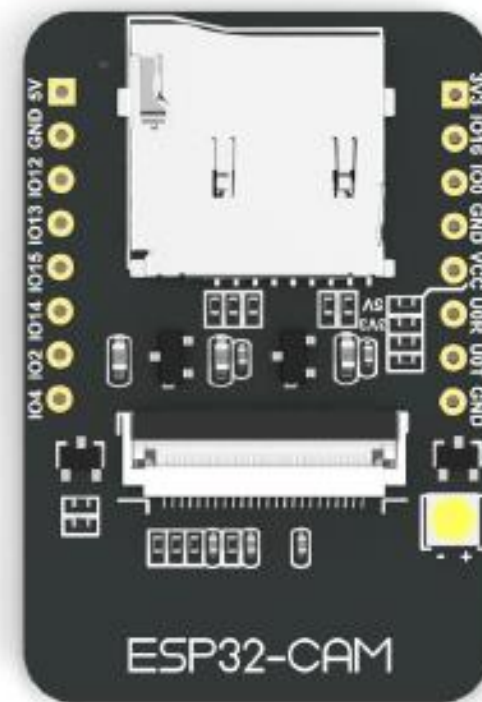
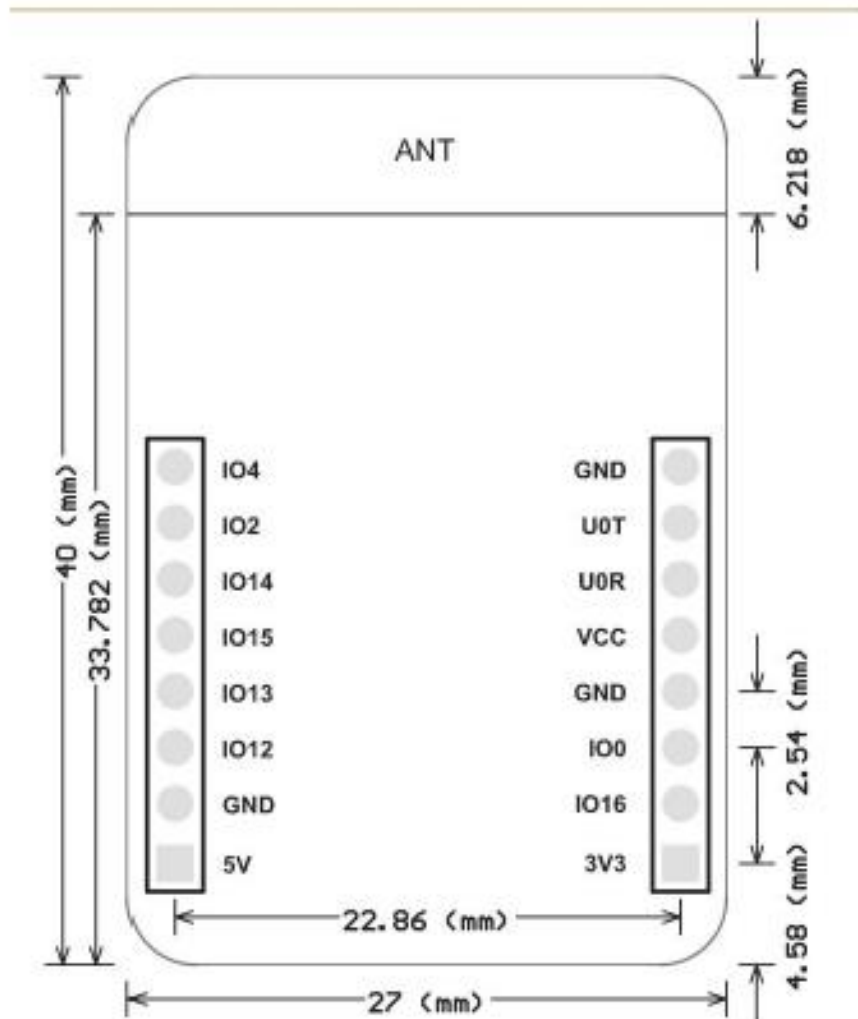


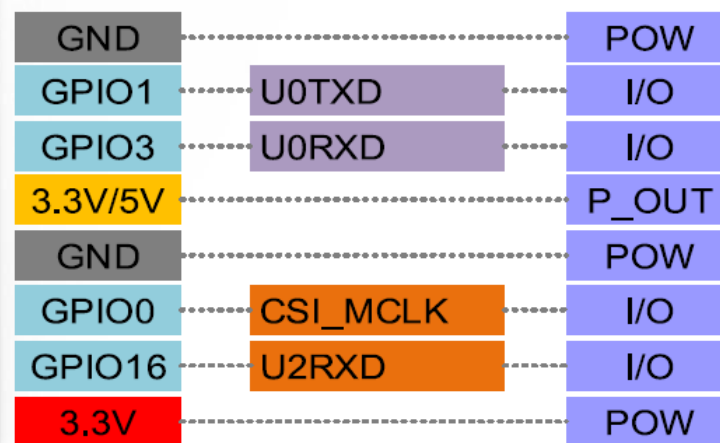
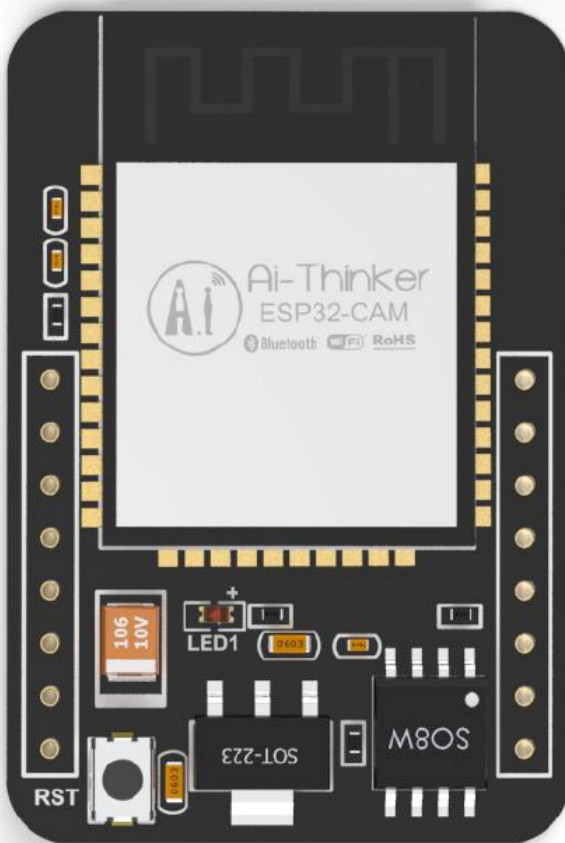
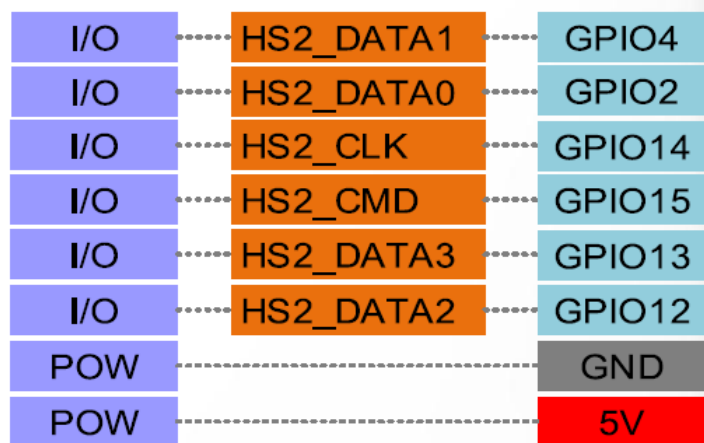
# ESP32-CAM

