

手把手帶領多款國產Smart AI CAM 與語音手勢辨識開發板

Open Edge AI & TinyML

講者: 章育銘

112/07/29 Room 615

COSCUP
開 源 人 年 會

講者介紹

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- # 甲種電匠
- # 交大電控博士休學中
- ... +99



專長: 自動化、系統整合、人工智慧...



講師介紹

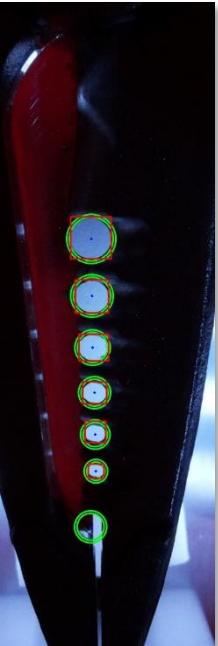


參加競賽	類別	名次
2021光寶盃極客松(AI電腦視覺檢測組)	全國賽	Merit Award
2019中華電信IOT大平台創意運用競賽	全國賽	亞軍
2019農機與生機學術研討會	全國賽	第一名
2019中華電信AIoT黑客松創新應用大賽	全國賽	冠軍
2018中華電信IOT大平台創意運用競賽	全國賽	最佳潛力獎
2018通訊大賽-聯發科技物聯網開發競賽	全國賽	季軍
2018農機與生機學術研討會	全國賽	第一名
2018第十一屆全國田間機器人競賽	全國賽	第一名
2018全國微電腦應用系統設計競賽	全國賽	值得注目獎
2018程式設計暨資訊應用競賽	校園賽	優等獎
2018亞洲智慧型機器人大賽(自走車摸黑組)	全國賽	佳作
107年度高教深耕計畫學生社群成果發表競賽	校園賽	第一名
2017第十屆全國田間機器人競賽	全國賽	最佳技術獎
106年度高教深耕計畫學生社群成果發表競賽	校園賽	第二名、佳作
2016城市盃智慧型自走車競賽(迷宮競速)	全國賽	第一名
2016春季全國機器人互動競賽(循跡競速)	全國賽	第三名

跟工作經驗一樣族繁不及備載... peko!

講師介紹

- 業界策略解決
- 競賽評審
- 系統整合施工



講師: 章育銘



講師介紹-相關教學

20230519 [國產IC開發方案]HUB 8735實務Training:
<https://www.youtube.com/watch?v=YZafxlf89aA>

WE-I Plus智慧儀錶辨識:
https://www.ideas-hatch.com/evb_share_detail.jsp?id=70

[MQTT 與 AIoT 整合運用 社群分享會]CoreMaker-01 串接 Arduino 環境AI 語音辨識&手勢判斷 教學:
https://www.youtube.com/watch?v=dMBI8v92u_4&t=1050s



三、訓練數據蒐集

下載ARC GNU Toolchain

Step1. 點選或git clone 下載套件壓縮檔案

```
https://github.com/foss for synopsys dwc arc processors/toolchain/releases/download/arc 2020.09 release/arc_gnu_2020.09_prebuilt_elf32_le_linux_install.tar.gz
```

Step2. 解壓縮檔案

```
$ sudo tar xzvf arc_gnu_2020.09_prebuilt_elf32_le_linux_install.tar.gz
```

Step3. 變更環境變數

```
$ gedit ~/.bashrc
```

將下列加入檔案之中，並儲存

```
export PATH=/home/miku/arc_gnu_2020.09_prebuilt_elf32_le_linux_install/bin:$PATH
```

```
$ source ~/.bashrc
```

YouTube TW 搜尋

Ameba Pro2

十分鐘快速上手 國產Ameba Pro2晶片

Realtek AMB82-mini AI Camera (Ameba RTL8735B)

講師: 章育銘

11/07/26 0:00 / 17:27 • 前言 >

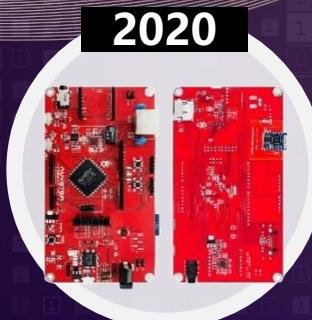
[十分鐘快速上手AI Camera] 國產瑞昱Ameba Pro2晶片人臉偵測範例



