視障人士帶來便利。



學生向評審展示計劃書



學生到大專院校學習開放數據知識

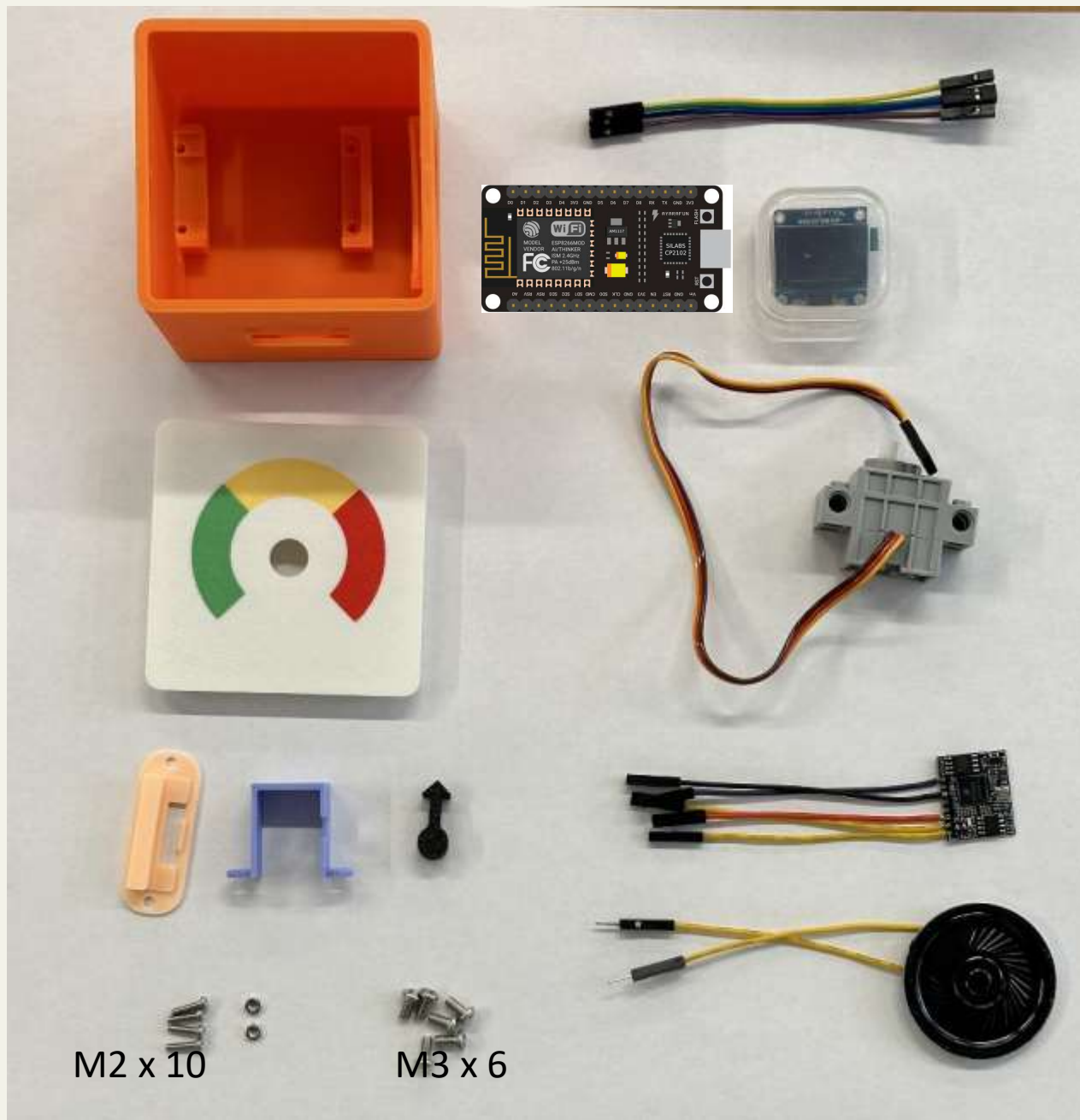


老師及家長為「農圃小隊」打氣

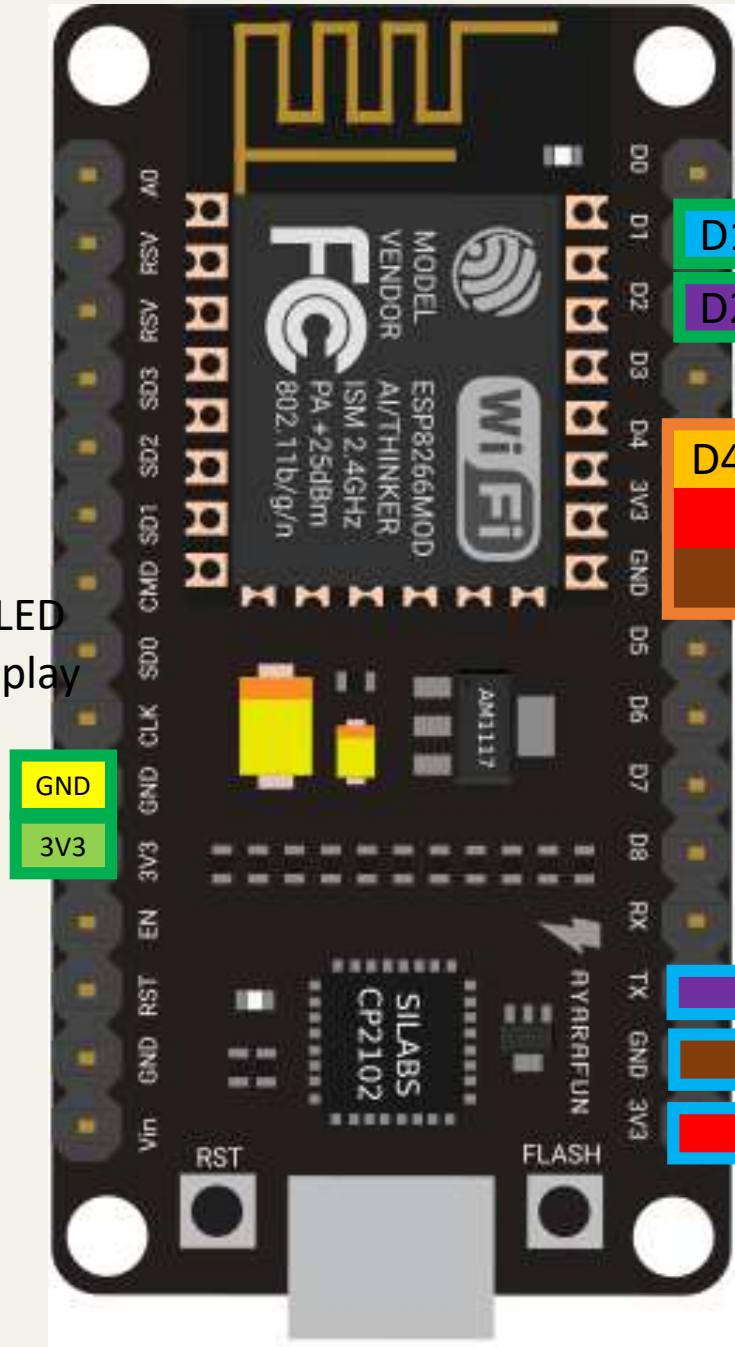
設計與製作以下主題的物聯網裝置：

- (1) 巴士到站提示
- (2) 天氣顯示





OLED display



OLED display

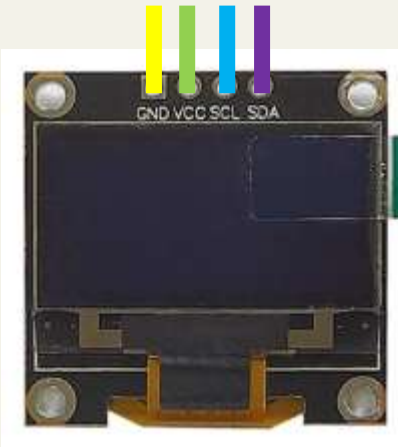
D1

D2

D4

Servo Motor

TTS module



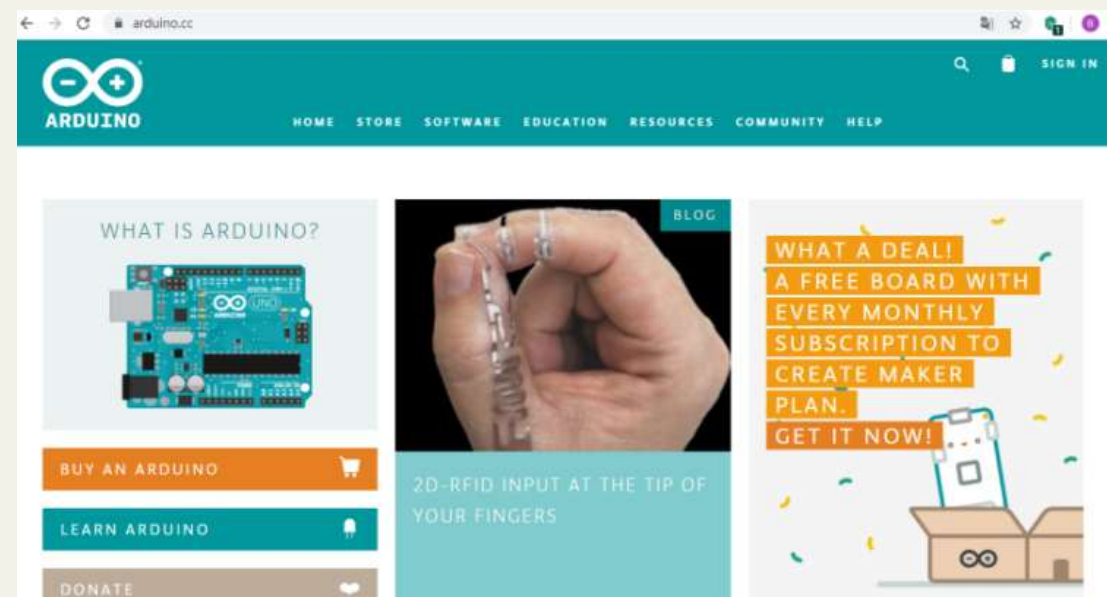
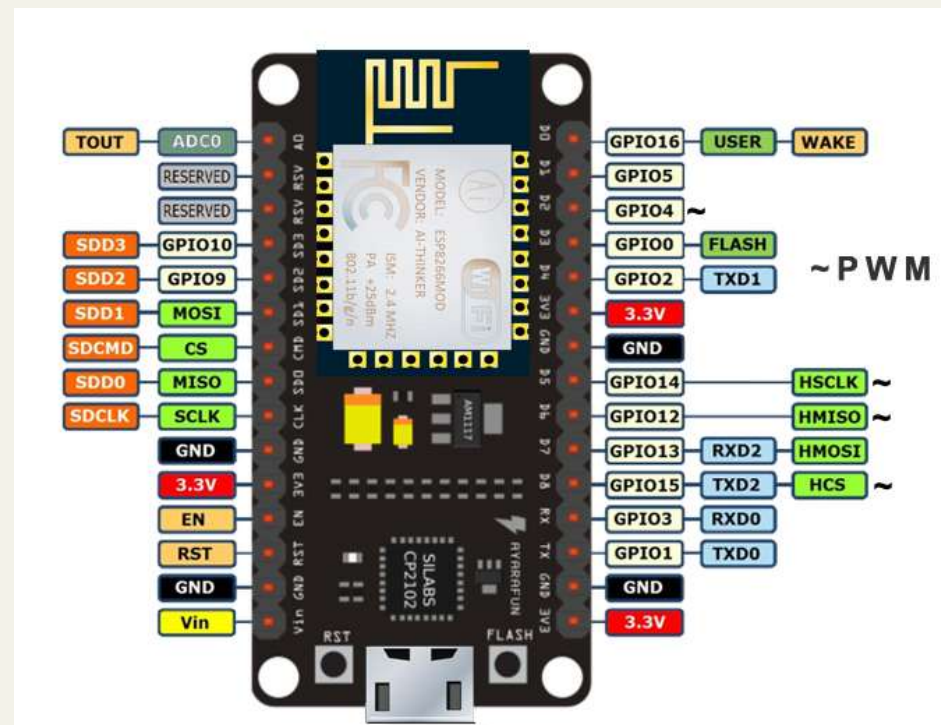
ESP8266 node MCU	Servo Motor
3V3	V(Red)
GND	GND(Brown)
D4(GPIO2)	Signal(Orange)

ESP8266 node MCU	OLED display
3V3	VCC
GND	GND
D1	SCL
D2	SDA

ESP8266 node MCU	TTS module	Speaker
	SPK+	O
	SPK-	O
5V	5V(Red)	
GND	GND(Brown)	
TX	RX	

NodeMCU 簡介

- ▶ NodeMCU是一款基於**ESP8266 Wi-Fi模組**的開源物聯網平台
- ▶ 結合了**Wi-Fi連接和微控制器功能**
- ▶ 使開發者能夠**輕鬆構建物聯網進行研習**





編程



20260122 Opendata

1_NodeMCU

2_Servo

3_OLED

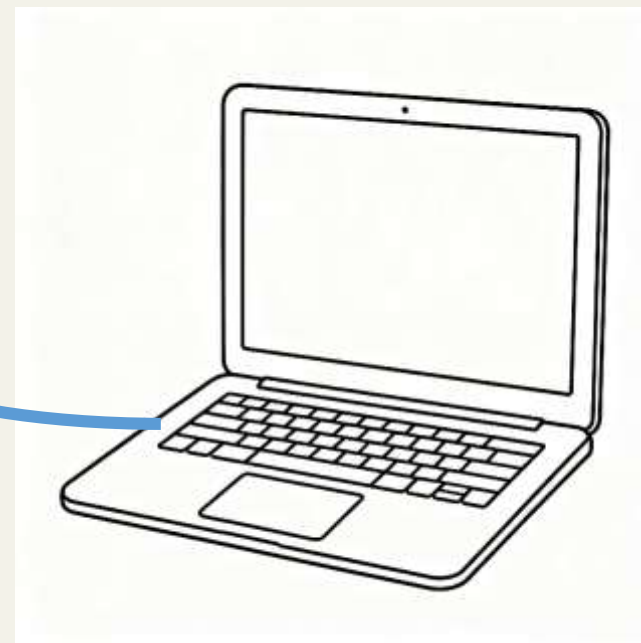
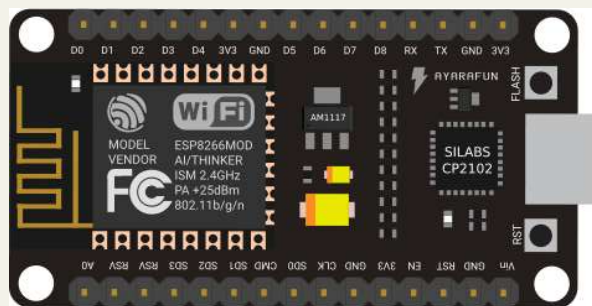
4_Text_to_Speech

5_BUS ETA

6_HKO

ANS

Images



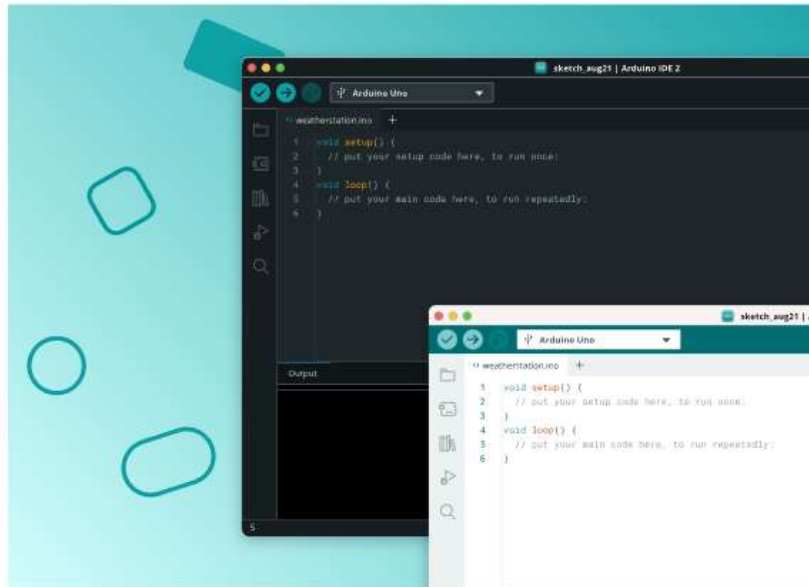
打開'1_NodeMCU.ino'



Arduino 開發軟件

► 安裝Arduino 開發工具軟體IDE

<https://www.arduino.cc/en/software>



Arduino IDE 2.3.7

[Release notes](#)

The new major release of the Arduino IDE is faster and even more powerful! In addition to a more modern editor and a more responsive interface it features autocompletion, code navigation, and even a live debugger. For more details, check the [Arduino IDE 2.0 documentation](#).