## AI影像辨識應用

講師：鳳山科技中心 傅仲儀主任

# ESP32-CAM 模组





# ESP32-CAM開發板特點

1. 雙核32位元CPU
2. RAM：內置520 KB + 外部4MPSRAM
3. 支援WIFI與藍芽連線模式
4. 板載OV2640或OV7670攝像頭
5. 板載閃光燈
6. 板載支援TF卡檔案存取(最大插入32G)

# 課程表

09:00~10:00 ESP32-CAM 簡介與開發環境建置

10:00~11:00 模組程式自訂指令與人臉辨識實作

11:00~12:00 tfjs 物件監視、物件追蹤實作

13:00~14:00 tfjs 姿態辨識智慧控制實作

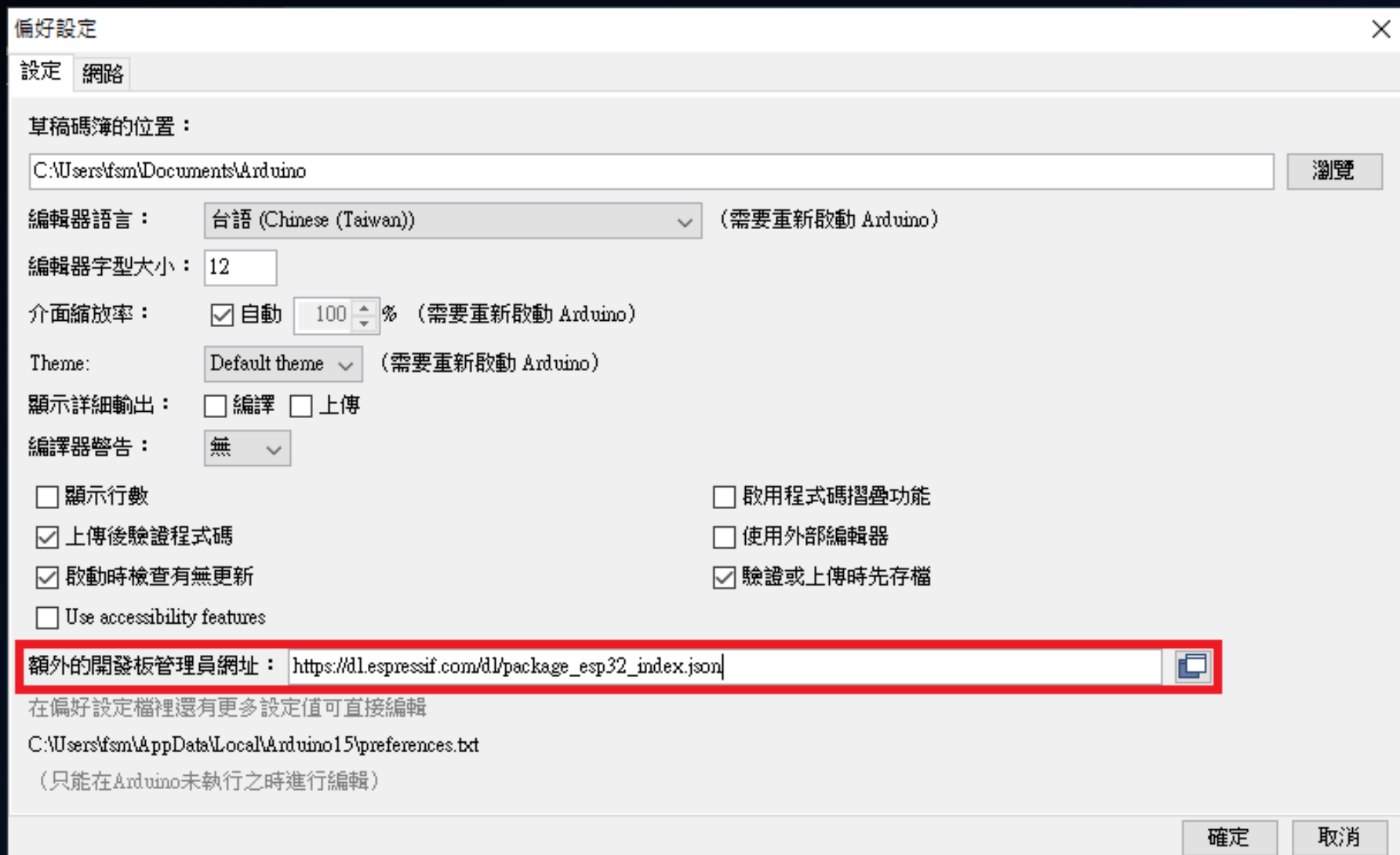
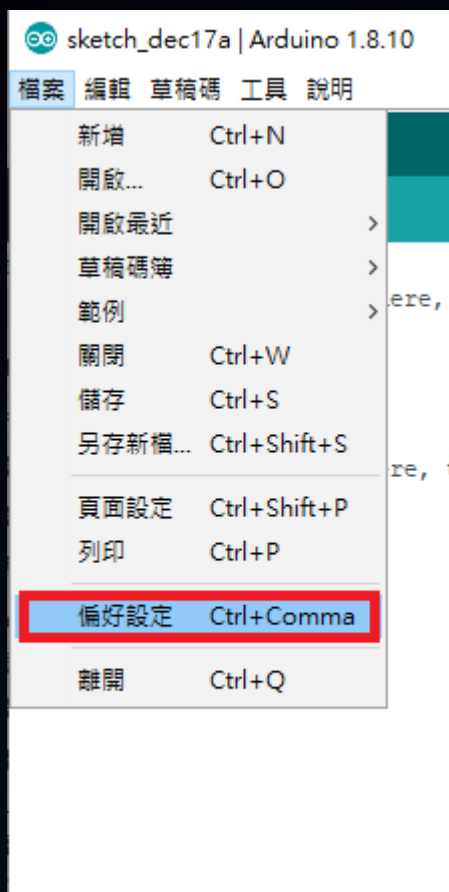
14:00~15:00 tfjs 深度學習自走車實作

