

# Workshop on assembling a “Smart Energy-storage Device”

「智慧儲能裝置」組裝工作坊



STEM Education Centre

STEM 教育中心

May 2024



# 智慧儲能裝置挑戰賽

STEM Education Centre and Arts & Technology Education Centre

時間 Time	工作坊環節 Workshop session
10 min	介紹儲能裝置及示範 Introduction to energy storage devices and demonstrations
70 min	組裝儲能裝置 Assembling the energy-storage device
20 min	講解操作裝置的電腦程式 Explaining the computer programme that operates the device
10 min	重點簡介比賽規則 A brief introduction to the competition rules
10 min	問題解答 Question and answer



# 智慧儲能裝置挑戰賽

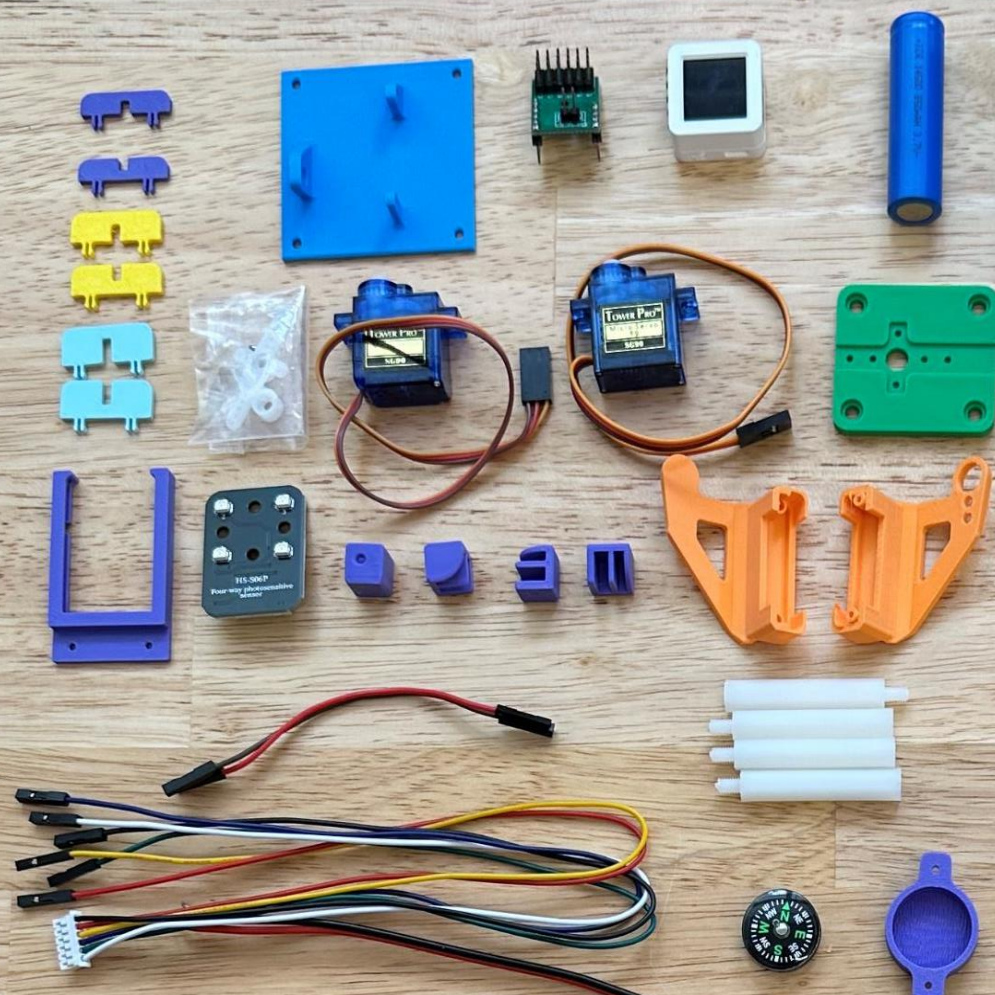
STEM Education Centre and Arts & Technology Education Centre

智慧儲能裝置操作示範



(3)



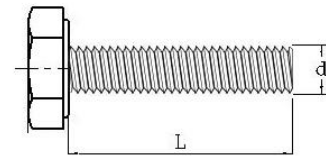


裝嵌儲能裝置所需的部件及電子元件



# 螺絲數目

## Number of screws



d: 螺紋直徑 L: 長度

M3螺絲

M3 x 6

(直徑: 3mm, 長: 6mm)

(diameter: 3mm, length: 6mm)

種類 Type	長度 Length	數目 Number
M3 screw 螺絲	6mm	8
M2 screw 螺絲	6mm	13
M2 screw 螺絲	8mm	6
M2 screw 螺絲	14mm	2
M2 nut 螺絲母	--	15
M4 hexagonal pillar 六角柱	40mm	4
M4 screw 螺絲	8mm	4
M4 nut 螺絲母	--	4
Servo screw 伺服馬達螺絲	4mm	2

1a

# 固定太陽能電源管理模組

## Mount the Solar Power Management Module

Completed

M3螺絲(6mm長) 4粒

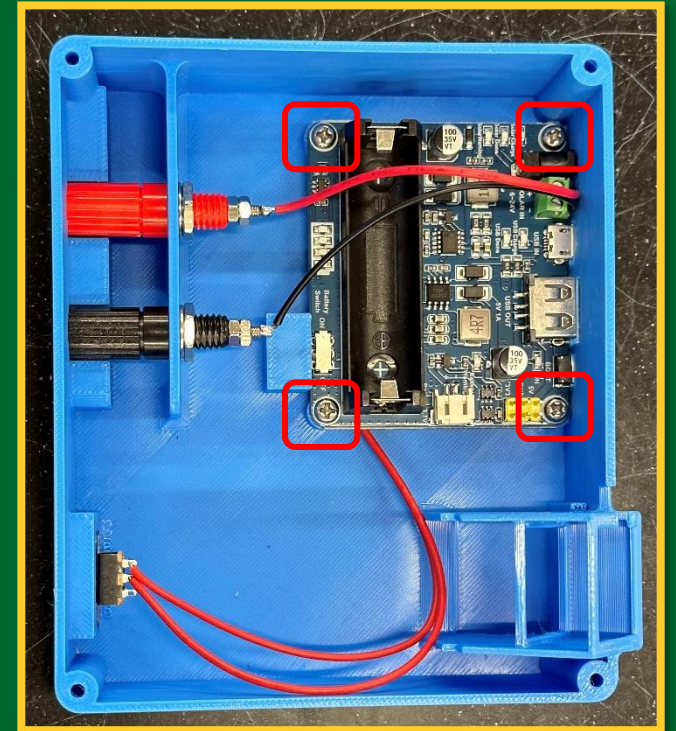
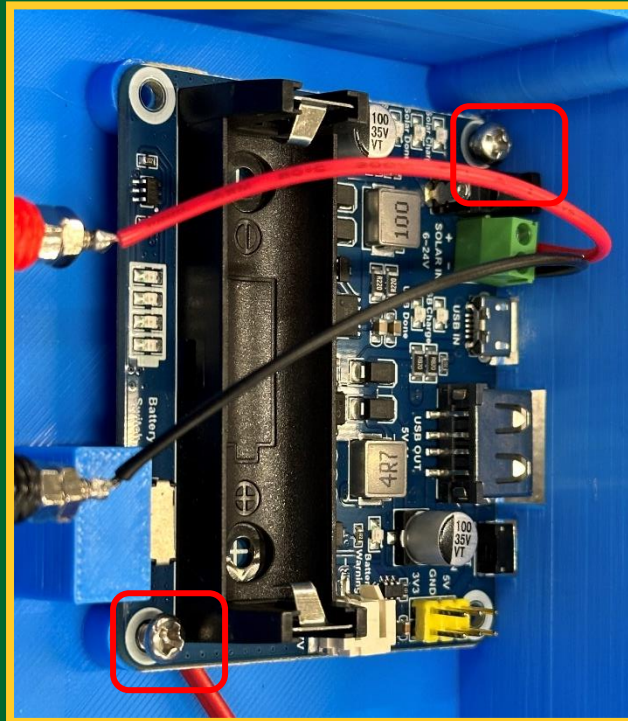
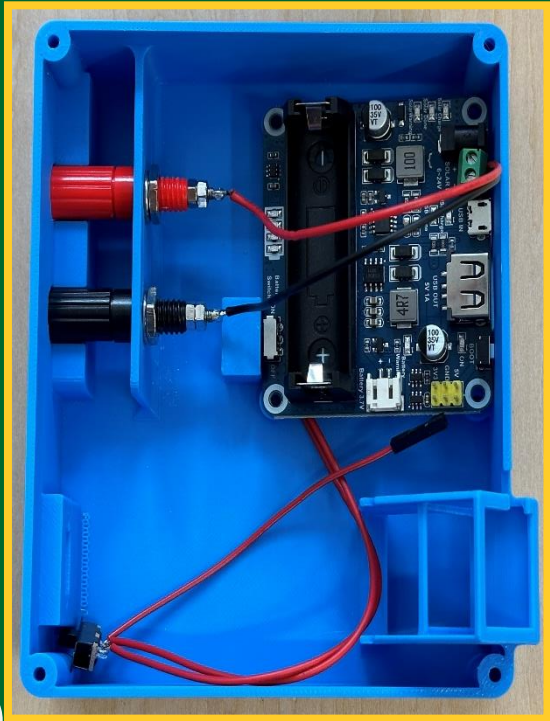


M3 screw (length: 6mm) 4 pieces

M3 x 6:

代表直徑 3mm 及 長 6mm 的螺絲

represent a screw with a diameter of 3 mm and a length of 6 mm





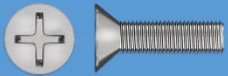
1b

# 固定供電開關

## Mount the Power Supply Switch

Completed

M2螺絲(8mm長)

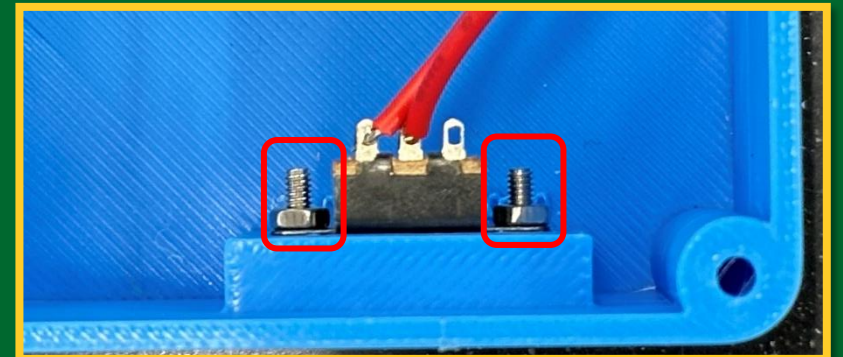
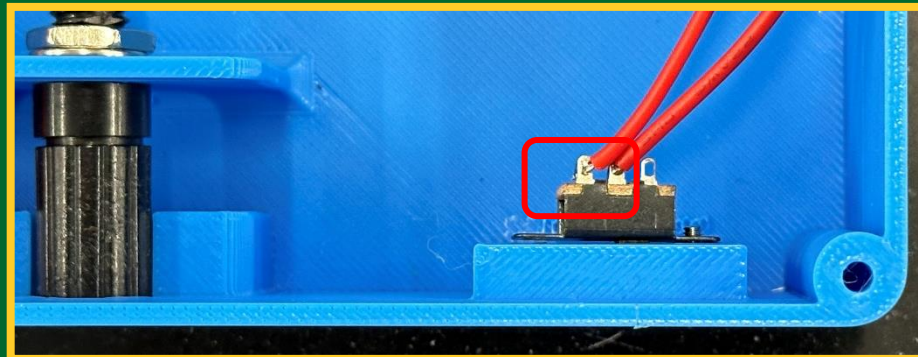
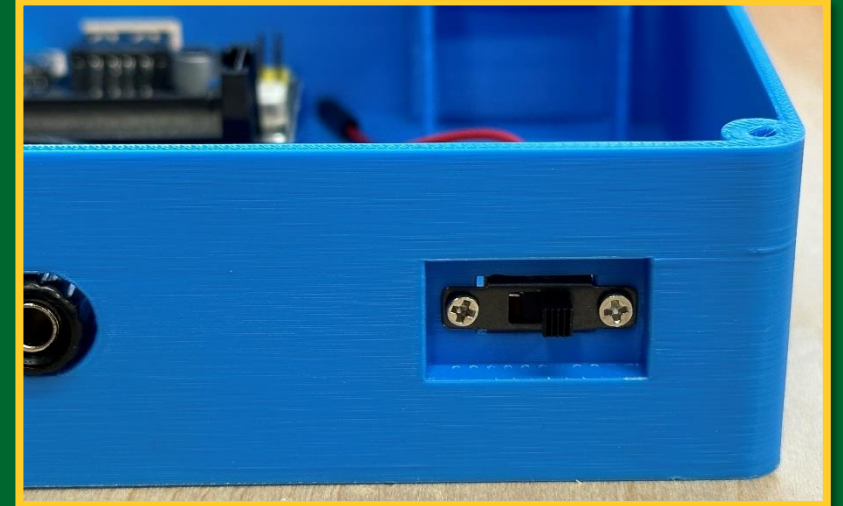
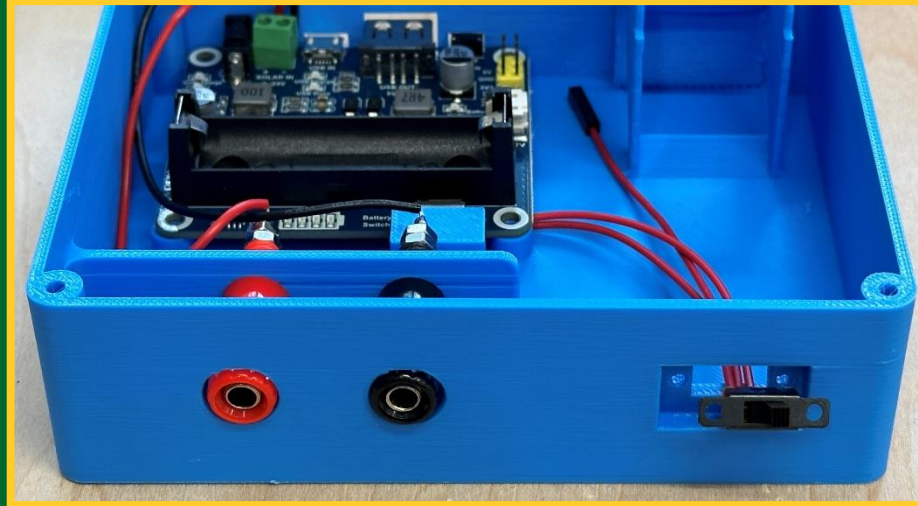


M2 Screw(8mm long)

螺絲母



screw nut

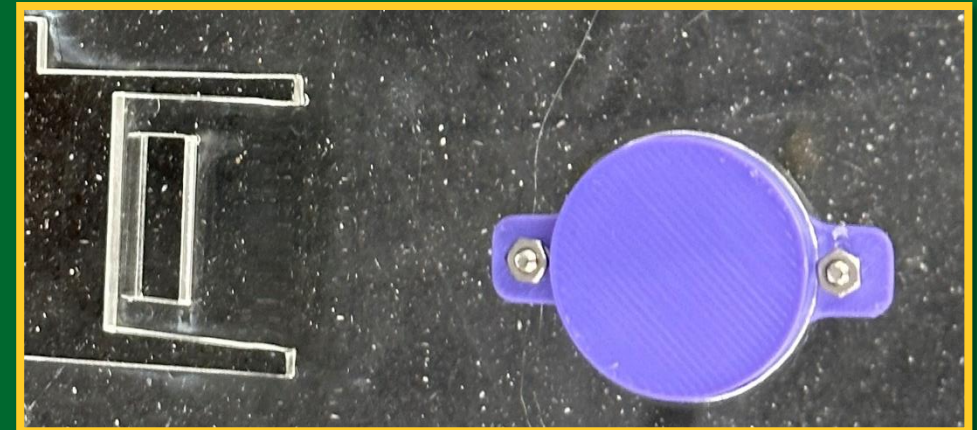
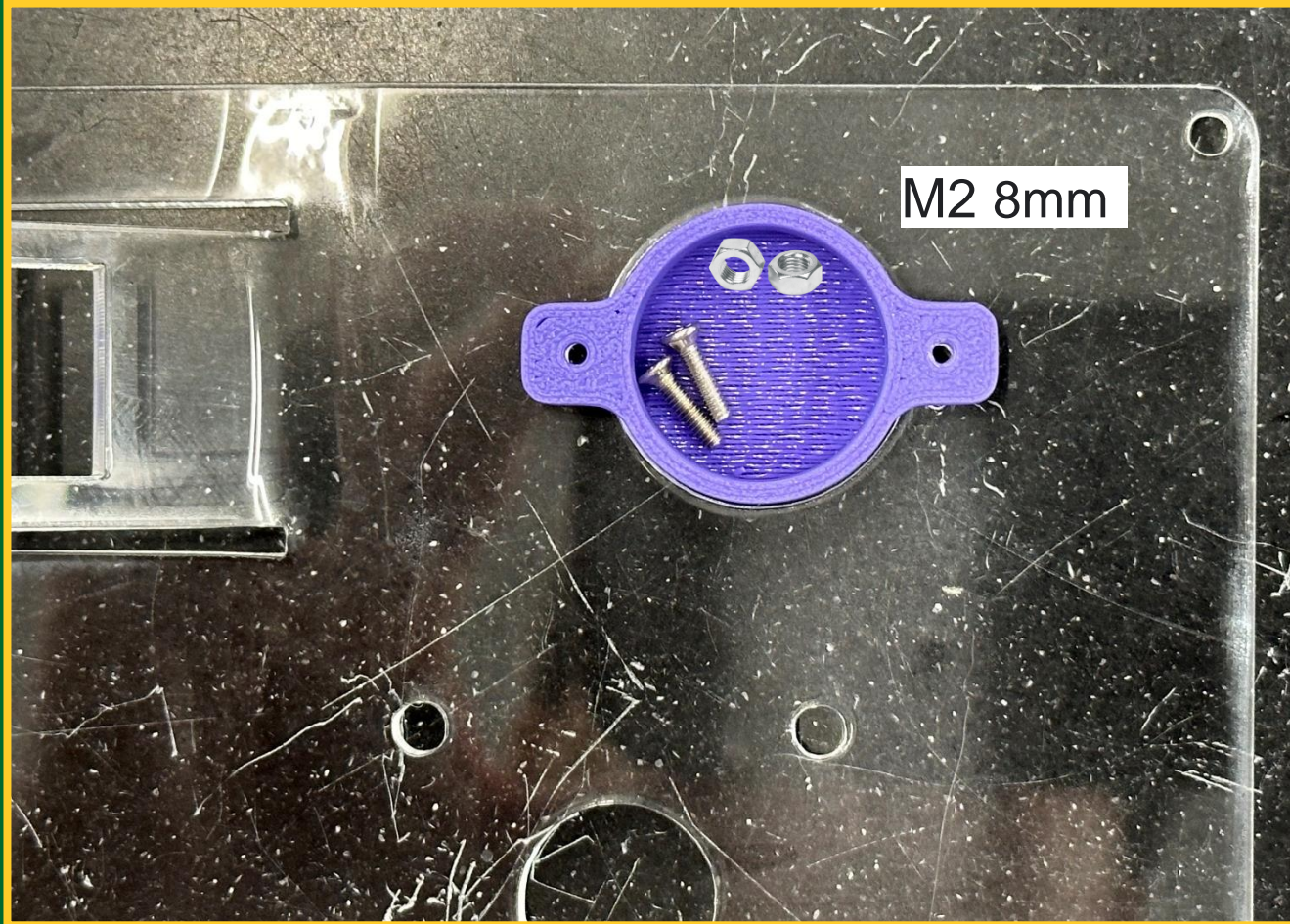




2a

將小羅盤固定在裝置面板上

Fix the small compass on the Device Base Plate

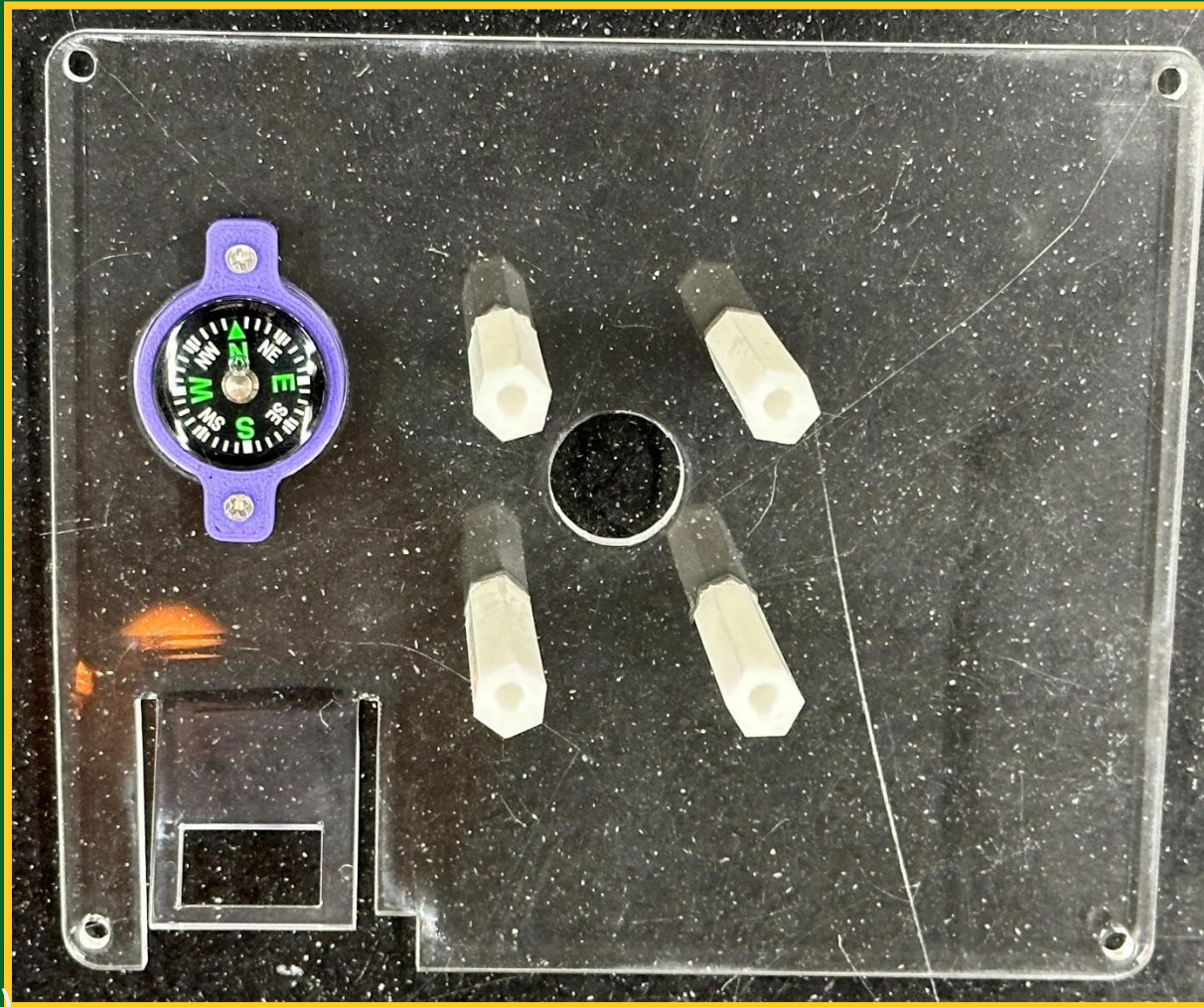




2b

安裝40mm長的M4六角柱 (4 枝)

Install the 40mm long M4 Hexagonal Pillars (4 pieces)

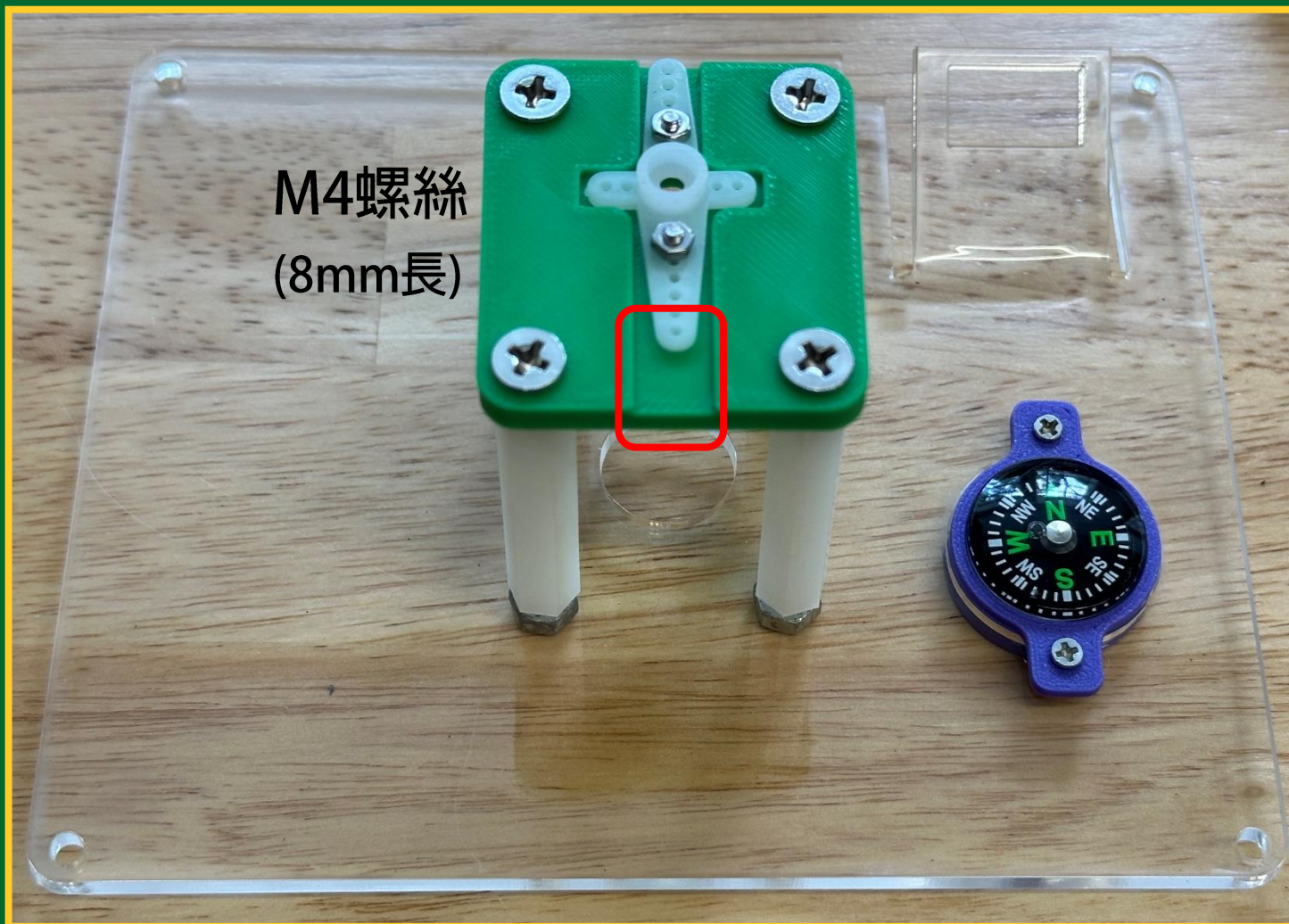
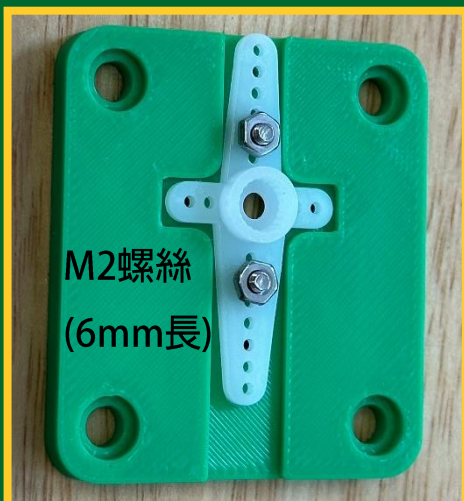