Windows Win 10 or newer (64-bit)

DOWNLOAD

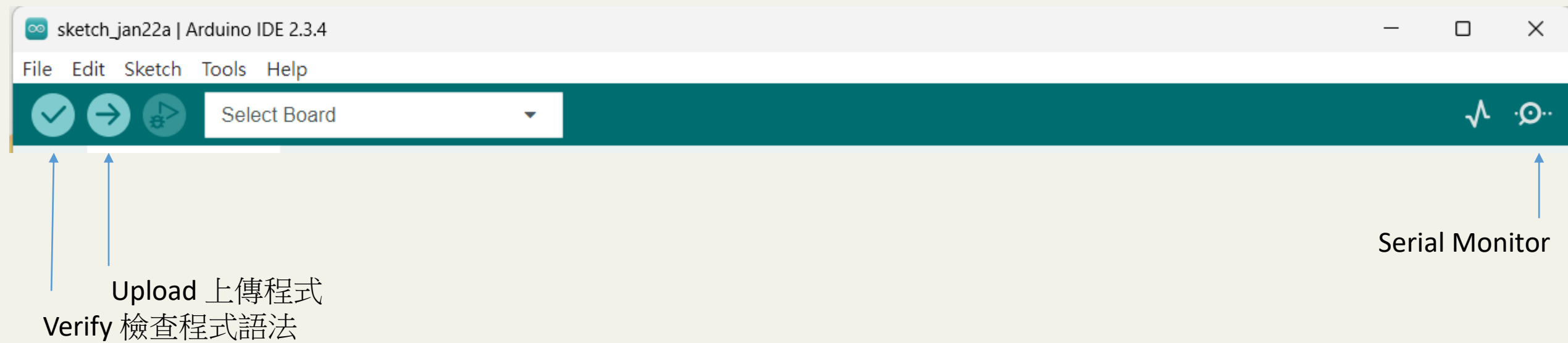


Nightly Builds

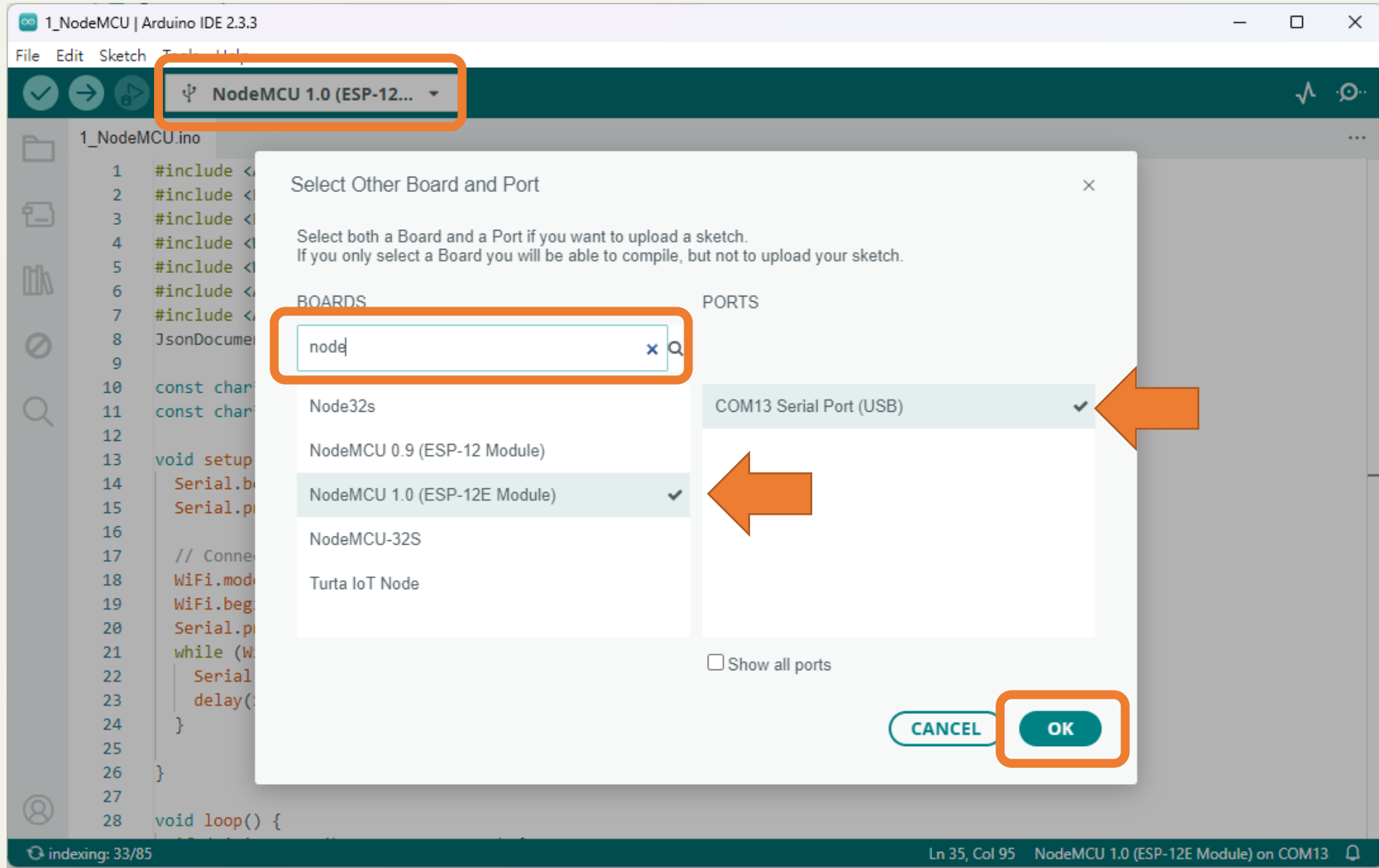
Download a preview of the incoming release with the most updated features and bugfixes.

The Arduino IDE 2.0 is open source and its source code is hosted on [GitHub](#).

【Arduino IDE介面介紹】



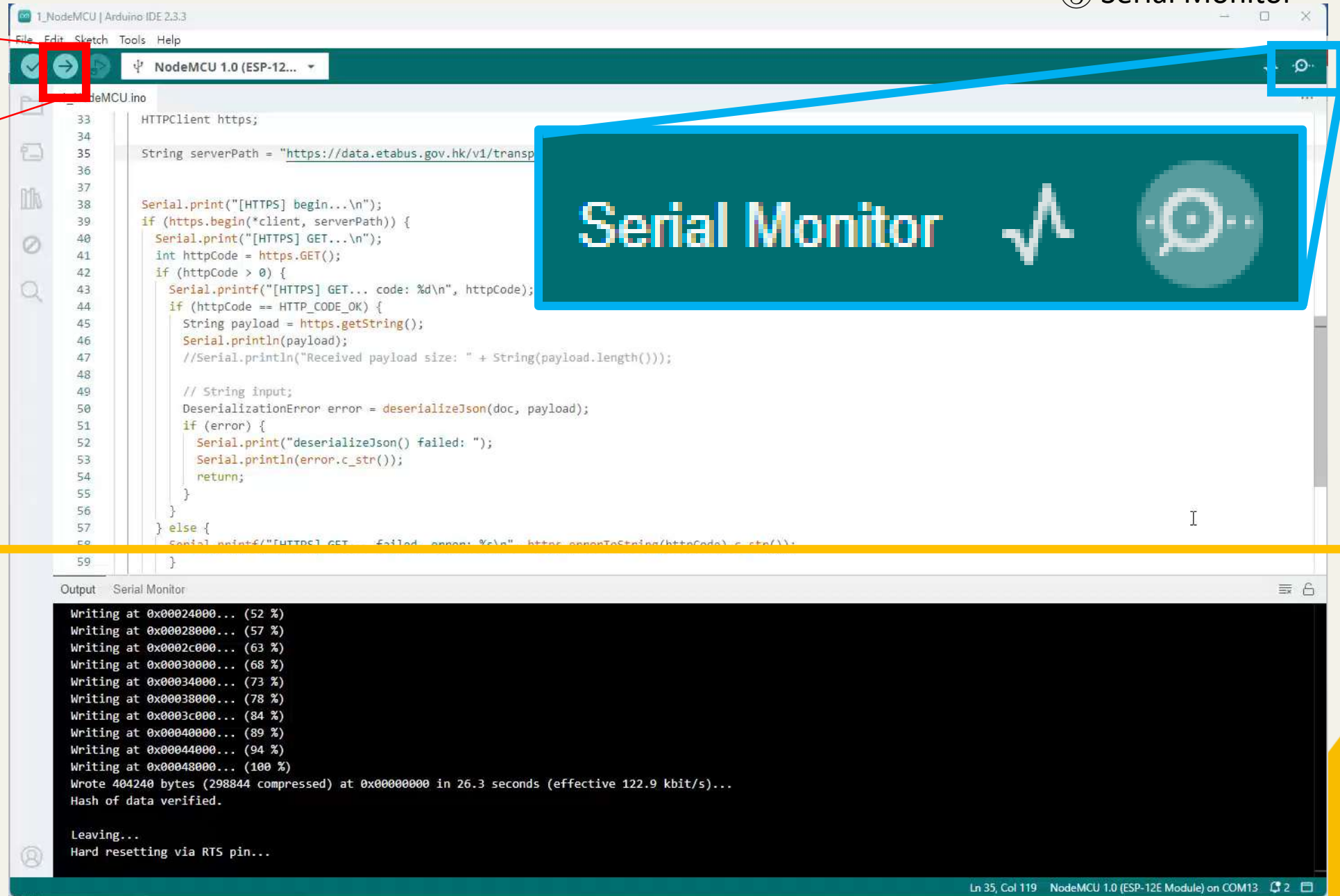
NodeMCU 開發板



①上載程式

Upload

③ Serial Monitor



② Done uploading

Serial Monitor



35

```
[{"type": "StopOTA", "version": "1.0", "generated_timestamp": "2026-01-15T11:11:56+08:00", "data": [{"co": "K08", "route": "2300", "dir": "1", "service_type": "1", "seq": "4", "dest_tc": "臺灣(海濱花園)", "dest_sc": "臺灣(海濱花園)", "dest_en": "TSUEN WAN (RIVIERA GARDENS)", "eta_seq": "1", "eta": "2026-01-15T11:14:47+08:00", "rmk_tc": "原定班次", "rmk_sc": "原定班次", "rmk_en": "Scheduled Bus", "data_timestamp": "2026-01-15T11:11:45+08:00"}, {"co": "K08", "route": "2300", "dir": "1", "service_type": "1", "seq": "10", "dest_tc": "臺灣(海濱花園)", "dest_sc": "臺灣(海濱花園)", "dest_en": "TSUEN WAN (RIVIERA GARDENS)", "eta_seq": "2", "eta": "2026-01-15T11:15:47+08:00", "rmk_tc": "原定班次", "rmk_sc": "原定班次", "rmk_en": "Scheduled Bus", "data_timestamp": "2026-01-15T11:11:45+08:00"}, {"co": "K08", "route": "2300", "dir": "1", "service_type": "1", "seq": "16", "dest_tc": "臺灣(海濱花園)", "dest_sc": "臺灣(海濱花園)", "dest_en": "TSUEN WAN (RIVIERA GARDENS)", "eta_seq": "3", "eta": "2026-01-15T11:16:47+08:00", "rmk_tc": "原定班次", "rmk_sc": "原定班次", "rmk_en": "Scheduled Bus", "data_timestamp": "2026-01-15T11:11:45+08:00"}, {"co": "K08", "route": "2300", "dir": "1", "service_type": "1", "seq": "4", "dest_tc": "臺灣(海濱花園)", "dest_sc": "臺灣(海濱花園)", "dest_en": "TSUEN WAN (RIVIERA GARDENS)", "eta_seq": "1", "eta": "2026-01-15T11:54:47+08:00", "rmk_tc": "原定班次", "rmk_sc": "原定班次", "rmk_en": "Scheduled Bus", "data_timestamp": "2026-01-15T11:11:45+08:00"}, {"co": "K08", "route": "330", "dir": "0", "service_type": "1", "seq": "5", "dest_tc": "油蔴地", "dest_sc": "油蔴地", "dest_en": "YAU TONG", "eta_seq": "1", "eta": "2026-01-15T11:45:11+08:00", "rmk_tc": "原定班次", "rmk_sc": "原定班次", "rmk_en": "Scheduled Bus", "data_timestamp": "2026-01-15T11:11:45+08:00"}, {"co": "K08", "route": "330", "dir": "0", "service_type": "1", "seq": "5", "dest_tc": "油蔴地", "dest_sc": "油蔴地", "dest_en": "YAU TONG", "eta_seq": "1", "eta": null, "rmk_tc": "服務只限於星期六、日及公眾假期", "rmk_sc": "服務只限於星期六、日及公眾假期", "rmk_en": "This route only operates on Saturdays, Sundays and Public Holidays", "data_timestamp": "2026-01-15T11:11:45+08:00"}, {"co": "K08", "route": "330", "dir": "0", "service_type": "1", "seq": "5", "dest_tc": "油蔴地", "dest_sc": "油蔴地", "dest_en": "YAU TONG", "eta_seq": "1", "eta": null, "rmk_tc": "服務只限於星期六、日及公眾假期", "rmk_sc": "服務只限於星期六、日及公眾假期", "rmk_en": "This route only operates on Saturdays, Sundays and Public Holidays", "data_timestamp": "2026-01-15T11:11:45+08:00"}, {"co": "K08", "route": "380", "dir": "1", "service_type": "1", "seq": "10", "dest_tc": "臺灣(海濱花園)", "dest_sc": "臺灣(海濱花園)", "dest_en": "TSUEN WAN (RIVIERA GARDENS)", "eta_seq": "1", "eta": "2026-01-15T11:14:10+08:00", "rmk_tc": "原定班次", "rmk_sc": "原定班次", "rmk_en": "Scheduled Bus", "data_timestamp": "2026-01-15T11:11:45+08:00"}, {"co": "K08", "route": "380", "dir": "1", "service_type": "1", "seq": "16", "dest_tc": "臺灣(海濱花園)", "dest_sc": "臺灣(海濱花園)", "dest_en": "TSUEN WAN (RIVIERA GARDENS)", "eta_seq": "2", "eta": "2026-01-15T11:15:10+08:00", "rmk_tc": "原定班次", "rmk_sc": "原定班次", "rmk_en": "Scheduled Bus", "data_timestamp": "2026-01-15T11:11:45+08:00"}, {"co": "K08", "route": "380", "dir": "1", "service_type": "1", "seq": "10", "dest_tc": "臺灣(海濱花園)", "dest_sc": "臺灣(海濱花園)", "dest_en": "TSUEN WAN (RIVIERA GARDENS)", "eta_seq": "1", "eta": null, "rmk_tc": "服務只限於星期六、日及公眾假期", "rmk_sc": "服務只限於星期六、日及公眾假期", "rmk_en": "This route only operates on Saturdays and Public Holidays", "data_timestamp": "2026-01-15T11:11:45+08:00"}, {"co": "K08", "route": "R230", "dir": "0", "service_type": "1", "seq": "11", "dest_tc": "交通總匯(康翠園)", "dest_sc": "交通總匯(康翠園)", "dest_en": "TSUI SPA TSUI EAST (KOWLOON)", "eta_seq": "1", "eta": null, "rmk_tc": "服務只限於星期六及公眾假期", "rmk_sc": "服務只限於星期六及公眾假期", "rmk_en": "This route only operates on Saturdays and Public Holidays", "data_timestamp": "2026-01-15T11:11:45+08:00"}]}
```