15:00~16:00 綜合討論

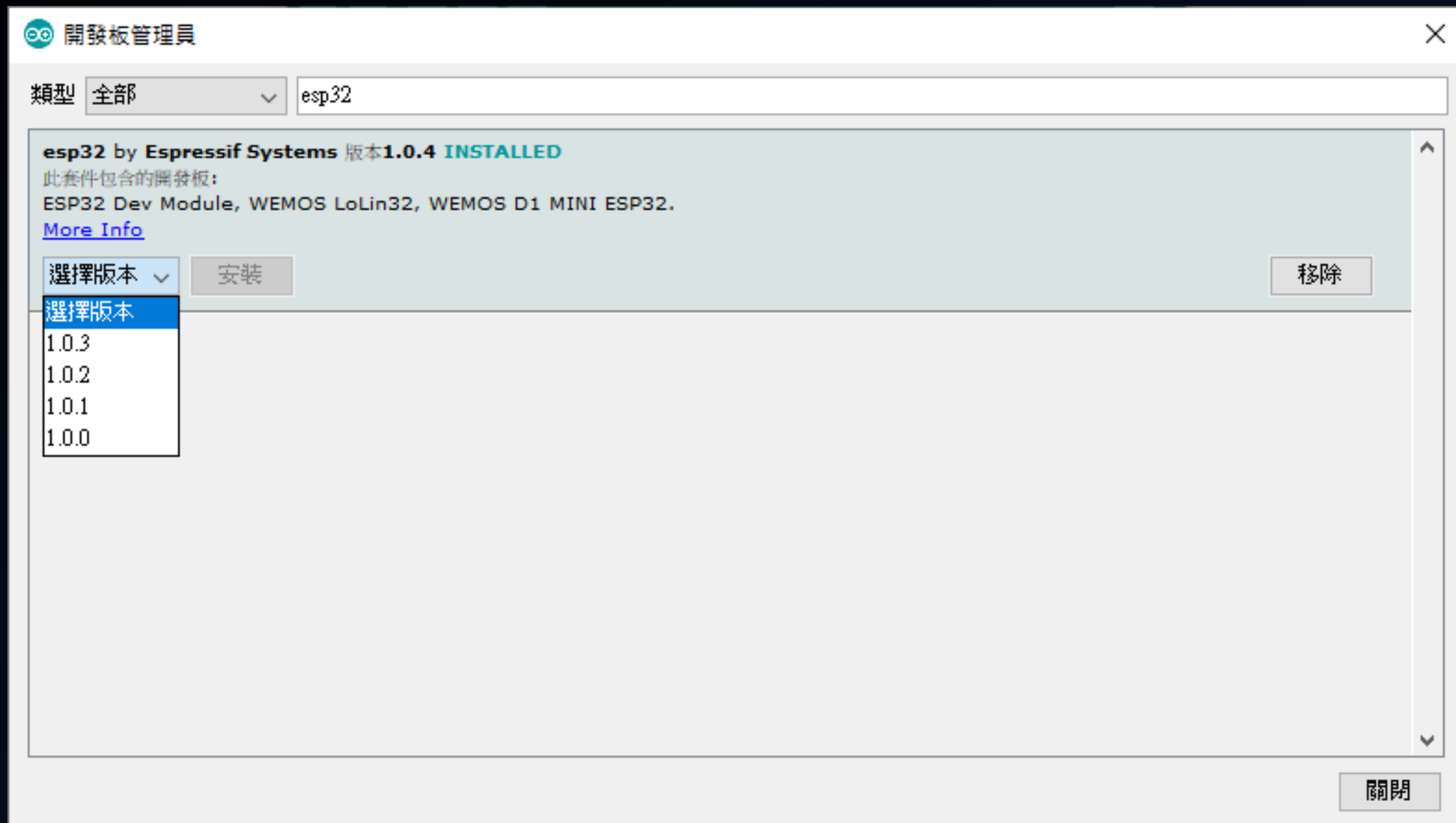
## 09:00~10:00 ESP32-CAM簡介與開發環境建置

- (1) 研習檔案 <https://github.com/fustyles/Workshop>
- (2) 模組程式 <https://github.com/fustyles/Arduino>  
點選  並解壓縮壓縮檔。
- (3) 安裝 Arduino IDE 1.8.10 (最新版)  
[https://www.arduino.cc/download\\_handler.php](https://www.arduino.cc/download_handler.php)
- (4) 安裝 ESP32系統 1.0.4 (最新版)  
[https://dl.espressif.com/dl/package\\_esp32\\_index.json](https://dl.espressif.com/dl/package_esp32_index.json)

# 安裝 ESP32系統 1.0.4 (最新版)



# 可更改 ESP32系統 版本





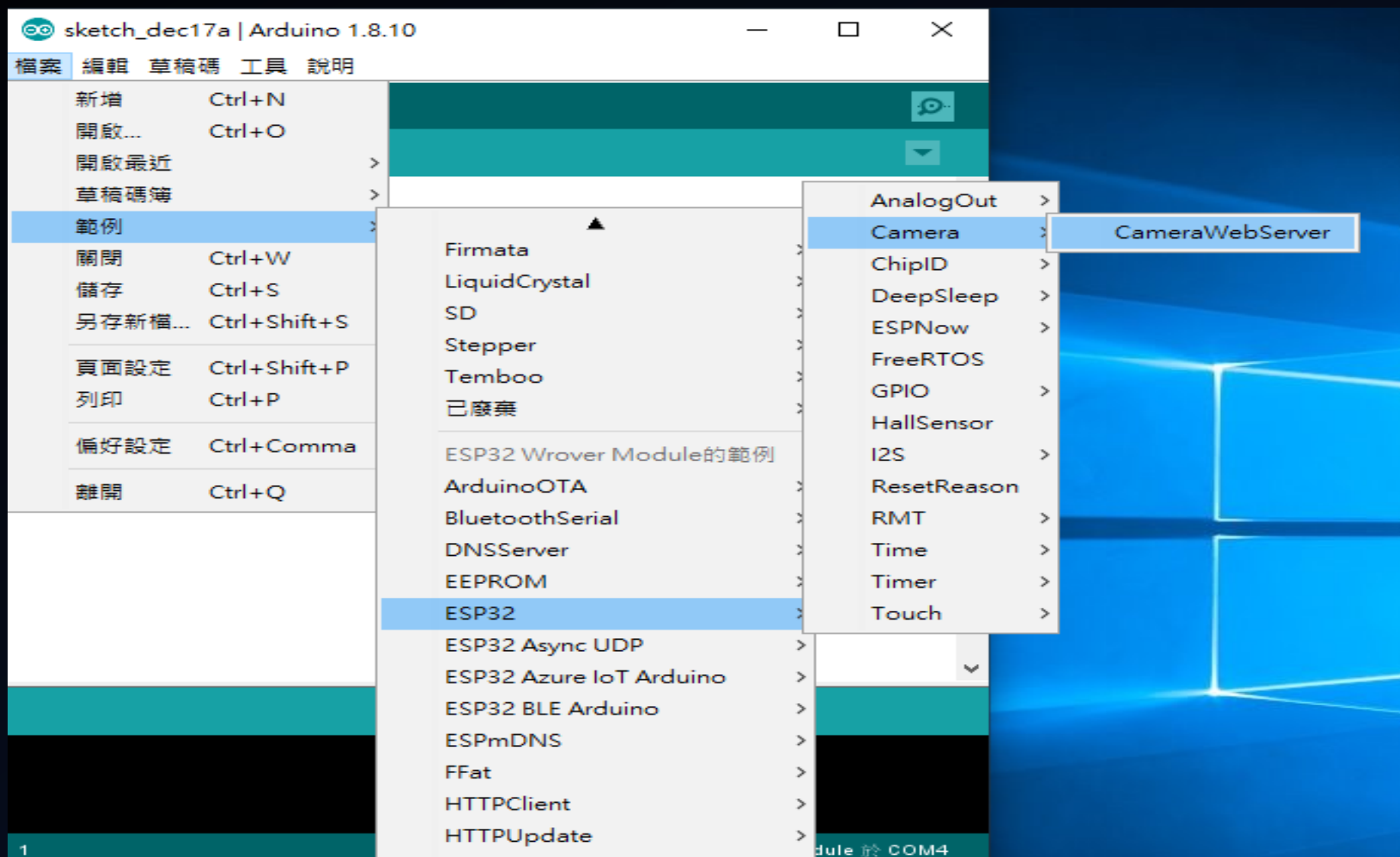
(5) 安裝ESP32-CAM驅動程式

[http://www.wch.cn/download/CH341SER\\_ZIP.html](http://www.wch.cn/download/CH341SER_ZIP.html)