3

# 安裝伺服馬達支架

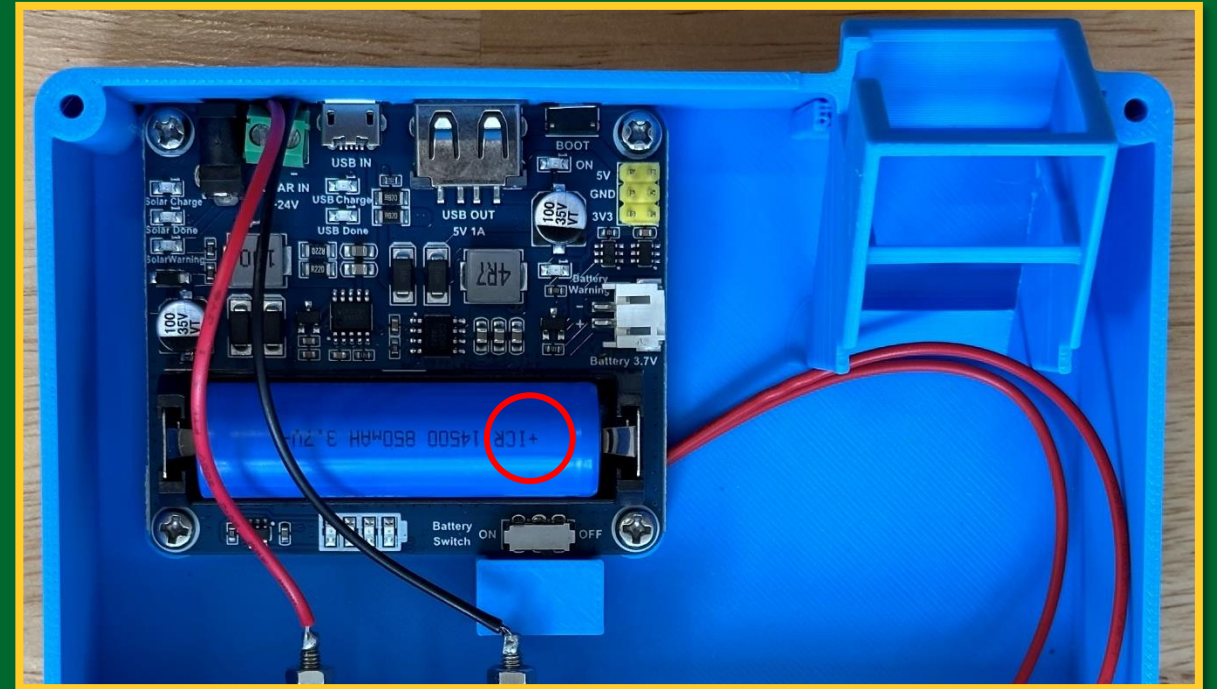
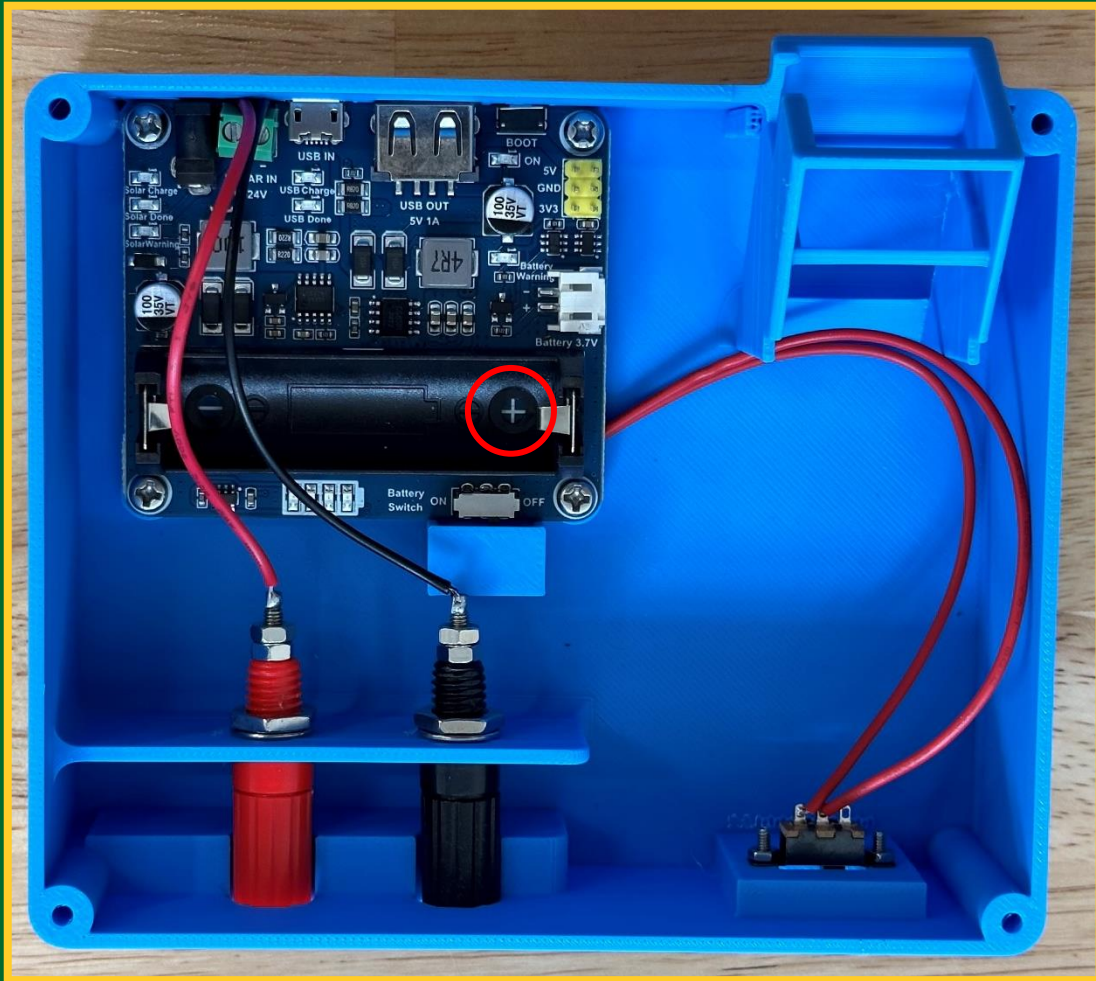
## Install the Servo Motor Support Bracket





4

# 安裝可充電電池 Install the Rechargeable Battery



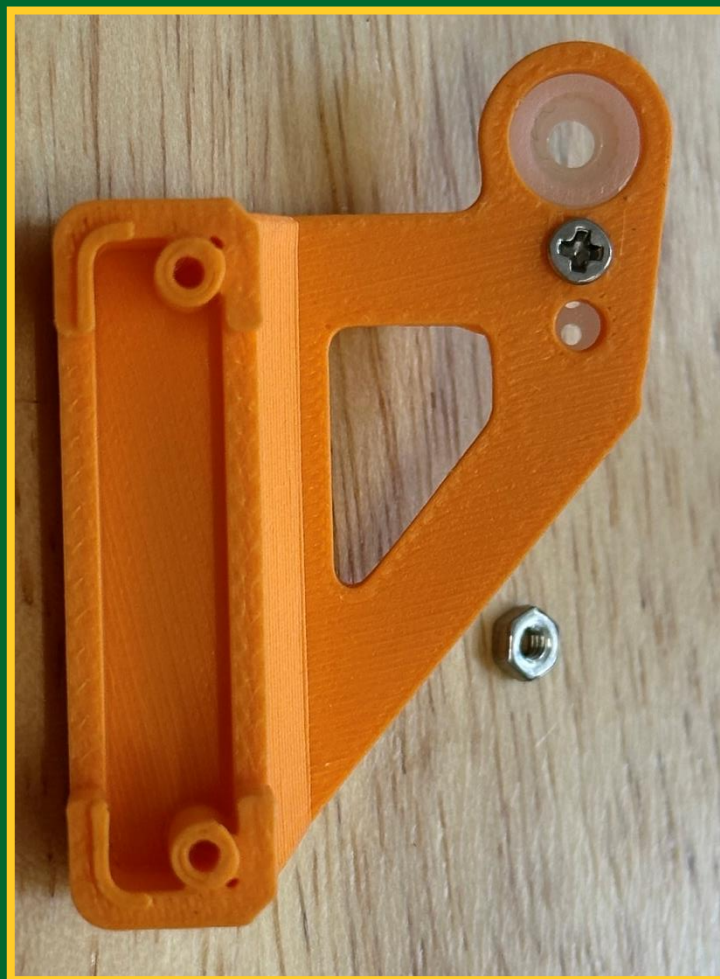
(1  
1)



5a

# 安裝水平轉動架

## Install the Horizontal Swivel Bracket

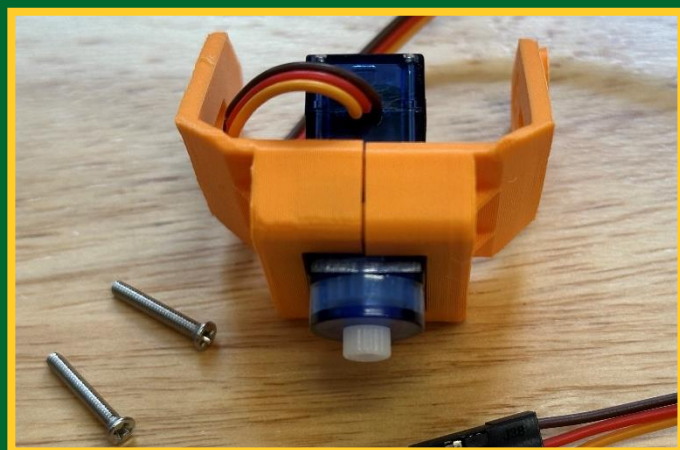
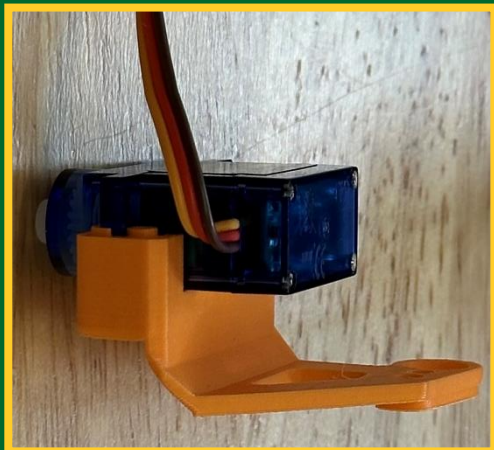




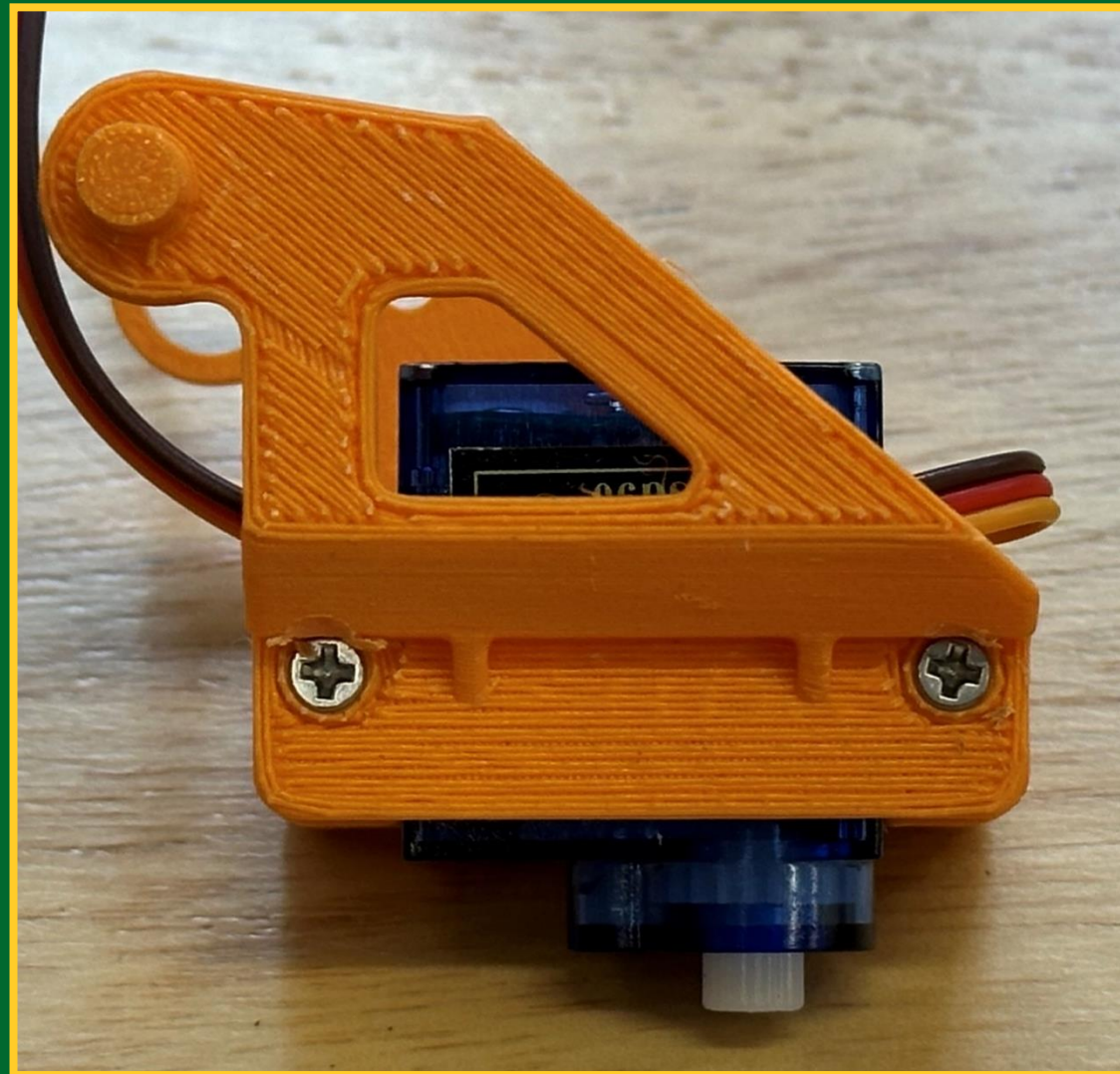
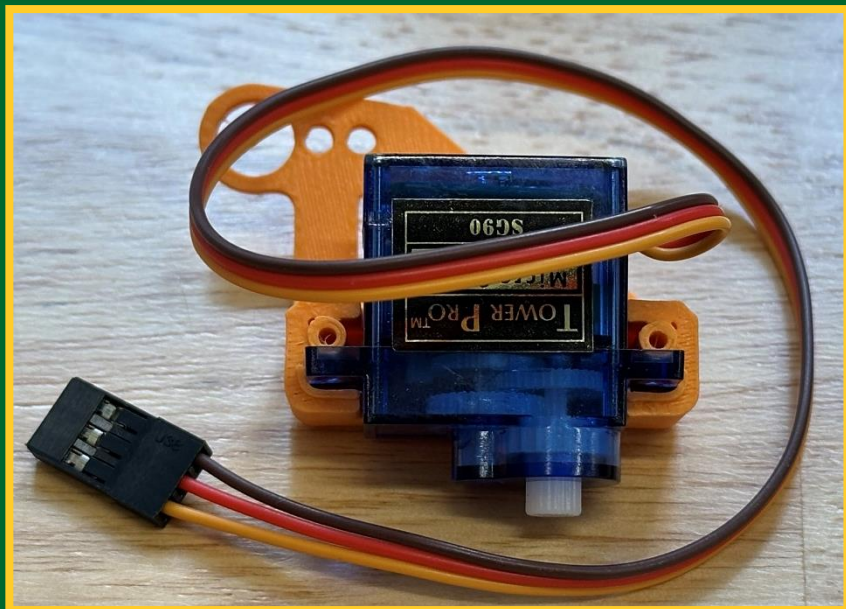
5b

# 安裝水平轉動架

## Install the Horizontal Swivel Bracket



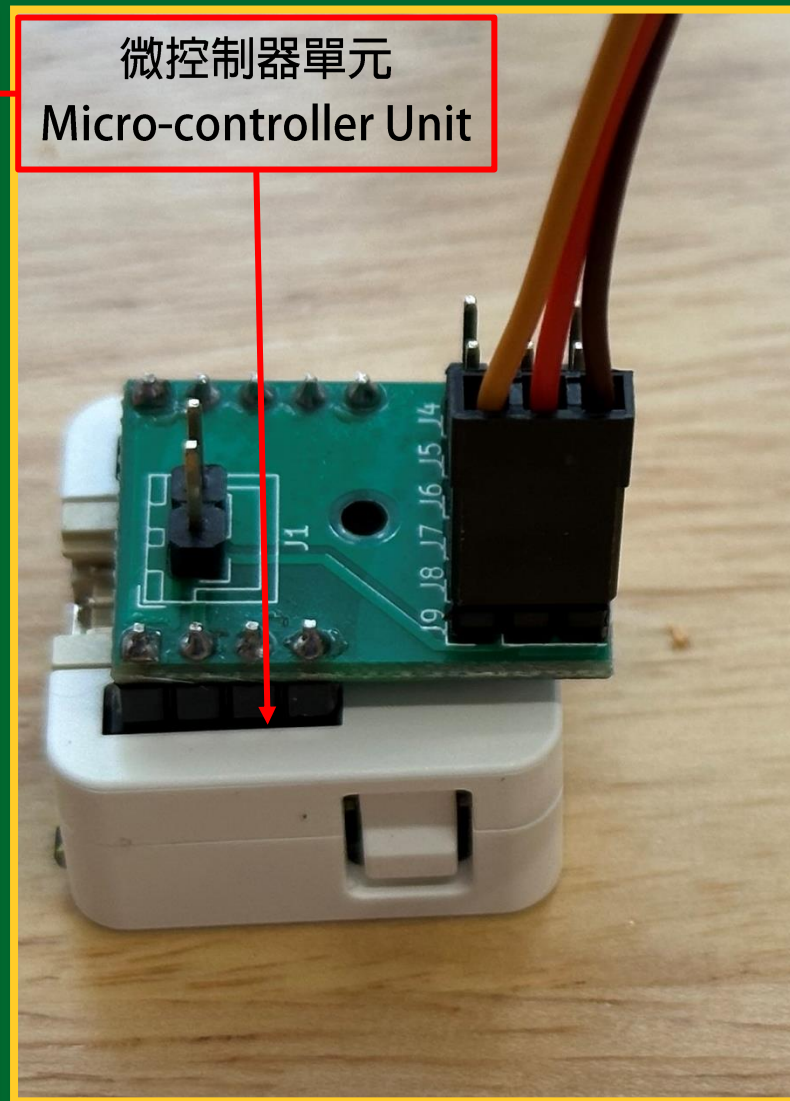
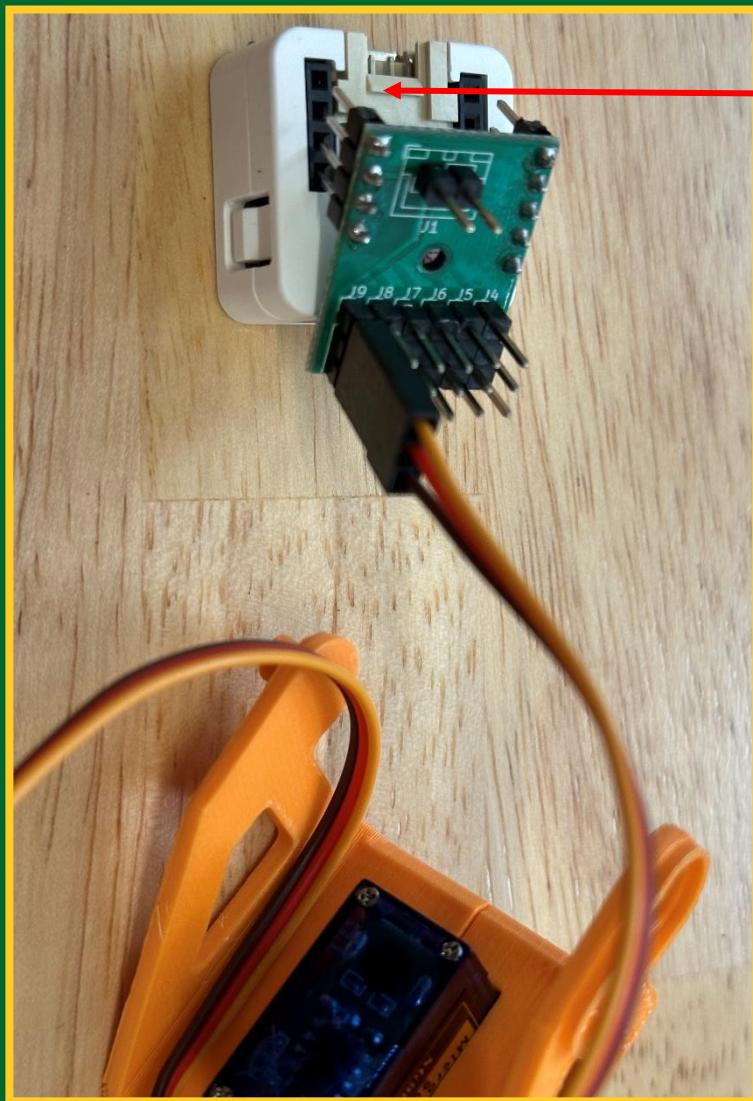
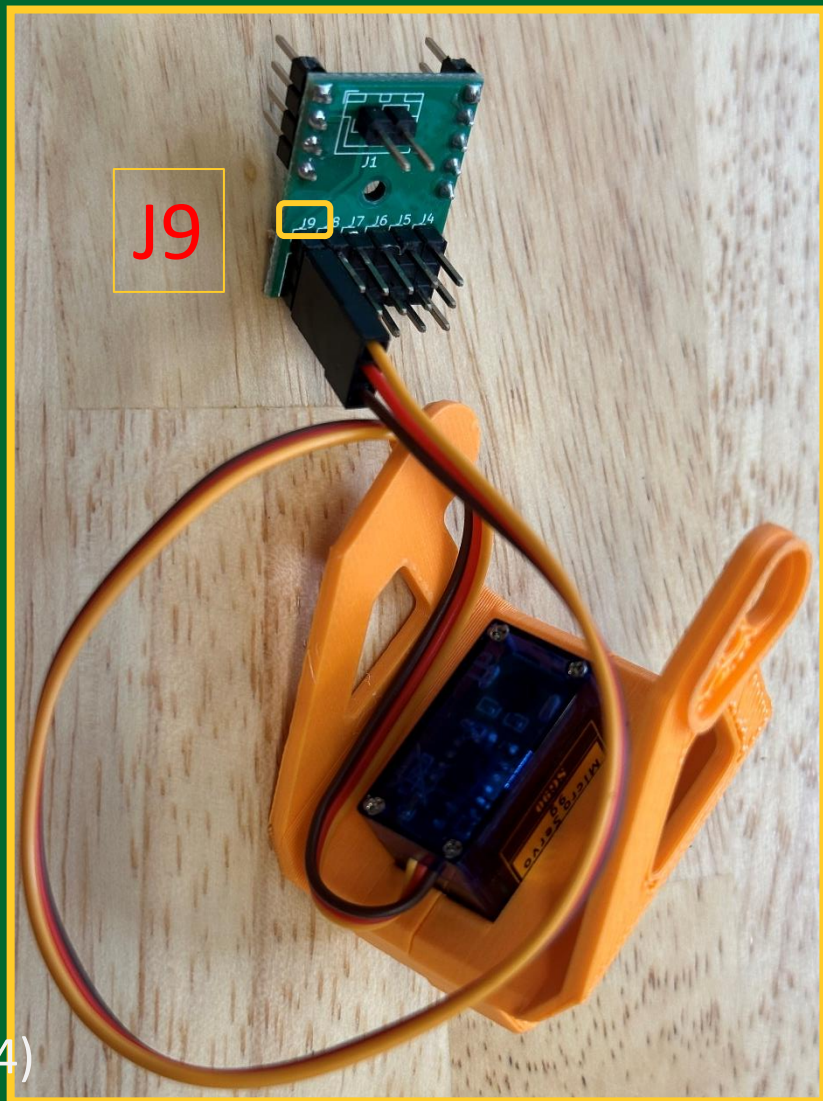
M2螺絲  
(14mm長)





5c

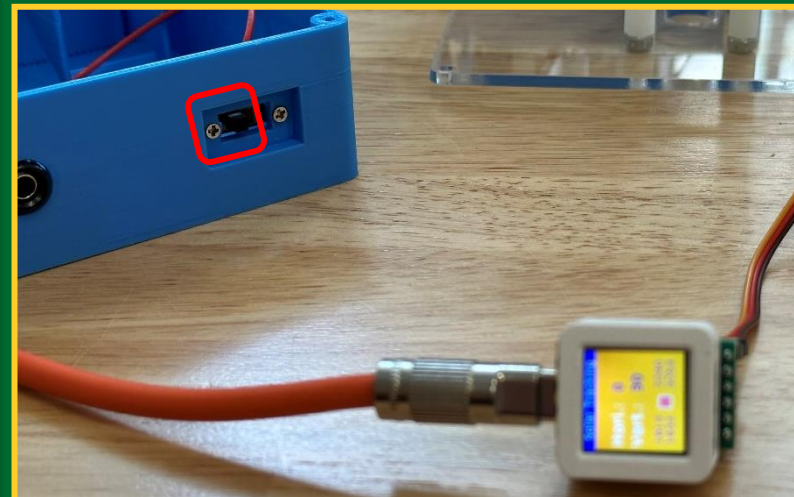
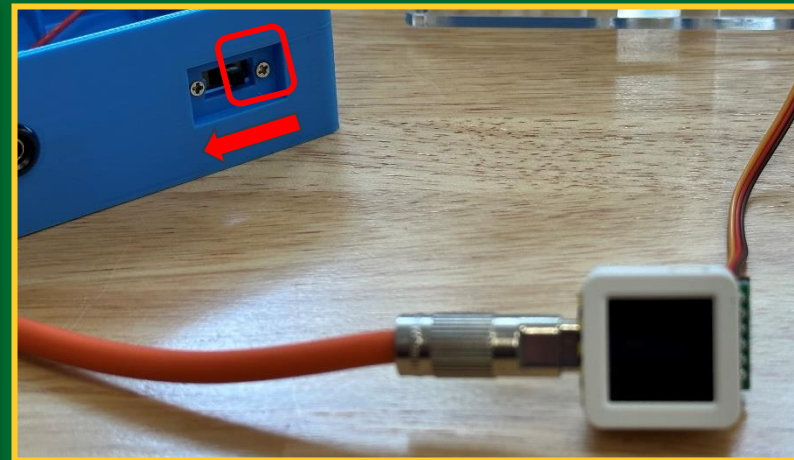
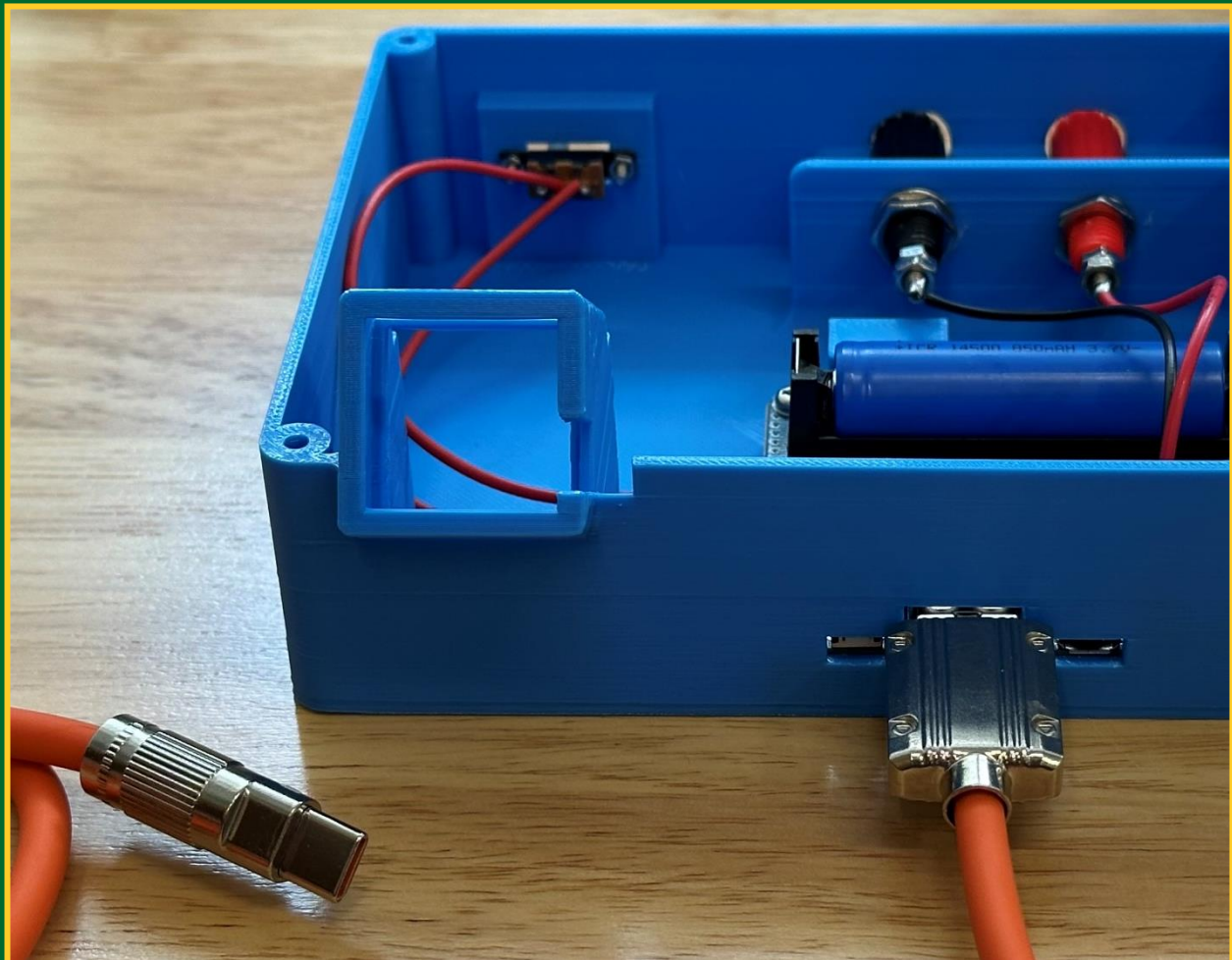
# 安裝水平轉動架 Install the Horizontal Swivel Bracket