從無到有、持續累積 國產IC公板



DSI 5168



NuMaker-IoT-M487



WE-I PLUS



Filogic 130



HUB 5168+



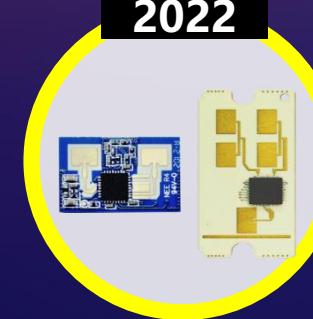
DSI 2598+



OPL1000 EVB



CoreMaker-01



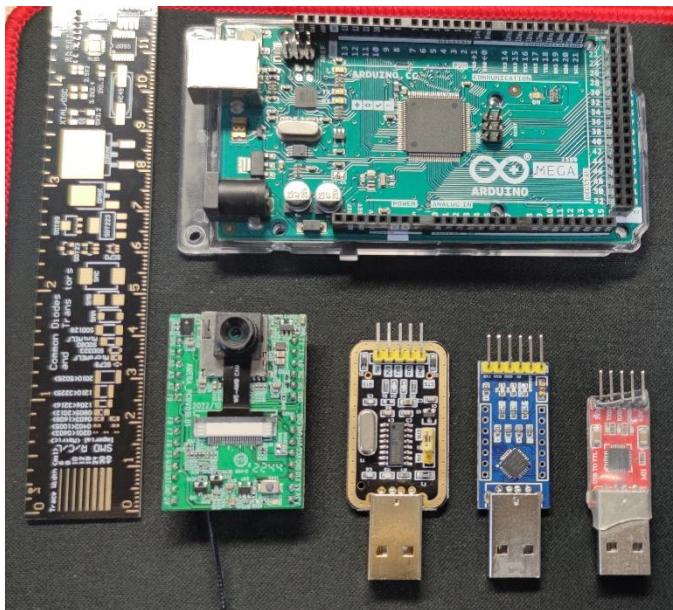
PU02/PH12



HUB 8735

HUB 8735大綱

1. 前言
2. 使用Google Colab製作AI模型
3. 以Arduino IDE將模型燒入晶片
4. labelImg標注工具介紹
5. 其他



HUB 8735

購買通路

智造工具包

晶片原廠
瑞昱半導體

晶片採用
Ameba RTL8735

【開發板特點】

- 兼容Arduino開發特性
- 具備多功能影像處理的高度集成模組
- 內置NPU AI 運算引擎加速處理AI模型
- 802.11 a/b/g/n 雙頻Wi-Fi與BLE低耗電藍牙傳輸
- 可廣泛應用於各種結合影像識別或AI運算之物聯網場域

The slide features a promotional graphic for the HUB 8735 development board. At the top, the product name "HUB 8735" is displayed in large, bold, white letters against a blue gradient background. To the right are two icons: a shopping cart labeled "購買通路" (Purchase Path) and a circular icon with a gear labeled "智造工具包" (Smart Manufacturing Tool Kit). Below the title, there are two dark blue rounded rectangles containing text: "晶片原廠 瑞昱半導體" (Chip Manufacturer Realtek Semiconductor) and "晶片採用 Ameba RTL8735" (Chip Used Ameba RTL8735). To the right of these, under the heading "【開發板特點】" (Development Board Features), is a bulleted list of five points describing the board's capabilities. At the bottom, there are two photographs of the HUB 8735 board. The left photo shows the front side with a camera module, a SIM card slot, and other components. The right photo shows the back side, which has a large, prominent silver RF module with the text "Fn-Link 6235Z-RRB C06177 2227 00" printed on it. The entire graphic is set against a light blue background with a wavy pattern at the bottom.