美化排版 ☒

```
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  "version": "1.0",
  "generated_timestamp": "2025-11-17T12:11:53+08:00",
  "data": [
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      "route": "238M",
      "dir": "I",
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      "seq": 4,
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      "dest_sc": "荃灣(海濱花園)",
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      "rmk_en": "",
      "data_timestamp": "2025-11-17T12:11:47+08:00"
    },
    {
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      "route": "238M",
      "dir": "I",
      "service_type": 1,
      "seq": 4,
      "dest_tc": "荃灣(海濱花園)",
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  ]
}
```

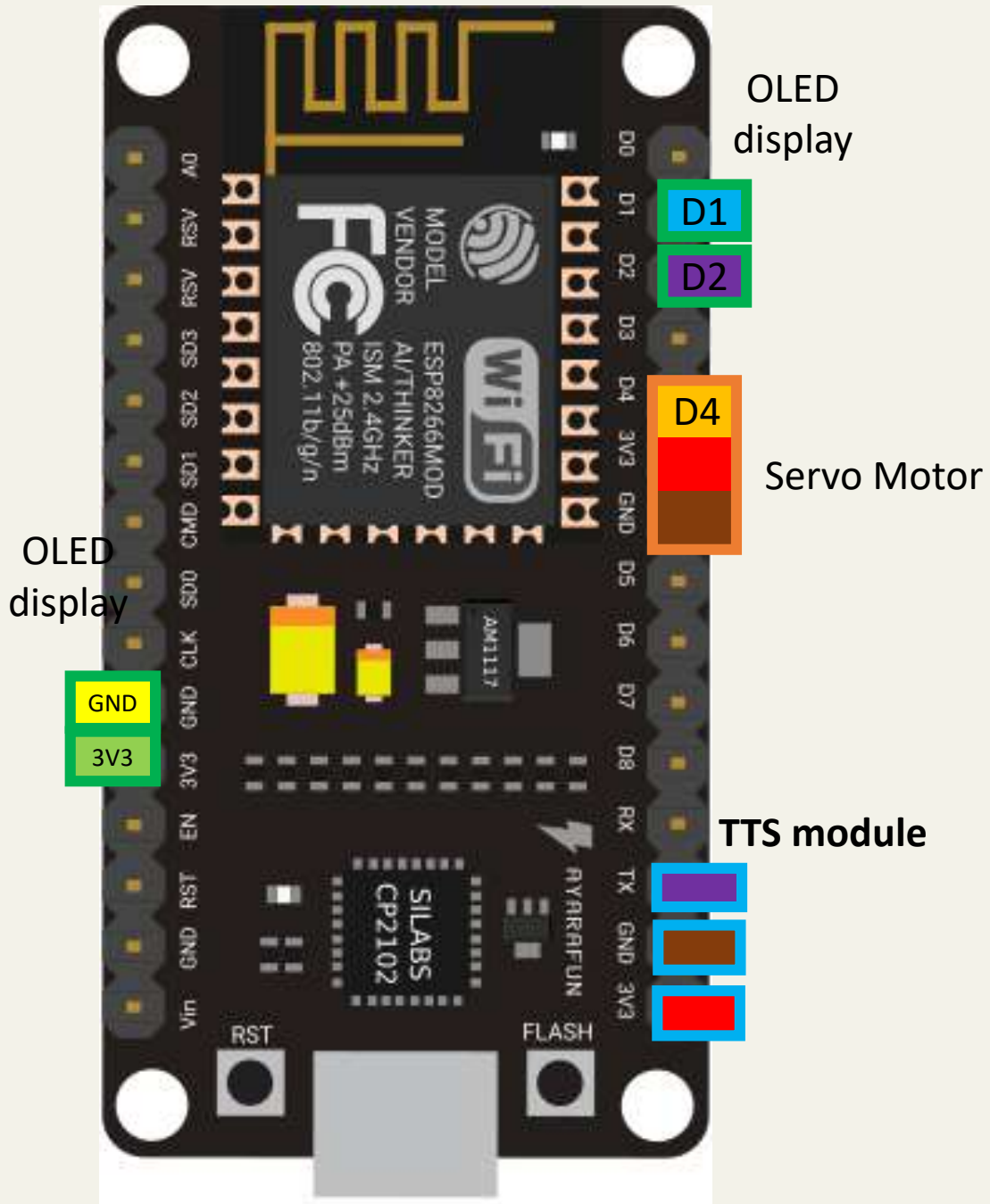
Wifi id and password

```
const char* ssid = "Wifi id";  
const char* password = "Wifi password";
```

Servo Motor 伺服馬達



Servo Motor 伺服馬達



ESP8266 node MCU	Servo Motor
5V	5V(Red)
GND	GND(Brown)
D4(GPIO2)	Signal(Orange)

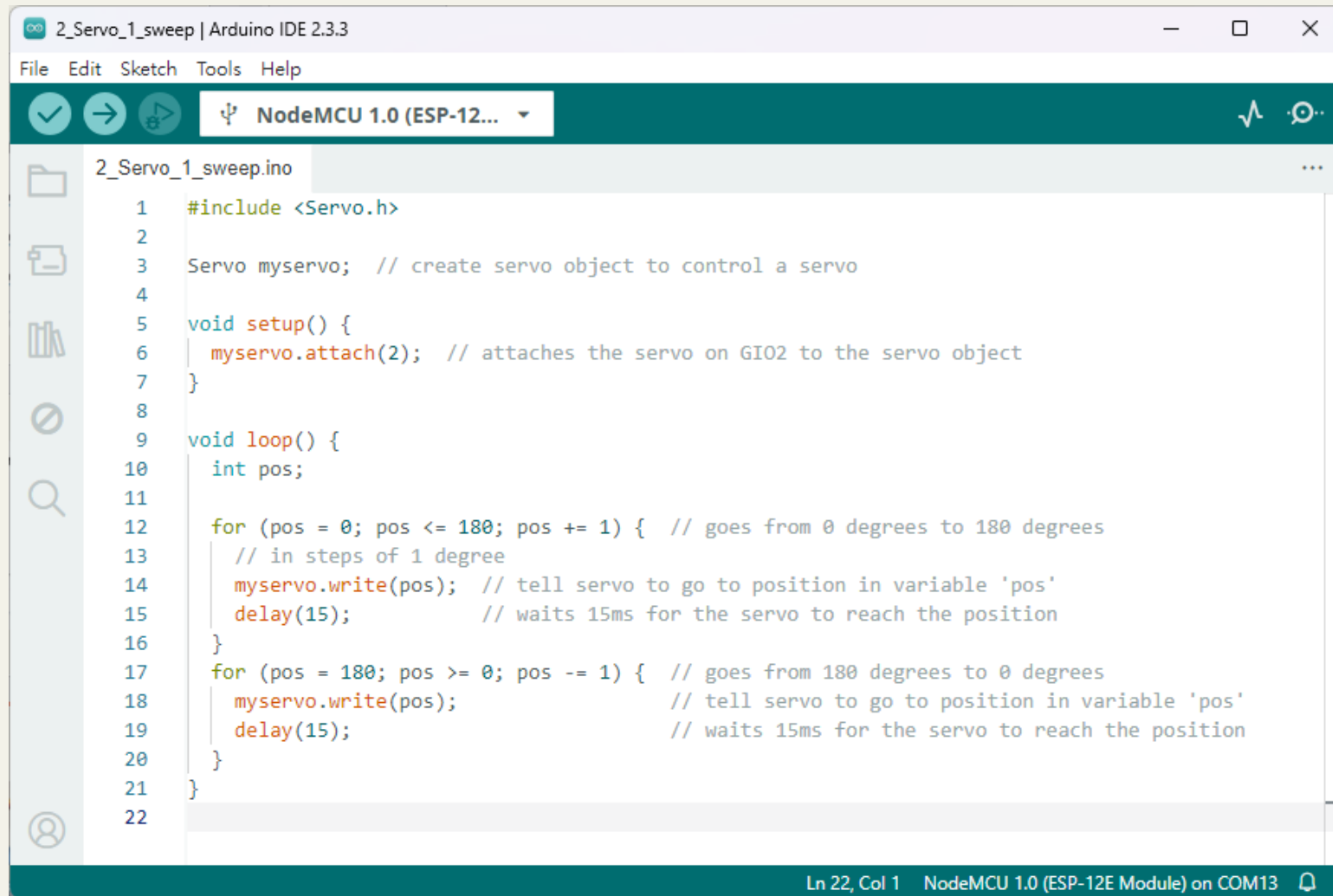
伺服馬達

- 由馬達、電位計和控制器組成
- 透過控制器對馬達進行精確的控制，使得馬達能夠按照預定的速度和位置進行運動

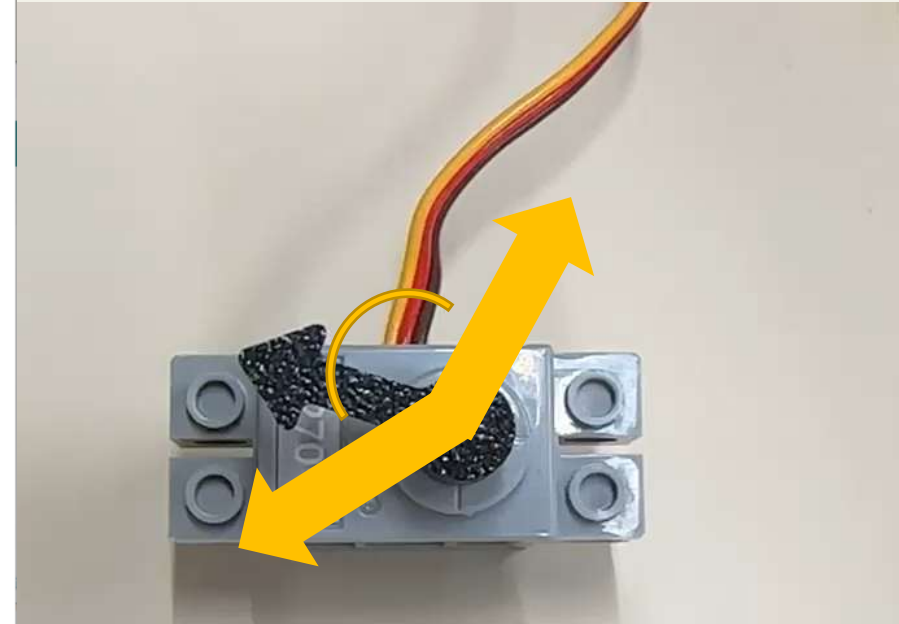


[source] 超圖解Arduino互動設計入門 第3版

上載程式 “2_Servo.ino”



```
2_Servo_1_sweep | Arduino IDE 2.3.3
File Edit Sketch Tools Help
NodeMCU 1.0 (ESP-12...
2_Servo_1_sweep.ino
1  #include <Servo.h>
2
3  Servo myservo; // create servo object to control a servo
4
5  void setup() {
6    myservo.attach(2); // attaches the servo on GPIO2 to the servo object
7  }
8
9  void loop() {
10   int pos;
11
12   for (pos = 0; pos <= 180; pos += 1) { // goes from 0 degrees to 180 degrees
13     // in steps of 1 degree
14     myservo.write(pos); // tell servo to go to position in variable 'pos'
15     delay(15);          // waits 15ms for the servo to reach the position
16   }
17   for (pos = 180; pos >= 0; pos -= 1) { // goes from 180 degrees to 0 degrees
18     myservo.write(pos); // tell servo to go to position in variable 'pos'
19     delay(15);          // waits 15ms for the servo to reach the position
20   }
21 }
22
Ln 22, Col 1 NodeMCU 1.0 (ESP-12E Module) on COM13
```





VS



PWM Signals

Pulse Width Modulation (PWM)

- A PWM is a rectangular signal has a period and a duty cycle. The period is when it repeats and the duty cycle is the width of the HIGH time.
- PWMs are commonly used to dim LEDs and control Servo motors.

50% duty cycle



75% duty cycle



25% duty cycle

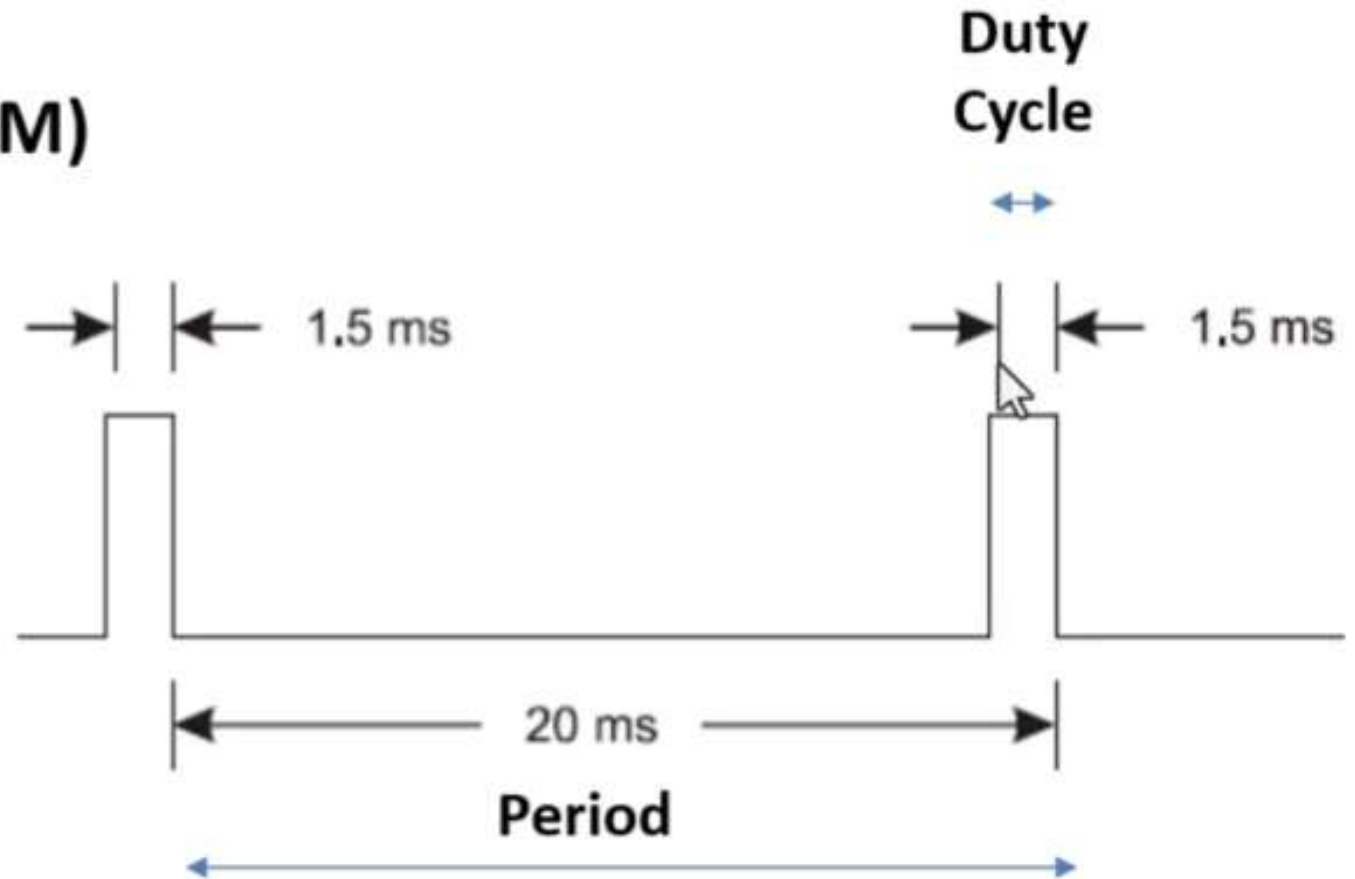


Period

Arduino Servo Library

Pulse Width Modulation (PWM)

- The Arduino has a library called "Servo" that can automatically generate a PWM signal specifically for controlling servo motors.
- The period always is 20ms.
- The duty cycle is variable.