(6) 安裝USB TTL驅動程式

<https://www.silabs.com/products/development-tools/software/usb-to-uart-bridge-vcp-drivers>

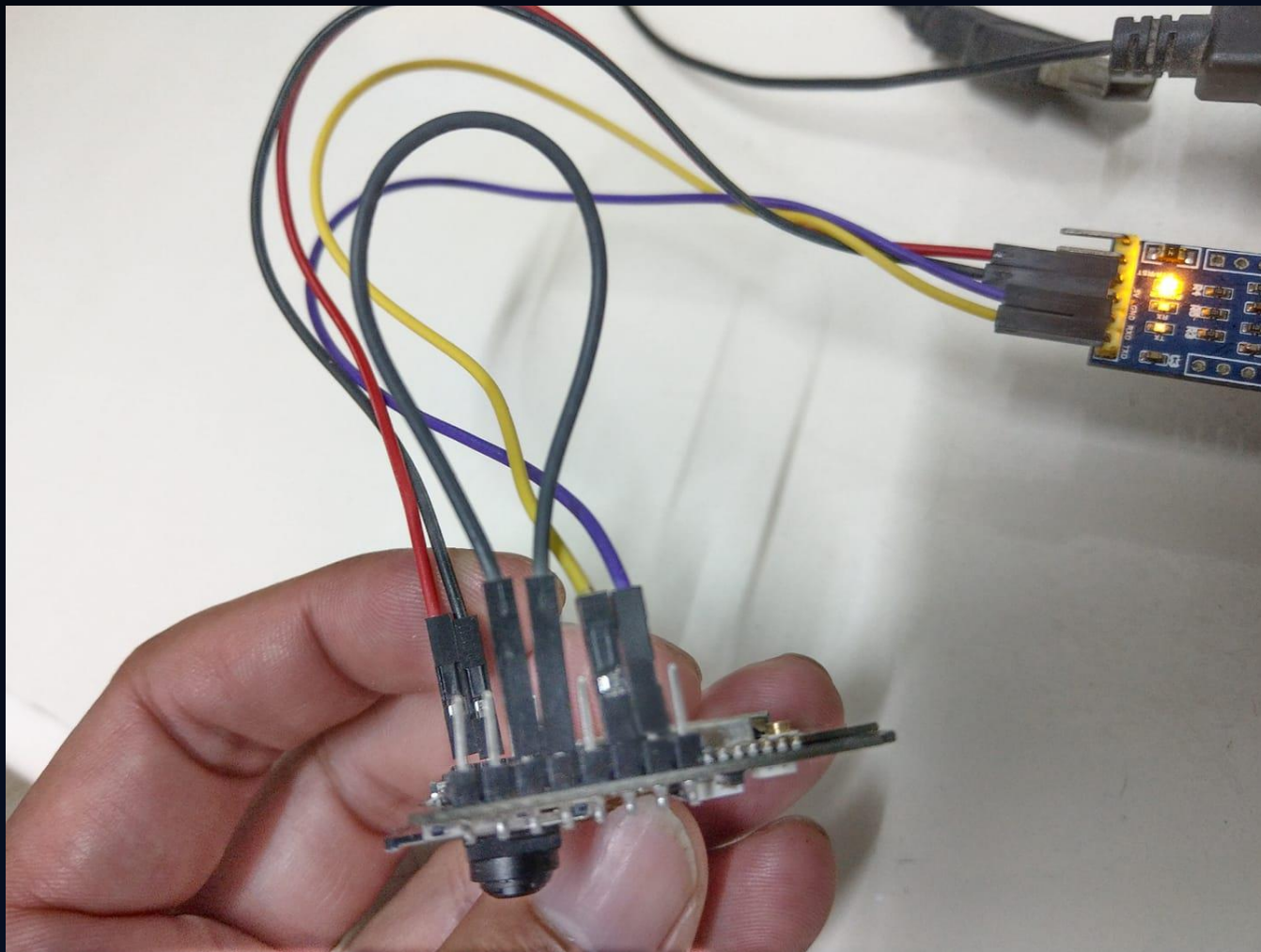
## (7) 人臉辨識範例



# USB TTL連接ESP32-CAM

USB TTL	ESP32-CAM
5V	5V
GND	GND
RXD	UOT
TXD	UOR
	IO0接GND

按Reset鍵進入燒錄模式  
-> 上傳韌體  
-> 移除IO0接GND  
-> 按Reset鍵



## (8) 上傳韌體設定



### (9) 申請 Google 帳號

<https://accounts.google.com/signup/v2/webcreateaccount?continue=https%3A%2F%2Faccounts.google.com%2FManageAccount&gmb=exp&biz=false&flowName=GlifWebSignIn&flowEntry=SignUp>

### (10) 申請 Line Notify 帳號

<https://jackterrylau.pixnet.net/blog/post/228035426-2019-08-09%E7%94%B3%E8%AB%8B%E4%B8%80%E5%80%8Bline-notify-token-%E4%BE%86-%E7%94%A8line-%E5%B9%AB%E4%BD%A0>

(11) 網頁程式撰寫：利用Webduino積木網站產生Javascript程式碼  
雲端平台<https://id.webduino.io/signin>或教育版