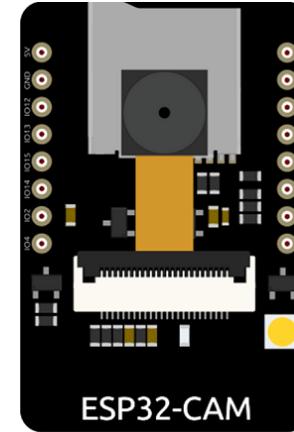
一、前言

HUB 8735 Smart AI CAM



SPI	x 1組
I2C	x 2組
PWM	x 4組
UART	x 2組
ADC	x 7組
GPIO	x 15組

ESP32-CAM



SPI	x 1組
I2C	x 0組
PWM	x 3組
UART	x 1組
ADC	x 7組
GPIO	x 10組



HUB 8735擁有與ESP32-CAM相同的PIN腳定義與排序，方便硬體互換



HUB 8735使用相同於ESP32-CAM的軟體指令集，不必再重新熟悉軟體開發架構

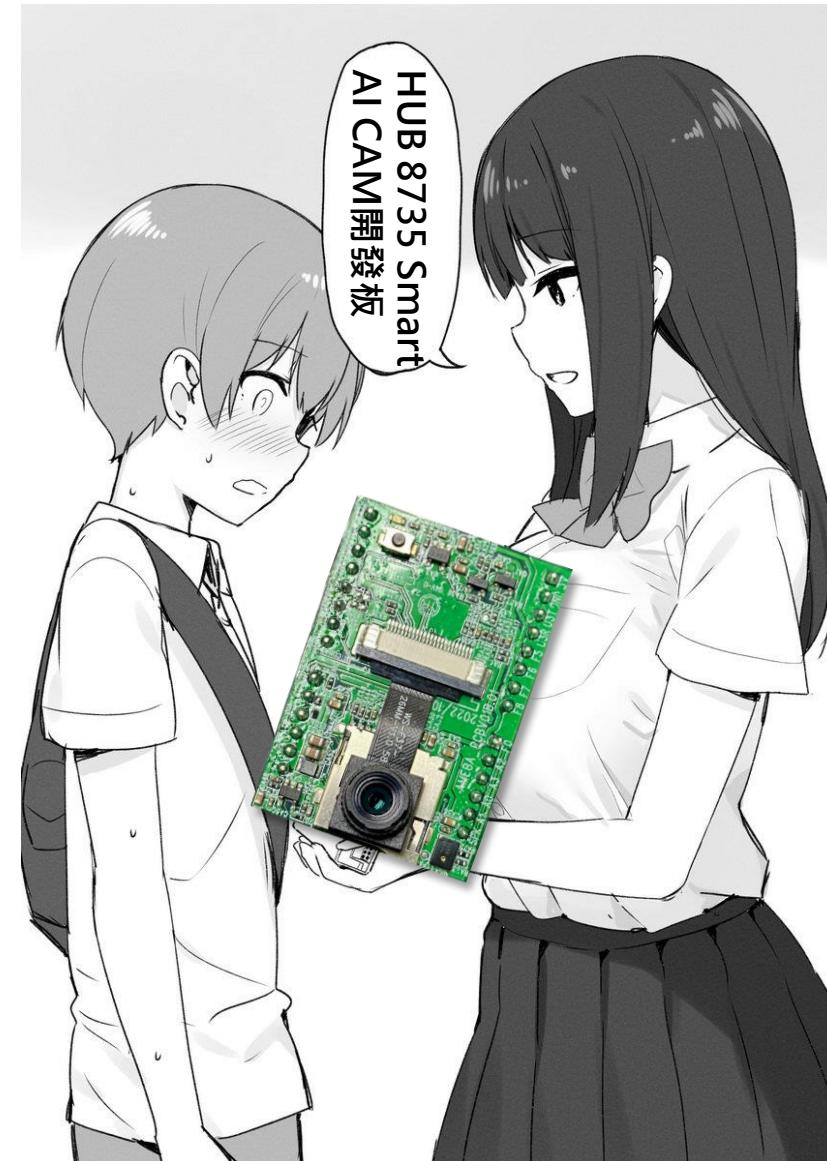
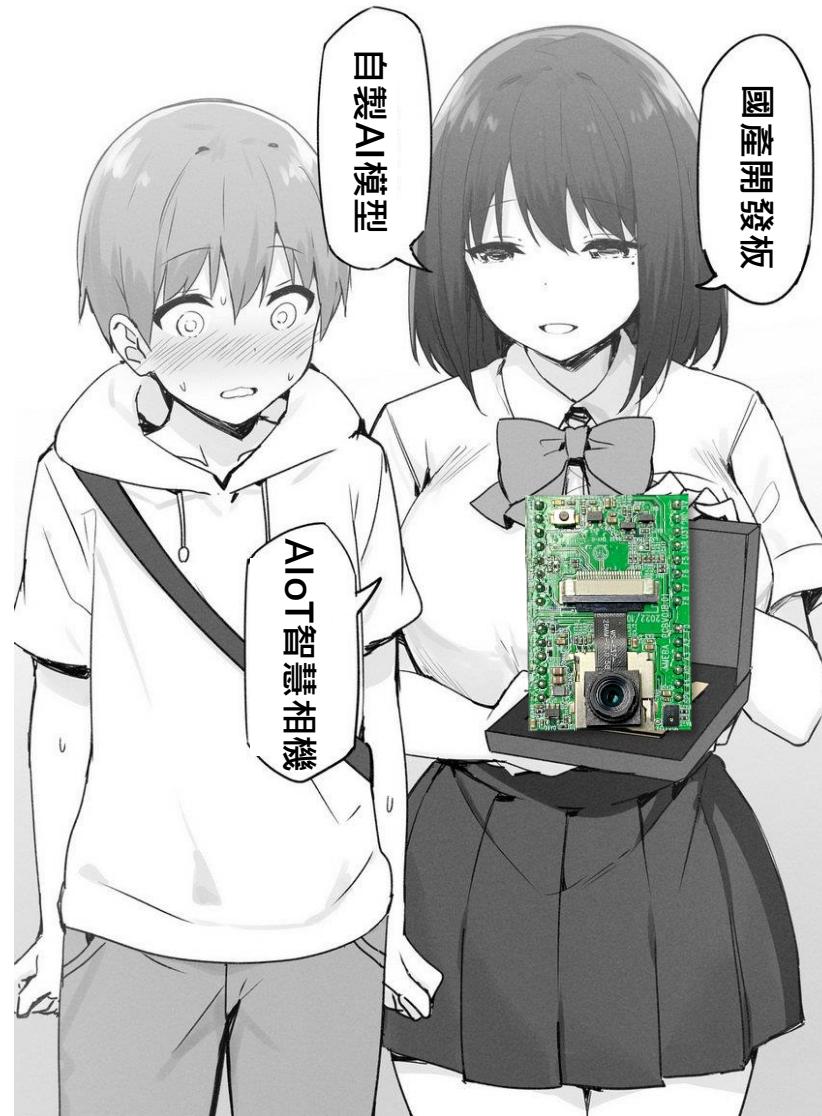
一、前言

表1. HUB 8735 Smart AI CAM

功能	描述
處理器	RTL8735B AIOT國產晶片
影像輸入	搭配國產Full HD 1080P CMOS感測
語音輸入	內建MIC語音輸入功能
儲存裝置	支援SD記憶卡
無線連通	Wi-Fi 2.4GHz/5GHz Bluetooth BLE 無線影像串流
影像壓縮	H.264/265
AI處理	提供多種pre-trained AI models供快速上手
UART介面	提供UART串接多種控制平台，如Arduino等。使用UART控制Smart AI CAM的行為
USB介面	USB影像輸出
I/O擴充板	依照開發者需求擴充功能。 Speaker語音輸出功能 IMU sensor 擴充溫度、震動、濕度等功能

一、前言

今日課程將會學習到:



二、使用Google Colab製作AI模型-設定GPU運算模式

Step 1: Click **Edit** at top left of your notebook.