Arduino Servo Library



```
1 #include <Servo.h>
2
3 Servo myservo; // create servo object to control a servo
4
5 void setup() {
6   myservo.attach(2); // attaches the servo on GIO2 to the servo object
7 }
8
9 void loop() {
10   int pos;
11
12   for (pos = 0; pos <= 180; pos += 1) { // goes from 0 degrees to 180 degrees
13     // in steps of 1 degree
14     myservo.write(pos); // tell servo to go to position in variable 'pos'
15     delay(15); // waits 15ms for the servo to reach the position
16   }
17   for (pos = 180; pos >= 0; pos -= 1) { // goes from 180 degrees to 0 degrees
18     myservo.write(pos); // tell servo to go to position in variable 'pos'
19     delay(15); // waits 15ms for the servo to reach the position
20   }
21 }
22
```

伺服馬達角度

0°

180°

脈衝寬度

1000us

2000us

伺服馬達

- 脈衝寬度對應角度值
 - 45deg >600us
 - 90deg>1500us
 - 225deg>2400us



产品参数

宝贝名称	伺服舵机
工作电压:	3.3V ~ 6V
额定电压:	4.8V
额定电流:	200ma
堵转电流:	700ma
打滑电流:	450ma
最大扭矩:	500g.cm
角度转速:	60 ° /0.12s
最高转速:	/
脉冲宽度对应角度值:	-45度-600us、 90度-1500us、 225度-2400us

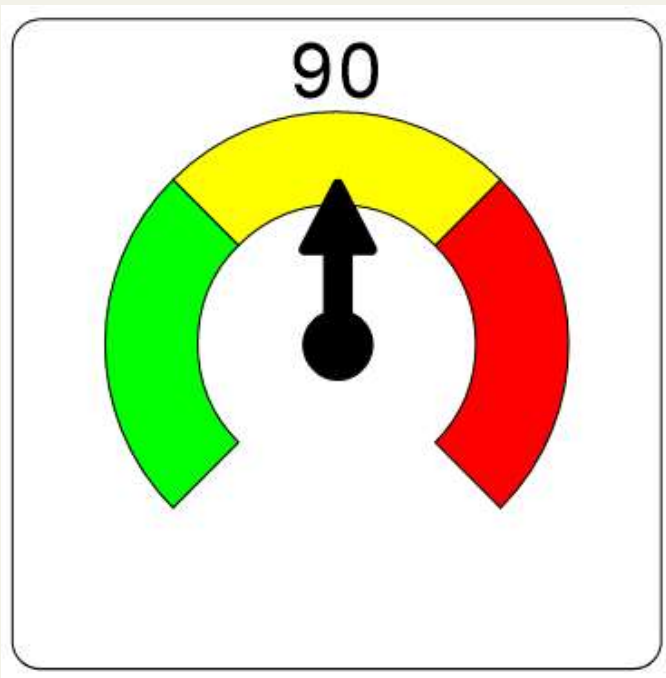
“2_Servo.ino”

→ 修改程式

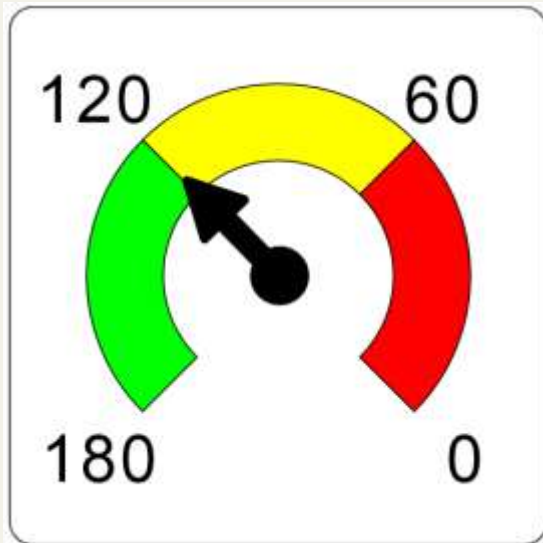
```
1  #include <Servo.h>
2
3  Servo myservo;
4
5  void setup() {
6    myservo.attach(2); // attaches the servo on GPIO2 to the servo object
7  }
8
9  void loop() {
10   int pos;
11
12   for (pos = 0; pos <= 180; pos += 1) { // goes from 0 degrees to 180 degrees
13     // in steps of 1 degree
14     myservo.write(pos); // tell servo to go to position in variable 'pos'
15     delay(15);          // waits 15ms for the servo to reach the position
16   }
17   for (pos = 180; pos >= 0; pos -= 1) { // goes from 180 degrees to 0 degrees
18     myservo.write(pos); // tell servo to go to position in variable 'pos'
19     delay(15);          // waits 15ms for the servo to reach the position
20   }
21 }
22
```

Ln 22, Col 1 NodeMCU 1.0 (ESP-12E Module) on COM13

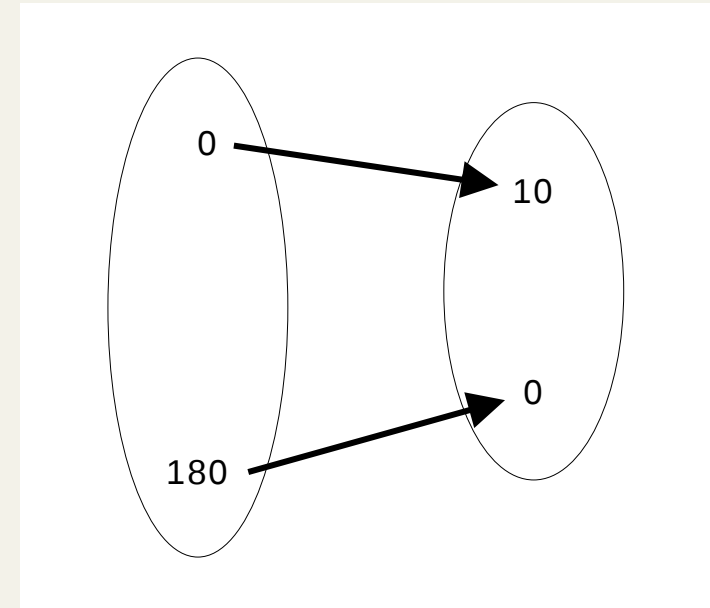
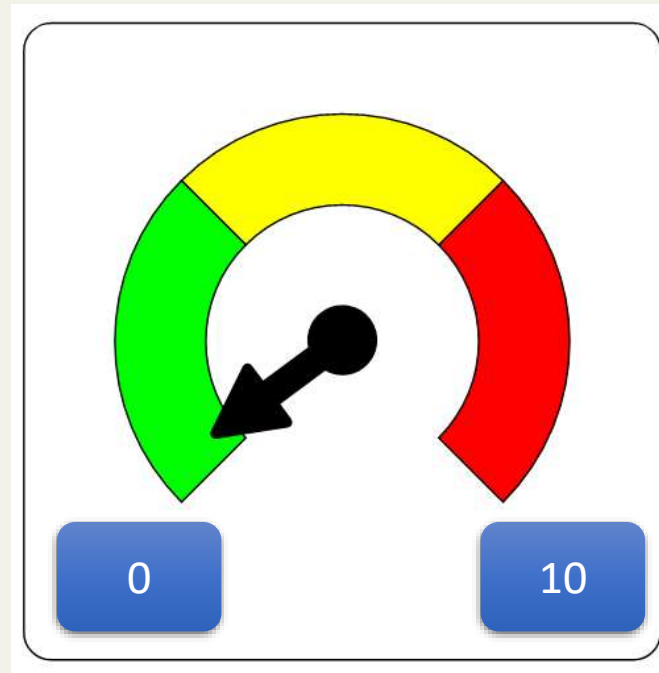
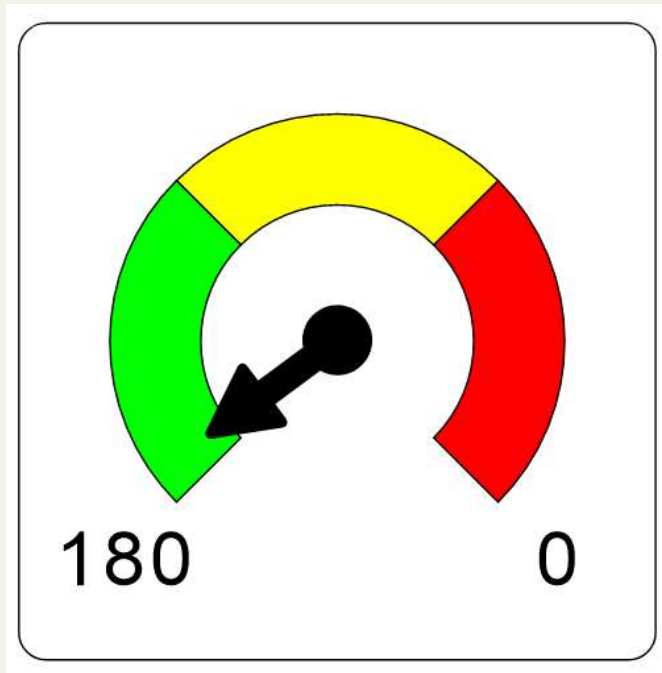




```
10 void loop() {
11     int pos;
12
13     for (pos = 0; pos <= 180; pos += 1) { // goes from 0 degrees to 180 degrees
14         // in steps of 1 degree
15         myservo.write(pos); // tell servo to go to position in variable 'pos'
16         delay(15);          // waits 15ms for the servo to reach the position
17     }
18     for (pos = 180; pos >= 0; pos -= 1) { // goes from 180 degrees to 0 degrees
19
20         myservo.write(pos);          // tell servo to go to position in variable 'pos'
21         delay(15);                    // waits 15ms for the servo to reach the position
22     }
23
24     delay(2000);
25     myservo.write(90);
26     delay(2000);
27
28
29
30
31
32
33
34
35
36
37
38
39
40 }
```

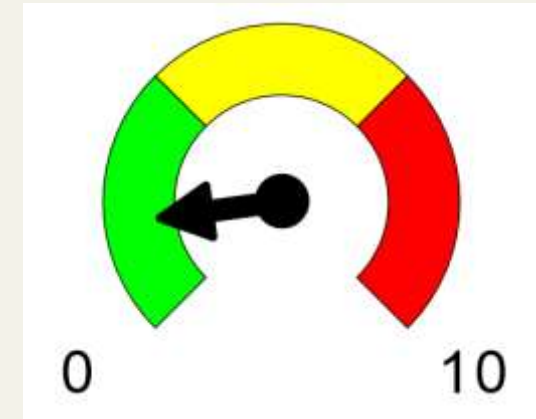


```
10 void loop() {
11     int pos;
12
13     for (pos = 0; pos <= 180; pos += 1) { // goes from 0 degrees to 180 degrees
14         // in steps of 1 degree
15         myservo.write(pos); // tell servo to go to position in variable 'pos'
16         delay(15);          // waits 15ms for the servo to reach the position
17     }
18     for (pos = 180; pos >= 0; pos -= 1) { // goes from 180 degrees to 0 degrees
19
20         myservo.write(pos);          // tell servo to go to position in variable 'pos'
21         delay(15);                    // waits 15ms for the servo to reach the position
22     }
23
24     delay(2000);
25     myservo.write(90);
26     delay(2000);
27
28     myservo.write(120);
29     delay(1000);
30     myservo.write(60);
31     delay(1000);
32
33
34
35
36
37
38
39
40 }
```



Mapping (映射)

```
10 void loop() {
11   int pos;
12
13   for (pos = 0; pos <= 180; pos += 1) { // goes from 0 degrees to 180 degrees
14     // in steps of 1 degree
15     myservo.write(pos); // tell servo to go to position in variable 'pos'
16     delay(15);          // waits 15ms for the servo to reach the position
17   }
18   for (pos = 180; pos >= 0; pos -= 1) { // goes from 180 degrees to 0 degrees
19
20     myservo.write(pos);          // tell servo to go to position in variable 'pos'
21     delay(15);                  // waits 15ms for the servo to reach the position
22   }
23
24   delay(2000);
25   myservo.write(90);
26   delay(2000);
27
28
29   myservo.write(120);
30   delay(1000);
31   myservo.write(60);
32   delay(1000);
33
34   int value = 2;
35   int angle = map(value, 10, 0, 0, 180);
36   myservo.write(angle);
37   delay(2000);
38
39
40 }
```



```
int value = 2;
int angle = map(value, 10, 0, 0, 180);
myservo.write(angle);
delay(2000);
```

OLED 顯示屏

SSD1306 OLED 0.96吋顯示屏

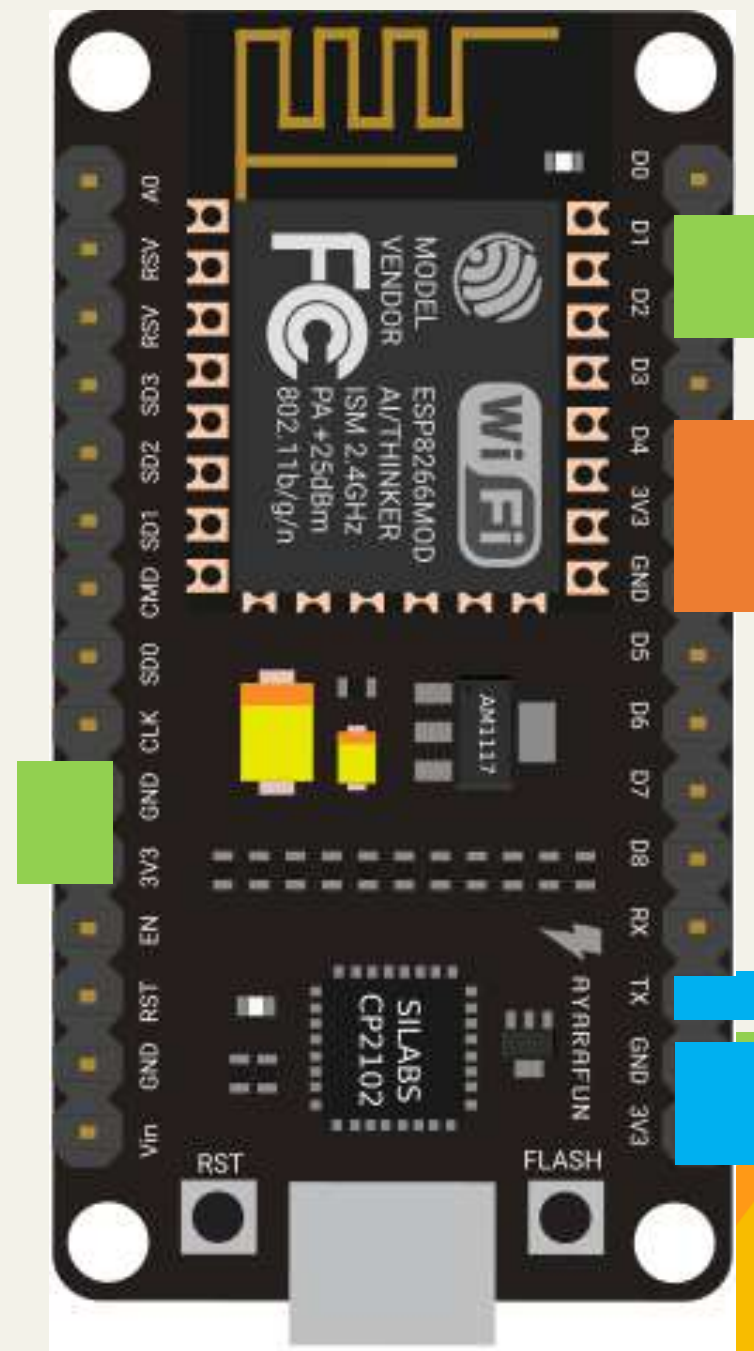


OLED 顯示屏

- 0.96吋顯示屏
- 可顯示文字或圖形
- 解析度為128x64像素



ESP8266 node MCU	OLED display
3V3	VCC
GND	GND
D1	SCL
D2	SDA



上載程式“3_OLED.ino”

```
void testdrawstyles(void) {  
  
    display.clearDisplay();  
    display.setTextColor(1);           // 1:OLED預設的顏色(這個會依該OLED的顏色來決定)  
    display.setTextSize(2);            // 設定文字大小  
    display.setCursor(20,0);           // 設定起始座標  
    display.print("Hello");            // 要顯示的字串  
    display.display();                 // 要有這行才會把文字顯示出來  
    delay(1000);  
}
```