5d

# 安裝水平轉動架 Install the Horizontal Swivel Bracket





5e

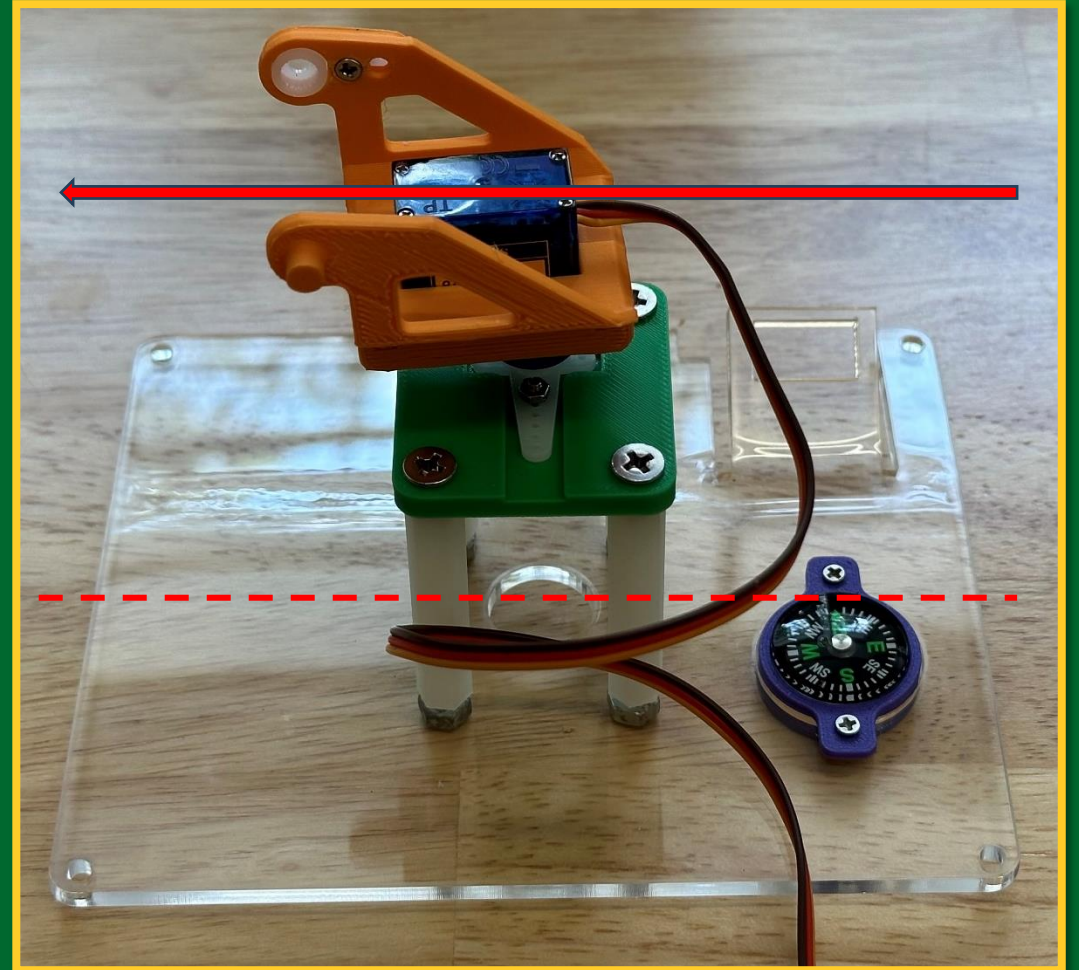
# 安裝水平轉動架

## Install the Horizontal Swivel Bracket

重置伺服馬達至零度，然後關閉電源

Reset the servo motor to zero degree and then switch off the power

微控制器單元  
Micro-controller Unit

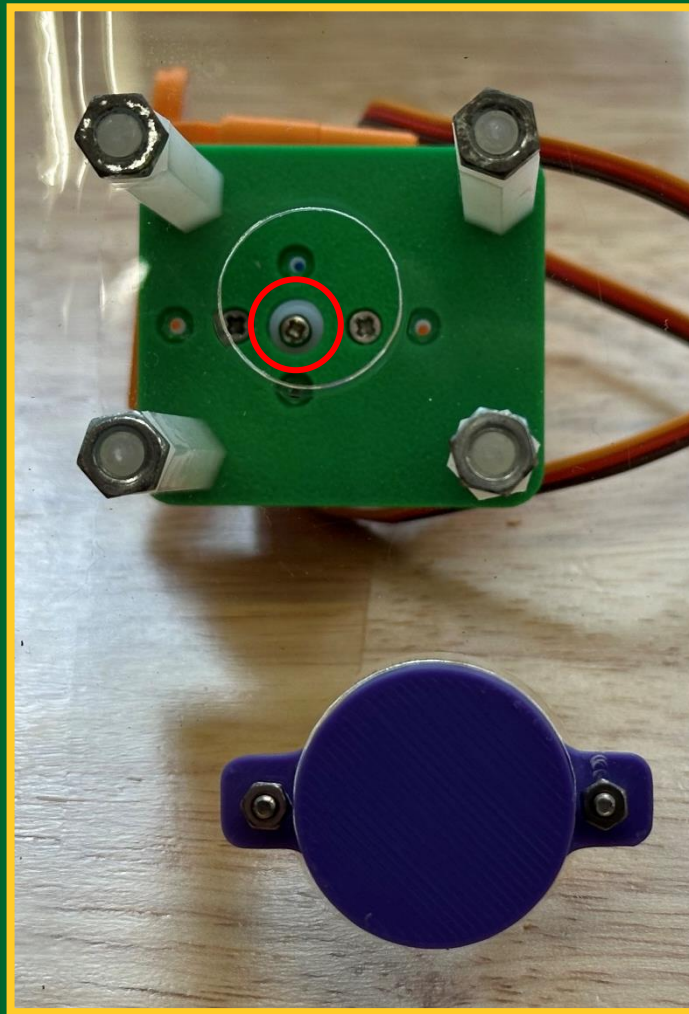
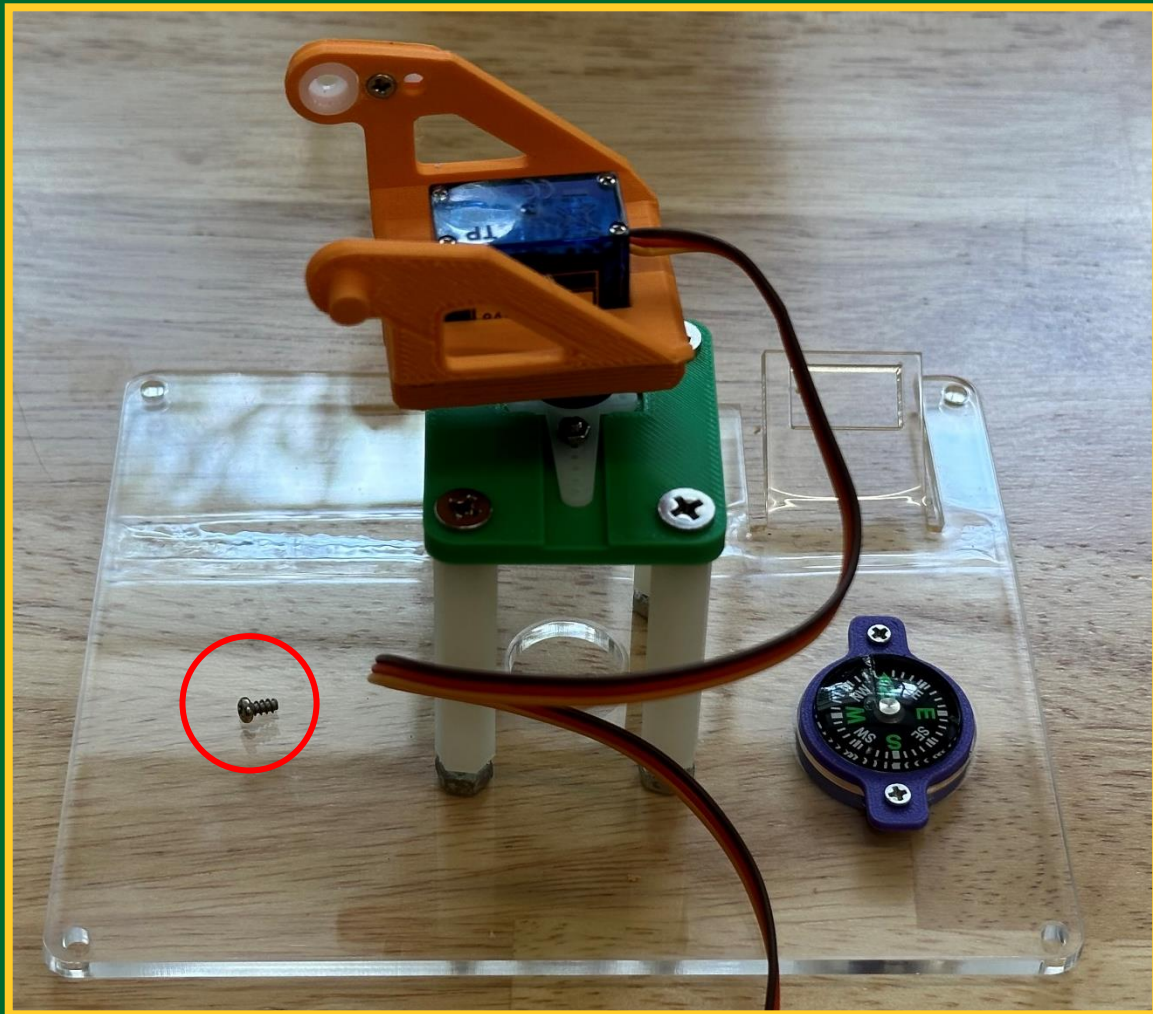




5f

# 安裝水平轉動架

## Install the Horizontal Swivel Bracket





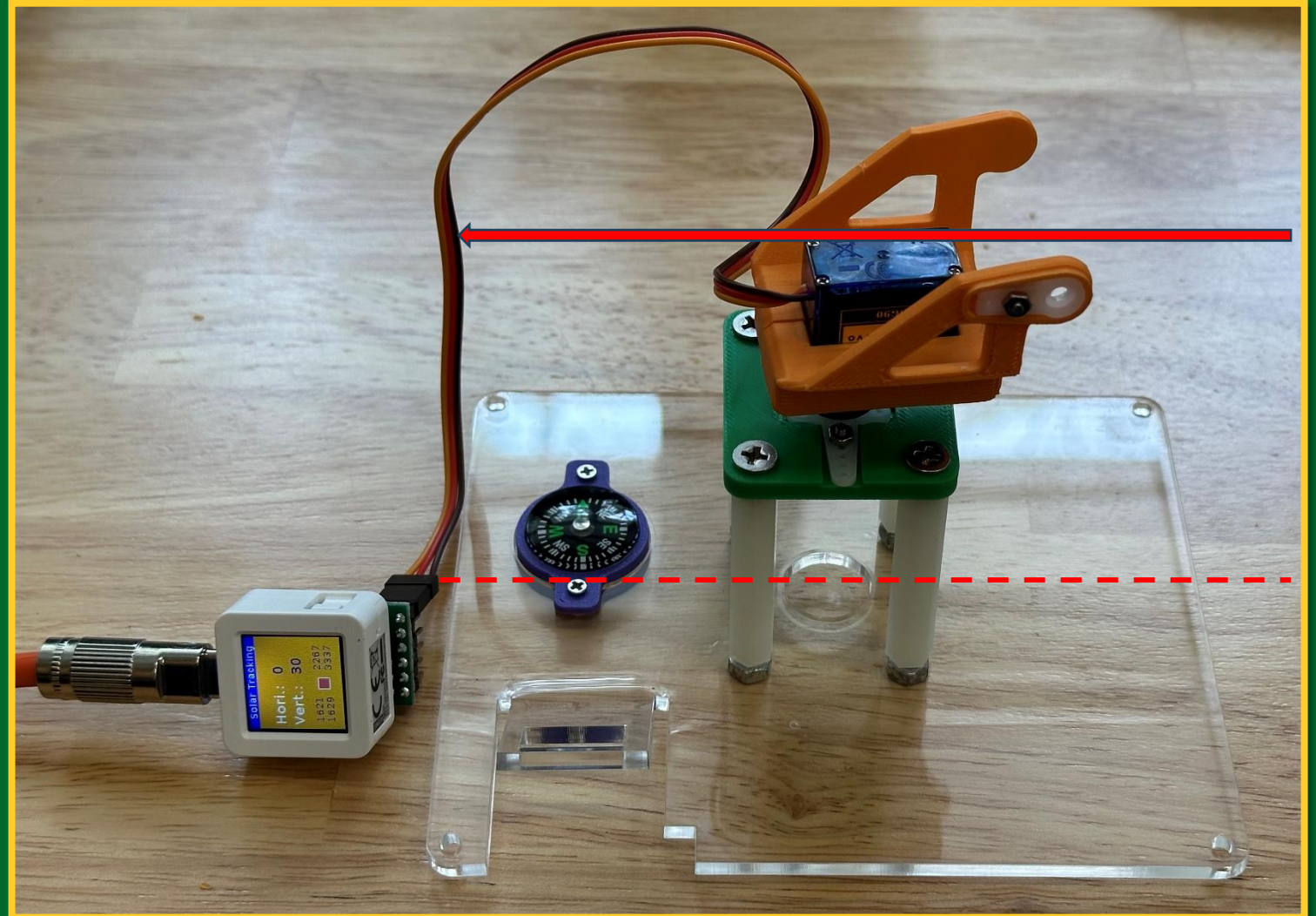
5g

# 安裝水平轉動架

## Install the Horizontal Swivel Bracket

重啟電源確保伺服馬達維持在正確方向

Restart the power to ensure that the servo motor remains in the correct direction.

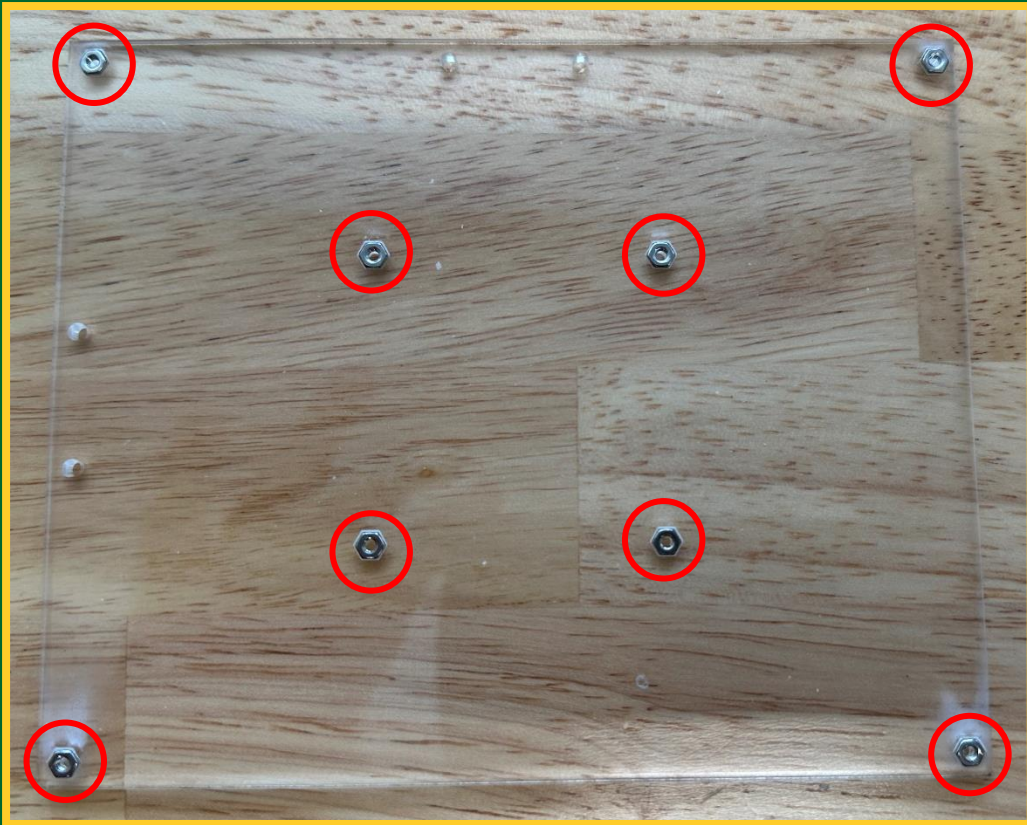




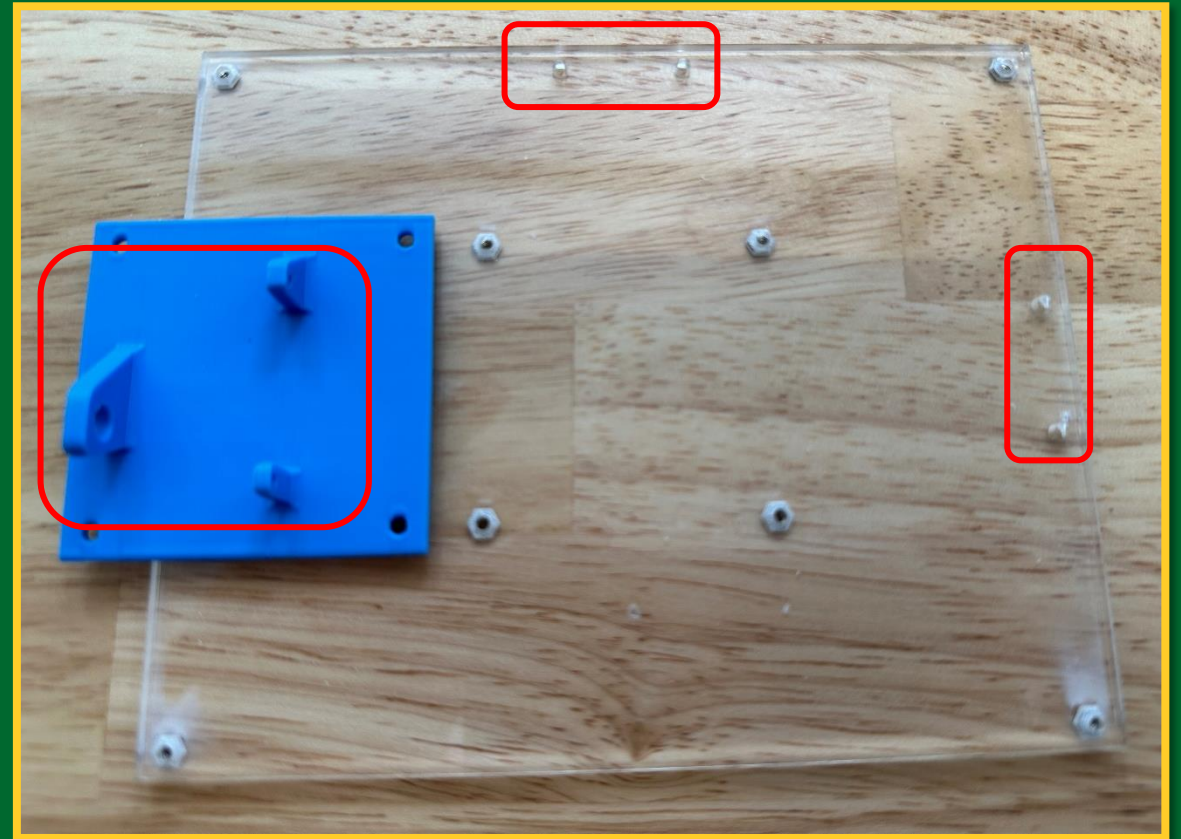
6a

# 安裝太陽能板 Install the Solar Panel

Completed



頂 Top

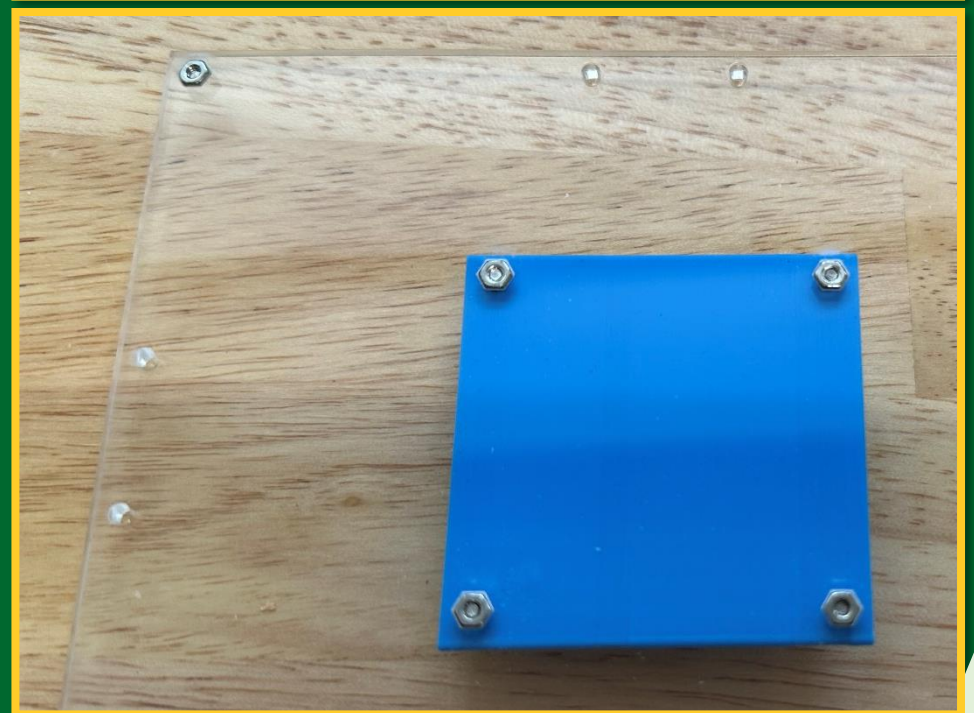
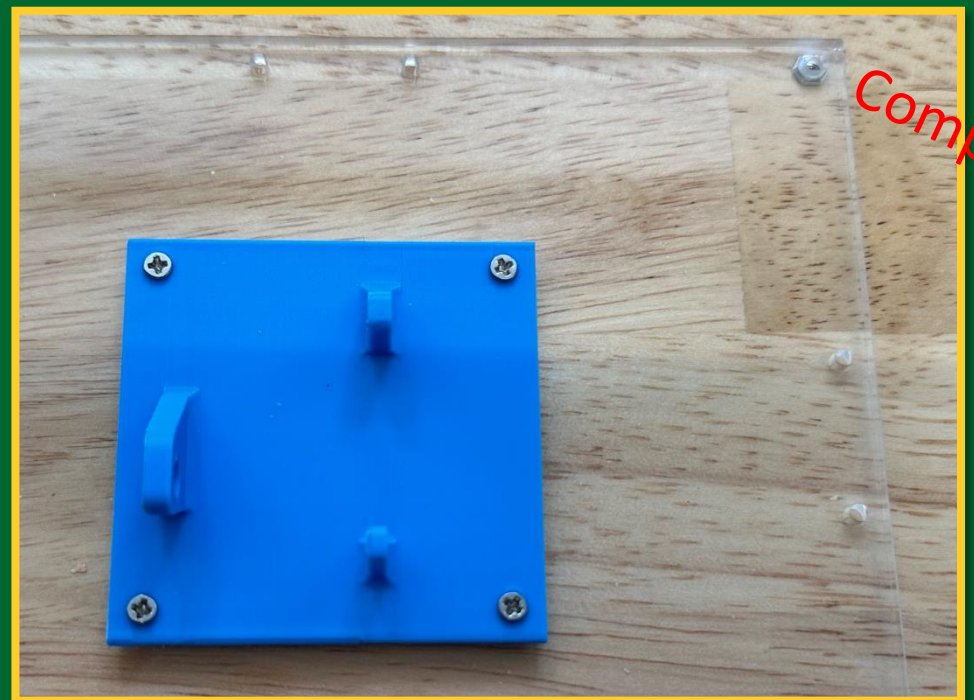
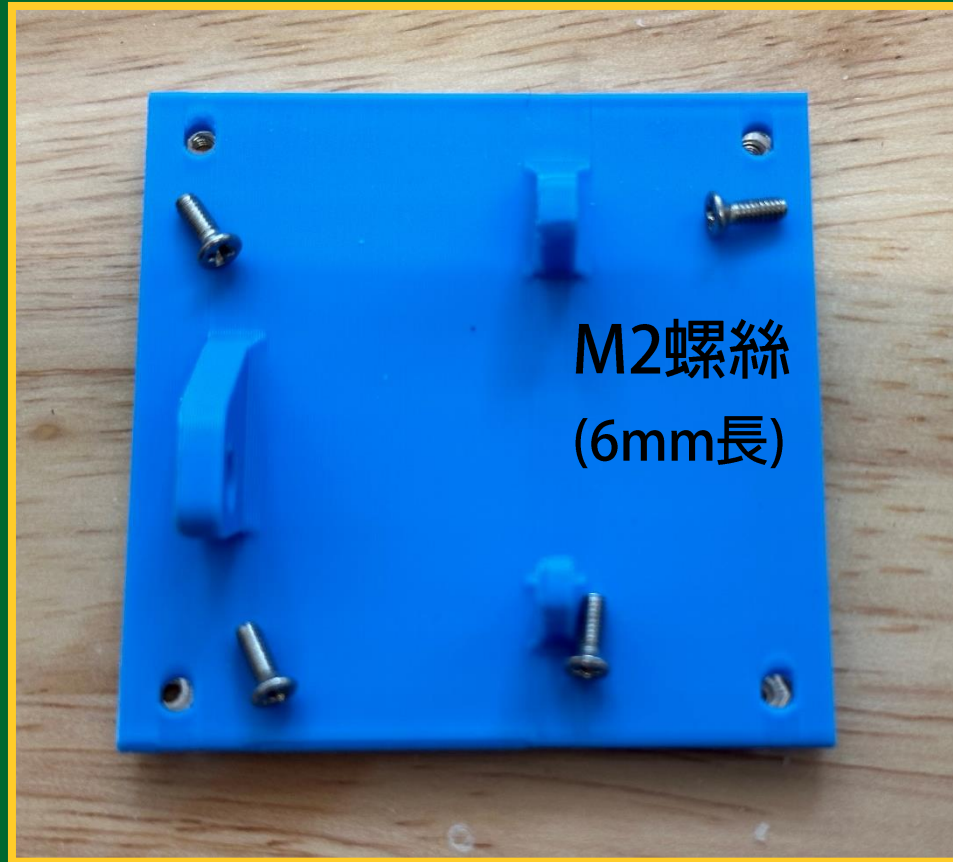