Step 2: Click **Notebook Settings** within dropdown.

Step 3: Select **GPU** from the **Hardware Accelerator** dropdown.

上課資料:
<https://github.com/wildman8606/HUB-8735-AMB82-Mini-AmebaPro2-tutorial>

圖1~3. 使用Colab GPU方式運算

二、使用Google Colab製作AI模型- 換自己的資料集2

```
D:\HUB 8735\0514\my_yolov4-tiny_test.cfg - Notepad++ +  
檔案(F) 編輯(E) 尋找(S) 檢視(V) 編碼(N) 語言(L) 設定(T) 工具(O) 巨集  
我的(D) my_yolov4-tiny_test.cfg  
  
1 [net]  
2 # Testing  
3 batch=1  
4 subdivisions=1  
5 # Training  
6 #batch=64  
7 #subdivisions=1  
8 width=416  
9 height=416  
10 channels=3  
11 momentum=0.9  
12 decay=0.0005  
13 angle=0  
14 saturation = 1.5  
15 exposure = 1.5  
16 hue=.1  
17  
18 learning_rate=0.00261  
19 burn_in=1000  
20  
21 max_batches = 2000200  
22 policy=steps  
23 steps=1600000,1800000  
24 scales=.1,.1  
25  
26  
27 #weights_reject_freq=1001  
28 #ema_alpha=0.9998  
29 #random_distant_percent=1000  
Normal text file
```