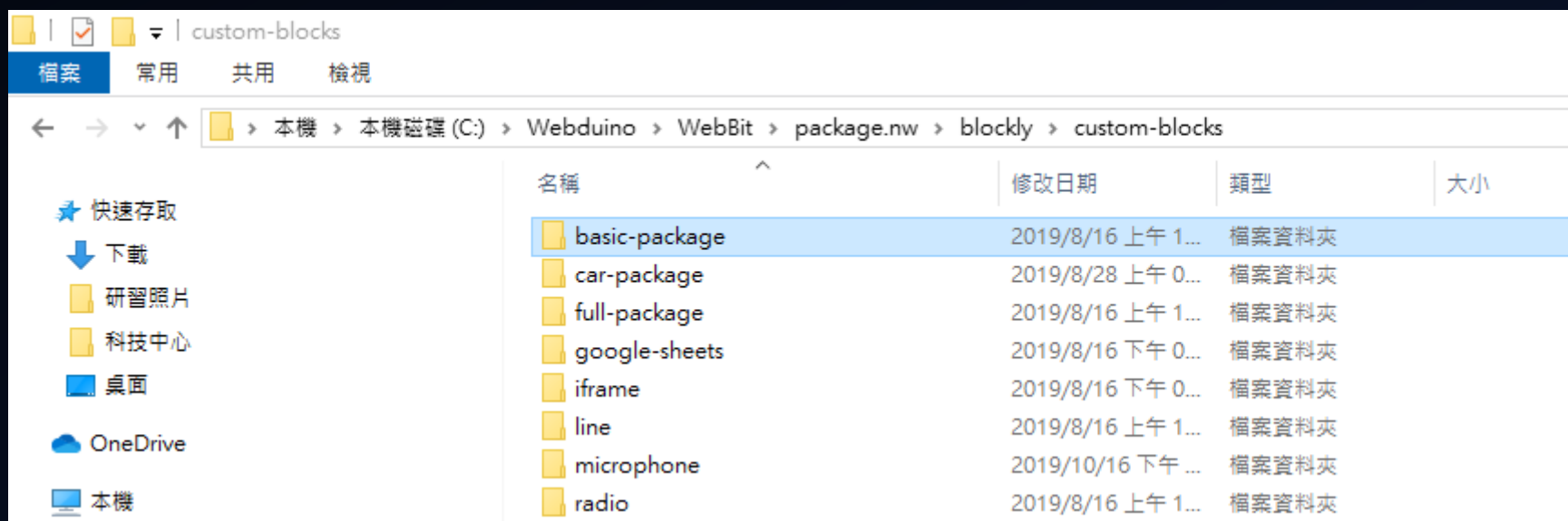


## Webbit教育版(離線版)

- 下載網址：Google搜尋 “WebBitSetup.exe”  
離線版：<https://ota.webduino.io/WebBitInstaller/WebBitSetup.exe>  
網頁版：<https://webbit.webduino.io/blockly/> (無法使用USB連線)
- 驅動程式：離線版安裝已內建，
- 更新韌體：<https://webbit.webduino.io/tutorials/doc/zh-tw/education/info/ota.html>

# Webbit教育版新增外掛自訂積木

- 研習資料：<https://github.com/fustyles/Workshop>  
點選  並解壓縮壓縮檔。
- 安裝外掛：解壓縮 2019.11.14\_webbit/basic-package.zip  
覆蓋目錄 C:\Webduino\WebBit\package.nw\blockly\custom-blocks



# 載入自訂積木功能

離線安裝版介面暫時無法執行AI視訊，以瀏覽器開啟積木網站。





顏色

函式

怪獸控制

偵測

語音 &amp; 音效

Web:Bit -

開發板

矩陣 LED

按鈕開關

偵測光線 &amp; 溫度

音樂 &amp; 聲音

九軸體感偵測

I/O 引腳

擴充功能 -

Google 試算表

氣象資訊

網路廣播

LINE

基礎套件包

MoonCar 自走車

自訂積木

“ ”

▼

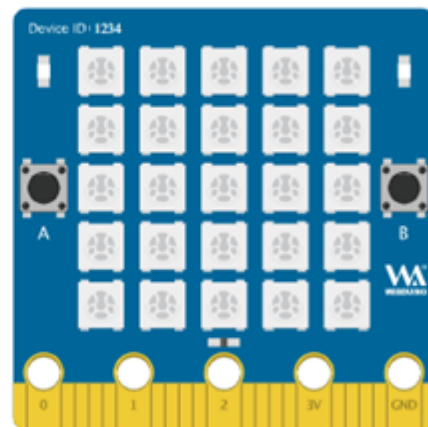
當紅外線 (腳位 1) 接收到訊號  
執行

紅外線接收的代碼

紅外線發射 (腳位 2), 發射代碼 (十六進位) “ ”

超音波傳感器, Trig 3 Echo 9 所擷取的距離 (公分)

伺服馬達, 腳位 1 旋轉角度 (0-180) 90



# 填入自訂積木連結，點選下拉選單add



# Webbit教育版 AI 自訂積木清單

[https://github.com/fustyles/Workshop/blob/master/2019.11.14\\_webbit/教育版自訂積木清單.txt](https://github.com/fustyles/Workshop/blob/master/2019.11.14_webbit/教育版自訂積木清單.txt)



Tensorflow.js(tfjs)介紹

<https://www.tensorflow.org/js/>

Tensorflow.js已訓練模型

<https://github.com/tensorflow/tfjs-models>

## 物件辨識 (coco-ssd)

### 圖片

[https://fustyles.github.io/webduino/TensorFlow/ObjectDetection\\_image/ObjectDetection\\_image\\_coco-ssd.html](https://fustyles.github.io/webduino/TensorFlow/ObjectDetection_image/ObjectDetection_image_coco-ssd.html)

### 視訊 (Chrome瀏覽器)

[https://fustyles.github.io/webduino/TensorFlow/ObjectDetection\\_video/ObjectDetection\\_video\\_coco-ssd.html](https://fustyles.github.io/webduino/TensorFlow/ObjectDetection_video/ObjectDetection_video_coco-ssd.html)

### 可辨識物件列表

<https://github.com/tensorflow/tfjs-models/blob/master/coco-ssd/src/classes.ts>

## 物件辨識 (mobilenet)

圖片

[https://fustyles.github.io/webduino/TensorFlow/ObjectDetection\\_image/ObjectDetection\\_image\\_mobilenet.html](https://fustyles.github.io/webduino/TensorFlow/ObjectDetection_image/ObjectDetection_image_mobilenet.html)

視訊 (Chrome瀏覽器)

[https://fustyles.github.io/webduino/TensorFlow/ObjectDetection\\_video/ObjectDetection\\_video\\_mobilenet.html](https://fustyles.github.io/webduino/TensorFlow/ObjectDetection_video/ObjectDetection_video_mobilenet.html)

可辨識物件列表

[https://github.com/tensorflow/tfjs-models/blob/master/mobilenet/src/imagenet\\_classes.ts](https://github.com/tensorflow/tfjs-models/blob/master/mobilenet/src/imagenet_classes.ts)

## 姿態辨識 posenet

圖片(單人)

[https://fustyles.github.io/webduino/TensorFlow/PoseDetection\\_image/PoseDetection\\_image.html](https://fustyles.github.io/webduino/TensorFlow/PoseDetection_image/PoseDetection_image.html)

圖片(多人)

[https://fustyles.github.io/webduino/TensorFlow/PoseDetection\\_image/PoseDetection\\_image\\_multi.html](https://fustyles.github.io/webduino/TensorFlow/PoseDetection_image/PoseDetection_image_multi.html)

視訊(單人)(Chrome瀏覽器)

[https://fustyles.github.io/webduino/TensorFlow/PoseDetection\\_video/PoseDetection\\_video.html](https://fustyles.github.io/webduino/TensorFlow/PoseDetection_video/PoseDetection_video.html)

視訊(多人)(Chrome瀏覽器)

[https://fustyles.github.io/webduino/TensorFlow/PoseDetection\\_video/PoseDetection\\_video\\_multi.html](https://fustyles.github.io/webduino/TensorFlow/PoseDetection_video/PoseDetection_video_multi.html)

# BodyPix

圖片

[https://fustyles.github.io/webduino/TensorFlow/BodyPix\\_image/BodyPix\\_image.html](https://fustyles.github.io/webduino/TensorFlow/BodyPix_image/BodyPix_image.html)

視訊(Chrome瀏覽器)

[https://fustyles.github.io/webduino/TensorFlow/BodyPix\\_video/BodyPix\\_video.html](https://fustyles.github.io/webduino/TensorFlow/BodyPix_video/BodyPix_video.html)



knn-classifier 手寫或匯入圖片訓練辨識(可訓練辨識數字)