→練習: 修改程式，在顯示屏另一位置上顯示另一組文字，且文字大小不同



建議答案

```
void testdrawstyles(void) {  
  
    display.clearDisplay();  
    display.setTextColor(1);           // 1:OLED預設的顏色(這個會依該OLED的顏色來決定)  
    display.setTextSize(2);           // 設定文字大小  
    display.setCursor(20,0);          // 設定起始座標  
    display.print("Hello");           // 要顯示的字串  
    display.display();                // 要有這行才會把文字顯示出來  
    //delay(1000);  
    display.setTextSize(4);           // 設定文字大小  
    display.setCursor(0,20);          // 設定起始座標  
    display.print("STEM");            // 要顯示的字串  
    display.display();                // 要有這行才會把文字顯示出來  
    delay(1000);  
}
```



Text to Speech (TTS) Module

文字轉語音模塊

“4_Text_to_Speech.ino”

```
//发送TTS数据包测试DTS33A语音模块
int Send_Data_To_TTS_Module(void)
{
    String TTS_String = "Welcome to STEM Education Centre ";
    //Example//String TTS_String = "[v1][s3][t5]The next bus will arrive in three minutes ";
    //The meaning of [v3][s3][t0] is to simultaneously set the volume , speed and tone to level 3,(0-9)
    //共消费[n2]100 元, 请拨打电话[n1]12325, 手机号码[n3]16620527001。
    // [n*] *为 1 时按数字发音, *为2 时按数值发音, *为3时按电话号码格式发音

    u16 data_len=0;
    data_len = TTS_String.length()+2;//data length//数据包的长度

    Serial.write(0xFD);          //head//数据头
    Serial.write(data_len>>8);    //length H//数据包长度 高位字节
    Serial.write(data_len);       //length //数据包长度 低位字节

    Serial.write(0x01);          //CMD//命令字
    Serial.write(0x04);          //REF=UTF-8//编码参数, 0x04代表UTF-8
    Serial.println(TTS_String);   //Text content that needs to be synthesized//需要合成的文本内容

    return 1;
}
```



```
//发送TTS数据包测试DTS33A语音模块
int Send_Data_To_TTS_Module(void)
{
    String TTS_String = "Welcome to STEM Education Centre ";
    //Example//String TTS_String = "[v1][s3][t5] Welcome to STEM Education Centre ";
    //The meaning of [v3][s3][t0] is to simultaneously set the volume , speed and tone to level 3,(0-9)
    //共消费[n2]100 元，请拨打电话[n1]12325，手机号码[n3]16620527001。
    // [n*] *为 1 时按数字发音，*为2 时按数值发音，*为3时按电话号码格式发音

    u16 data_len=0;
    data_len = TTS_String.length()+2;//data length//数据包的长度

    Serial.write(0xFD);           //head//数据头
    Serial.write(data_len>>8);     //length H//数据包长度 高位字节
    Serial.write(data_len);        //length //数据包长度 低位字节

    Serial.write(0x01);           //CMD//命令字
    Serial.write(0x04);           //REF=UTF-8//编码参数，0x04代表UTF-8
    Serial.println(TTS_String);    //Text content that needs to be synthesized//需要合成的文本内容

    return 1;
}
```

練習

→修改程式，改變音量、聲調及語速

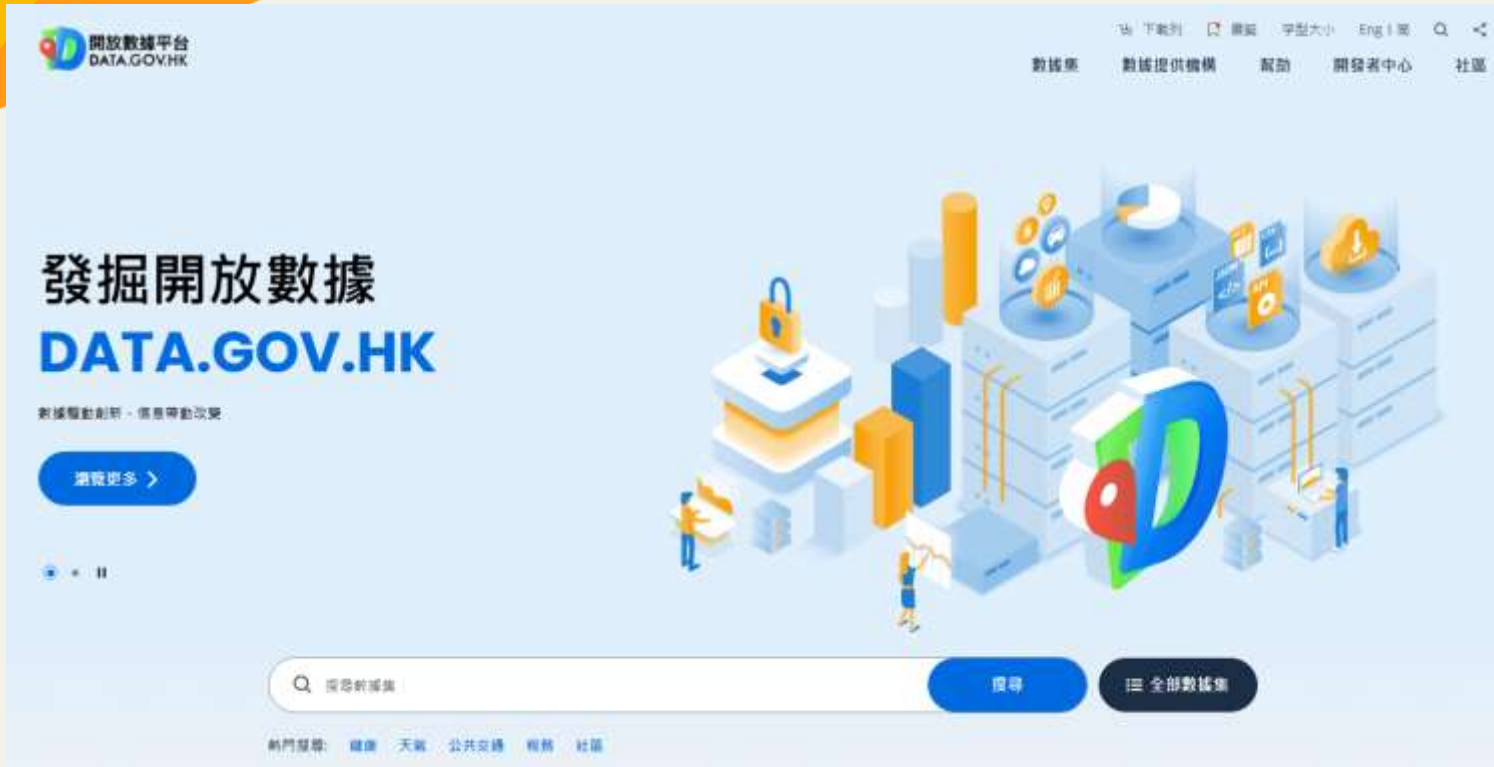
→例句: “The next bus will arrive in three minutes ”



主題 1：巴士到站提示







<https://data.gov.hk/>

「開放數據平台」以機器可讀格式提供開放數據，供商業或非商業目的免費重複使用，以促進網絡和移動應用程序和解決方案的開發，以及學術研究和分析。

九龍巴士及龍運巴士路線實時到站數據

https://data.gov.hk/tc-data/dataset/hk-td-tis_21-etakmb

▼ 9個JSON格式的數據資源

- 巴士站列表數據
- 網址: <https://data.etabus.gov.hk/v1/transport/kmb/stop>
- 預計到達時間數據(巴士站)
- 網址: https://data.etabus.gov.hk/v1/transport/kmb/stop-eta/{stop_id}



打開檔案” 5_BUS_ETA.ino”

1. <https://search.kmb.hk/kmbwebsite/>
2. <https://data.etabus.gov.hk/v1/transport/kmb/stop>
3. https://data.etabus.gov.hk/v1/transport/kmb/stop-eta/{stop_id}



► <https://search.kmb.hk/kmbwebsite/>

KMB

LWB

ENG

繁

簡

|

A

巴士路線

11D

搜尋

乘客資訊

路線及收費

路線開出

● 樂富總站 (WT901)

○ 杏林街 (WT626)

○ 嘉諾撒聖家學校 (KC630)

○ 衙前圍道 (KC632)

○ 侯王道 (KC253)

○ 九龍城轉車站-富豪 \$5.8 東方酒店

○ 譽·港灣 (WT297)

○ 采頤花園 (WT302)

○ 坪石邨 (WT307)

○ 啟業邨 (KT316)

○ 九龍灣站(東九文化)

Map showing the route of bus 11D, starting from Leung Fook Station (WT901) and ending at Kowloon Station (East Kowloon Cultural Centre). The route is highlighted in blue and orange, passing through various MTR stations and landmarks.

► 複製文字 “延文禮士道 (WT220)”

巴士路線 11D

觀塘碼頭 (KT942)

敬業街 (KT215)

成樂街休憩公園 (KT448)

觀塘駿業里 (KT629)

觀塘轉車站 - 龍紀之庭 (KT636)

觀塘轉車站 - 牛棚角站 (KT645)

觀塘定富街 (KT646)

香港建造學院-九龍灣院校

德福花園 (KT658)

11D 往樂富

延文禮士道 (WT220)

途經此站的巴士路線:
7B, 85, 11D, 75X, 85A

11D 往樂富

譽·港灣 (WT698)

太子道東工業貿易大樓外

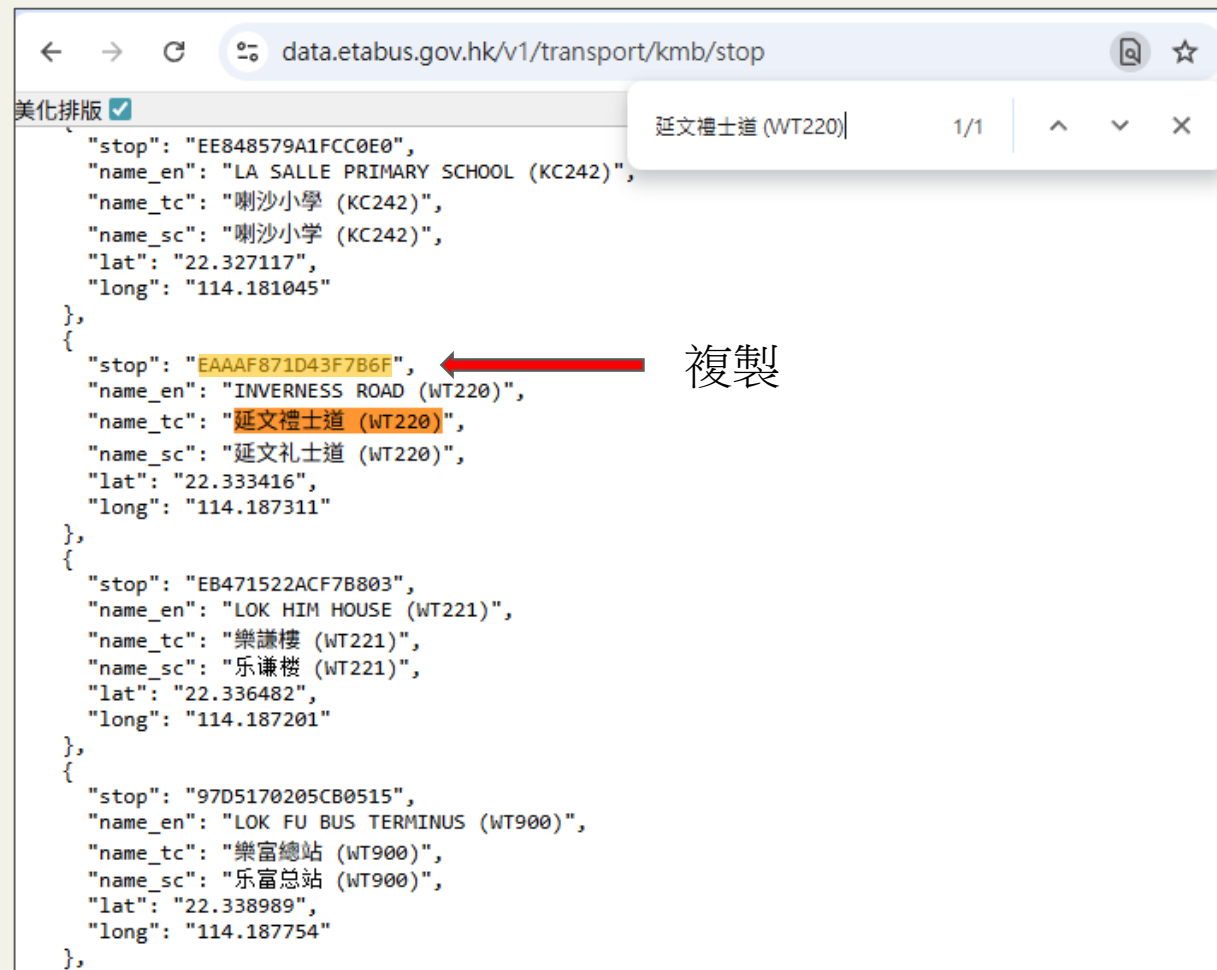
途經此站的巴士路線:
13, 16, 1A, 24, 27, 2A, 42, 11D, 13D, 16P, 16X, 27X, 98C, 98S, 213D, 296C, 298X

<https://data.etabus.gov.hk/v1/transport/kmb/stop>

✓美化排版

→“Ctrl + F”搜尋巴士站

→複製“stop id”