底 Bottom



6b

# 安裝太陽能板 Install the Solar Panel

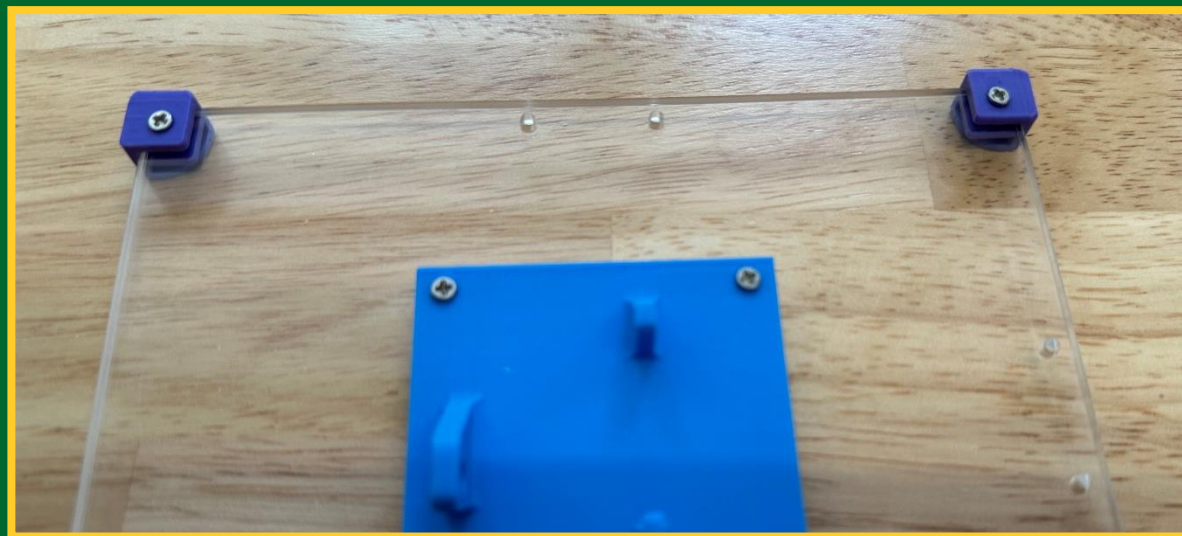
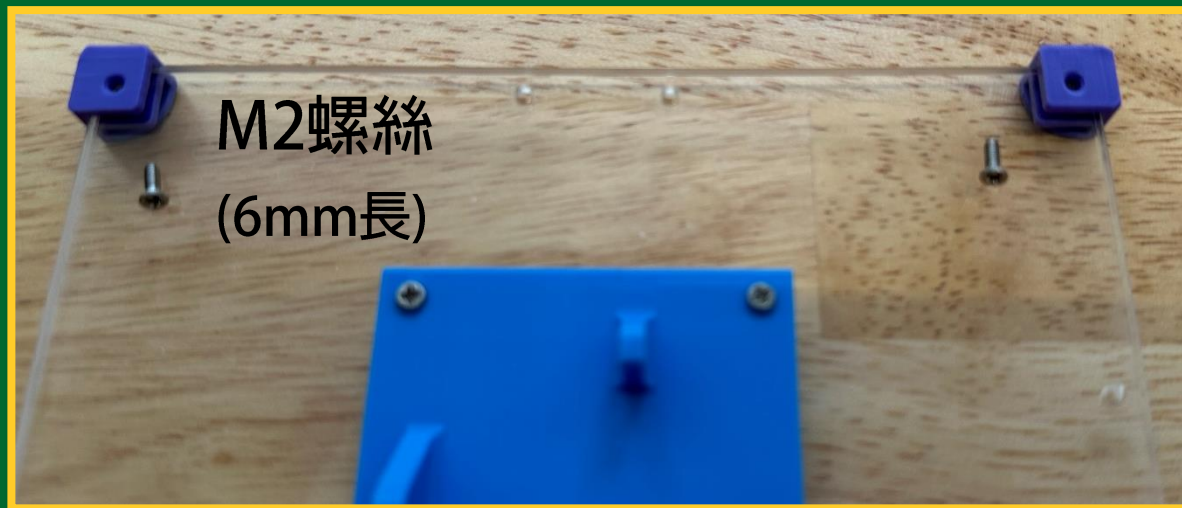
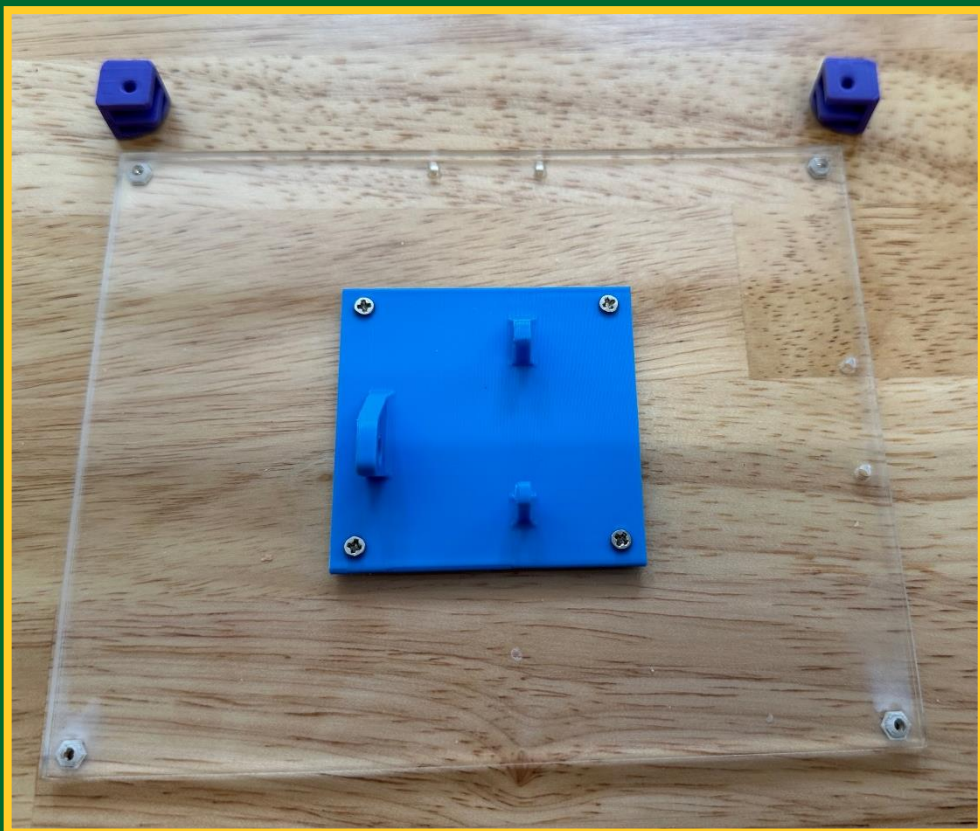




6c

# 安裝太陽能板 Install the Solar Panel

Completed

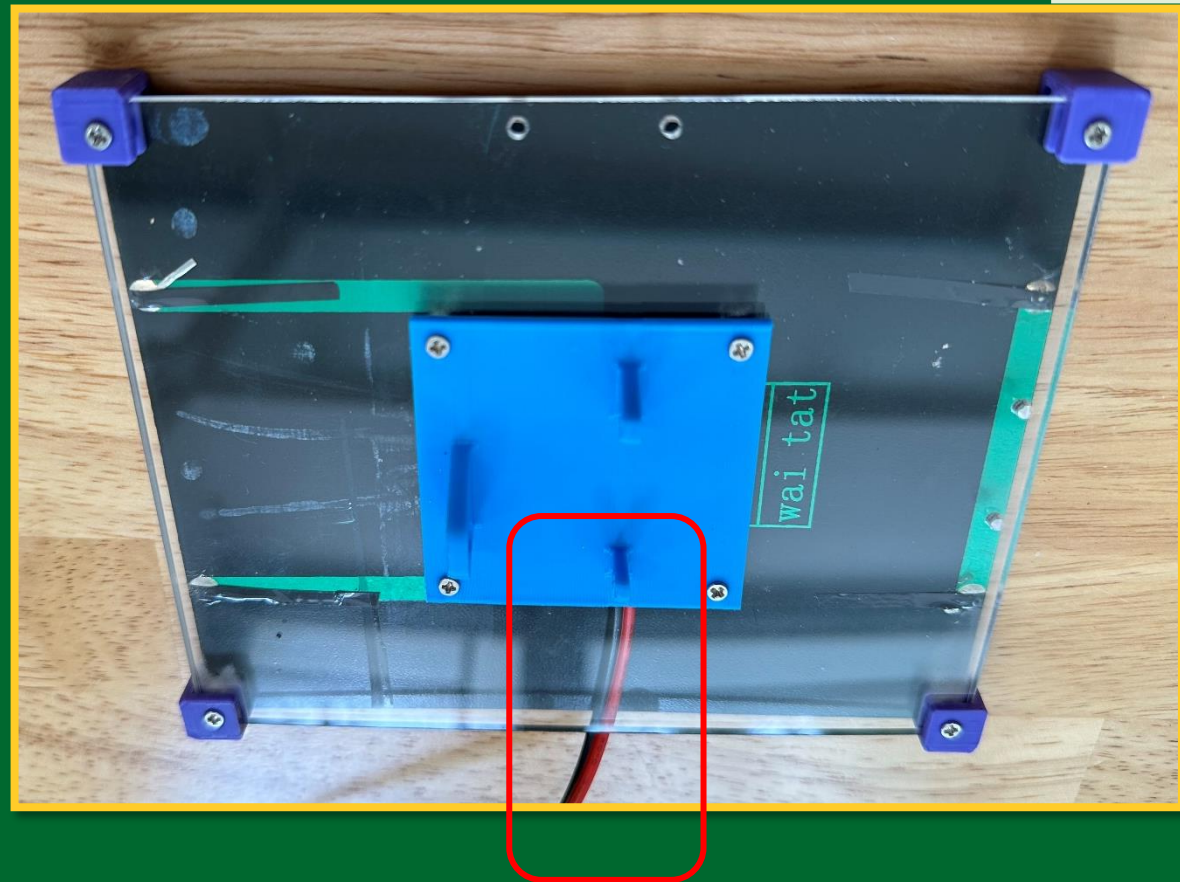
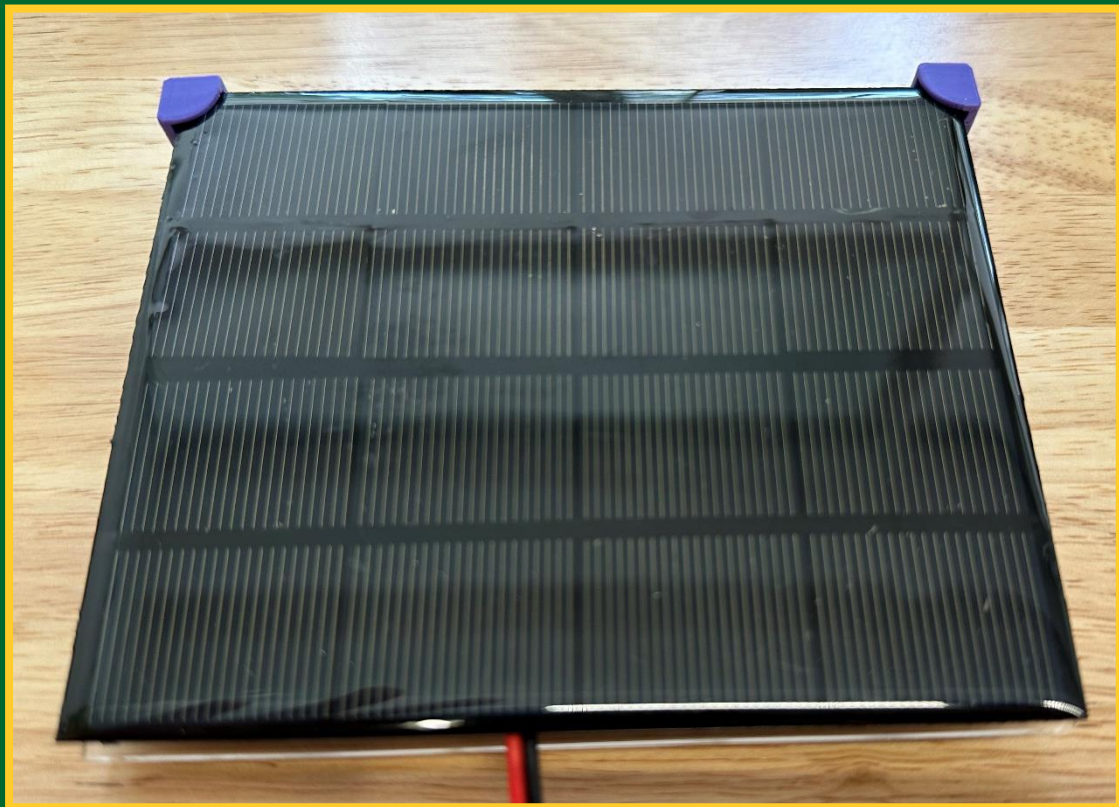




6d

# 安裝太陽能板 Install the Solar Panel

Completed



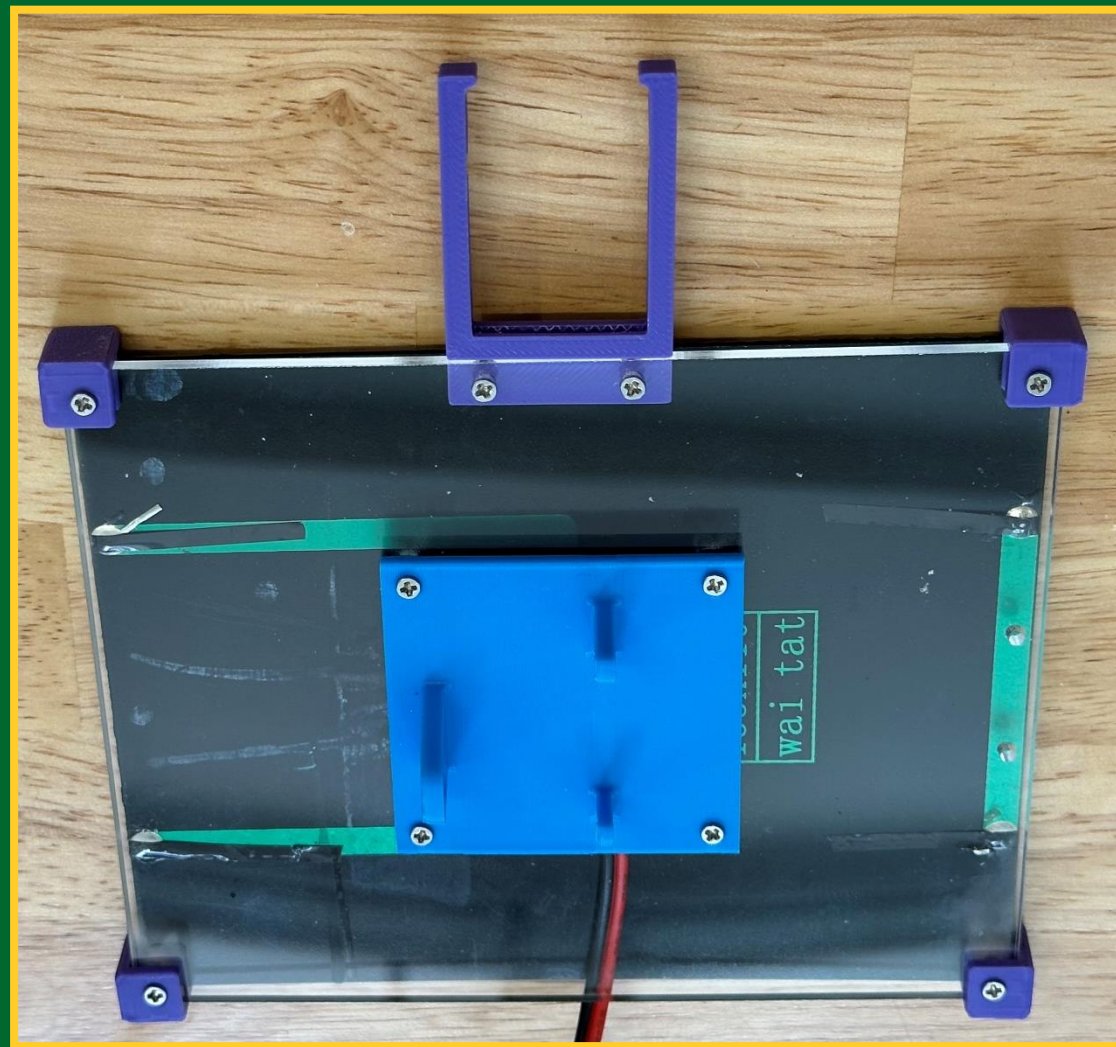
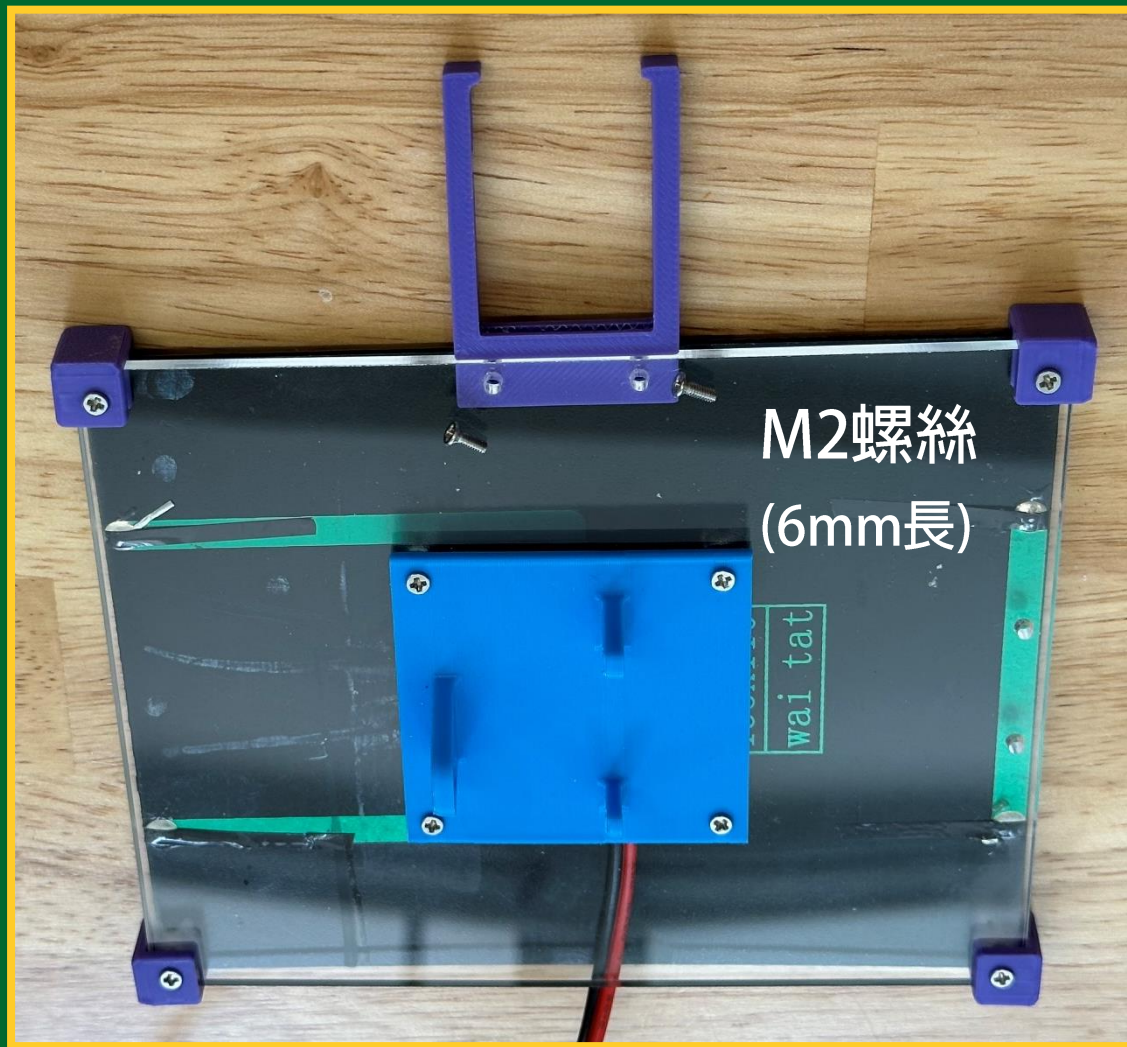


7a

# 安裝四路光敏傳感器

## Install the Four-way Photo-sensitive Sensor

Completed

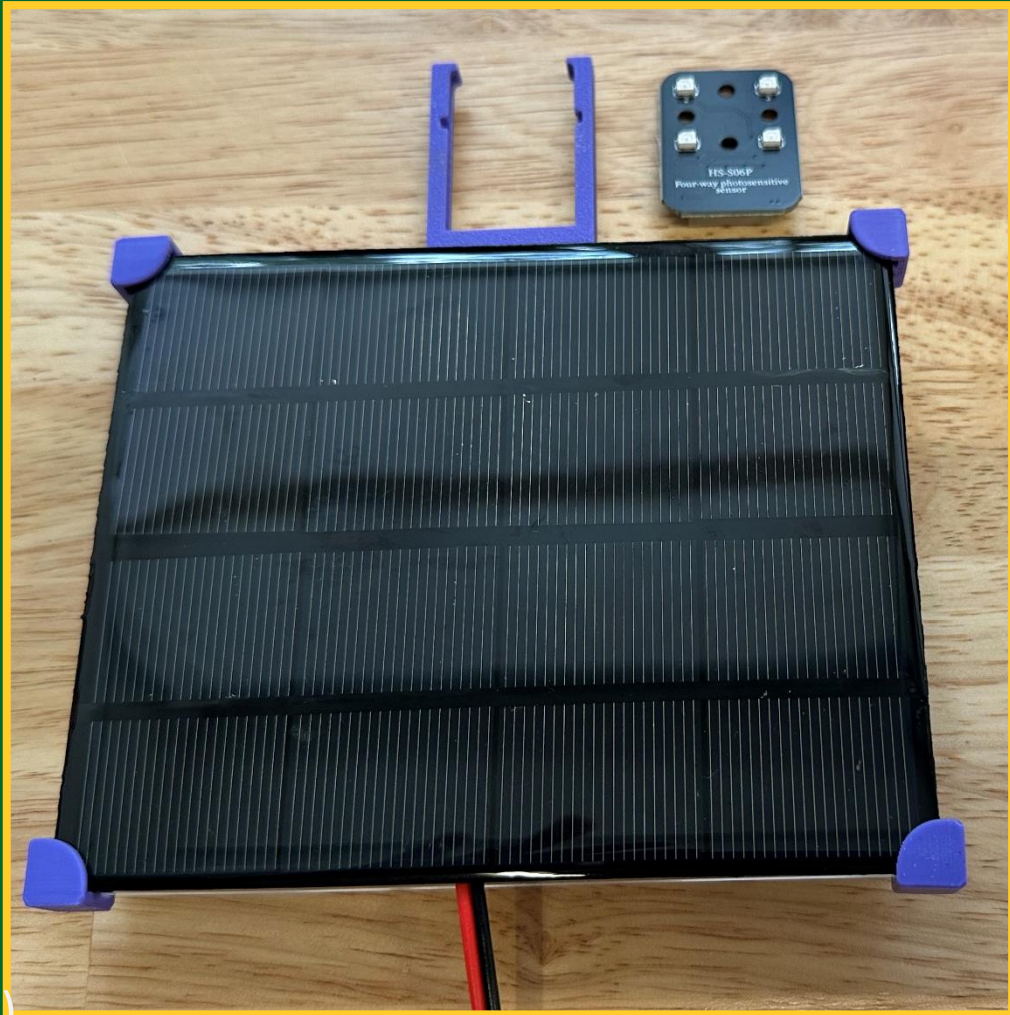




7b

# 安裝四路光敏傳感器

## Install the Four-way Photo-sensitive Sensor





8

# 安放光敏傳感器的分隔器

Placement of the Photo-sensitive Sensor's Divider



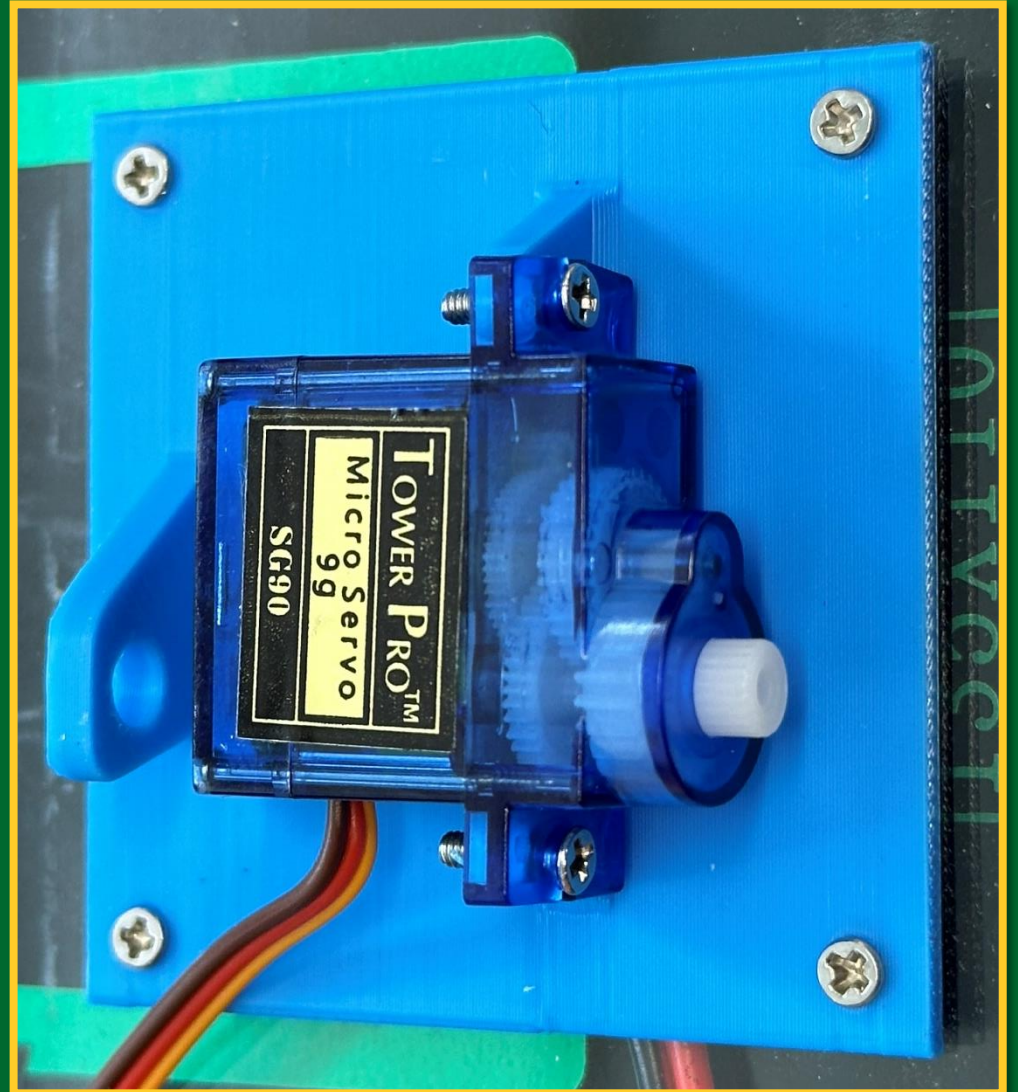
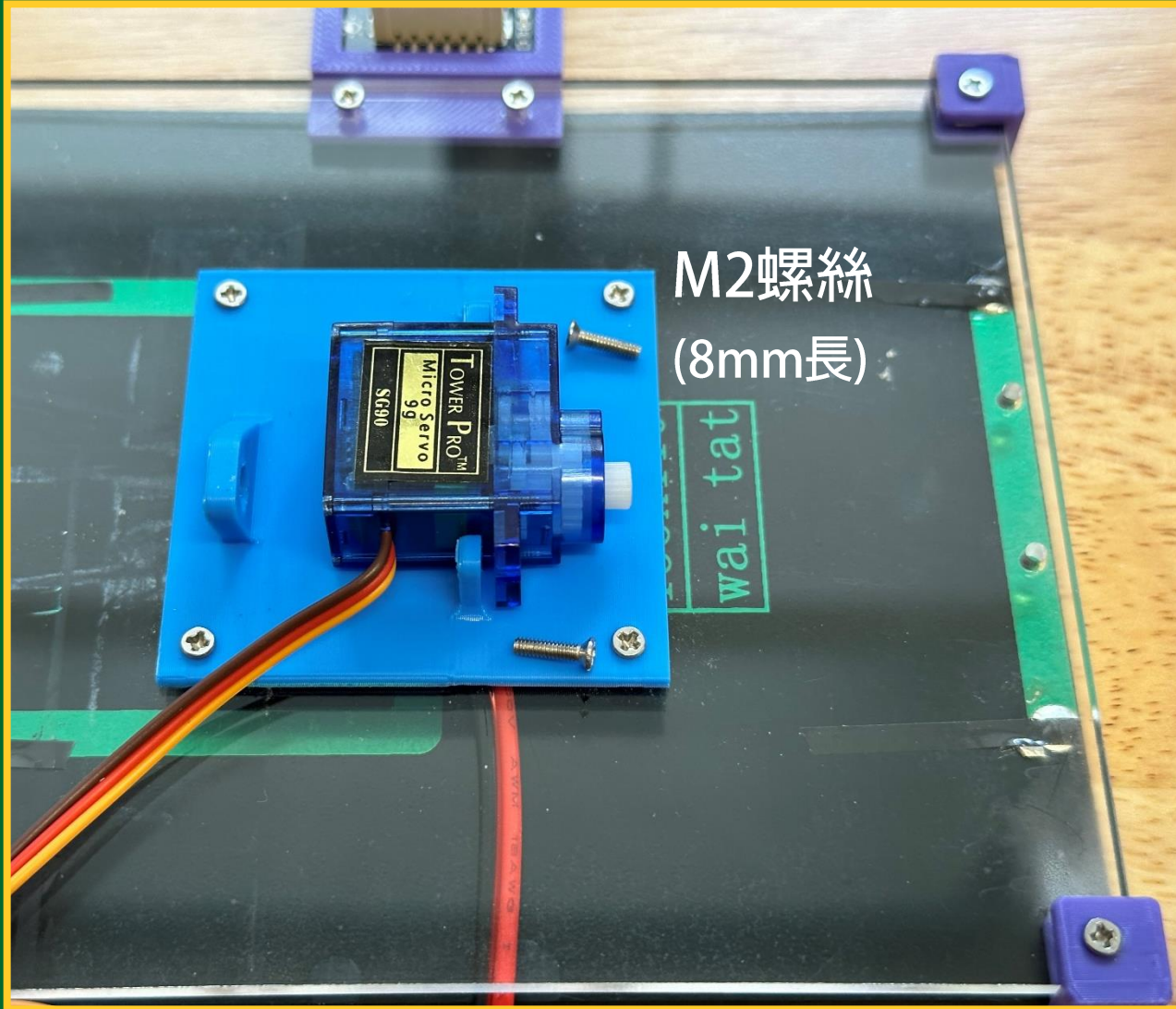