[https://fustyles.github.io/webduino/TensorFlow/DigitRecognition\\_knn-classifier/DigitRecognition\\_knn-classifier.html](https://fustyles.github.io/webduino/TensorFlow/DigitRecognition_knn-classifier/DigitRecognition_knn-classifier.html)

knn-classifier 視訊深度學習

[https://fustyles.github.io/webduino/TensorFlow/VideoRecognition\\_knn-classifier/VideoRecognition\\_knn-classifier.html](https://fustyles.github.io/webduino/TensorFlow/VideoRecognition_knn-classifier/VideoRecognition_knn-classifier.html)

10:00~11:00 模組程式自訂指令與人臉辨識實作

## (1) 模組程式架構解說

### 1. 可跨網域執行、可使用HTTPS

[https://github.com/fustyles/Workshop/tree/master/2019.12.20\\_esp32-cam/ESP32-CAM\\_MyBlockly](https://github.com/fustyles/Workshop/tree/master/2019.12.20_esp32-cam/ESP32-CAM_MyBlockly)

### 2. 可視訊串流、不可跨網域執行、不可使用HTTPS

[https://github.com/fustyles/Workshop/tree/master/2019.12.20\\_esp32-cam/ESP32-CAM\\_MyBlockly\\_STREAM](https://github.com/fustyles/Workshop/tree/master/2019.12.20_esp32-cam/ESP32-CAM_MyBlockly_STREAM)

### 3. 官方範例改寫模組 (人臉辨識實作)

[https://github.com/fustyles/Workshop/tree/master/2019.12.20\\_esp32-cam/CameraWebServer](https://github.com/fustyles/Workshop/tree/master/2019.12.20_esp32-cam/CameraWebServer)

### 4. SD卡管理

[https://github.com/fustyles/Workshop/tree/master/2019.12.20\\_esp32-cam/ESP32-CAM\\_SD\\_Manager\\_PAGE](https://github.com/fustyles/Workshop/tree/master/2019.12.20_esp32-cam/ESP32-CAM_SD_Manager_PAGE)

## ☰ Toggle OV2640 settings

Resolution	QVGA(320x240) ▼
Quality	10 <input type="range"/> 63
Brightness	-2 <input type="range"/> 2
Contrast	-2 <input type="range"/> 2
Saturation	-2 <input type="range"/> 2
Special Effect	No Effect ▼
AWB	<input checked="" type="checkbox"/>
AWB Gain	<input checked="" type="checkbox"/>
WB Mode	Auto ▼
AEC SENSOR	<input checked="" type="checkbox"/>
AEC DSP	<input type="checkbox"/>
AE Level	-2 <input type="range"/> 2