在 .ino 上作修改

https://data.etabus.gov.hk/v1/transport/kmb/stop-eta/{stop_id}



<https://data.etabus.gov.hk/v1/transport/kmb/stop-eta/EAAAF871D43F7B6F>

打開網址

<https://data.etabus.gov.hk/v1/transport/kmb/stop-eta/EAAAF871D43F7B6F>

美化排版 ☒

```
{
  "type": "StopETA",
  "version": "1.0",
  "generated_timestamp": "2025-11-26T14:12:28+08:00",
  "data": [
    {
      "co": "KMB",
      "route": "11D",
      "dir": "I",
      "service_type": 1,
      "seq": 19,
      "dest_tc": "樂富",
      "dest_sc": "乐富",
      "dest_en": "LOK FU",
      "eta_seq": 1,
      "eta": "2025-11-26T14:41:34+08:00",
      "rmk_tc": "原定班次",
      "rmk_sc": "原定班次",
      "rmk_en": "Scheduled Bus",
      "data_timestamp": "2025-11-26T14:12:17+08:00"
    },
  ],
}
```

```
{
  "type": "StopETA",
  "version": "1.0",
  "generated_timestamp": "2026-01-09T16:44:08+08:00",
  "data": [
    {
      "co": "KMB",
      "route": "11D",
      "dir": "I",
      "service_type": 1,
      "seq": 19,
      "dest_tc": "樂富",
      "dest_sc": "乐富",
      "dest_en": "LOK FU",
      "eta_seq": 1,
      "eta": "2026-01-09T16:59:34+08:00",
      "rmk_tc": "",
      "rmk_sc": "",
      "rmk_en": "",
      "data_timestamp": "2026-01-09T16:43:48+08:00"
    },
    {
      "co": "KMB",
      "route": "11D",
      "dir": "I",
      "service_type": 1,
      "seq": 19,
      "dest_tc": "樂富",
      "dest_sc": "乐富",
      "dest_en": "LOK FU",
      "eta_seq": 2,
      "eta": "2026-01-09T17:22:58+08:00",
      "rmk_tc": "原定班次",
      "rmk_sc": "原定班次",
      "rmk_en": "Scheduled Bus",
      "data_timestamp": "2026-01-09T16:43:48+08:00"
    },
    {
      "co": "KMB",
      "route": "75X",
      "dir": "I",
      "service_type": 1,
      "seq": 1,
      "dest_tc": "樂富",
      "dest_sc": "乐富",
      "dest_en": "LOK FU",
      "eta_seq": 1,
      "eta": "2026-01-09T17:22:58+08:00",
      "rmk_tc": "原定班次",
      "rmk_sc": "原定班次",
      "rmk_en": "Scheduled Bus",
      "data_timestamp": "2026-01-09T16:43:48+08:00"
    },
  ],
}
```

修改程式 > 上載

```
void loop() {  
  if (WiFi.status() == WL_CONNECTED) {  
    std::unique_ptr<BearSSL::WiFiClientSecure> client(new BearSSL::WiFiClientSecure);  
    client->setInsecure();  
  
    HTTPClient https;  
  
    String serverPath = "https://data.etabus.gov.hk/v1/transport/kmb/stop-eta/EAAAF871D43F7B6F";  
    const char* route = "11D";  
    // 延文禮士道 (WT220)
```

結果

Output Serial Monitor x

Message (Enter to send message to 'NodeMCU 1.0 (ESP-12E Module)' on 'COM13') New Line 115200 baud

```
[HTTPS] begin...  
[HTTPS] GET...  
[HTTPS] GET... code: 200  
Date: 2025-12-24  
Time: 11:36  
Route :85A  
To :KWONG YUEN  
eta1 :2025-12-24T11:52:23+08:00  
16 mins  
eta2 :2025-12-24T12:22:21+08:00  
46 mins  
📍📶[v1][s3][t5]Bus will arrive in sixteen minutes  
Waiting 20s before the next round...
```

Serial Monitor

伺服馬達



OLED 顯示屏



文字轉語音模塊



練習1: 伺服馬達→顯示ETA



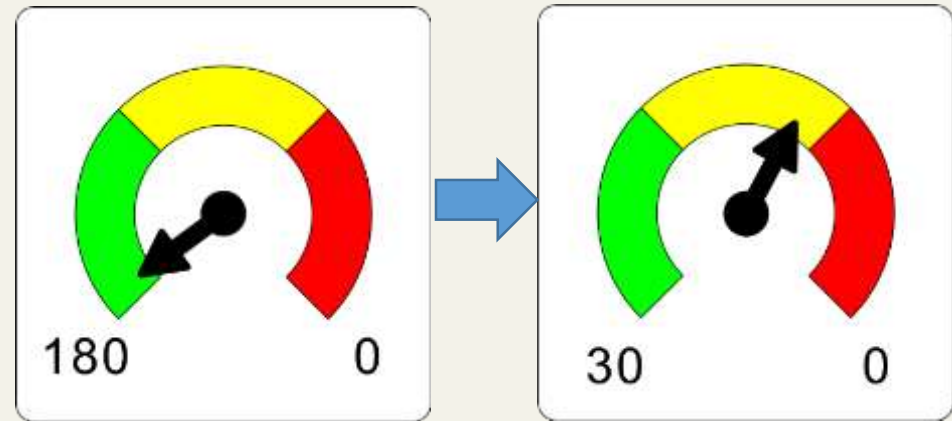
```
void setup() {
```



```
//myservo.attach(2); //Connect to D4  
myservo.attach(2, 600, 2300);  
myservo.write(90);  
delay(4000);  
int pos;
```

90degree

```
//task1 servo  
/*  
int angle = map(diffMinutes1, 10, 0, 0, 180);  
myservo.write(angle);  
delay(50);  
myservo.detach();*/
```



練習2: OLED 顯示屏→ 顯示第二個到站時間

```
if (diffMinutes1 >= 0) {  
    //oled  
    display.setTextColor(1); //WHITE  
    display.setCursor(0,0); //(128,64)  
    display.setTextSize(1);  
    display.print(route);  
    display.print(":");  
    display.println(destination);  
    display.setCursor(10,10);  
    display.setTextSize(2);  
    display.print(diffMinutes1, 0);  
    display.setCursor(30,15);  
    display.setTextSize(1);  
    display.print(" min");  
    display.display();  
}
```

```
222      /*if (diffMinutes2 >= 0) {  
223          //task2  
224          //To show the 2nd ETA  
225              display.setCursor(0,0);  
226              display.setTextSize(2);  
227              display.print(diffMinutes2, 0);  
228              display.setCursor(0,0);  
229              display.setTextSize(1);  
230              display.println("min");  
231              display.display();  
232      }  
233      */
```



練習3:文字轉語音模塊→ 修改語音

Line 238

```
//task3 TTS module
String minutesText = NumberToWords(diffMinutes1);          // Convert the number to text
TTS_string = "[v1][s3][t5]Bus will arrive in " + minutesText + " minutes";

Send_Data_To_TTS_Module(TTS_string);
delay(5000);
```

TTS_string = "[v1][s3][t5]Bus will arrive in " + minutesText + " minutes";

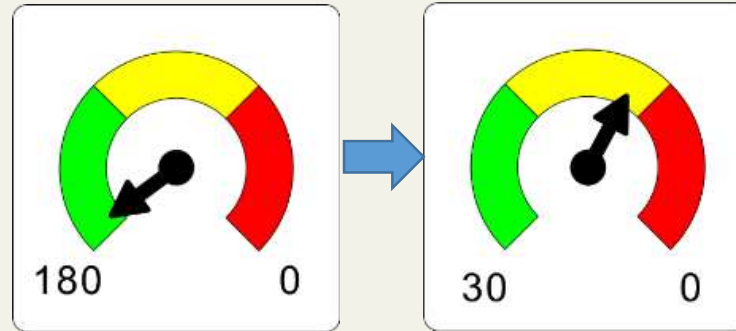
```
// Function to convert numbers to words from 1 to 25
String NumberToWords(int number) {
    const char* words[] = {
        "", "one", "two", "three", "four", "five", "six", "seven", "eight", "nine",
        "ten", "eleven", "twelve", "thirteen", "fourteen", "fifteen",
        "sixteen", "seventeen", "eighteen", "nineteen", "twenty",
        "twenty one", "twenty two", "twenty three", "twenty four", "twenty five"
    };

    return words[number]; // Return the corresponding word
}
```

→播放”Bus goes to KWONG YUEN will arrive in twenty four minutes”

巴士到站提示 - 練習

1. 伺服馬達
→ Mapping



2. OLED 顯示屏
→ 於螢幕加入第二架士到站時間

```
//task1 servo
/*
int angle = map(diffMinutes1, 10, 0, 0, 180);
myservo.write(angle);
delay(50);
myservo.detach();*/
```

```
222      /*if (diffMinutes2 >= 0) {
223          //task2
224          //To show the 2nd ETA
225              display.setCursor(0,0);
226              display.setTextSize(2);
227              display.print(diffMinutes2, 0);
228              display.setCursor(0,0);
229              display.setTextSize(1);
230              display.println("min");
231              display.display();
232      }
233      */
```



- 3*. 文字轉語音模塊 (destination) (minutesText)
→ 播放 "Bus goes to KWONG YUEN will arrive in twenty four minutes"

```
//task3 TTS module
String minutesText = NumberToWords(diffMinutes1); // Convert the number to text
TTS_string = "[v1][s3][t5]Bus will arrive in " + minutesText + " minutes";

Send_Data_To_TTS_Module(TTS_string);
delay(5000);
```



ANS

1

```
//task1
int angle = map(diffMinutes1, 0, 30, 0, 180);
myservo.write(angle);
delay(50);
```

2

```
if (diffMinutes2 >= 0) {
//task2
//To show the 2nd ETA
    display.setCursor(70,10);
    display.setTextSize(2);
    display.print(diffMinutes2, 0);
    display.setCursor(100,15);
    display.setTextSize(1);
    display.println("min");
    display.display();
}
```

3

```
//task3 TTS module
String minutesText = NumberToWords(diffMinutes1); // Convert the number to text
TTS_string = "[v1][s3][t7]Bus goes to " + destination + " will arrive in " + minutesText + " minutes";
Send_Data_To_TTS_Module(TTS_string);
delay(5000);
```

遇到的問題(1)

- 和巴士App有出入

```
[HTTPS] begin...  
[HTTPS] GET...  
[HTTPS] GET... code: 200  
Date: 2025-12-24  
Time: 15:57  
Route :75X  
To :TAI PO (FU SHIN)  
eta1 :2025-12-24T15:58:07+08:00  
1 mins  
eta2 :2025-12-24T16:07:57+08:00  
10 mins  
◆□□□[v1][s3][t7]Bus goes to TAI PO (FU SHIN) will arrive in one minutes  
Waiting 20s before the next round...
```



遇到的問題(2)

```
[HTTPS] begin...  
[HTTPS] GET...  
[HTTPS] GET... code: 200  
Date: 2025-12-24  
Time: 15:45  
Route :75X  
To :TAI PO (FU SHIN)  
eta1 :2025-12-24T15:44:48+08:00  
-1 mins  
eta2 :2025-12-24T15:57:47+08:00  
12 mins  
  
Waiting 20s before the next round...
```

```
{  
  "co": "KMB",  
  "route": "75X",  
  "dir": "I",  
  "service_type": 1,  
  "seq": 11,  
  "dest_tc": "大埔(富善)",  
  "dest_sc": "大埔(富善)",  
  "dest_en": "TAI PO (FU SHIN)",  
  "eta_seq": 1,  
  "eta": "2025-12-24T15:44:49+08:00",  
  "rmk_tc": "",  
  "rmk_sc": "",  
  "rmk_en": "",  
  "data_timestamp": "2025-12-24T15:45:50+08:00"  
},
```

出現負數

$$44 - 45 = -1$$



天氣顯示

上載程式"6_HKO.ino"

本港地區天氣報告

<https://data.weather.gov.hk/weatherAPI/opendata/weather.php?dataType=rhrread&lang=en>



查看數據字典

- <https://data.gov.hk/tc-data/dataset/hk-hko-rss-current-weather-report>



香港天文台
開放數據應用程式介面說明書

Request 例子

<https://data.weather.gov.hk/weatherAPI/opendata/weather.php?dataType=flw&lang=tc>

Request

參數	可接受的數值	說明
dataType	flw fnd rhrread warnsum warningInfo swt	flw: 本港地區天氣預報 fnd: 九天天氣預報 rhrread: 本港地區天氣報告 warnsum: 天氣警告一覽 warningInfo: 詳細天氣警告資訊 swt: 特別天氣提示
lang	en tc sc	en: 英文 tc: 繁體中文 sc: 簡體中文 預設語言: en

本港地區天氣報告

<https://data.weather.gov.hk/weatherAPI/opendata/weather.php?dataType=rhrread&lang=en>

本港地區天氣報告

取得 溫度、濕度、紫外線指數、天氣標記(icon)等數據

<https://data.weather.gov.hk/weatherAPI/opendata/weather.php?dataType=rhrread&lang=en>

```
{
  "rainfall": {
    "data": [
      {
        "unit": "mm",
        "place": "Central & Western District",
        "max": 0,
        "main": "FALSE"
      },
      {
        "unit": "mm",
        "place": "Eastern District",
        "max": 0,
        "main": "FALSE"
      }
    ],
  },
}
```

```
"temperature": {
  "data": [
    {
      "place": "King's Park",
      "value": 23,
      "unit": "C"
    },
    {
      "place": "Hong Kong Observatory",
      "value": 23,
      "unit": "C"
    },
    {
      "place": "Wong Chuk Hang",
      "value": 24,
      "unit": "C"
    }
  ],
}
```

```
"icon": [52],
"iconUpdateTime": "2025-12-24T11:55:00+08:00",
"uvindex": {
  "data": [
    {
      "place": "King's Park",
      "value": 1,
      "desc": "low"
    }
  ]
},
```

```
"humidity": {
  "recordTime": "2025-12-24T16:00:00+08:00",
  "data": [
    {
      "unit": "percent",
      "value": 70,
      "place": "Hong Kong Observatory"
    }
  ]
}
```

天氣標記

編號	50	51	52	53	54
天氣插圖					
說明	陽光充沛	間有陽光	短暫陽光	間有陽光幾陣驟雨	短暫陽光有驟雨

編號	60	61	62	63	64	65
天氣插圖						
說明	多雲	密雲	微雨	雨	大雨	雷暴

https://www.hko.gov.hk/textonly/v2/explain/wxicon_c.htm

天氣標記

編號	70	71	72	73	74	75	76	77
天氣插圖								
說明	天色良好(只在農曆第一日晚間使用)	天色良好(只在農曆第二日至第六日晚間使用)	天色良好(只在農曆第七日至第十三日晚間使用)	天色良好(只在農曆第十四日至第十七日晚間使用)	天色良好(只在農曆第十八日至第二十四日晚間使用)	天色良好(只在農曆第二十五日至第三十日晚間使用)	大致多雲(只在晚間使用)	天色大致良好(只在晚間使用)
編號	80	81	82	83	84	85		
天氣插圖								
說明	大風	乾燥	潮濕	霧	薄霧	煙霞		
編號	90	91	92	93				
天氣插圖								
說明	熱	暖	涼	冷				

於OLED顯示屏 顯示圖片

6_HKO_ANS - images.h | Arduino IDE 2.3.3

File Edit Sketch Tools Help

NodeMCU 1.0 (ESP-12E ...)