9a

# 安裝垂直轉動架

## Install the Vertical Swivel Bracket

Completed



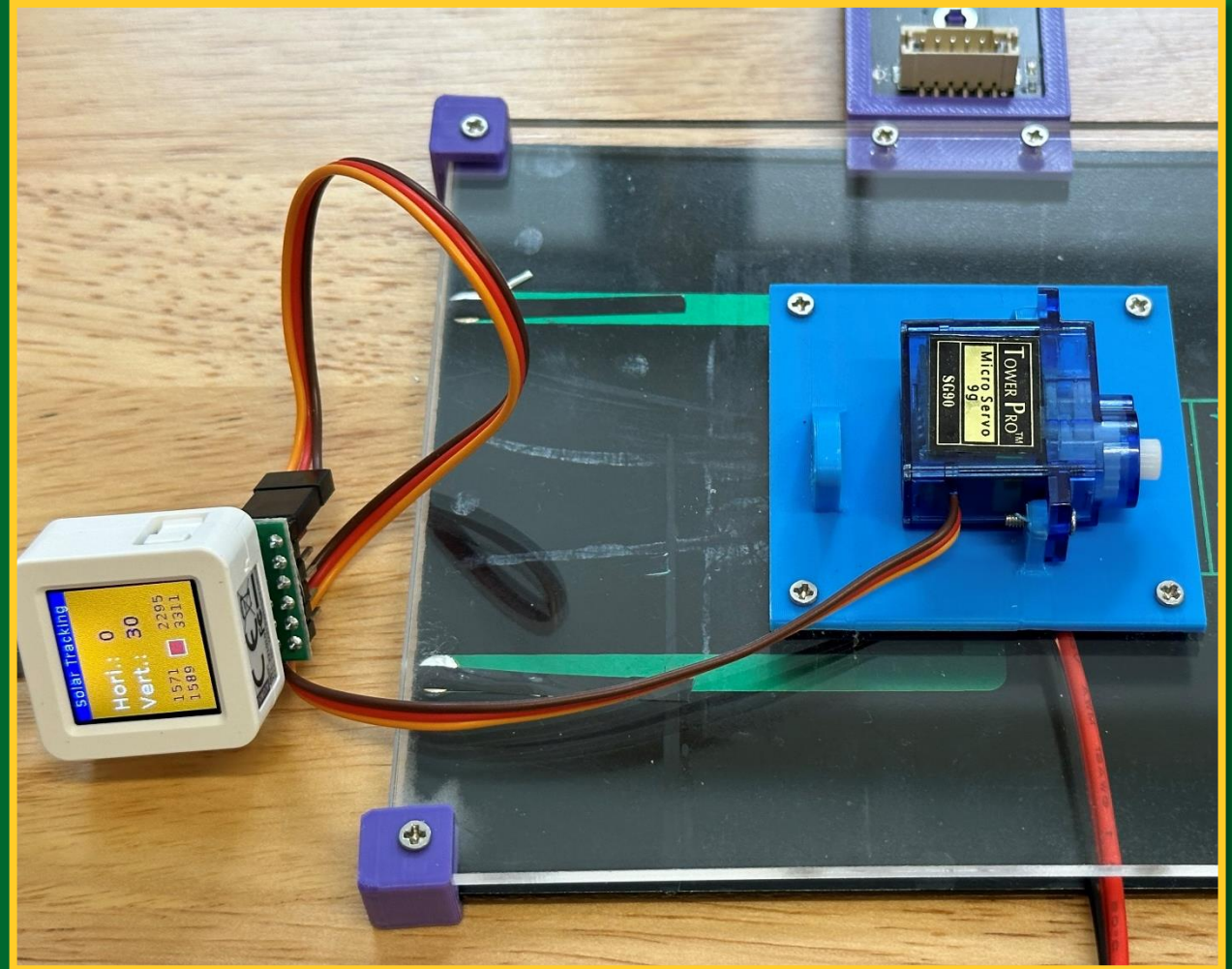
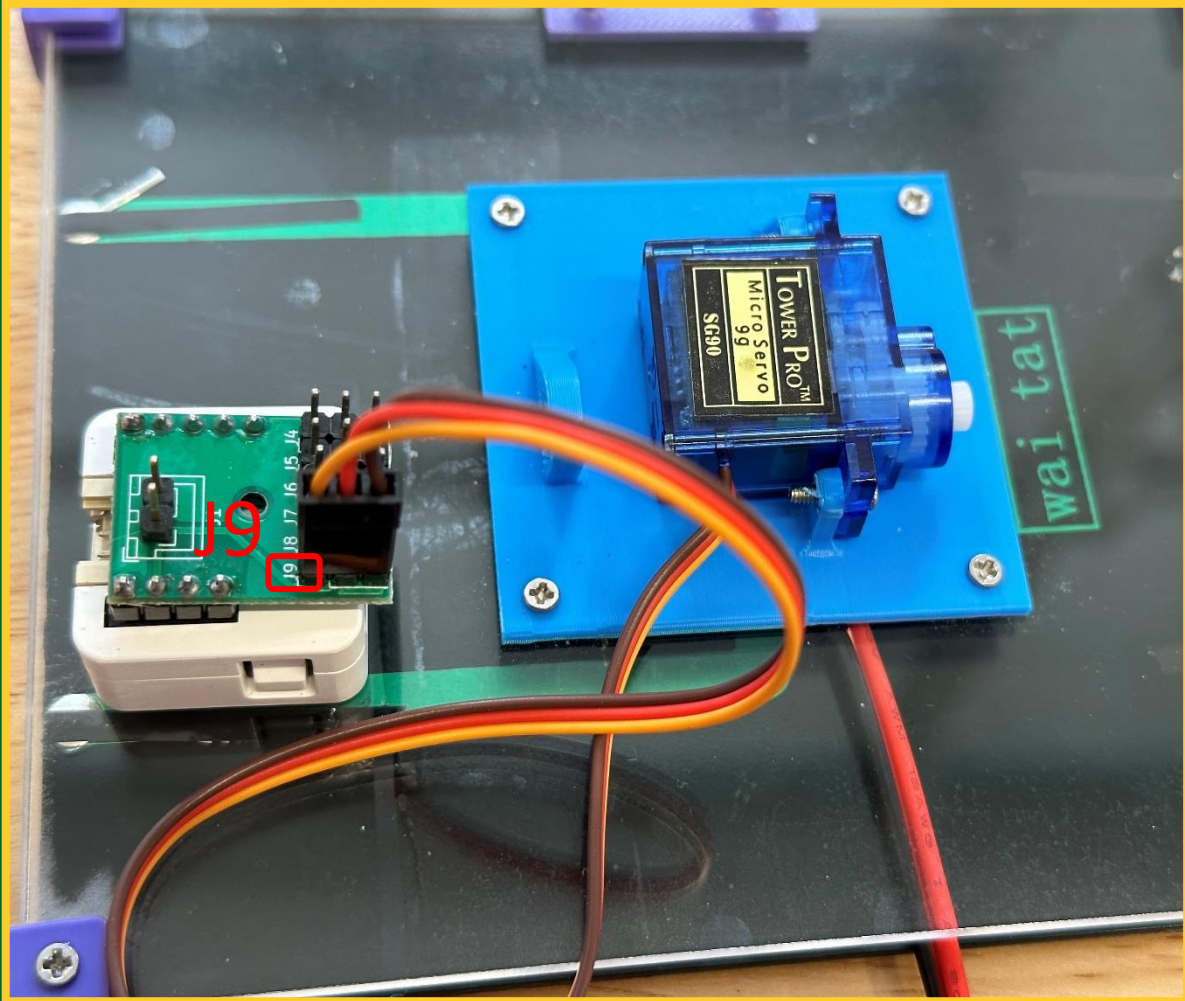


9b

# 安裝垂直轉動架

## Install the Vertical Swivel Bracket

Completed

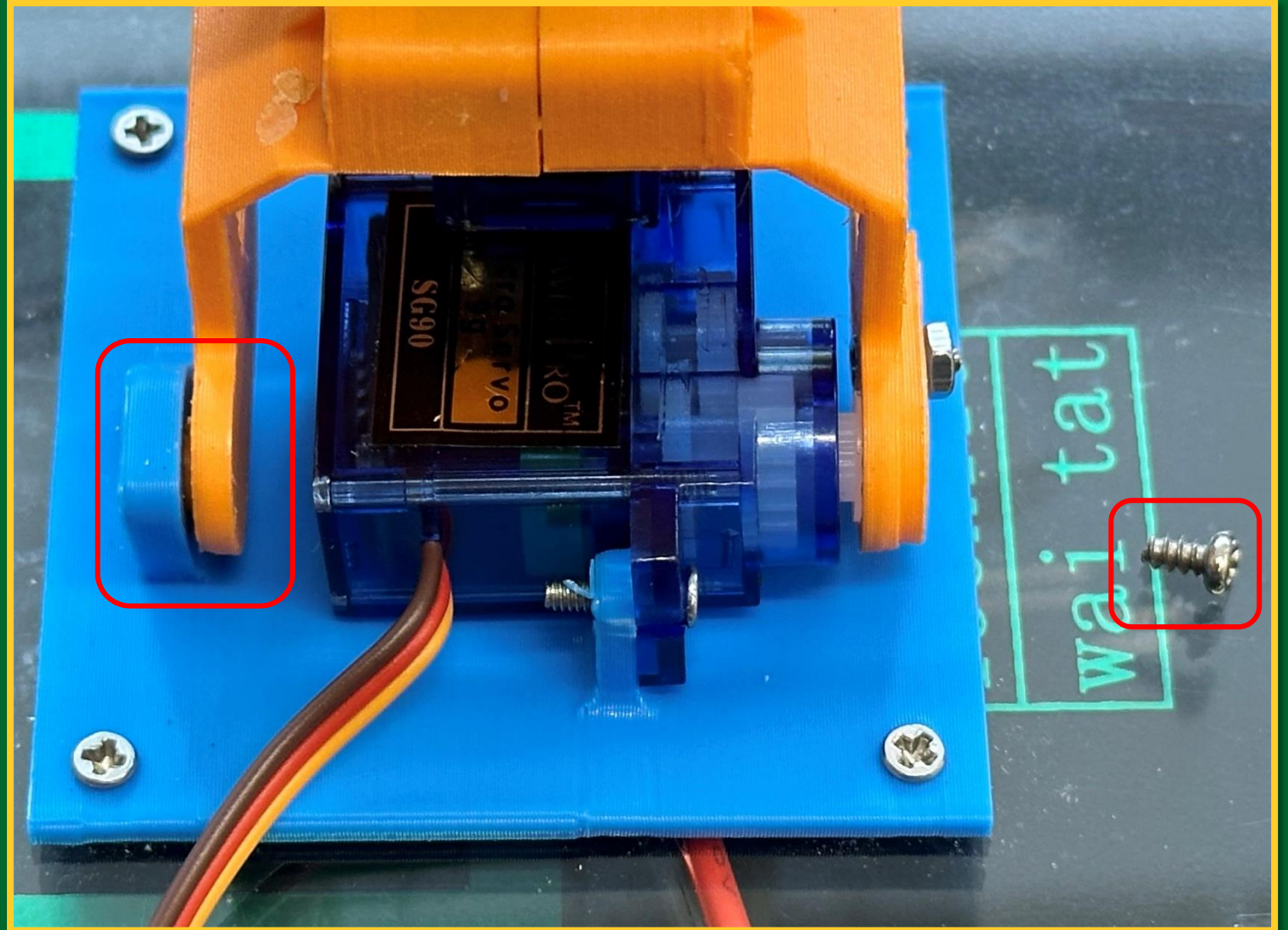
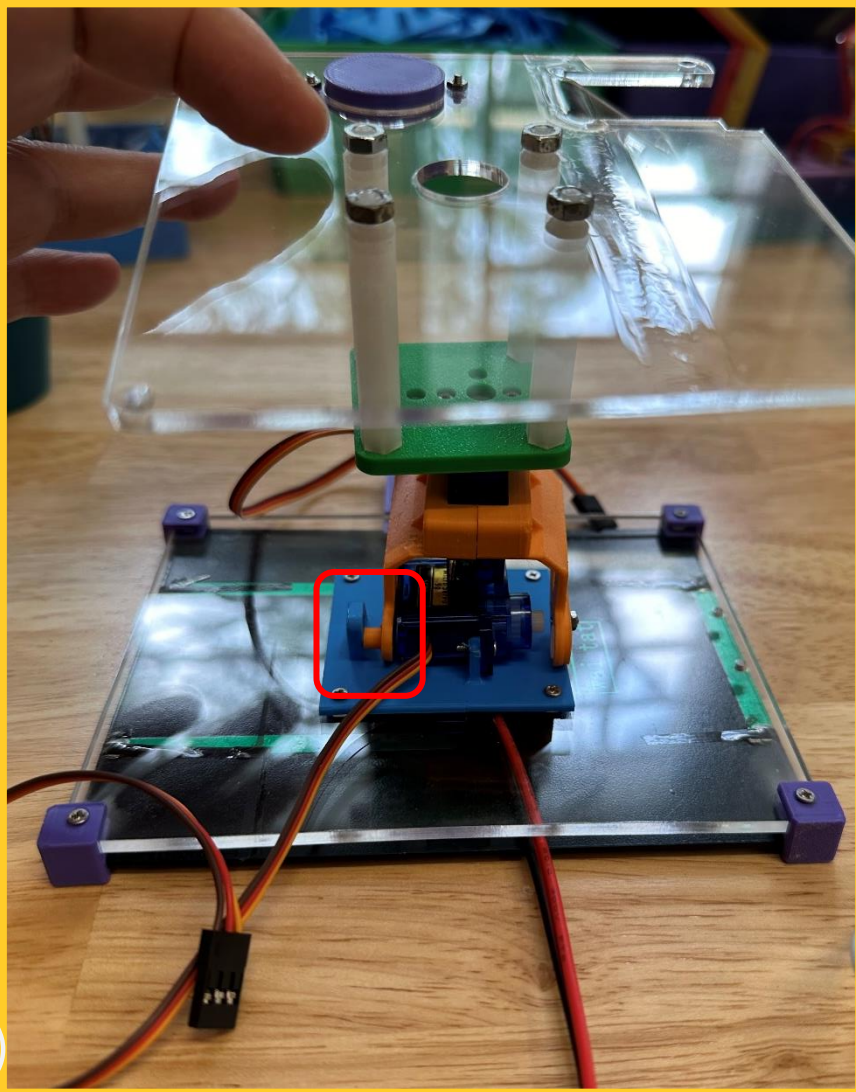




9c

# 安裝垂直轉動架

## Install the Vertical Swivel Bracket

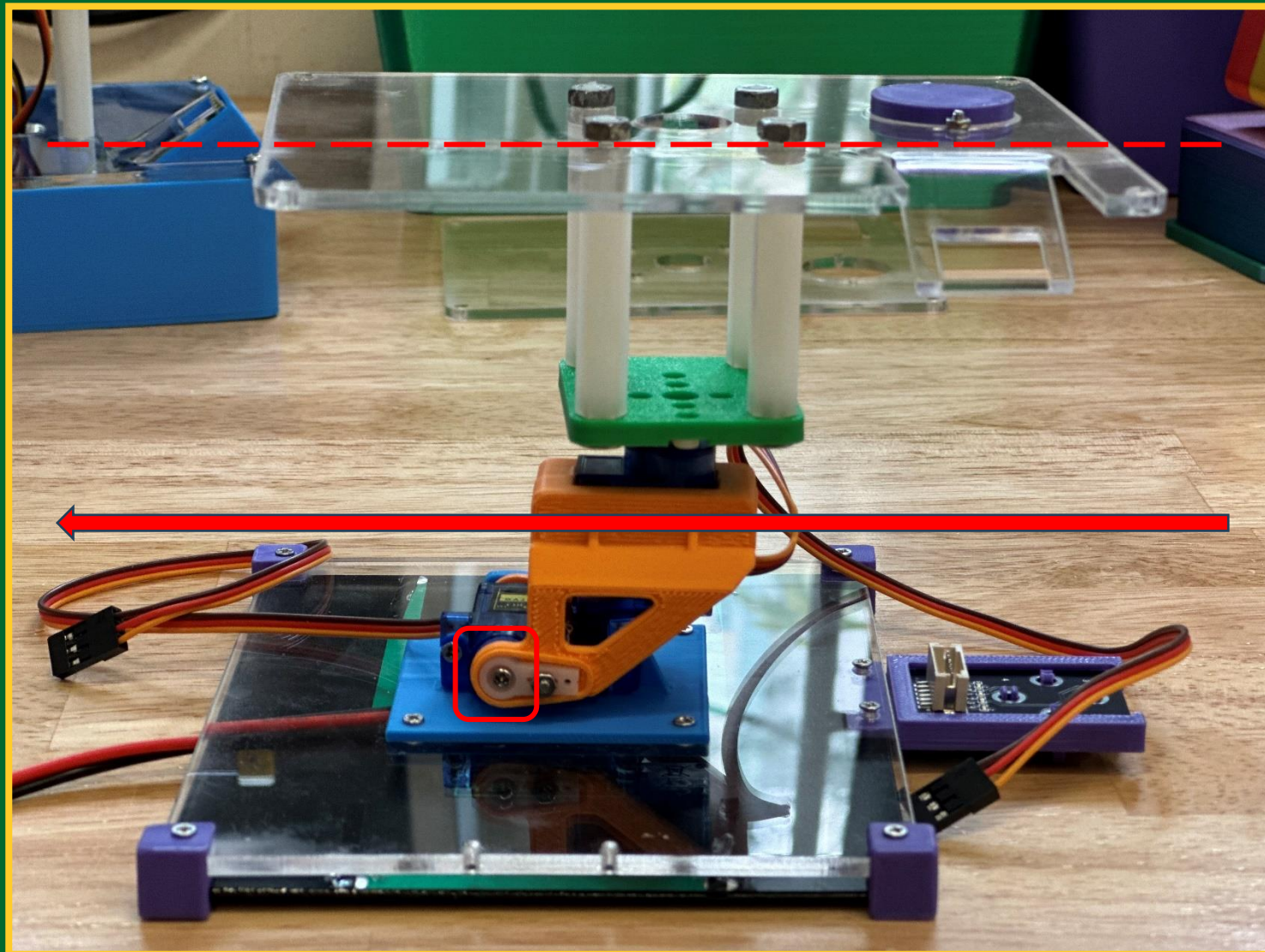




9d

# 安裝垂直轉動架

## Install the Vertical Swivel Bracket

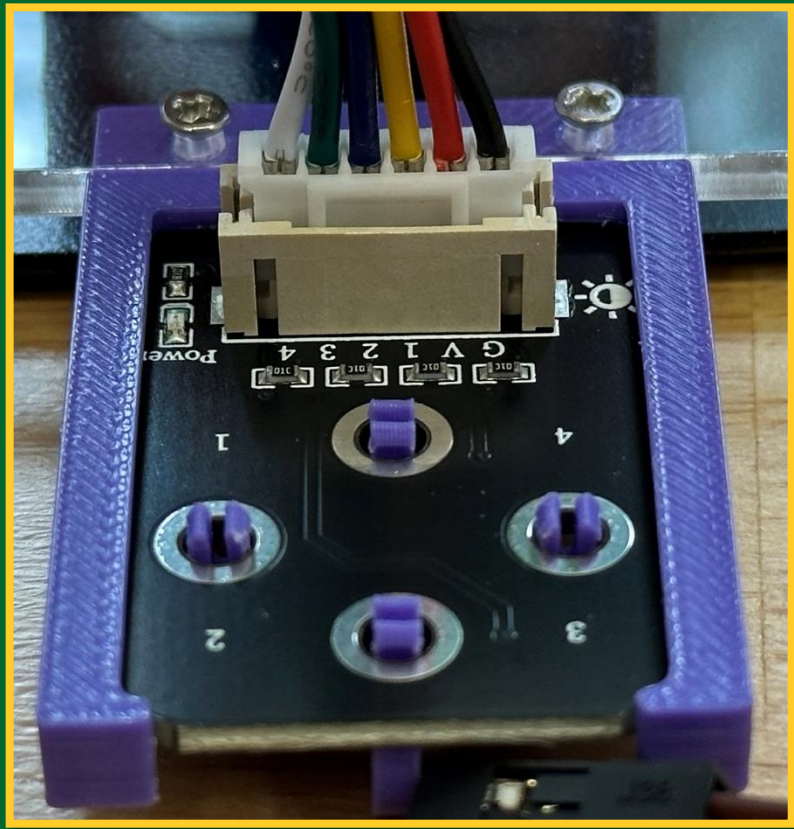
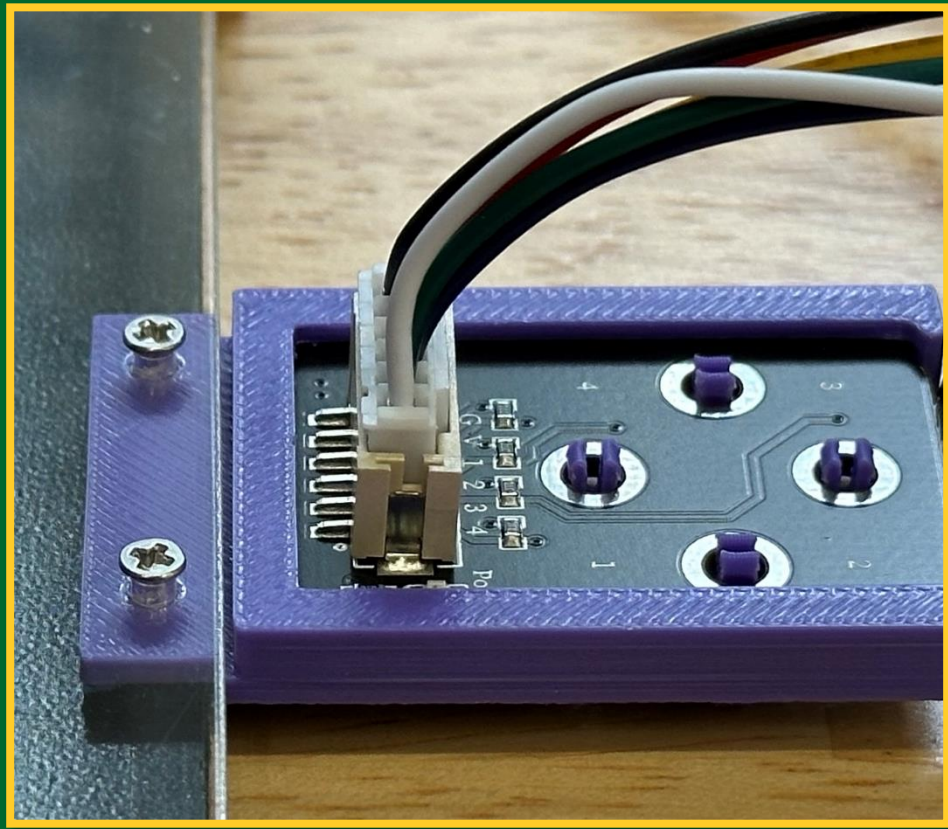