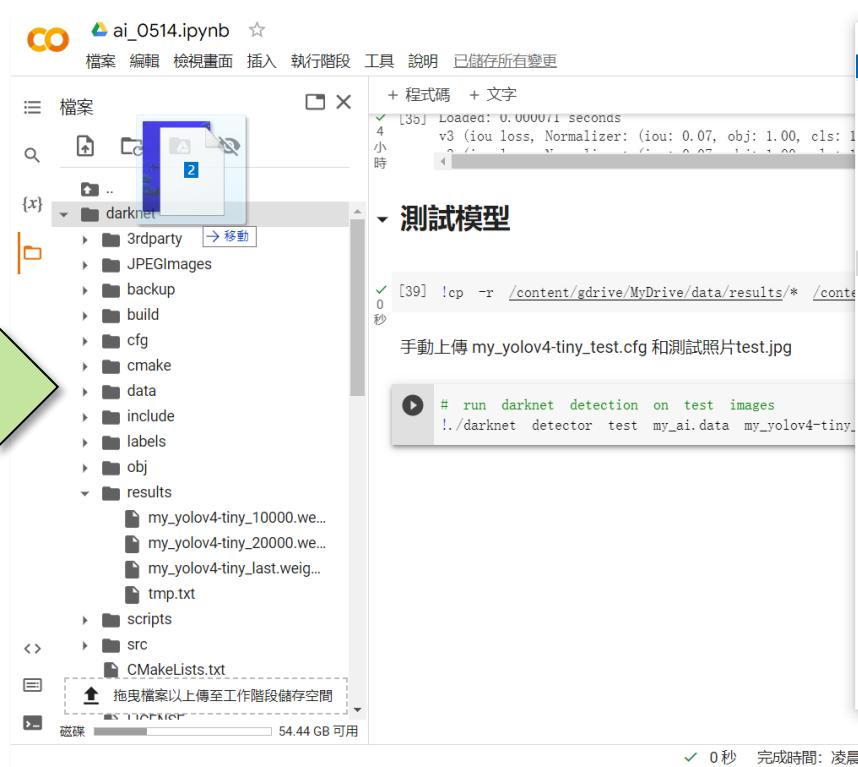


圖1. 新增及修改.cfg

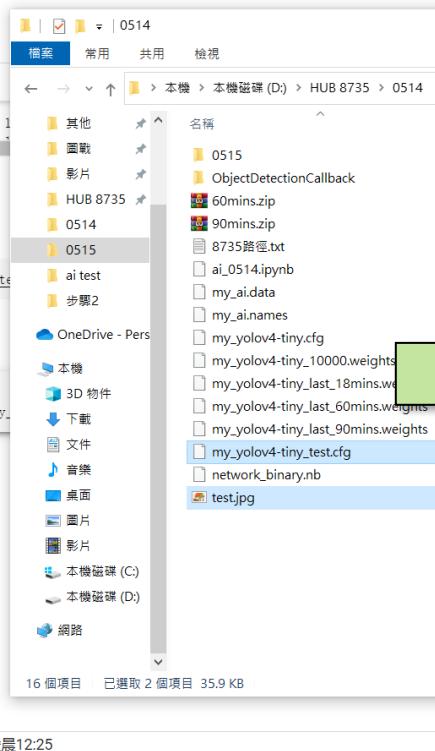


圖2. 上傳測試模型設定與測試照片

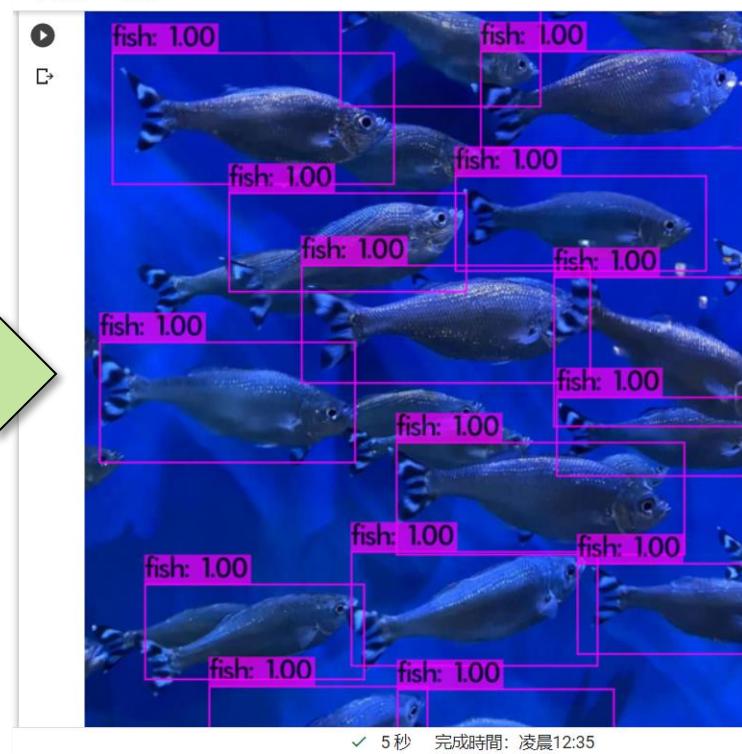


圖3. 成功辨識



成功編譯

三、以Arduino IDE將模型燒入晶片-HUB 8735環境準備

步驟1. 需安裝Arduino IDE 1.8.19之後的版本

步驟2. 開啟Arduino IDE，透過檔案->偏好設定，在Additional Boards Manager URLs 填入以下連結後：
https://github.com/ideashatch/HUB-8735/raw/main/amebapro2_arduino/Arduino_package/ideasHatch.json

步驟3. 再從工具->開發板管理員中找到HUB 8735的開發板資料。

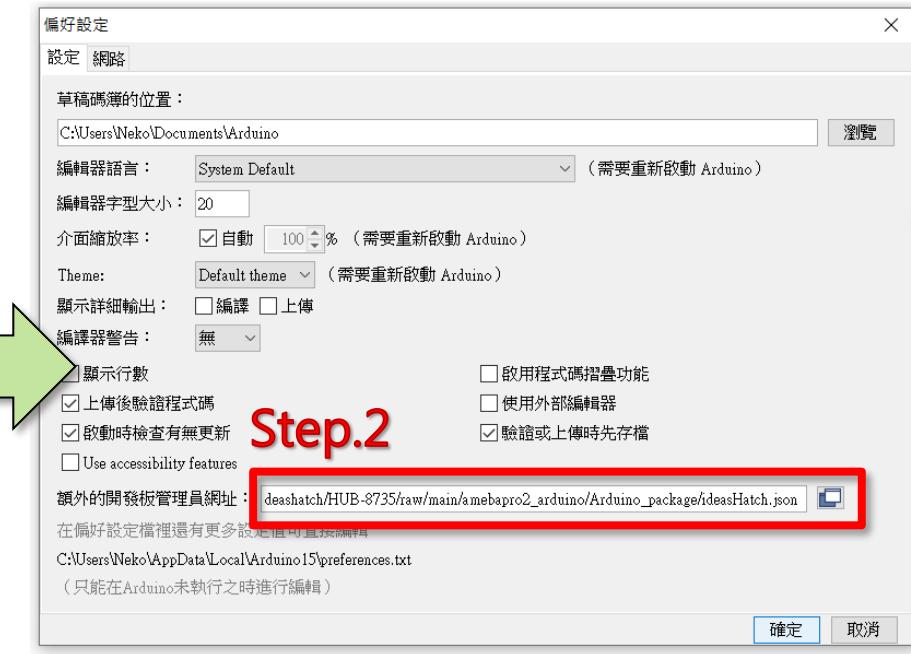


圖3. 進入'開發板管理員'

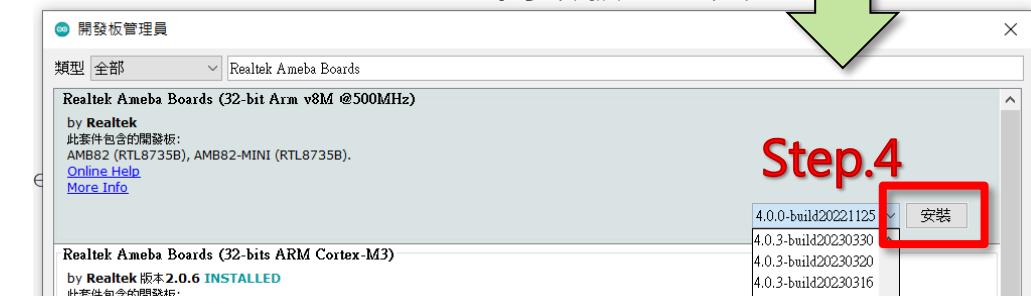


圖4. 輸入'Realtek'找到開發板安裝

三、以Arduino IDE將模型燒入晶片-燒錄HUB 8735 (4)

步驟1. 下載VLC Media Player:

<https://github.com/portapps/vlc-portable/releases>

步驟2. 開啟序列埠監控視窗

步驟3. 拔掉BOOT_MODE跳腺

步驟4. 按下重置鈕

步驟5. 查看ip

步驟6. 連線即時串流協定

(Real Time Streaming Protocol, RTSP)