6_HKO_ANS.ino images.h

Copy

```
1 //https://mischianti.org/images-to-byte-array-online-converter-cpp-arduino/
2
3
4 // 'bear', 64x64px
5 const unsigned char bear [] PROGMEM = {
6   0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
7   0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
8   0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x18, 0x0f, 0xf0, 0x00,
9   0x00, 0x00, 0x00, 0x19, 0xde, 0x38, 0x08, 0x00, 0x00, 0x1f, 0x81, 0xfe, 0x31, 0xe0, 0x04, 0x00,
10  0x00, 0x60, 0xec, 0x00, 0x00, 0x61, 0xe6, 0x00, 0x00, 0x80, 0x30, 0x00, 0x00, 0x02, 0x22, 0x00,
11  0x01, 0x00, 0x30, 0x08, 0x40, 0x0e, 0x12, 0x00, 0x01, 0x3e, 0x00, 0x00, 0x80, 0x03, 0x12, 0x00,
12  0x00, 0x22, 0x00, 0x04, 0x80, 0x01, 0x92, 0x00, 0x02, 0x43, 0x00, 0x00, 0x00, 0x00, 0x42, 0x00,
13  0x02, 0x46, 0x00, 0x03, 0x00, 0x00, 0x22, 0x00, 0x02, 0x08, 0x00, 0x01, 0x00, 0xc0, 0x34, 0x00,
14  0x03, 0x30, 0x1c, 0x01, 0x00, 0xf0, 0x1c, 0x00, 0x01, 0x00, 0x38, 0x00, 0x00, 0x00, 0x0c, 0x00,
15  0x01, 0x80, 0x40, 0x00, 0x00, 0x00, 0x06, 0x00, 0x00, 0xe0, 0x00, 0x00, 0x00, 0x00, 0x02, 0x00,
16  0x00, 0xc0, 0x00, 0x00, 0x00, 0x00, 0x01, 0x00, 0x00, 0x80, 0x00, 0x00, 0x00, 0xe0, 0x01, 0x00,
17  0x01, 0x00, 0x0e, 0x00, 0x01, 0xd0, 0x00, 0x80, 0x01, 0x00, 0x1f, 0x00, 0x01, 0xc8, 0x00, 0xc0,
18  0x02, 0x00, 0x2f, 0x80, 0x21, 0xf8, 0x01, 0xc0, 0x02, 0x00, 0x3b, 0x80, 0x01, 0xf8, 0x00, 0xe0,
19  0x04, 0x00, 0x3f, 0x83, 0xe1, 0xf8, 0x00, 0xe0, 0x07, 0x00, 0x3f, 0x98, 0x0d, 0x60, 0x00, 0x40,
20  0x0e, 0x00, 0x1e, 0x20, 0x02, 0x00, 0x00, 0x20, 0x04, 0x00, 0x01, 0x47, 0xf9, 0x00, 0x20, 0x20,
21  0x08, 0x00, 0x00, 0x9f, 0xfe, 0x80, 0x18, 0x30, 0x08, 0x00, 0x01, 0x38, 0x0e, 0x40, 0x04, 0x10,
22  0x0c, 0x08, 0x02, 0x61, 0xff, 0x00, 0x00, 0x30, 0x1c, 0x10, 0x02, 0x7f, 0xfe, 0x20, 0x00, 0x30,
23  0x18, 0x20, 0x02, 0x7f, 0xf6, 0x20, 0x04, 0x20, 0x08, 0x00, 0x00, 0x37, 0xfc, 0x20, 0x06, 0x20,
24  0x08, 0x00, 0x04, 0x1f, 0xf8, 0x20, 0x00, 0x20, 0x08, 0x20, 0x00, 0x0f, 0xf0, 0x60, 0x00, 0x20,
25  0x08, 0x20, 0x02, 0x00, 0x80, 0x40, 0x00, 0x60, 0x0a, 0x00, 0x03, 0x00, 0x80, 0x80, 0x10, 0x60,
26  0x0e, 0x00, 0x01, 0x00, 0x81, 0x00, 0x10, 0x40, 0x06, 0x00, 0x00, 0x80, 0x83, 0x00, 0x00, 0x40,
27  0x02, 0x04, 0x00, 0x40, 0x84, 0x00, 0x00, 0xc0, 0x03, 0x04, 0x00, 0x10, 0xf8, 0x00, 0x01, 0x80,
28  0x01, 0x04, 0x00, 0x07, 0xe0, 0x00, 0x01, 0x80, 0x00, 0x40, 0x00, 0x00, 0x00, 0x00, 0x03, 0x00,
29  0x00, 0xc0, 0x00, 0x00, 0x00, 0x00, 0x06, 0x00, 0x00, 0x60, 0x00, 0x00, 0x00, 0x00, 0x04, 0x00,
30  0x00, 0x20, 0x00, 0x00, 0x00, 0x00, 0x10, 0x00, 0x00, 0x10, 0x00, 0x00, 0x00, 0x10, 0x00,
```

<https://mischianti.org/images-to-byte-array-online-converter-cpp-arduino/>

Byte array generator

1. Select image

選擇檔案 未選擇任何檔案

or

1. Paste byte array

128 x 64 px

Read as horizontal Read as vertical

2. Image Settings

Canvas size(s):

■ usagi.jpg (file resolution: 225 x 225)

64

x

64

glyph

remove

Background color:

☒ White

☐ Black

☐ Transparent

Invert image colors



Brightness / alpha threshold:

128

0 - 255; if the brightness of a pixel is above the given level the pixel becomes white, otherwise they become black. When using alpha, opaque and transparent are used instead.

Scaling

scale to fit, keeping proportions ▼

Center:

☐ horizontally

☐ vertically

Note: centering the image only works when using a canvas larger than the original image.

3. Preview



4. Output

Code output format

Arduino code

Adds some extra Arduino code around the output for easy copy-paste. If multiple images are loaded, generates a byte array for each and appends a counter to the identifier.

☐ Add size to array☐ **Use Identifier:**

myBitmap

Draw mode:

Horizontal - 1 bit per pixel

If your image looks all messed up on your display, like the image below, try using a different mode.



Generate code

Copy

[illegible]

```
// Map icon values to bitmap images
switch (icon_0) {
  case 0 : bitmap = bear; break;
  case 50: bitmap = pic50Sunny; break;
  case 51: bitmap = pic51SunnyPeriods; break;
  case 52: bitmap = pic52SunnyIntervals; break;
  case 53: bitmap = pic53SunnyPeriodswithAFewShowers; break;
  case 54: bitmap = pic54SunnyIntervalswithShowers; break;
  case 60: bitmap = pic60Cloudy; break;
  case 61: bitmap = pic61Overcast; break;
  case 62: bitmap = pic62LightRain; break;
  case 63: bitmap = pic63Rain; break;
  case 64: bitmap = pic64HeavyRain; break;
  case 65: bitmap = pic65Thunderstorms; break;
  default:
    Serial.println("Invalid icon value");
    return; // Exit if the icon is invalid
}
```

6_HKO_ANSv2.ino

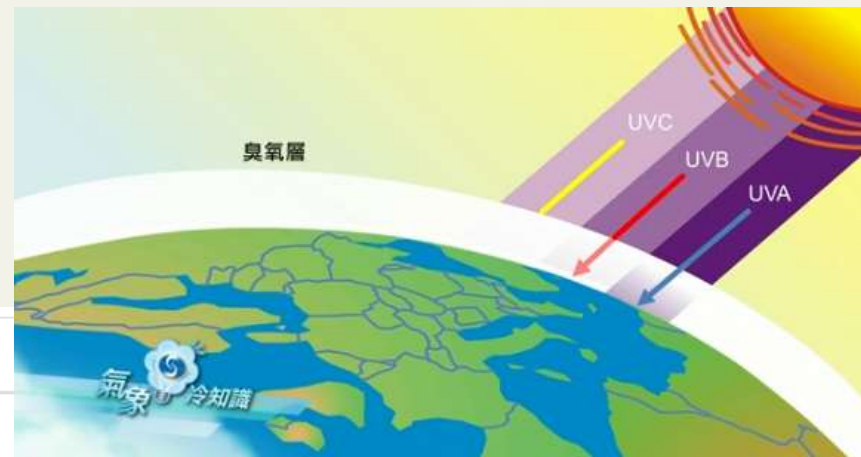
images.h

```
1
2 //https://mischianti.org/images-to-byte-array-online-converter-cpp-arduino/
3
4 // 'bear', 64x64px
5 const unsigned char bear [] PROGMEM = {
6   0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
7   0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
8   0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x18, 0x0f, 0xf0, 0x00,
9   0x00, 0x00, 0x00, 0x19, 0xde, 0x38, 0x08, 0x00, 0x00, 0x1f, 0x81, 0xfe, 0x31, 0xe0, 0x04, 0x00,
10  0x00, 0x60, 0xec, 0x00, 0x00, 0x61, 0xe6, 0x00, 0x00, 0x80, 0x30, 0x00, 0x00, 0x02, 0x22, 0x00,
11  0x01, 0x00, 0x30, 0x08, 0x40, 0x0e, 0x12, 0x00, 0x01, 0x3e, 0x00, 0x00, 0x80, 0x03, 0x12, 0x00,
12  0x00, 0x22, 0x00, 0x04, 0x80, 0x01, 0x92, 0x00, 0x02, 0x43, 0x00, 0x00, 0x00, 0x00, 0x42, 0x00,
13  0x02, 0x46, 0x00, 0x03, 0x00, 0x00, 0x22, 0x00, 0x02, 0x08, 0x00, 0x01, 0x00, 0xc0, 0x34, 0x00,
14  0x03, 0x30, 0x1c, 0x01, 0x00, 0xf0, 0x1c, 0x00, 0x01, 0x00, 0x38, 0x00, 0x00, 0x00, 0x0c, 0x00,
15  0x01, 0x80, 0x40, 0x00, 0x00, 0x00, 0x06, 0x00, 0x00, 0xe0, 0x00, 0x00, 0x00, 0x02, 0x00,
16  0x00, 0xc0, 0x00, 0x00, 0x00, 0x00, 0x01, 0x00, 0x00, 0x80, 0x00, 0x00, 0x00, 0xe0, 0x01, 0x00,
```

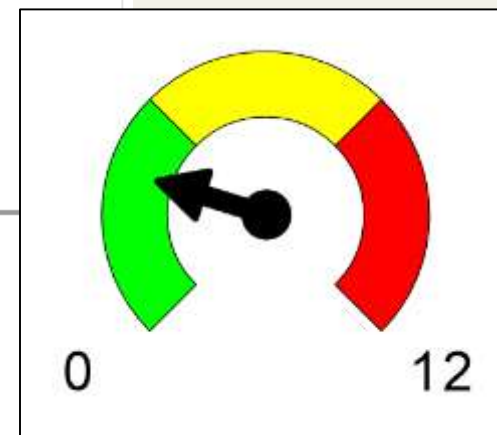
上載

伺服馬達：顯示紫外線指數

伺服馬達：顯示紫外線指數



紫外線指數	曝曬級數	建議防曬措施
0-2	低	不須特別採取防護措施
3-5	中	- 在中午時分進行戶外活動時，請選擇有遮蔭的地方 - 塗上最少為PA+及SPF30(理想情況下更高)的防曬液以阻隔紫外線A及紫外線B - 穿長袖而寬鬆的衣物、戴闊邊帽、利用傘子、配戴可阻隔紫外線的太陽眼鏡
6-7	高	- 盡量避免於中午時分在陽光下曝曬 - 如在戶外，請留在有遮蔭的地方 - 塗上最少為PA+及SPF30(理想情況下更高)的防曬液以阻隔紫外線A及紫外線B - 穿長袖而寬鬆的衣物、戴闊邊帽、利用傘子、配戴可阻隔紫外線的太陽眼鏡
8-10	甚高	- 盡量避免於中午時分在陽光下曝曬 - 如在戶外，請留在有遮蔭的地方 - 塗上最少為PA+及SPF30(理想情況下更高)的防曬液以阻隔紫外線A及紫外線B - 穿長袖而寬鬆的衣物、戴闊邊帽、利用傘子、配戴可阻隔紫外線的太陽眼鏡
≥ 11	極高	- 盡量避免於中午時分在陽光下曝曬 - 如在戶外，請留在有遮蔭的地方 - 塗上最少為PA+及SPF30(理想情況下更高)的防曬液以阻隔紫外線A及紫外線B - 穿長袖而寬鬆的衣物、戴闊邊帽、利用傘子、配戴可阻隔紫外線的太陽眼鏡



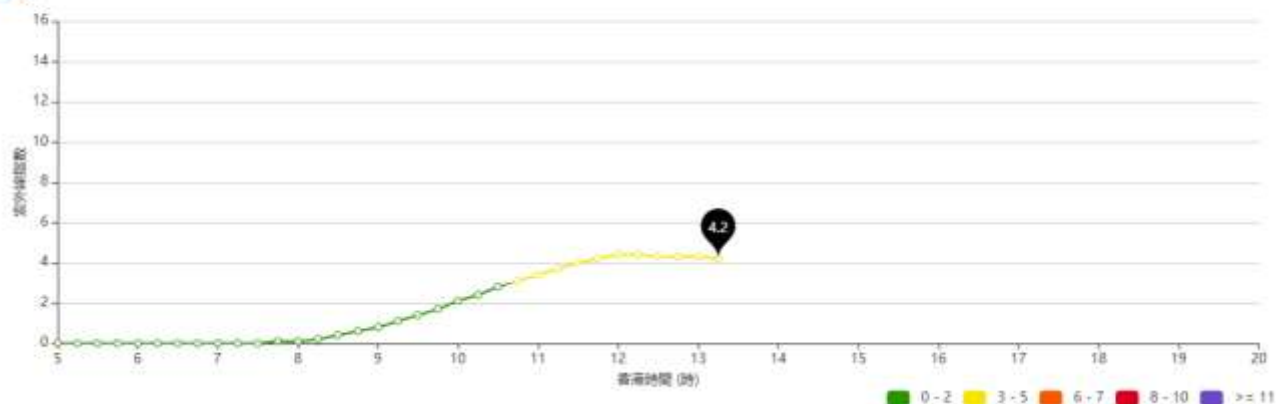
<https://www.hko.gov.hk/tc/wxinfo/uvinfo/uvinfo.html>

實時紫外線觀測



2026年1月13日十五分鐘平均紫外線指數
在昂士柏氣象站量度

出



其他地方的最高紫外線指數

地方	通常見到的最高紫外線指數
台灣阿里山 (約海拔2400米高)	14
Chilton, 英國倫敦附近	8
台灣南部恆春	13
香港	15
Lauder 新西蘭南島	12
美國夏威夷Mauna Loa (約海拔 3400米高)	20
澳洲墨爾本	10
墨西哥城	13
美國佛羅里達州邁阿密	11
澳洲珀斯	14
美國加州聖地牙哥	11
台灣台北	11
加拿大多倫多	10

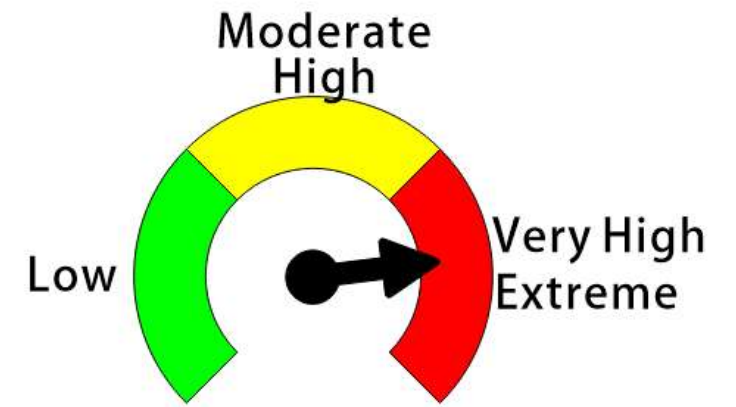
最高紫外線指數比較

影響地面紫外線強度的因素

因素	影響
在不同日子、時間和緯度所見到的太陽位置	太陽位置愈高，紫外線強度愈高
大氣中的臭氧量	臭氧吸收紫外線。大氣中愈多臭氧，到達地球表面的紫外線愈少
雲量和煙霞	紫外線被雲和煙霞吸收和散射
地面反射	大部分表面如草地，泥土、水體反射少於10% UV。但雪地則反射80% UV。沙面也反射10-25% UV。
高度	高度愈高，紫外線愈強，因為大氣沒有那麼厚而當中的臭氧吸收UV自然也較少

伺服馬達：顯示紫外線指數

```
95 //task : servo
96 if (uvindex_data_0_value< 2){
97   myservo.write(0);
98   delay(500);
99 }
100
101 if (uvindex_data_0_value>=2 && uvindex_data_0_value< 7 ){
102   myservo.write(0);
103   delay(500);
104 }
105
106
107 if (uvindex_data_0_value>=7){
108   myservo.write(0);
109   delay(500);
```