10a

# 連接所有電子部件至印刷電路板

Connect all electronic components to the Printed Circuit Board

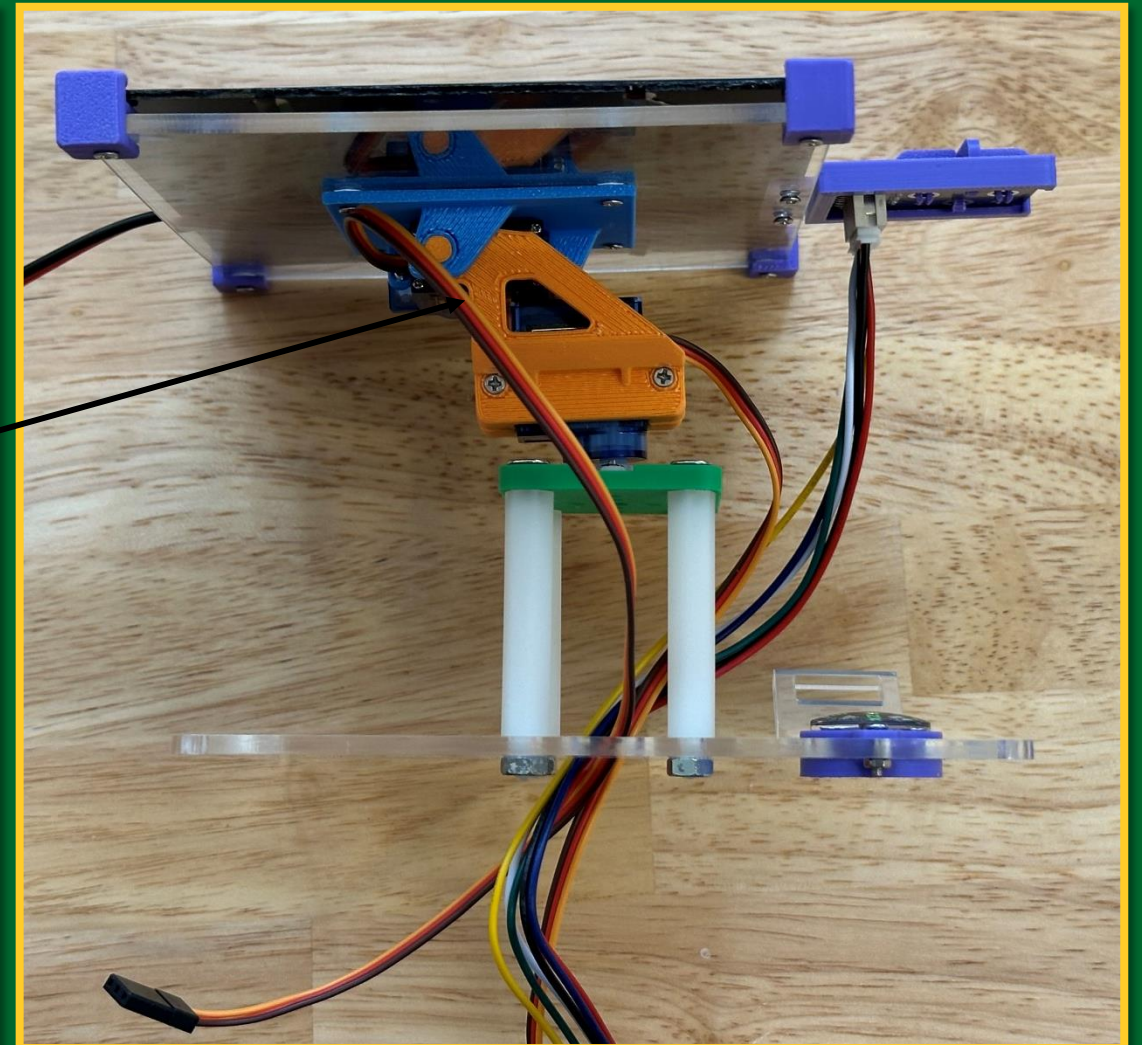
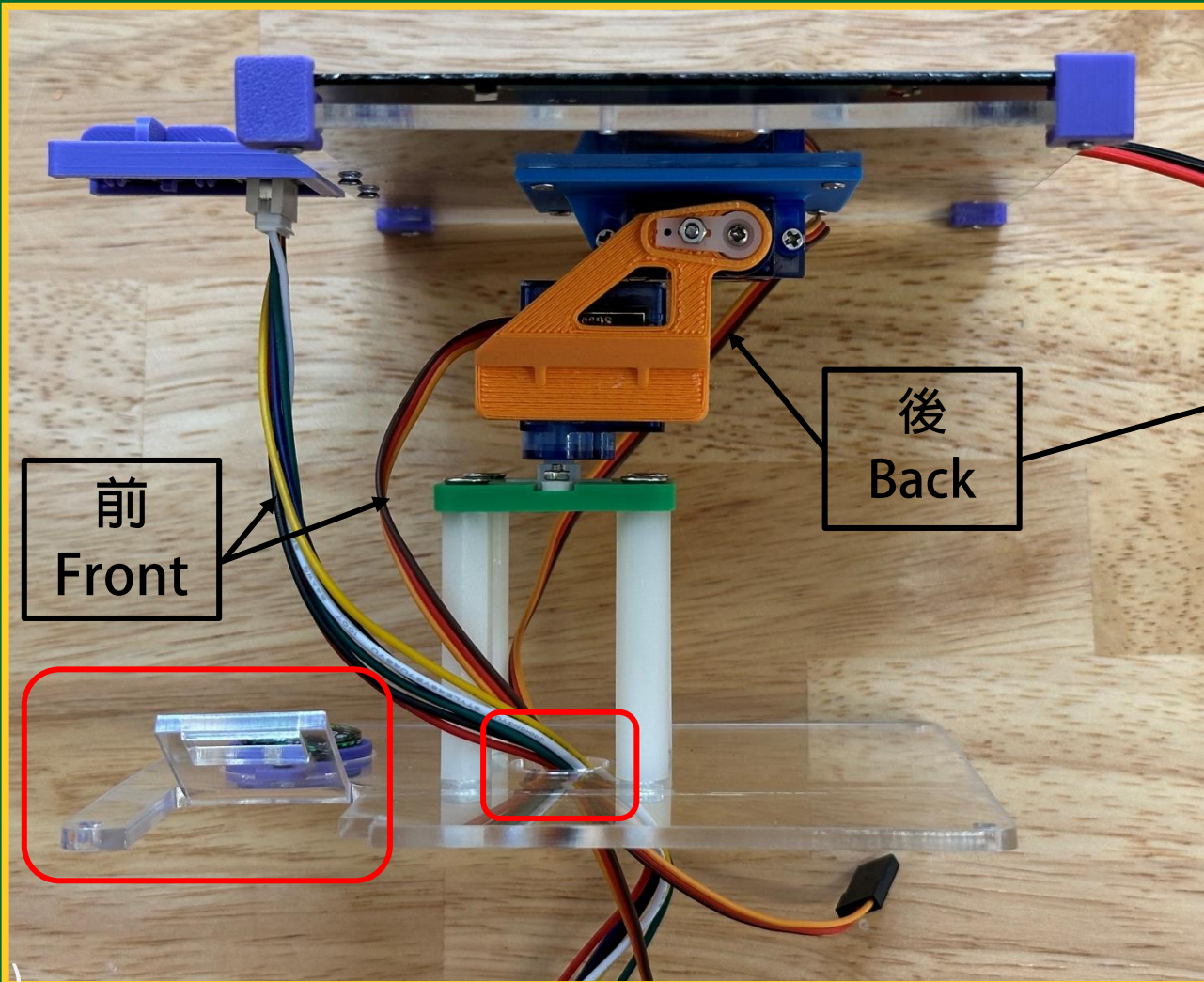




10b

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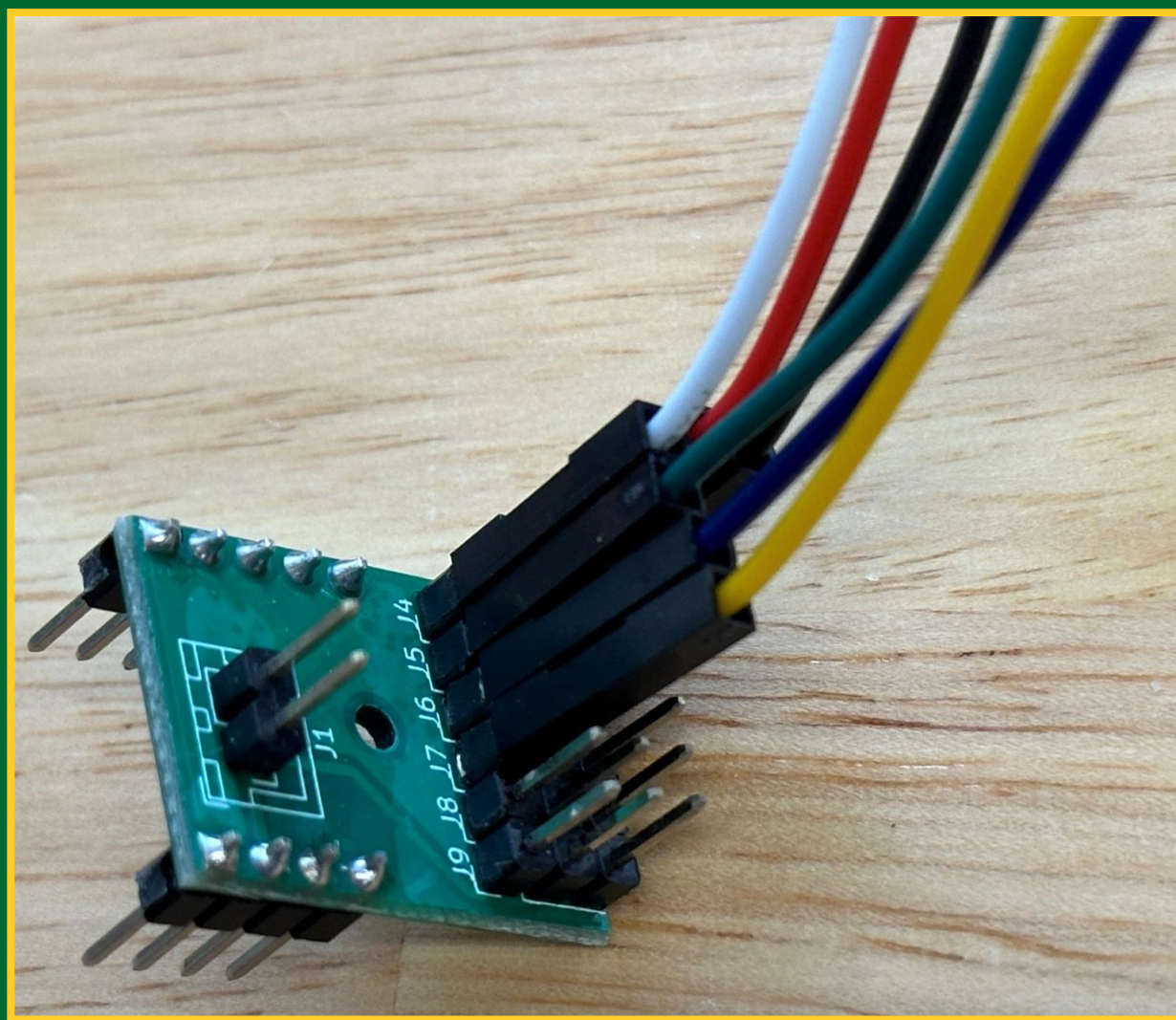
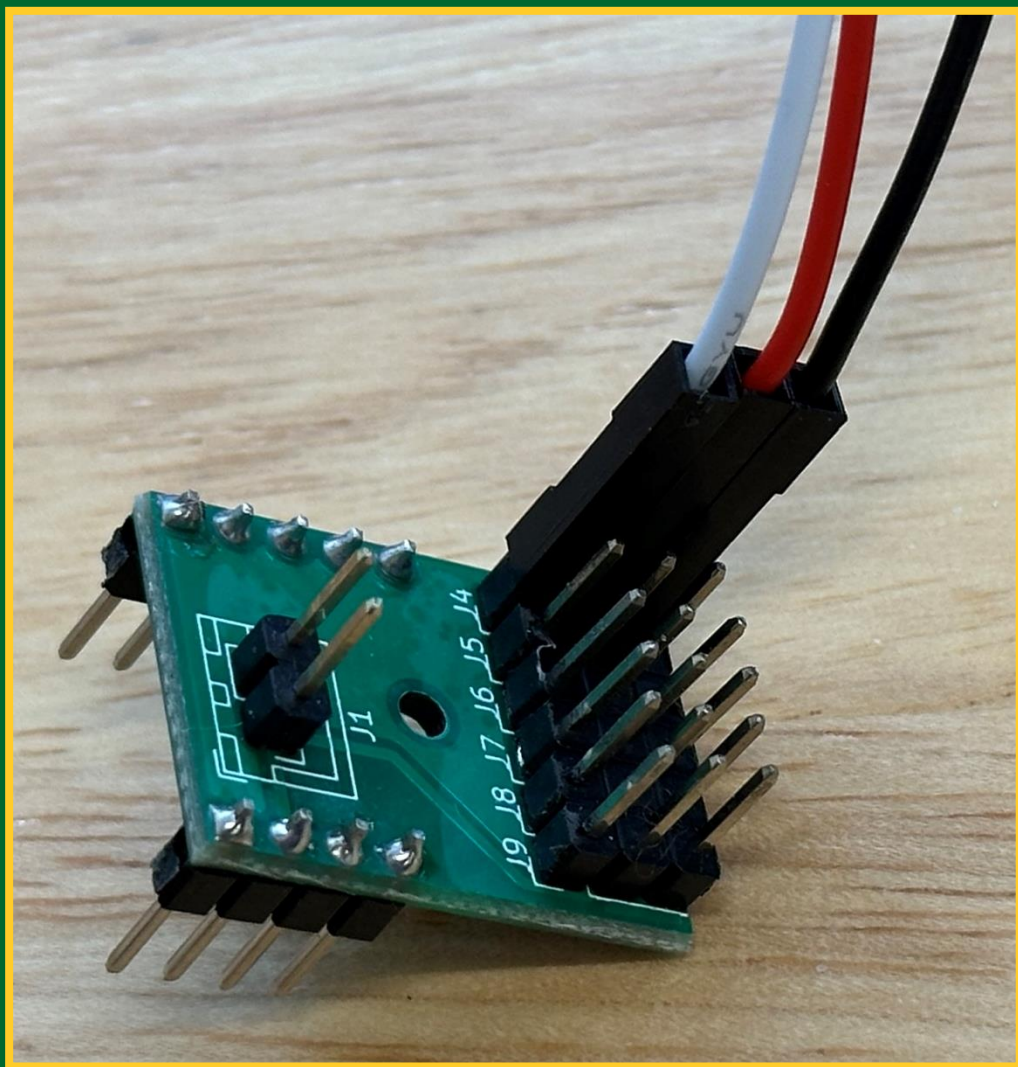




10c

# 連接所有電子部件至印刷電路板

Connect all electronic components to the Printed Circuit Board

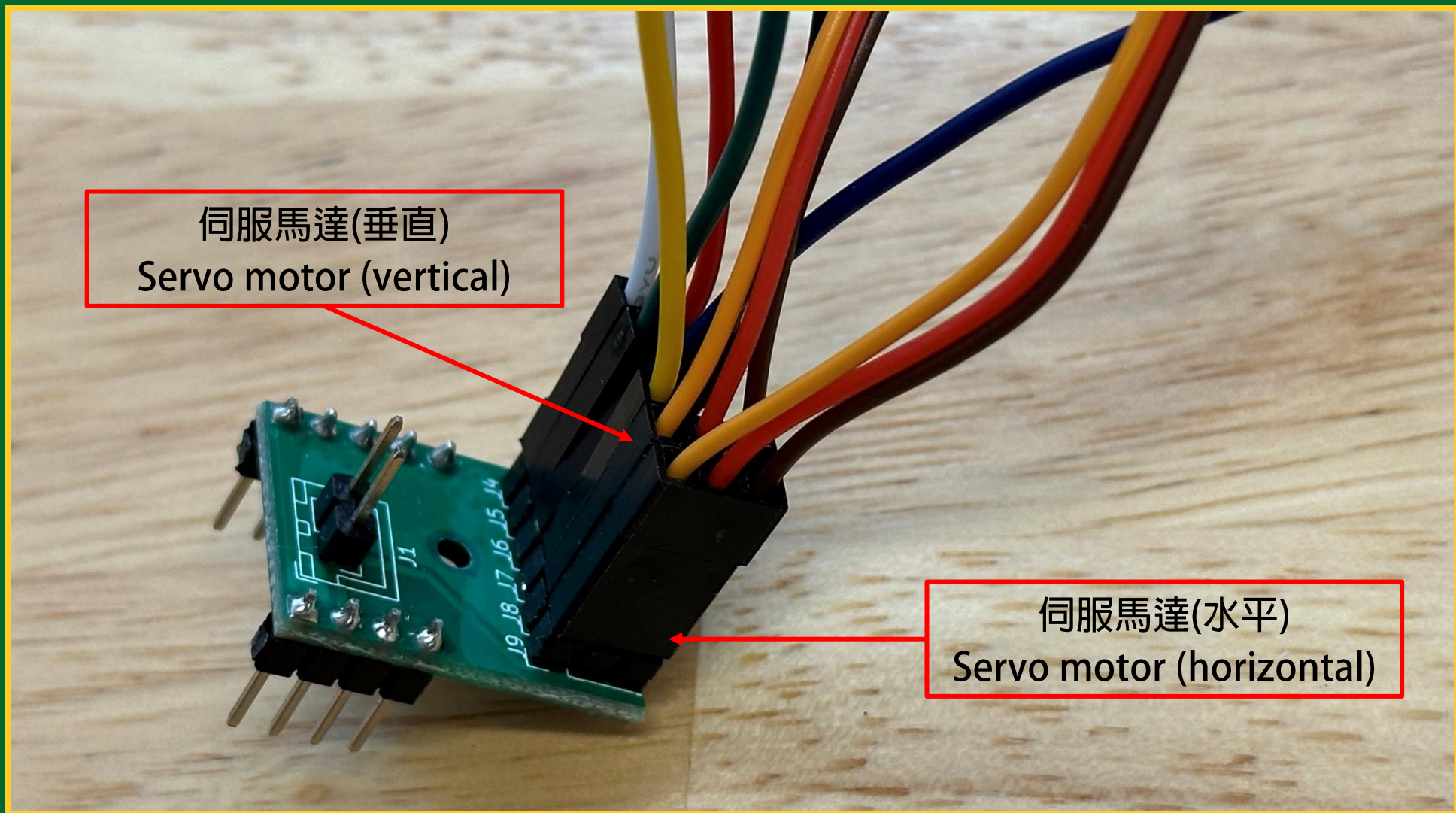




10d

# 連接所有電子部件至印刷電路板

Connect all electronic components to the Printed Circuit Board

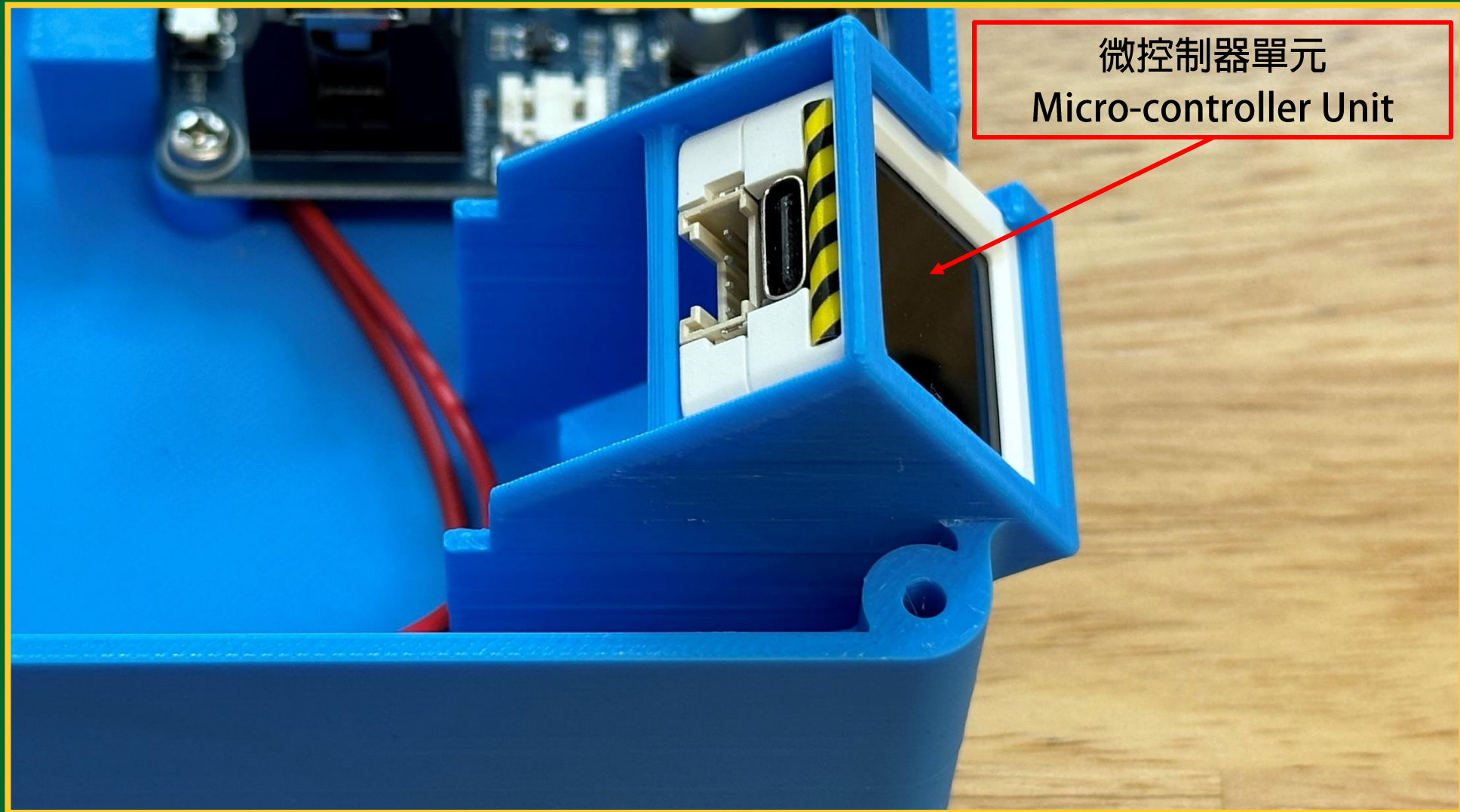




11a

# 連接微控制器單元至印刷電路板的接腳

Attach the **MCU** to **connector pins** of the printed circuit board

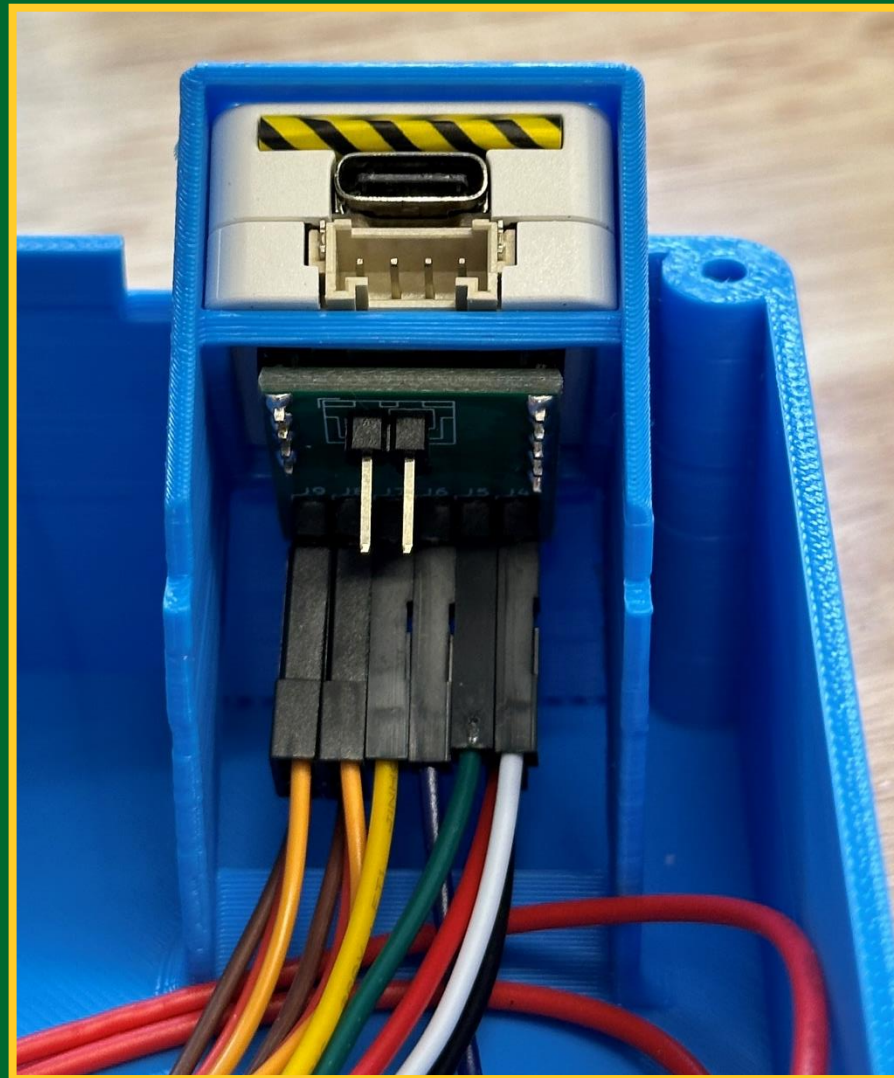
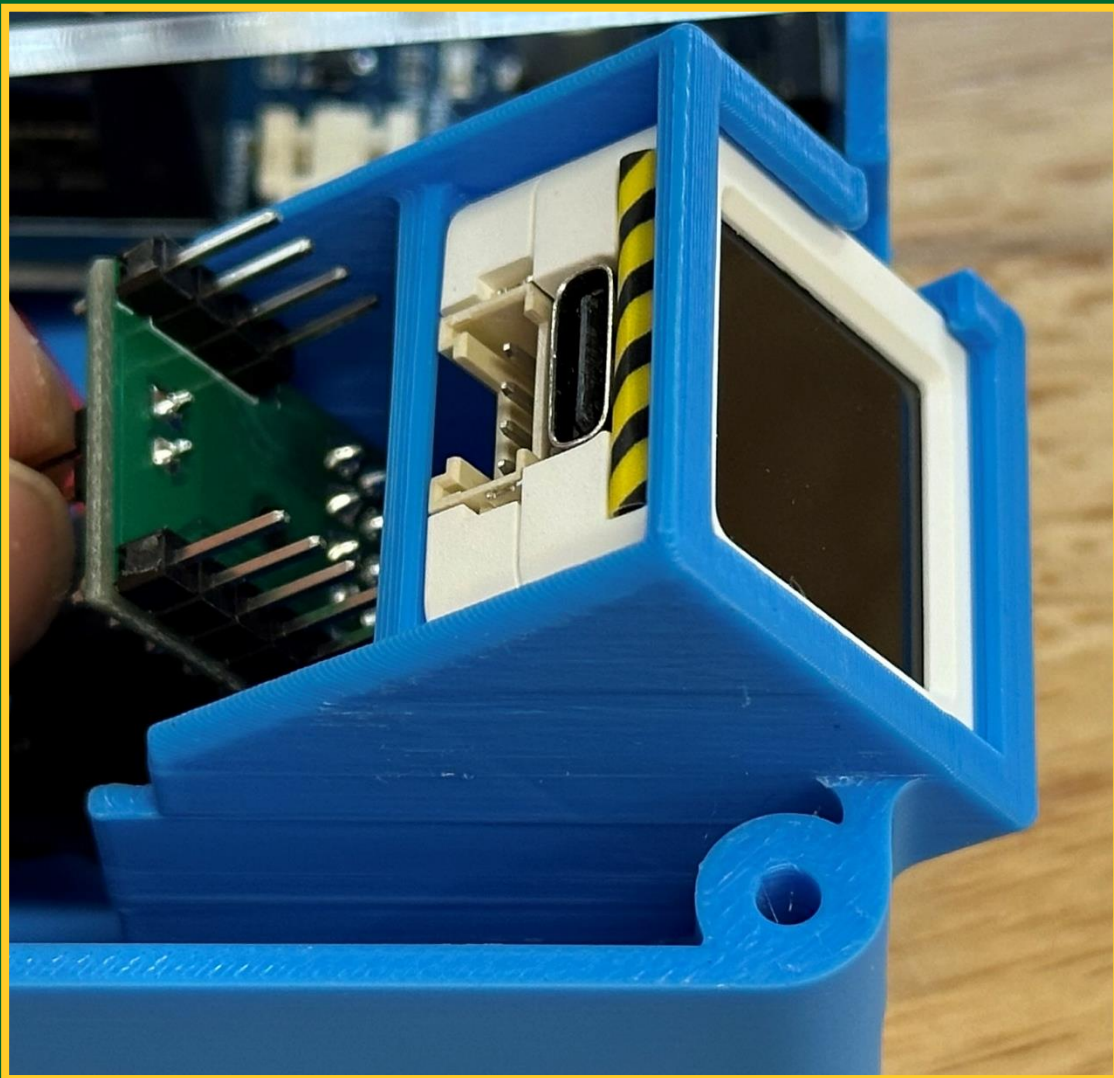