Face Detection ☒

Face Recognition ☒

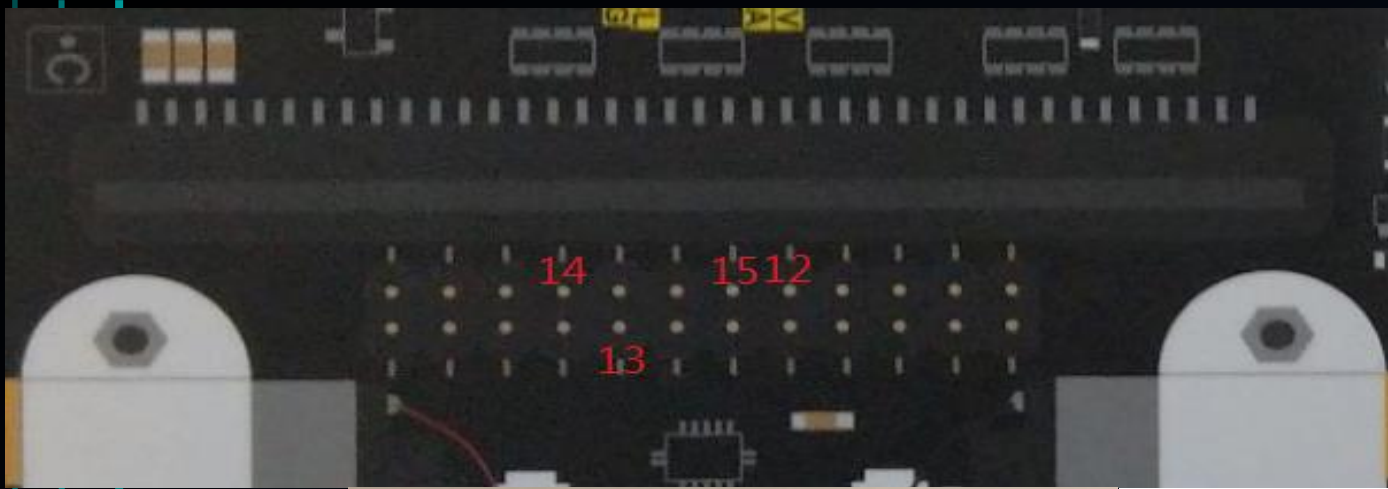
Get Still

Stop Stream

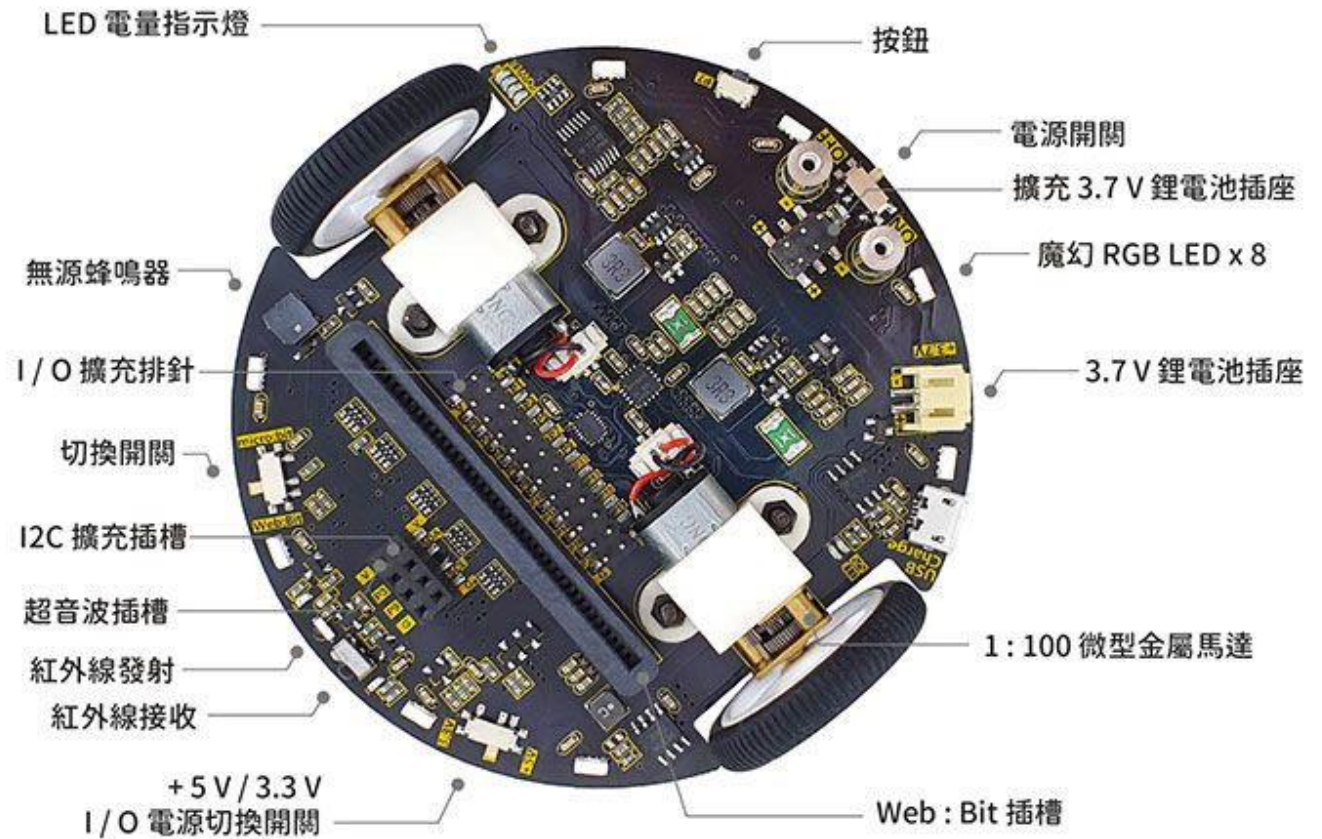
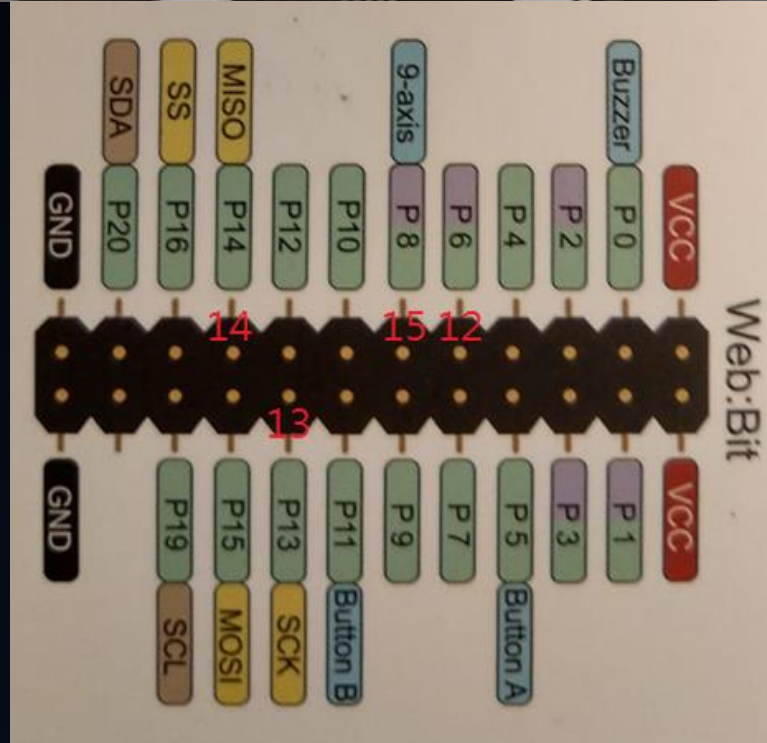
Enroll Face

- (2) 自訂指令控制閃光燈
- (3) 自訂指令控制伺服馬達
- (4) 自訂指令上傳畫面至 LineNotify
- (5) 自訂指令上傳畫面至 Google 雲端硬碟
- (6) 自訂指令儲存畫面至 TF卡
- (7) 自訂指令控制馬達驅動IC





登月小車切換開關至Webbit



11:00~12:00 tfjs物件監視、物件追蹤實作

(1) tfjs物件辨識模組程式解說

(2) 物件監視

上傳影像至LineNotify與Google雲端硬碟

[https://github.com/fustyles/Workshop/tree/master/2019.12.20\\_esp32-cam/ESP32-CAM\\_coco-ssd\\_PersonDetect\\_GoogleDrive\\_Linenotify](https://github.com/fustyles/Workshop/tree/master/2019.12.20_esp32-cam/ESP32-CAM_coco-ssd_PersonDetect_GoogleDrive_Linenotify)

(3) 物件追蹤

雙軸雲台追蹤物體

[https://github.com/fustyles/Workshop/tree/master/2019.12.20\\_esp32-cam/ESP32-CAM\\_coco-ssd\\_PeopleTracking](https://github.com/fustyles/Workshop/tree/master/2019.12.20_esp32-cam/ESP32-CAM_coco-ssd_PeopleTracking)

自走車追隨人走

[https://github.com/fustyles/Workshop/tree/master/2019.12.20\\_esp32-cam/ESP32-CAM\\_coco-ssd\\_ObjectTrackingCar\\_mqtt](https://github.com/fustyles/Workshop/tree/master/2019.12.20_esp32-cam/ESP32-CAM_coco-ssd_ObjectTrackingCar_mqtt)

13:00~14:00 tfjs姿態辨識智慧控制實作

(1) tfjs姿態辨識模組程式解說

(2) 姿態辨識控制閃光燈

通靈

[https://github.com/fustyles/Workshop/tree/master/2019.12.20\\_esp32-cam/ESP32-CAM\\_MultiPersonPose\\_ControlRelay01](https://github.com/fustyles/Workshop/tree/master/2019.12.20_esp32-cam/ESP32-CAM_MultiPersonPose_ControlRelay01)

超人飛行

[https://github.com/fustyles/Workshop/tree/master/2019.12.20\\_esp32-cam/ESP32-CAM\\_MultiPersonPose\\_ControlRelay02](https://github.com/fustyles/Workshop/tree/master/2019.12.20_esp32-cam/ESP32-CAM_MultiPersonPose_ControlRelay02)

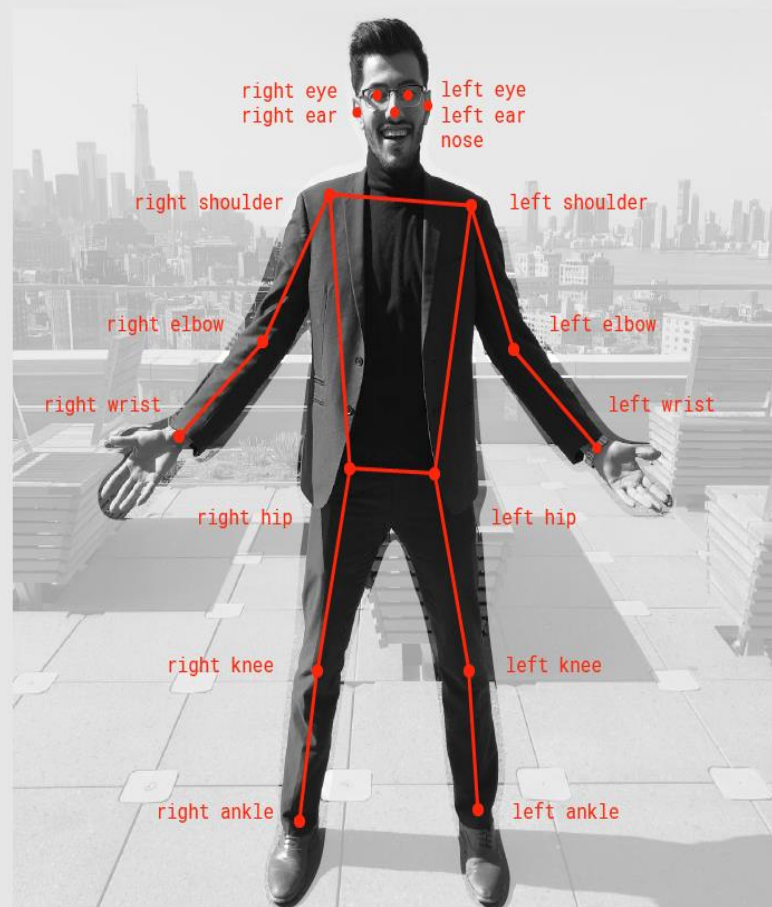




# 姿態辨識：

- Nose 鼻子
- Eye 眼睛
- Ear 耳朵
- Shoulder 肩膀
- Elbow 手肘
- Wrist 手腕
- Hip 臀部
- Knee 膝蓋
- Ankle 腳踝