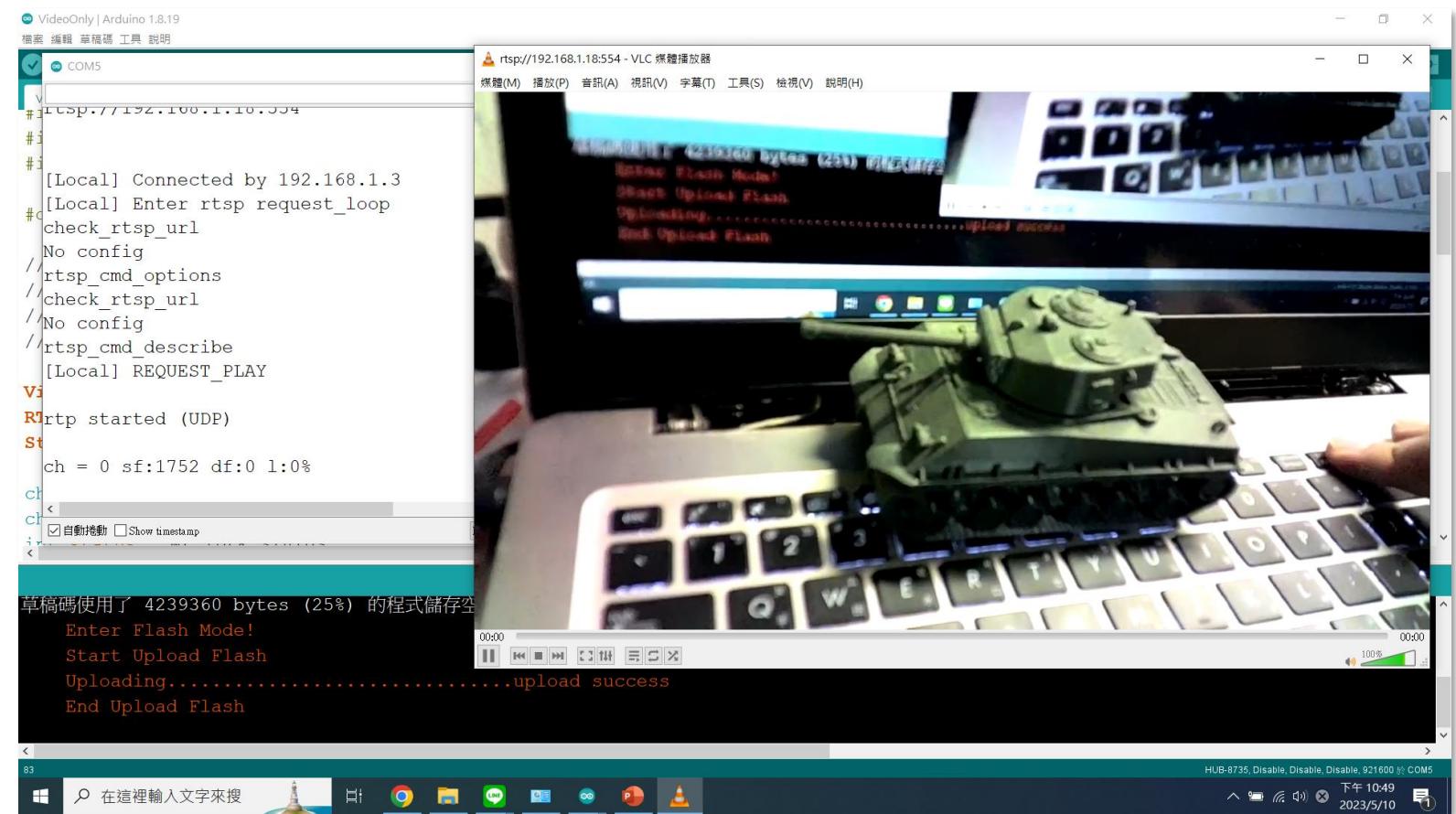


圖1. 成功畫面

三、以Arduino IDE將模型燒入晶片-燒錄HUB 8735 (7)