11b

# 連接微控制器單元至印刷電路板的接腳

Attach the **MCU** to **connector pins** of the printed circuit board

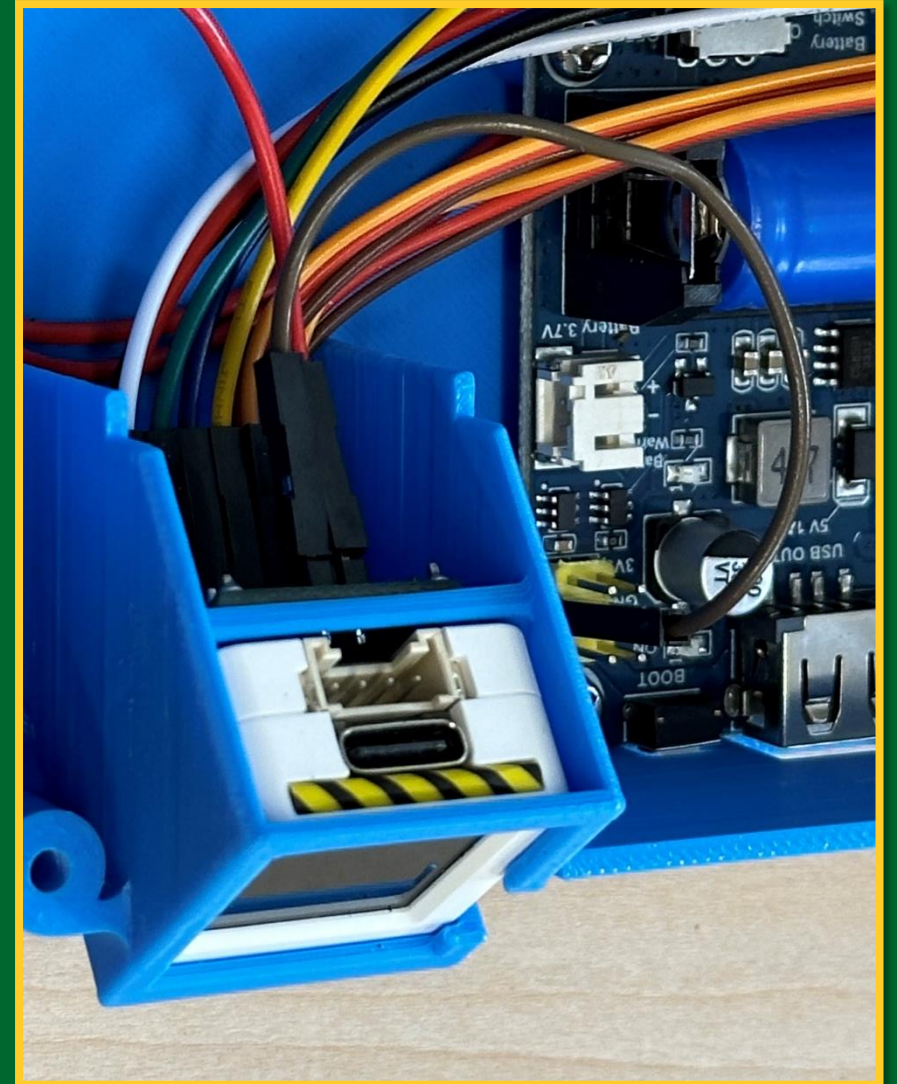
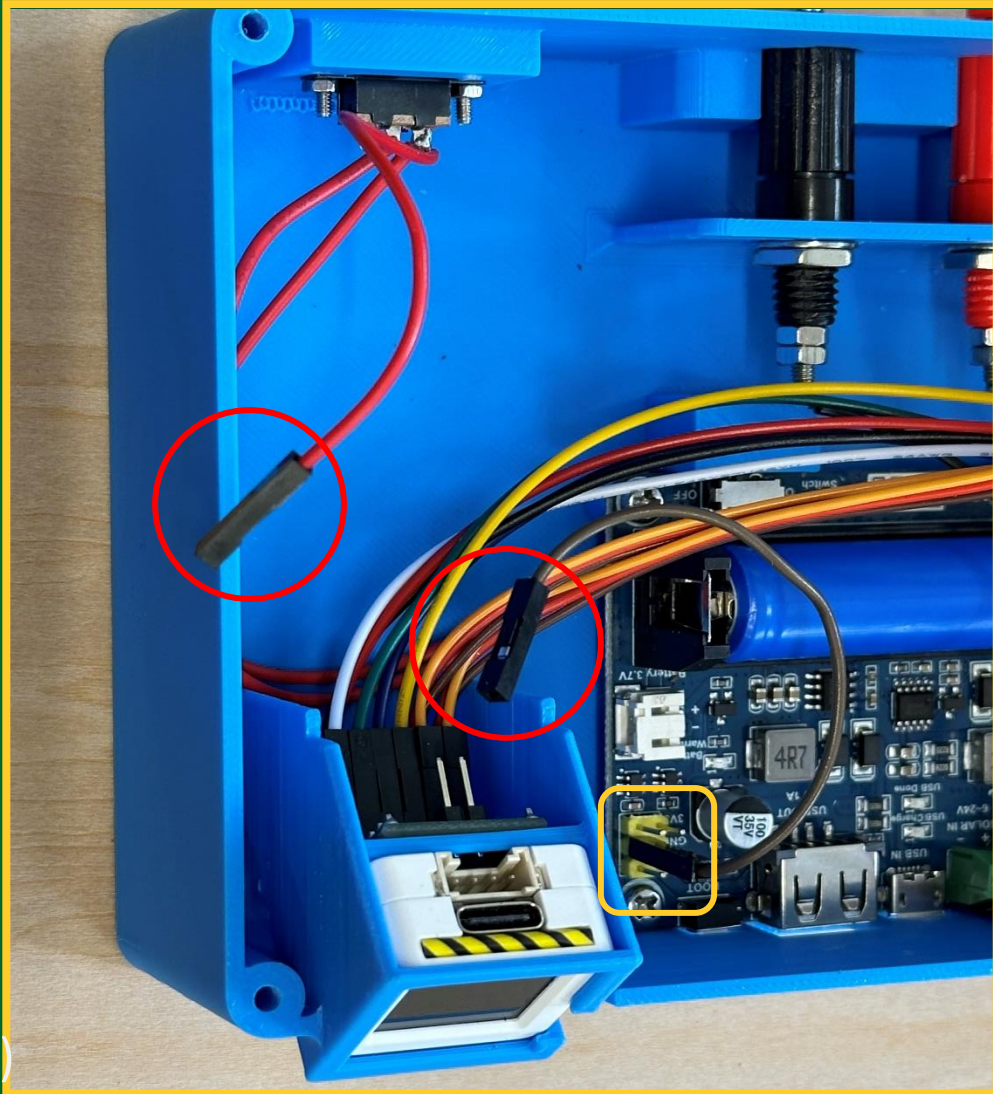




11c

# 連接微控制器單元至印刷電路板的接腳

Attach the MCU to connector pins of the printed circuit board

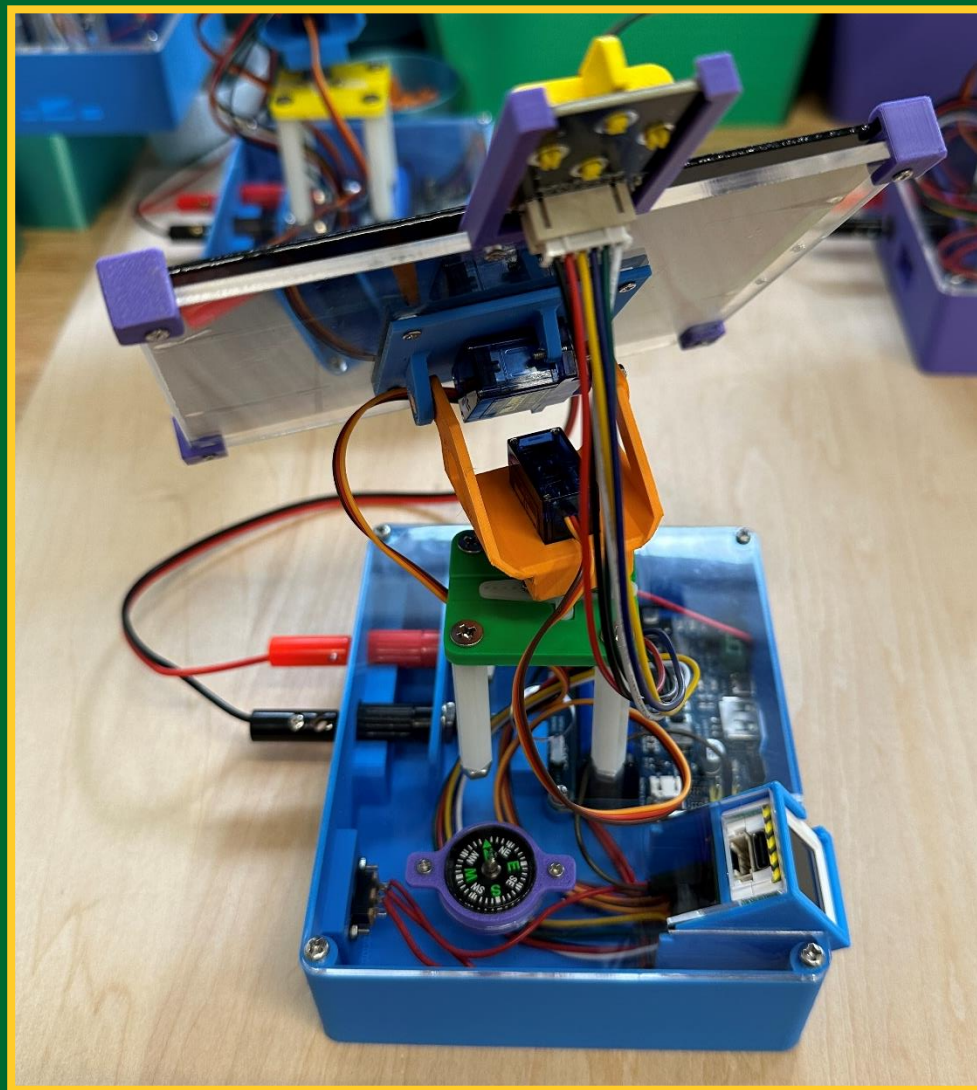
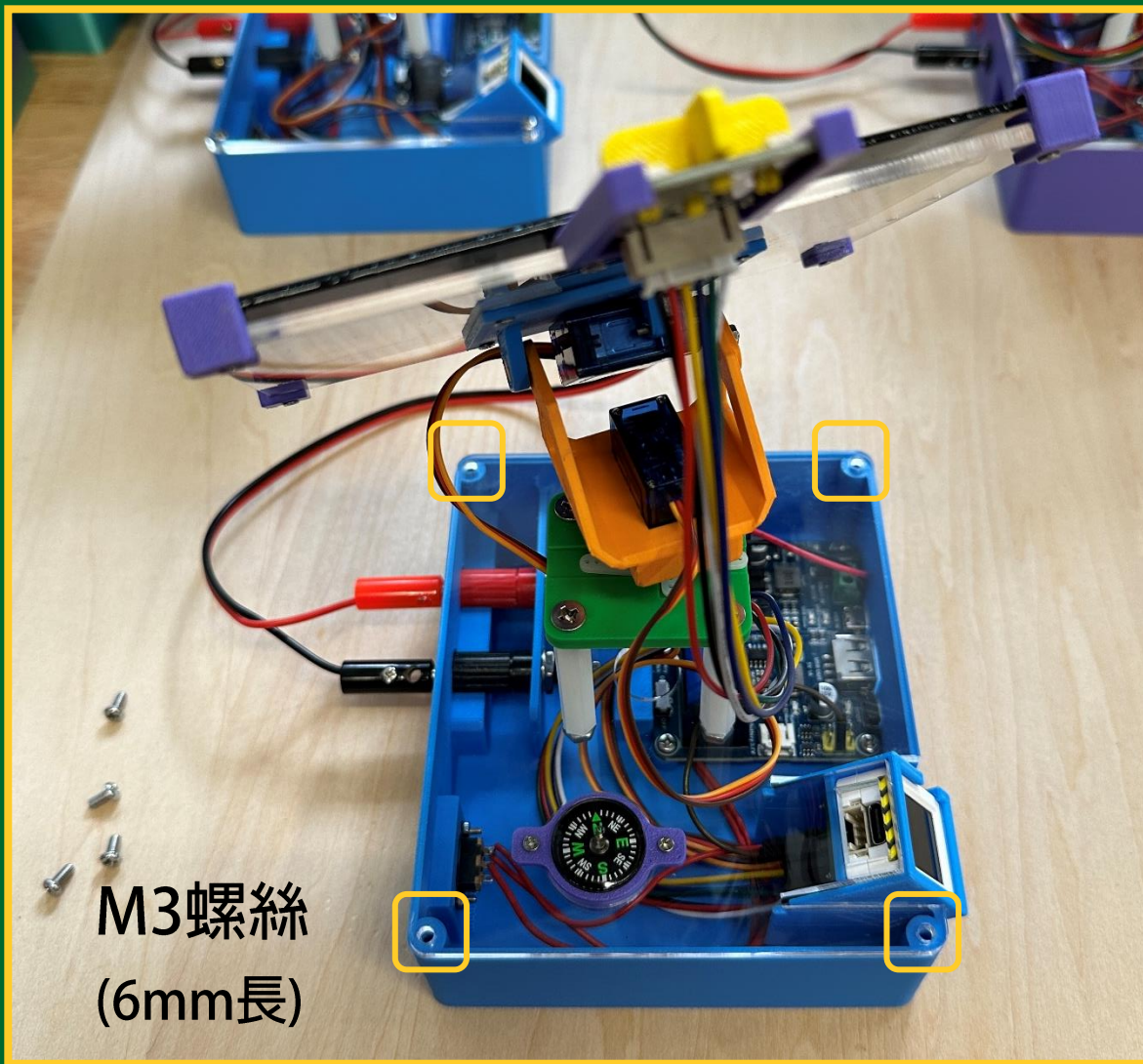




12

# 擺放及固定裝置基座面板

Positioning and fixing of the Base Top Plate of the device

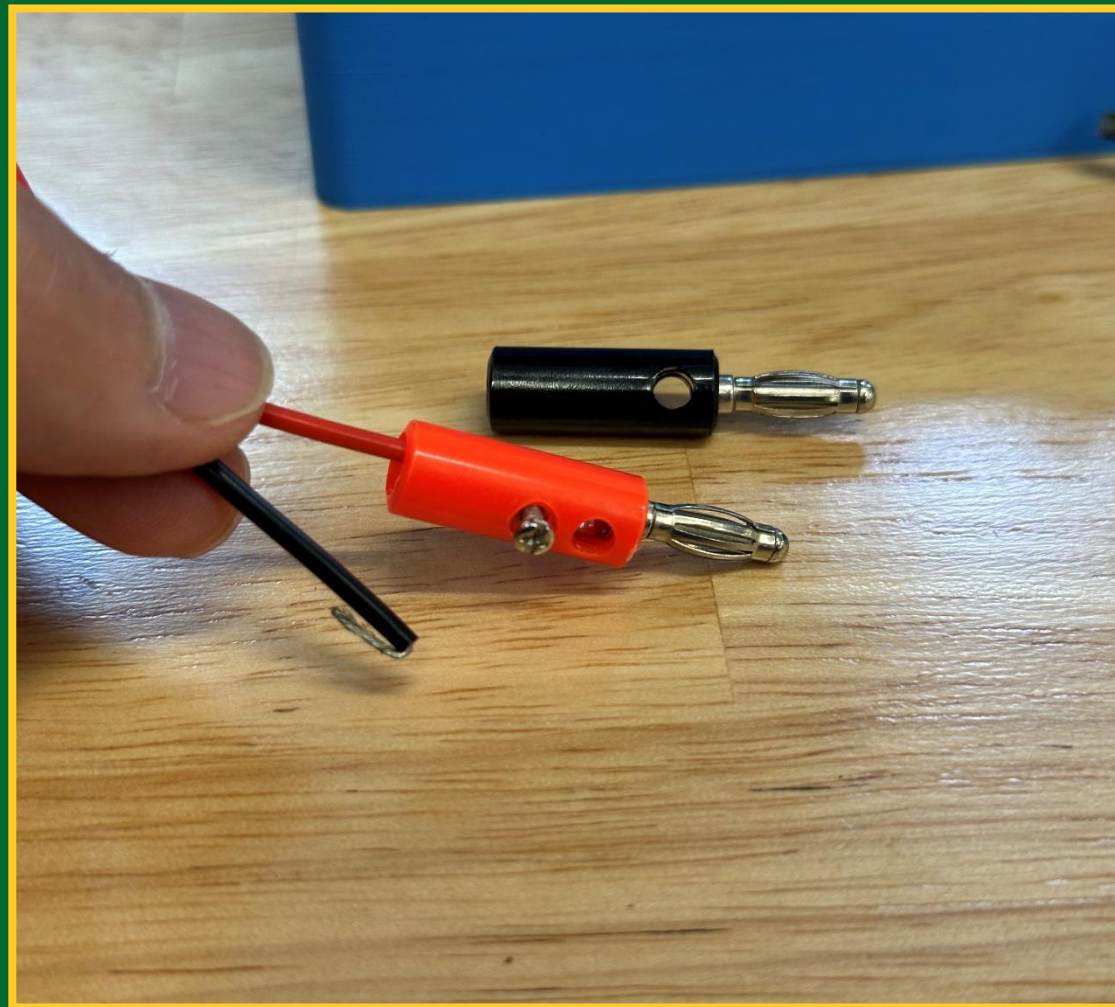
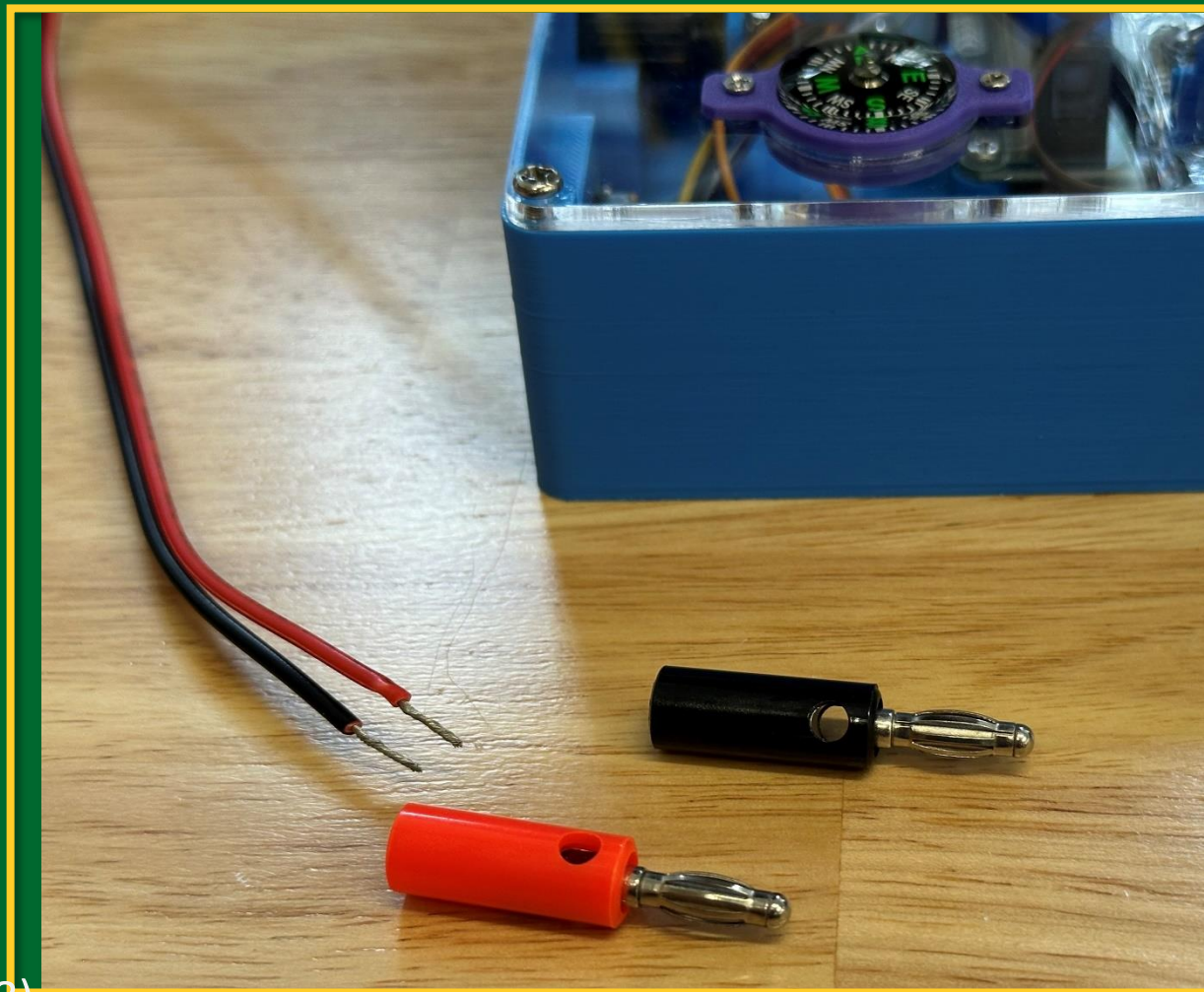




13a

# 連接太陽能板供電線至香蕉插

Connect the Solar Panel Power Cable to the Banana Plug





13b

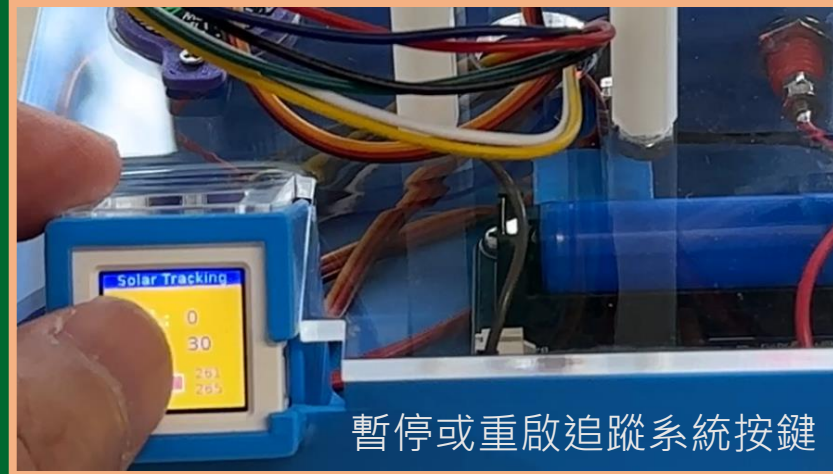
# 連接太陽能板供電線至香蕉插

Connect the Solar Panel Power Cable to the Banana Plug



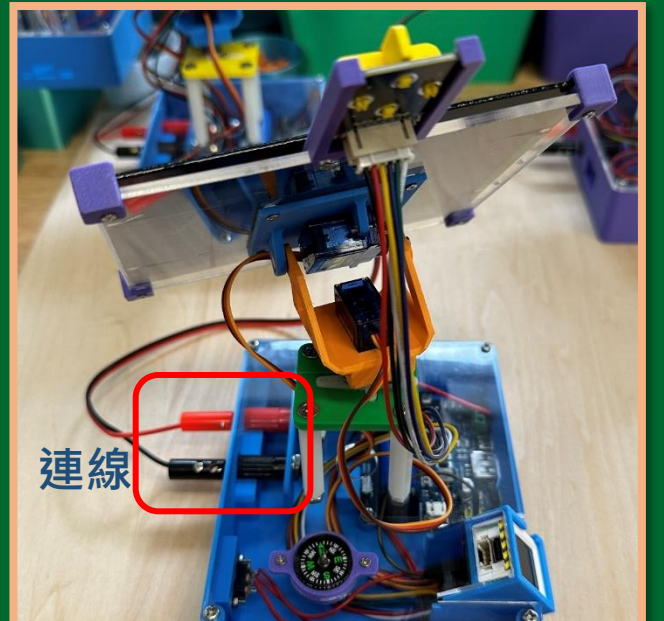
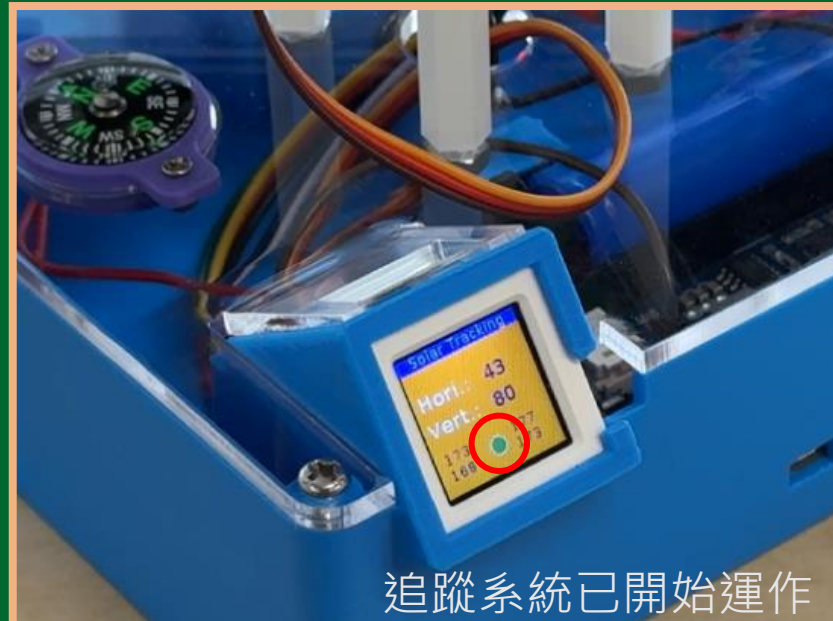
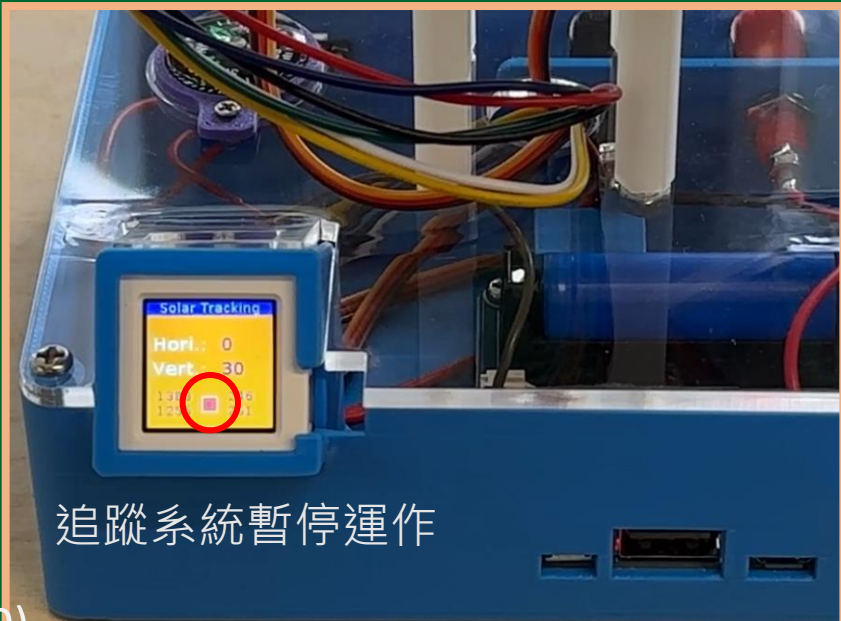