17 Pose Keypoints  
Returned by PoseNet



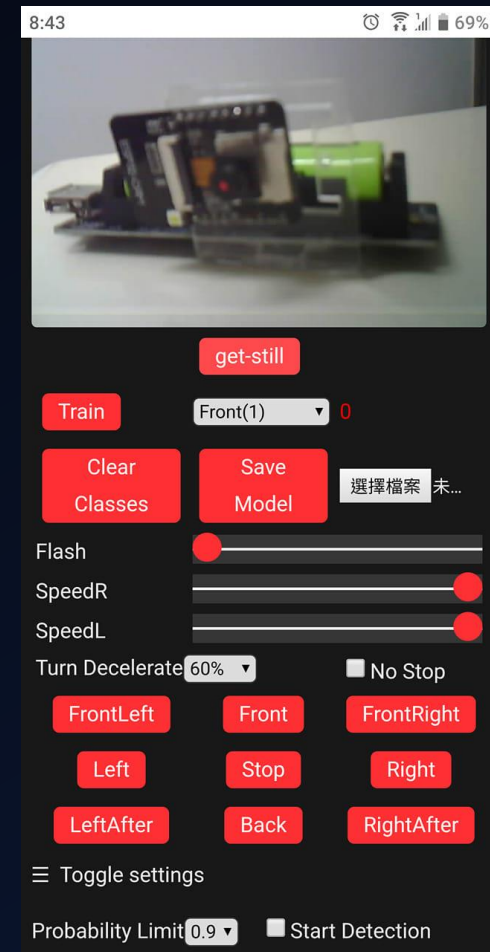
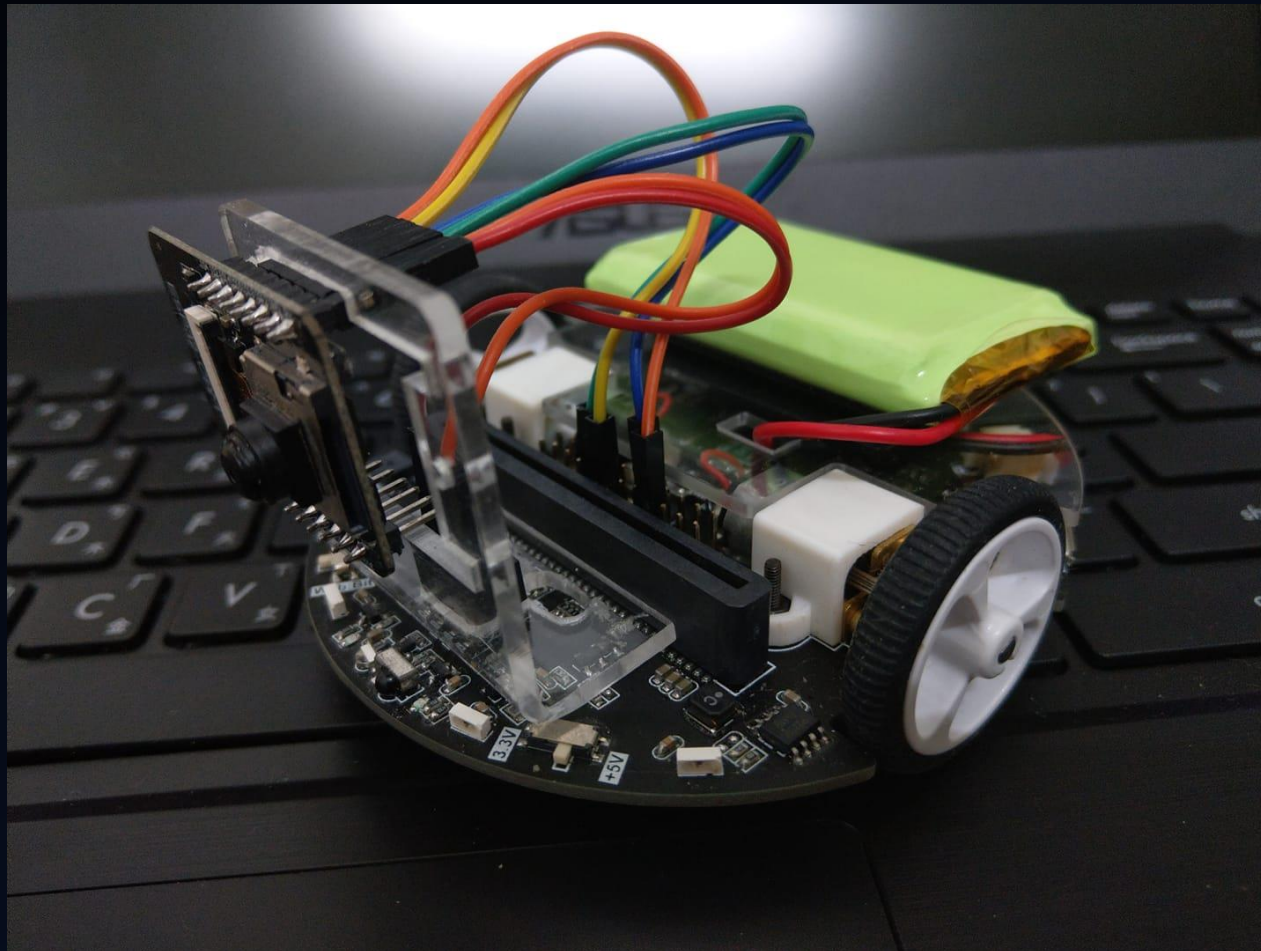
## 姿態辨識程式撰寫要點：

- 若不使用鏡像，視訊前人的右手對應 A I 回傳的右手參數。
- 若使用鏡像，視訊前人的右手對應 A I 回傳的左手參數。
- 各部位之間的距離會因人與視訊鏡頭間的距離而改變。可利用各部位距離間的比值關係不受距離視訊鏡頭遠近影響來設定判定姿態的條件。
- 設定一變數紀錄目前開關狀態做判斷，避免視訊偵測快速重複執行開關而使單晶片當機。
- 可設定較高的信心度，避免產生異常的偵測意外開關電器。



14:00~15:00 tfjs深度學習自走車實作

[https://github.com/fustyles/Arduino/tree/master/ESP32-CAM\\_CAR\\_2pwm\\_knn-classifier](https://github.com/fustyles/Arduino/tree/master/ESP32-CAM_Car/ESP32-CAM_CAR_2pwm_knn-classifier)





15:00~16:00 綜合討論

(1) AI於教學環境的發展與應用？