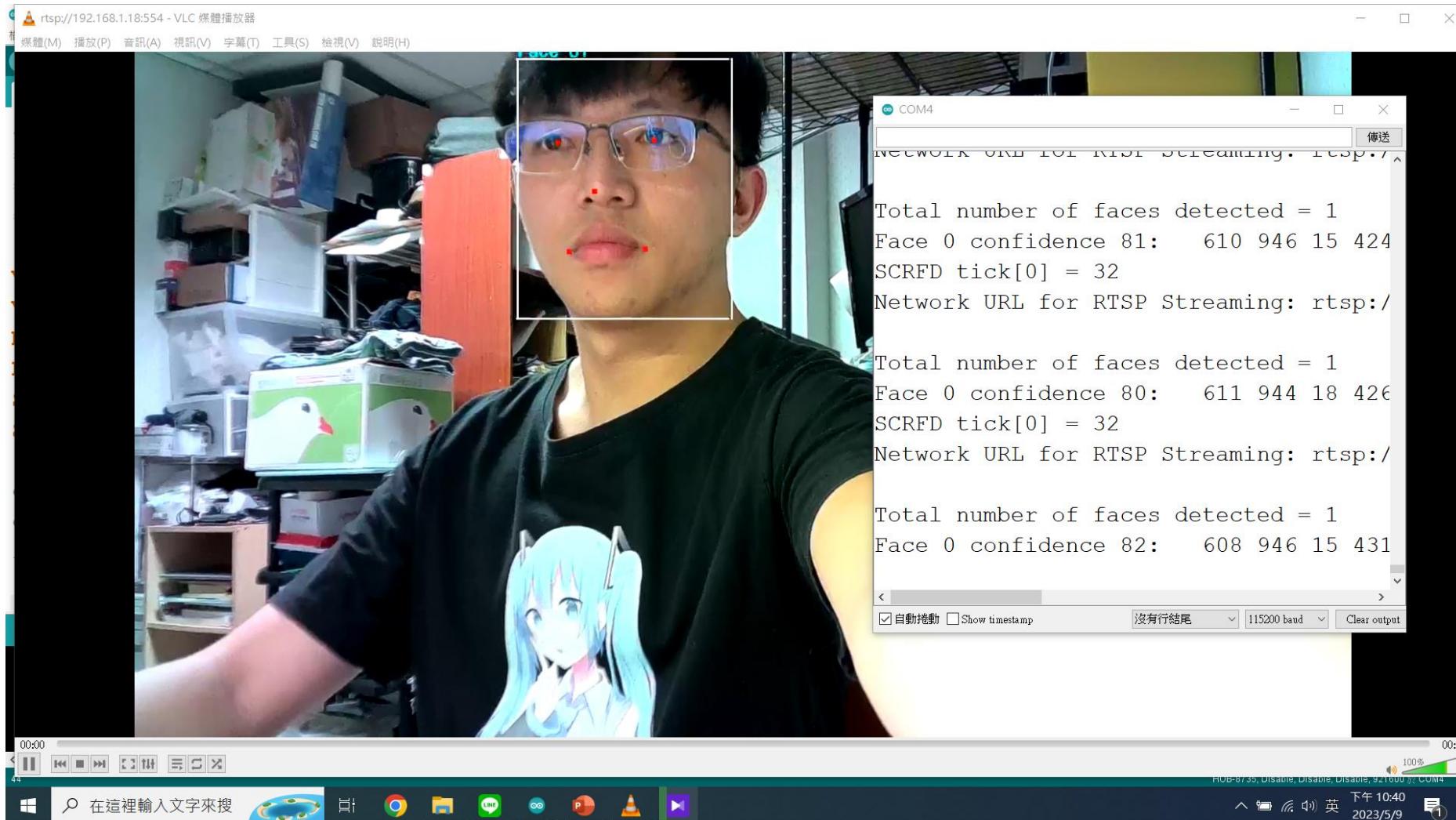


圖1. VLC Media Player操作

三、以Arduino IDE將模型燒入晶片-燒入自己的AI模型

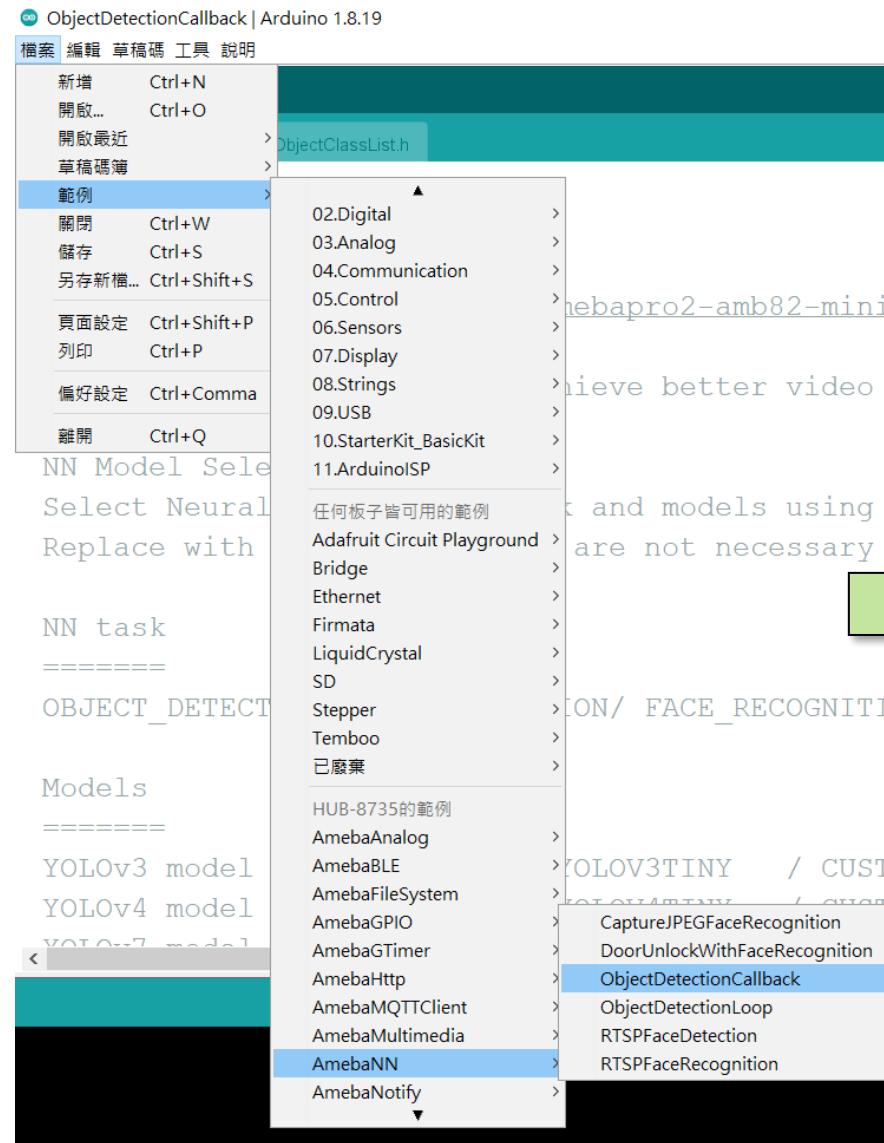


圖1. 開啟範例

```
ObjectDetectionItem {
    uint8_t index;
    const char* objectName;
    uint8_t filter;
};

// List of objects the pre-trained model is capable of recognizing