# 智慧儲能裝置操作簡介



## 注意：

裝置不用開啟已可以在陽光下充電，只要太陽能板完成連線(見下圖)，但請不要長時間暴曬裝置內的電池，以免發生危險。



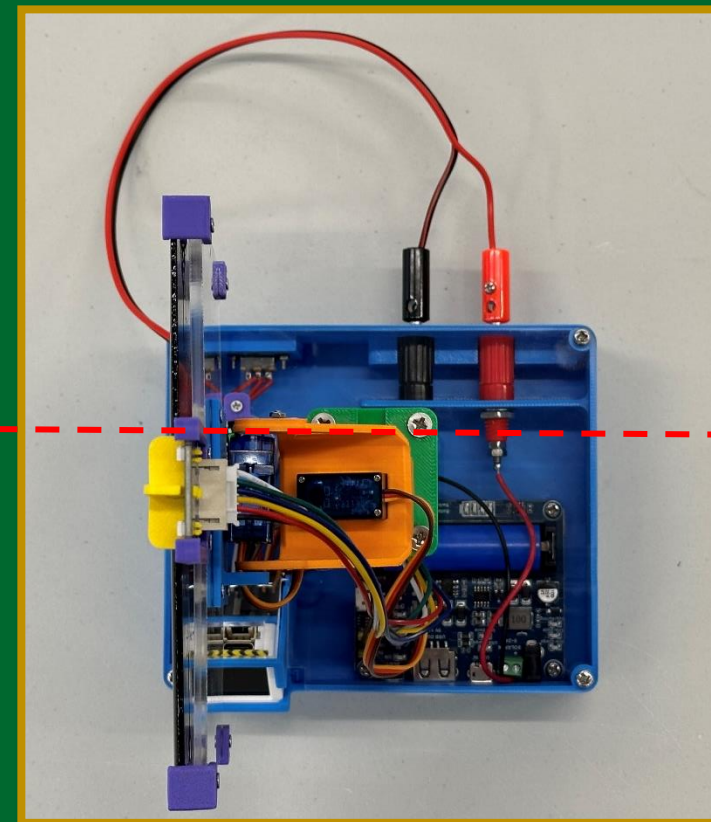
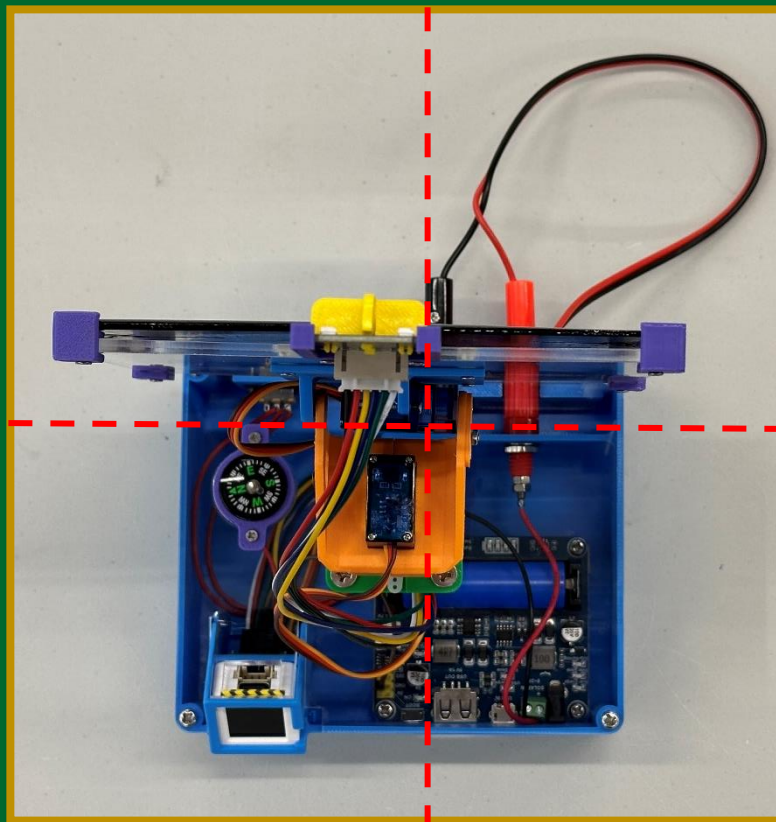
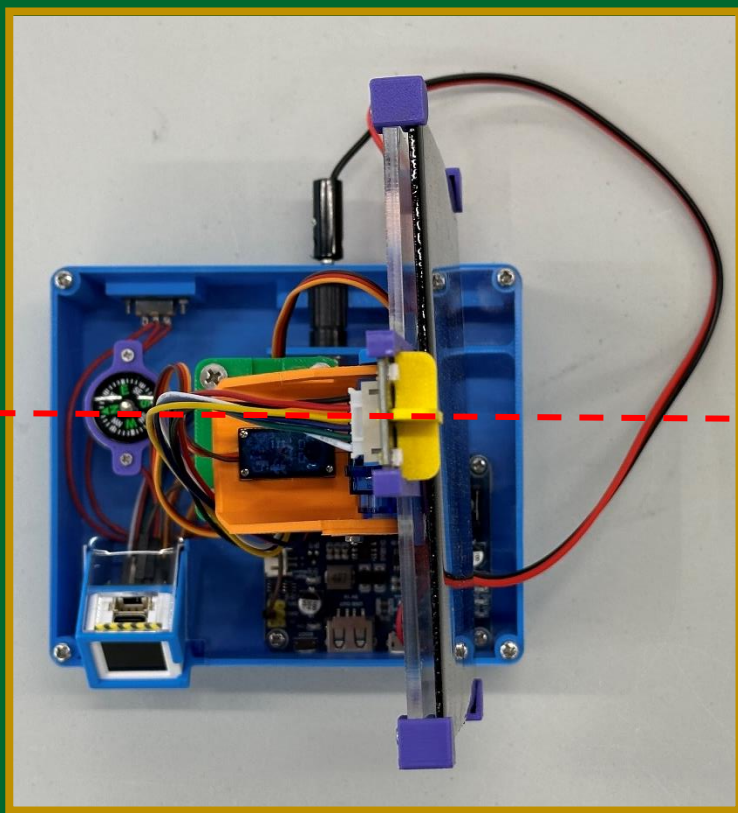


# 預設太陽能板可在水平方向擺動的範圍

$\sim 0^\circ$

$\sim 90^\circ$

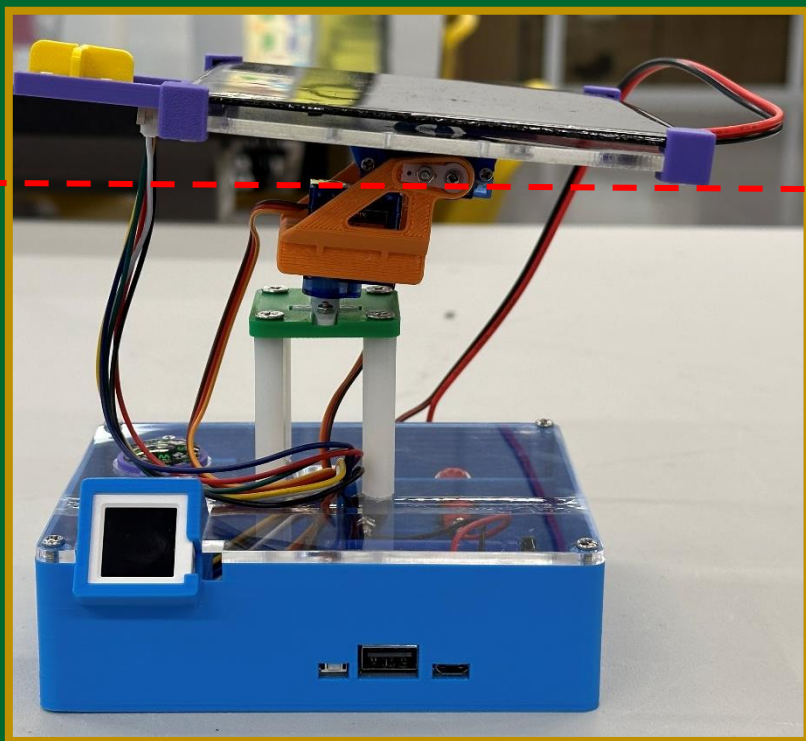
$\sim 180^\circ$



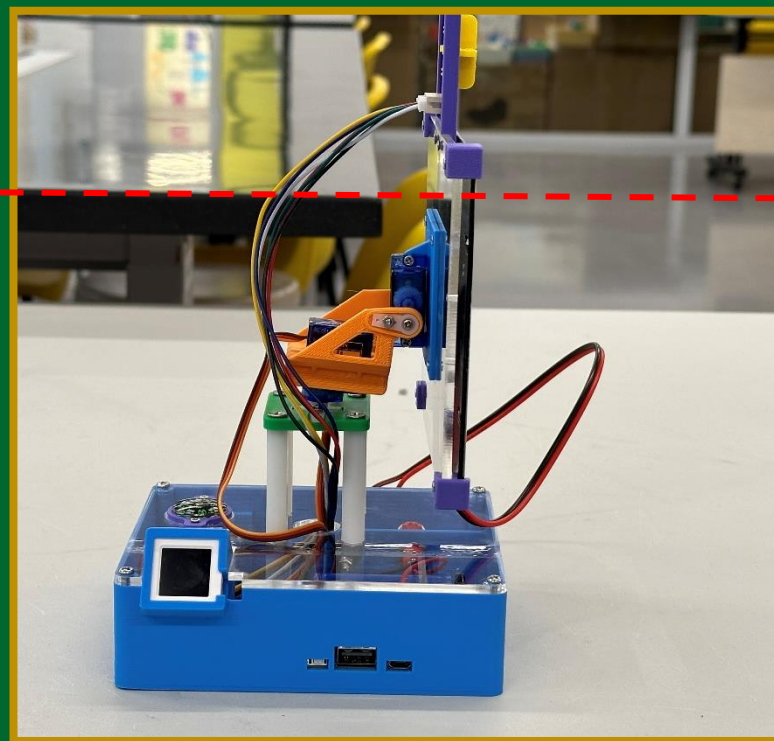


# 預設太陽能板可在垂直方向擺動的範圍

$\sim 0^\circ$



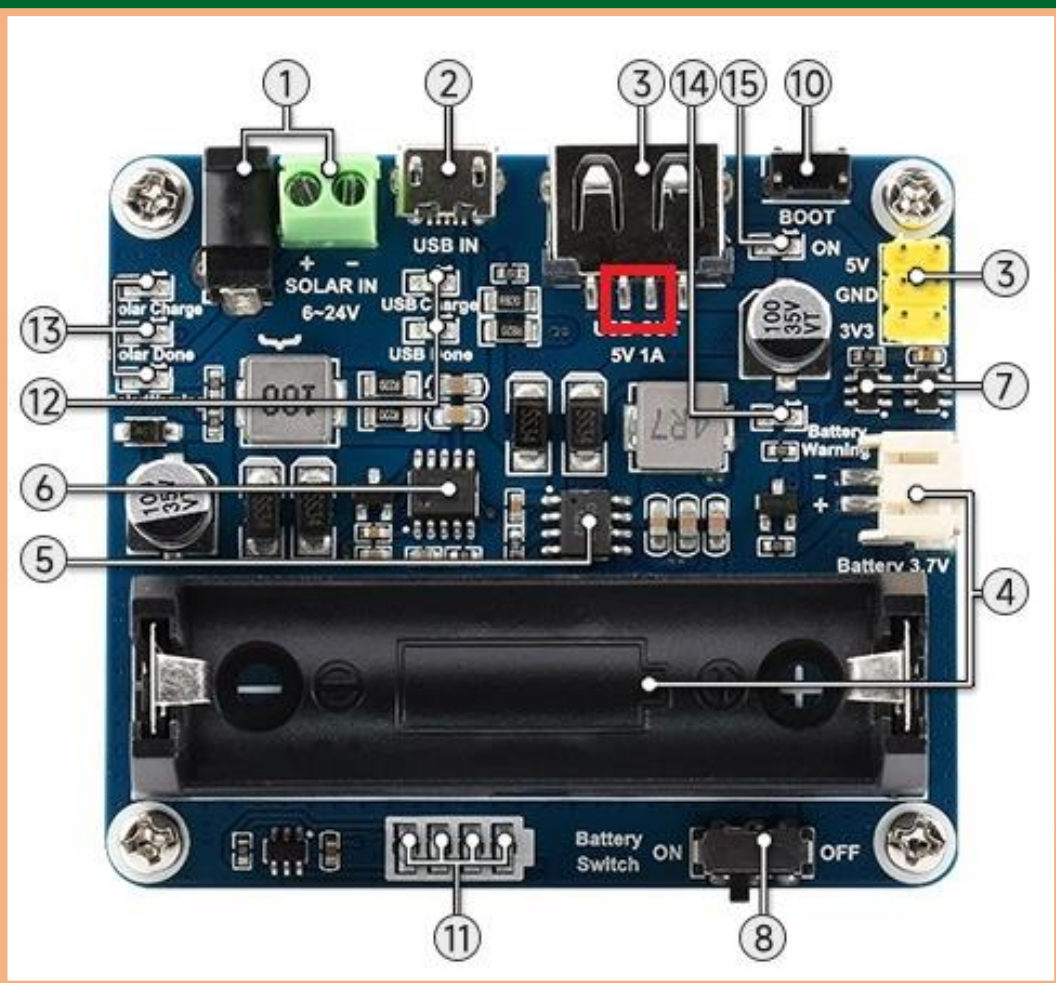
$\sim 90^\circ$





# 太陽能電源管理模組

## Solar power management module



### 【 接口简介 】

1. 太阳能充电接口  
可通过 DC-002 电源插座或接线端子接入太阳能板进行充电
2. **USB 充电接口**  
可通过 Micro USB 口接 5V 电源适配器进行充电
3. **5V/1A 电源输出接口**  
可通过 USB 口或 2.54mm 排针对外输出稳定 5V/1A 电源
8. 电池开关
9. **MPPTSET 设置开关 (背面)**  
支持 6V/9V/12V/18V/24V 档位设置, 切换至接近输入电压的档位, 充电效率更高
10. **BOOT 按键**
11. 电池电量指示灯

4. 电池接口  
可通过 PH2.0 端子或 14500 电池座接入 3.7V 锂电池

### 【 器件简介 】

5. **CS8501**  
USB 电源管理芯片, 用于 USB 充电和升压 5V/1A 输出
6. **CN3791**  
太阳能管理芯片, 用于太阳能板充电和降压输入
7. 锂电池保护芯片  
锂电池过充/过放保护

12. **USB 充电指示灯**  
USB Charge: 通过 USB 充电时亮灯  
USB Done : 通过 USB 充满后亮灯
13. 太阳能板状态灯  
Solar Charge: 通过太阳能板充电时亮灯  
Solar Done : 通过太阳能板充满后亮灯  
Solar Warning: 太阳能板反接时亮灯
14. 电池警示灯  
电池反接时亮灯
15. 电源输出状态灯  
5V/1A 输出





# Atom S3 編程

## Atom S3 programming

<http://uiflow2.m5stack.com>

The screenshot shows the Uiflow2 web interface. A modal dialog is open, displaying a grid of project thumbnails. The dialog has a search bar at the top left and tabs for 'My Projects' and 'Favorite Projects'. A red callout bubble with a close icon says 'Click here to create a cloud project.' At the bottom right of the dialog, the 'Cancel' button is highlighted with a red box. The 'Import' button is also visible next to it.





# Atom S3 編程

## Atom S3 programming

<http://uiflow2.m5stack.com>

File menu options:

- New Project
- Import
- Save
- Save as...
- Import project from local file**
- Export project to local file

Block-based program structure:

- Setup
  - Begin initialization  True
  - Init built-in hardware at beginning
- Loop
  - Update button,touch,etc. in loop
  - Update

Resources:

- SoC: ESP32-S3
- Software ⊕
- Hardware ⊕: BTN, PIN BTN, IR
- Unit ⊕
- Project Files ⊕

Bottom status bar: EZ DATA2, USB Device: AtomS3, Run





# Atom S3 編程

## Atom S3 programming

filename:  
SolarTrackingS3-7.m5f2

The screenshot shows the Ubidots IDE interface for a project named "Solar Tracking" on an Atom S3 device. The code is written in a block-based format and includes the following key sections:

- Setup:** Contains initialization blocks for pins 5, 6, 7, and 8, each with an attenuation of 11DB. It also includes "Init built-in hardware at beginning" and "Begin initialization" blocks.
- Variable Initialization:** A series of "set" blocks for variables: `angle_Horizontal` (0), `angle_Vertical` (30), `HlimitLow` (0), `HlimitHigh` (180), `VlimitLow` (0), `VlimitHigh` (90), `step_split` (5), `angleV_duty` (0-1023), and `angleH_duty` (0-1023).
- Reaction Variables:** A series of "set" blocks for `reactHlevel` (30), `reactVlevel` (20), `reactTime` (100), and `operate` (0).
- UI Elements:** "Set" blocks for text labels `label1` and `label3` using "convert to str" blocks, and "Set" blocks for `circle0` (hide) and `rect0` (show).
- Event Listeners:** "When button BtnA was clicked" and a "Loop" block with "Update" and servo control blocks.

Annotations in Chinese provide context for the code:

- Red box around pin initialization: 定義4個光敏傳感器與微控制器單元的連接位址
- Red box around angle and limit variables: 可因應不同環境或需要而作數值改變
- Red box around reaction variables: 可因應不同環境或需要而作數值改變





# Atom S3 編程

## Atom S3 programming

filename:  
SolarTrackingS3-7.m5f2

The screenshot displays the Atom S3 programming environment. On the left, a UI preview shows a 'Solar Tracking' interface with labels for 'Hori.: ---' and 'Vert.: ---'. Below it, a physical Atom S3 module is shown with a similar UI overlay, displaying 'Hori.: 133' and 'Vert.: 0' along with sensor data: 2555, 1709, 2299, and 2183.

The main area shows a block-based code editor for 'SolarTrackingS3'. The code includes:

- Init built-in hardware at beginning**
- set angle\_Horizontal to 0**: 太陽能板在水平方向的初始角度 (0° - 180°)
- set angle\_Vertical to 30**: 太陽能板在垂直方向的初始角度 (0° - 90°)
- set HlimitLow to 0**: 太陽能板水平方向的可變幅度 (0° - 180°)
- set HlimitHigh to 180**: 太陽能板水平方向的可變幅度 (0° - 180°)
- set VlimitLow to 0**: 太陽能板垂直方向的可變幅度 (0° - 90°)
- set VlimitHigh to 90**: 太陽能板垂直方向的可變幅度 (0° - 90°)
- set step\_split to 5**: 每次要變動時分多少步進行 (1 代表一次過完成)
- Init Pin 38 freq 50 Hz (1 ~ 4000000) duty angleV\_duty (0 ~ 1023)**
- Init Pin 39 freq 50 Hz (1 ~ 4000000) duty angleH\_duty (0 ~ 1023)**
- set reactHlevel to 30**: 4 個光敏傳感器的顯示數值均為 0 - 4095，靈敏度的設定: 左右相差 30 就會引發水平方向的移動，上下相差 20 就會引發垂直方向的移動為 20。
- set reactVlevel to 20**: 靈敏度的設定: 左右相差 30 就會引發水平方向的移動，上下相差 20 就會引發垂直方向的移動為 20。
- set reactTime to 100**: 每隔 0.1秒 更新數據一次
- set operate to 0**
- Set label1 text convert to str angle\_Horizontal**
- Set label3 text convert to str angle\_Vertical**





# Atom S3 編程 Atom S3 programming

## 下載程式至微控制器單元 Download the program to Atom S3

The screenshot displays the Ubidots IDE interface for programming an Atom S3 microcontroller. The main workspace shows a block-based program for a 'Solar Tracking' application. The program starts with a 'Setup' block containing the following logic:

- Begin initialization (checked)
- Set screen rotation to 180° (Built-in)
- Init Pin 5, 6, 7, and 8 with 11dB attenuation (0 ~ 3.3V)
- Init built-in hardware at beginning
- set angle\_Horizontal to 0
- set angle\_Verical to 30
- set HlimitLow to 0, HlimitHigh to 180
- set VlimitLow to 0, VlimitHigh to 90
- set step\_split to 5
- Init Pin 38 (freq 50 Hz) duty angleV\_duty (0 ~ 1023)
- Init Pin 39 (freq 50 Hz) duty angleH\_duty (0 ~ 1023)
- set reactHlevel to 30, reactVlevel to 20, reactTime to 100
- set operate to 0
- Set label1 text to convert to str angle\_Horizontal
- Set label3 text to convert to str angle\_Verical
- Set circle0 to hide
- Set rect0 to show

The UI preview shows a screen titled 'Solar Tracking' with 'Hori.: ---' and 'Vert.: ---' labels. The Resources panel indicates the SoC is ESP32-S3 and the software is MQTT. The bottom status bar shows 'USB Device: AtomS3' highlighted in a red box, indicating the device is connected for programming.

利用 type C USB 線連接 電腦  
與 Atom S3

Connect computer and Atom S3  
using type C USB cable



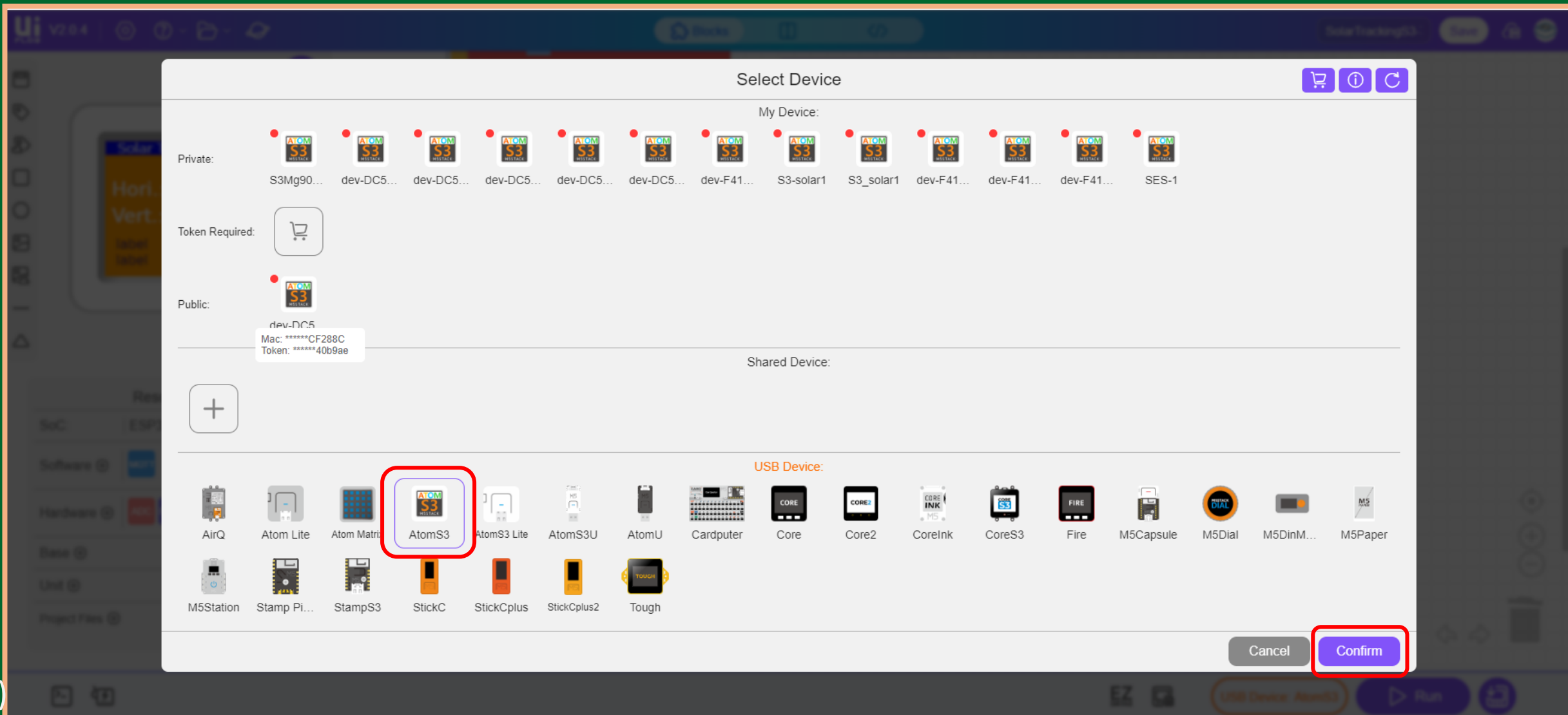


# Atom S3 編程

## Atom S3 programming

# 下載程式至微控制器單元

## Download the program to Atom S3





# Atom S3 編程

## Atom S3 programming

# 下載程式至微控制器單元

## Download the program to Atom S3

The screenshot displays the Ubidots IDE interface for programming an Atom S3 microcontroller. The main workspace shows a block-based code editor with the following structure:

- Setup** (Begin initialization: True)
  - Set screen rotation: 180° (Built-in)
  - Init Pin: 5 (attenuation: 11DB(0 ~ 3.3V))
  - Init Pin: 6 (attenuation: 11DB(0 ~ 3.3V))
  - Init Pin: 7 (attenuation: 11DB(0 ~ 3.3V))
  - Init Pin: 8 (attenuation: 11DB(0 ~ 3.3V))
  - Init built-in hardware at beginning
    - set angle\_Horizontal to 0
    - set angle\_Vertical to 30
    - set HlimitLow to 0
    - set HlimitHigh to 180
    - set VlimitLow to 0
    - set VlimitHigh to 90
    - set step\_split to 5
  - Init Pin: 38 (freq: 50 Hz (1 ~ 40000000) duty: angleV\_duty (0 ~ 1023))
  - Init Pin: 39 (freq: 50 Hz (1 ~ 40000000) duty: angleH\_duty (0 ~ 1023))
  - set reactHlevel to 30
  - set reactVlevel to 20
  - set reactTime to 100
  - set operate to 0
  - Set label1 text: convert to str (angle\_Horizontal)
  - Set label3 text: convert to str (angle\_Vertical)
  - Set circle0: hide
  - Set rect0: show
- Loop** (Update)
  - When button BtnA was clicked...
    - to servo\_set with: angleDif...
    - to angleH\_duty set duty\_ma...
    - to angleV\_duty set duty\_ma...

The bottom status bar indicates the device is connected as 'USB Device: AtomS3' and features a 'Run' button with a download icon highlighted in a red box.





# Atom S3 編程 Atom S3 programming

## 下載程式至微控制器單元 Download the program to Atom S3

The screenshot displays the UiFlow2 V2.0.3 interface. A modal dialog box titled "uiflow2.m5stack.com wants to connect to a serial port" is centered on the screen. The dialog lists the available serial port: "M5Stack AtomS3(UiFlow2) (COM20) - Paired". A red rectangle highlights this list item. At the bottom of the dialog, another red rectangle highlights the "Connect" button. The background shows a project named "SolarTrackingS3" with a code editor containing several blocks: "True", "on 180° Built-in", two "attenuation 11DB(0 ~ 3.3V)" blocks, a "When" block with a "Remember to save your project" notification, a "Loop" block with an "Update" block, and "to servo\_set with: angleDif...", "to angleH\_duty set duty\_ma...", and "to angleV\_duty set duty\_ma..." blocks. A black rectangular area obscures part of the code editor. The bottom status bar shows "USB Device: AtomS3" and a "Run" button.



# Atom S3 編程 Atom S3 programming

## 下載程式至微控制器單元 Download the program to Atom S3

The screenshot displays the Atom S3 programming interface. On the left, there is a component palette with various modules like 'WLAN STA', 'WLAN AP', 'NVS', 'Power', 'UI', 'Screen', 'Title', 'Label', 'Rect', 'Circle', 'EzData2.0', 'Variables', and 'Math'. The main workspace shows a block-based program with several blocks, including 'Init Pin' blocks and 'Set label' blocks. A 'WebTerminal' window is open in the foreground, showing the text 'Connected to Serial Port!'. The 'WebTerminal' window has a toolbar with icons for refresh, play, download, and file. The download icon, which is a computer with a downward arrow, is highlighted with a red circle. The 'WebTerminal' window also shows 'Row 24' and 'Col 94'.





# Atom S3 編程

## Atom S3 programming

# 下載程式至微控制器單元

## Download the program to Atom S3

The screenshot shows the UIDE V2.0.3 IDE interface for programming the Atom S3 microcontroller. The main workspace displays a block-based program for a "Solar Tracking" project. The program includes a "Setup" block with "Begin initialization" set to "True", "Set screen rotation" to "180°", and two "Init Pin" blocks for pins 5 and 6. A "WebTerminal" window is open in the center, showing a "Progress:" bar with a green progress indicator. The right sidebar shows a "Loop" block with "Update" and three "to servo\_set with: angleDif..." blocks. The bottom status bar shows "USB Device: AtomS3" and a "Run" button.



# 智慧儲能裝置挑戰賽

STEM Education Centre and Arts & Technology Education Centre

[www.atec.edu.hk/stemcentre/competition%202024/index.html](http://www.atec.edu.hk/stemcentre/competition%202024/index.html)



## 比賽項目：

1. 裝置效能比拼賽 -- 7月6日進行比賽
2. 裝置外觀設計比賽 -- 6月21日或之前先提交 video ( $\leq 5$  min)
3. 太陽能供電燈飾設計比賽 -- 6月21日或之前先提交兩張 photo

## STEM 教育中心可提供的支援

- 老師可預約使用 STEM 教育中心內的服務，包括 3D 打印、電線焊接及鐳射切割等
- 在不違反比賽的原則下，協助老師或同學解決儲能裝置在操作上出現的問題，包括編程設置等技術問題
- 6月中開始，學校可預約借用中心場地作實地測試