UV Index	Exposure Level
0-2	Low
3-5	Moderate
6-7	High
8-10	Very High
≥11	Extreme

天氣顯示- 練習

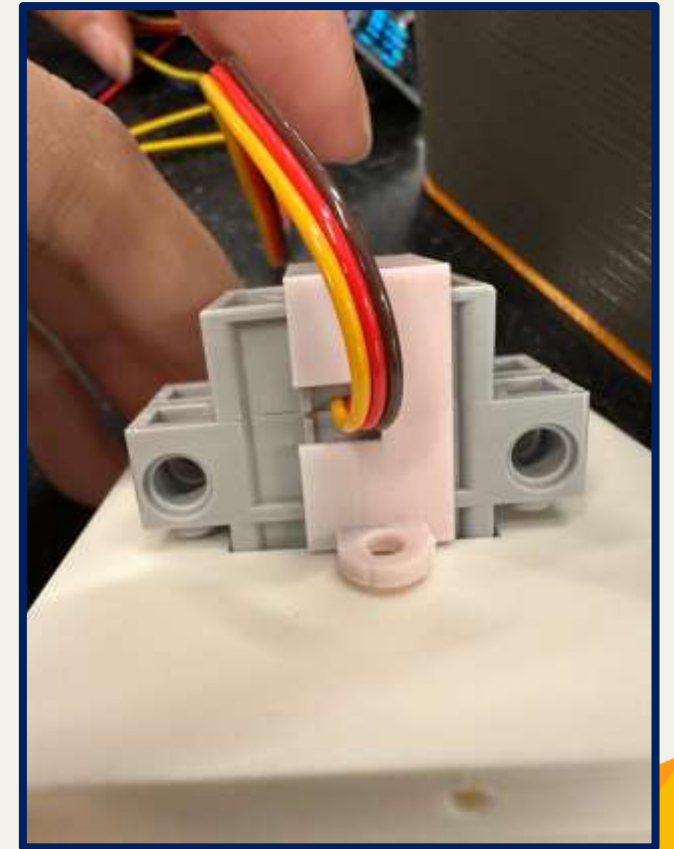
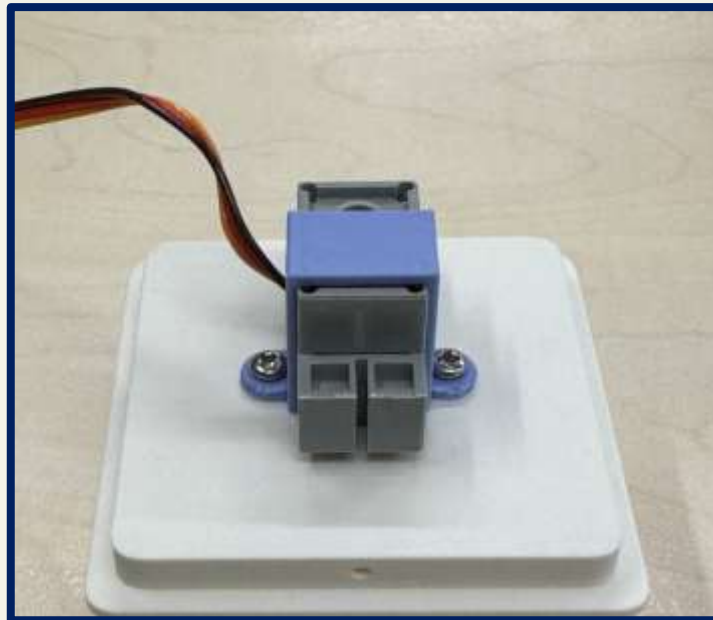
- OLED顯示屏：顯示圖像
- 伺服馬達：顯示紫外線指數
- 文字轉語音模塊：自由創作

例子: The temperature is **twenty** degree Celsius and the Humidity is **fifty three** percent.

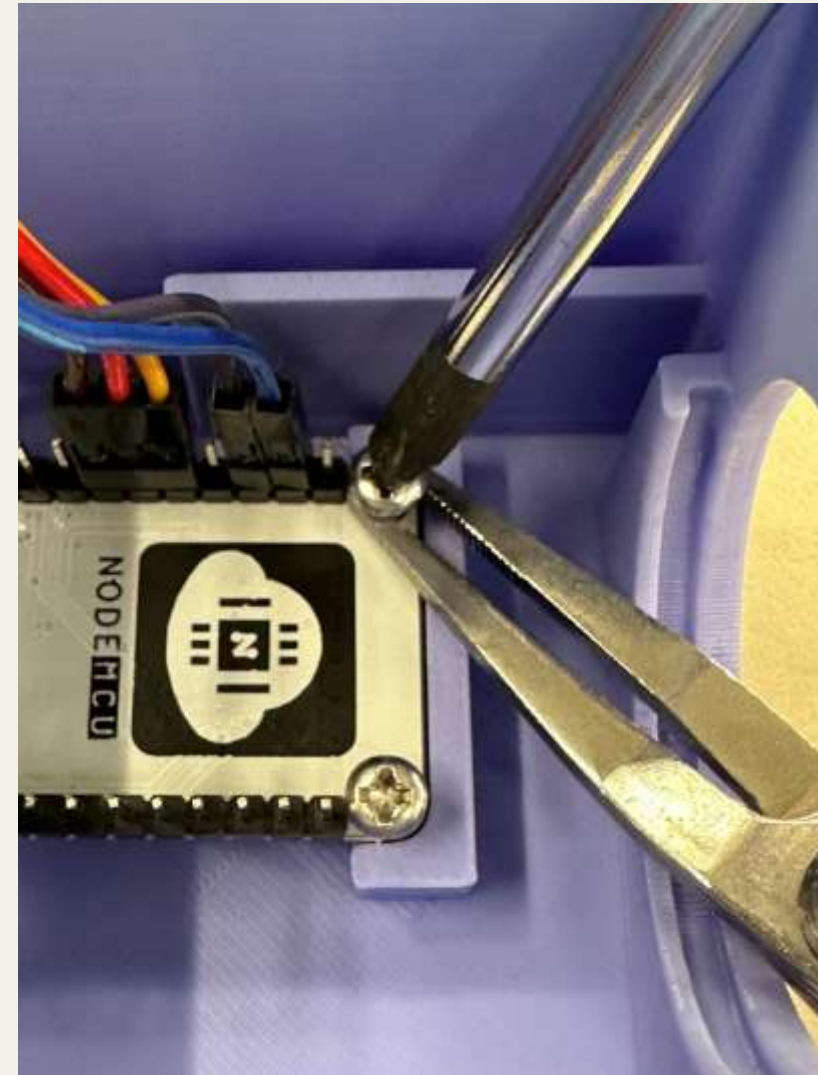
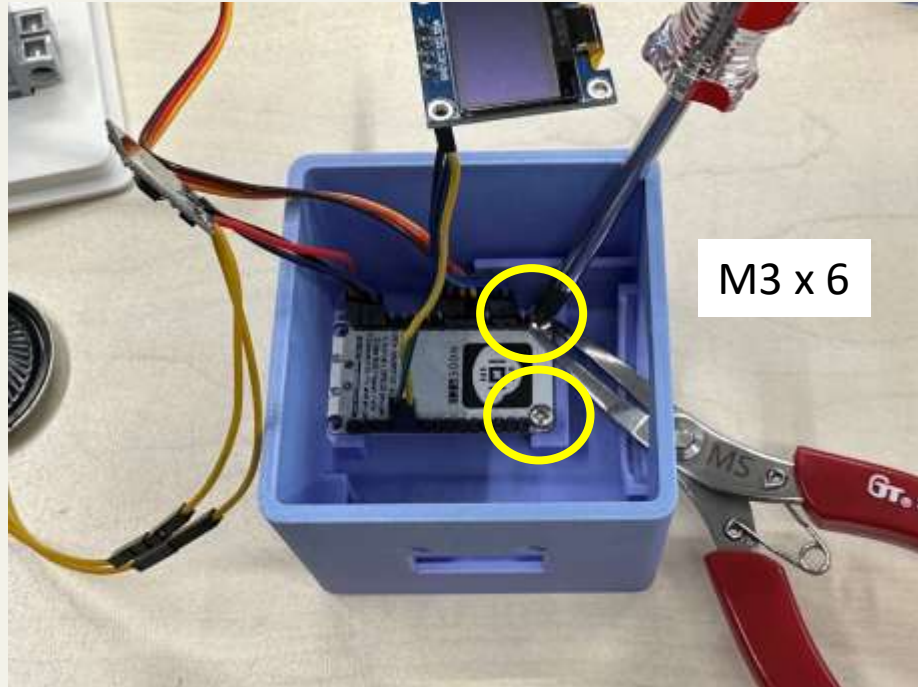


連接並組裝相關元件

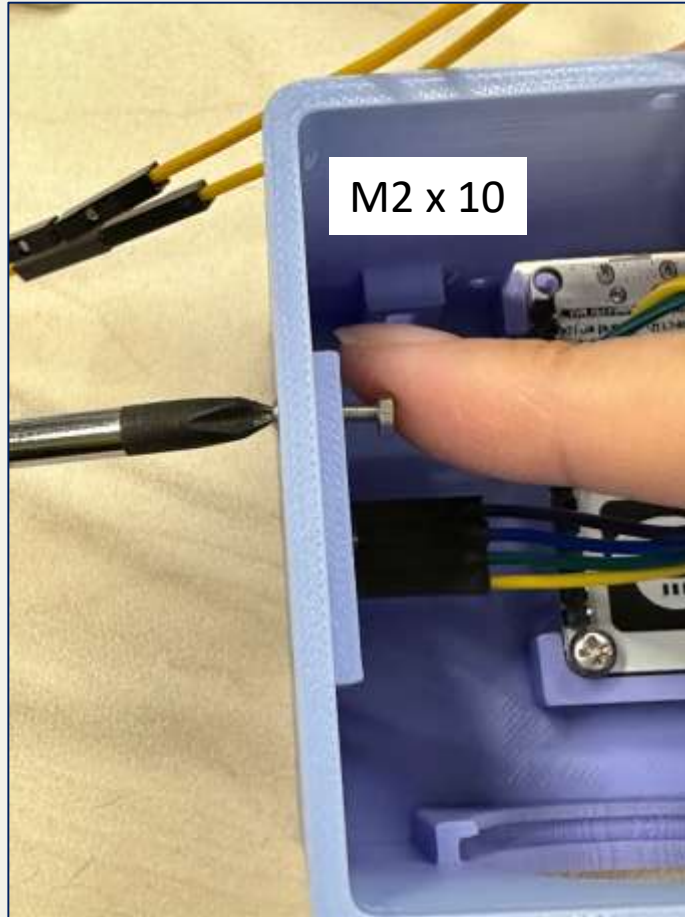
伺服馬達



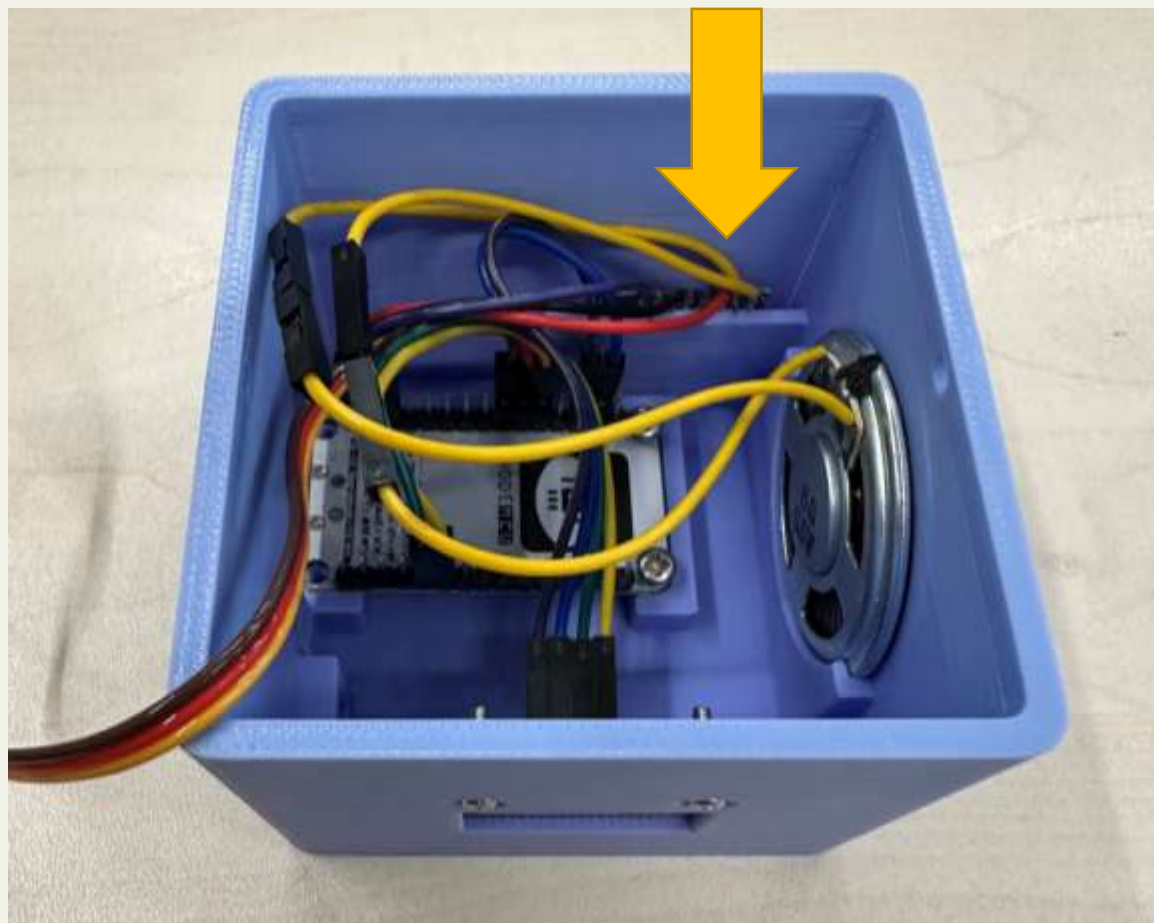
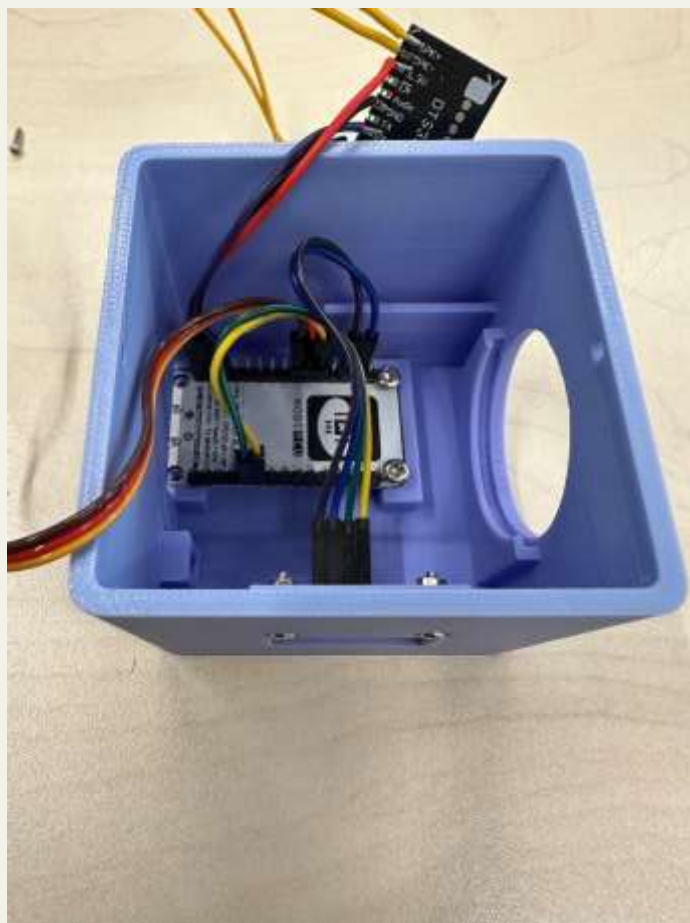
NodeMCU



OLED顯示屏



文字轉語音模塊





M2 x 10



M3 x 6

Thank
you