// Index number is fixed and hard-coded from training
// Set the filter value to 0 to ignore any recognized objects
ObjectDetectionItem itemList[3] = {
{0, "'fish", 1},
{1, "penguin", 1},
{2, "jellyfish", 1}};
```

圖2. 修改參數

四、labelImg標注工具介紹

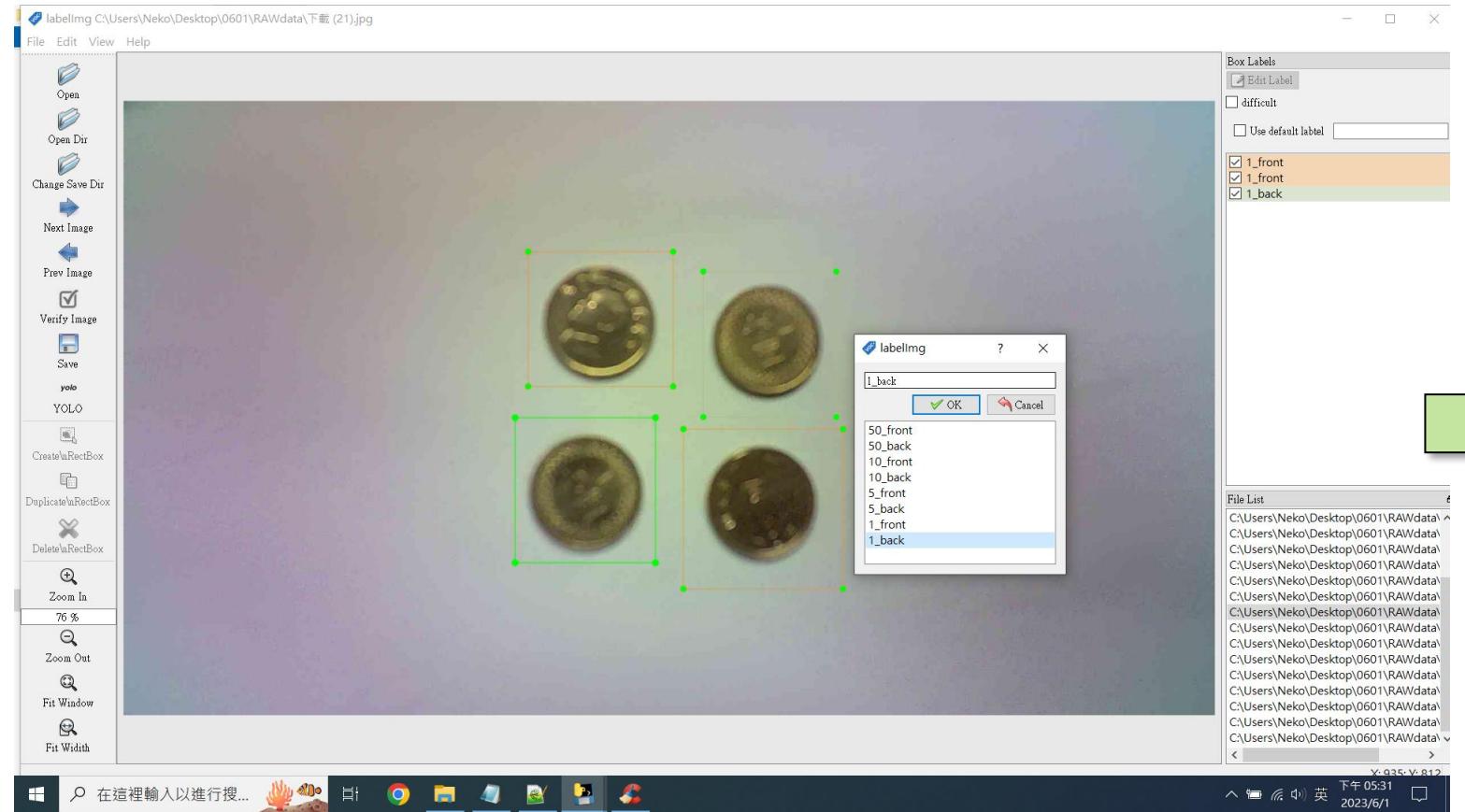
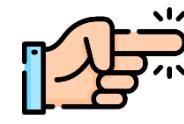


圖1. labelImg標注

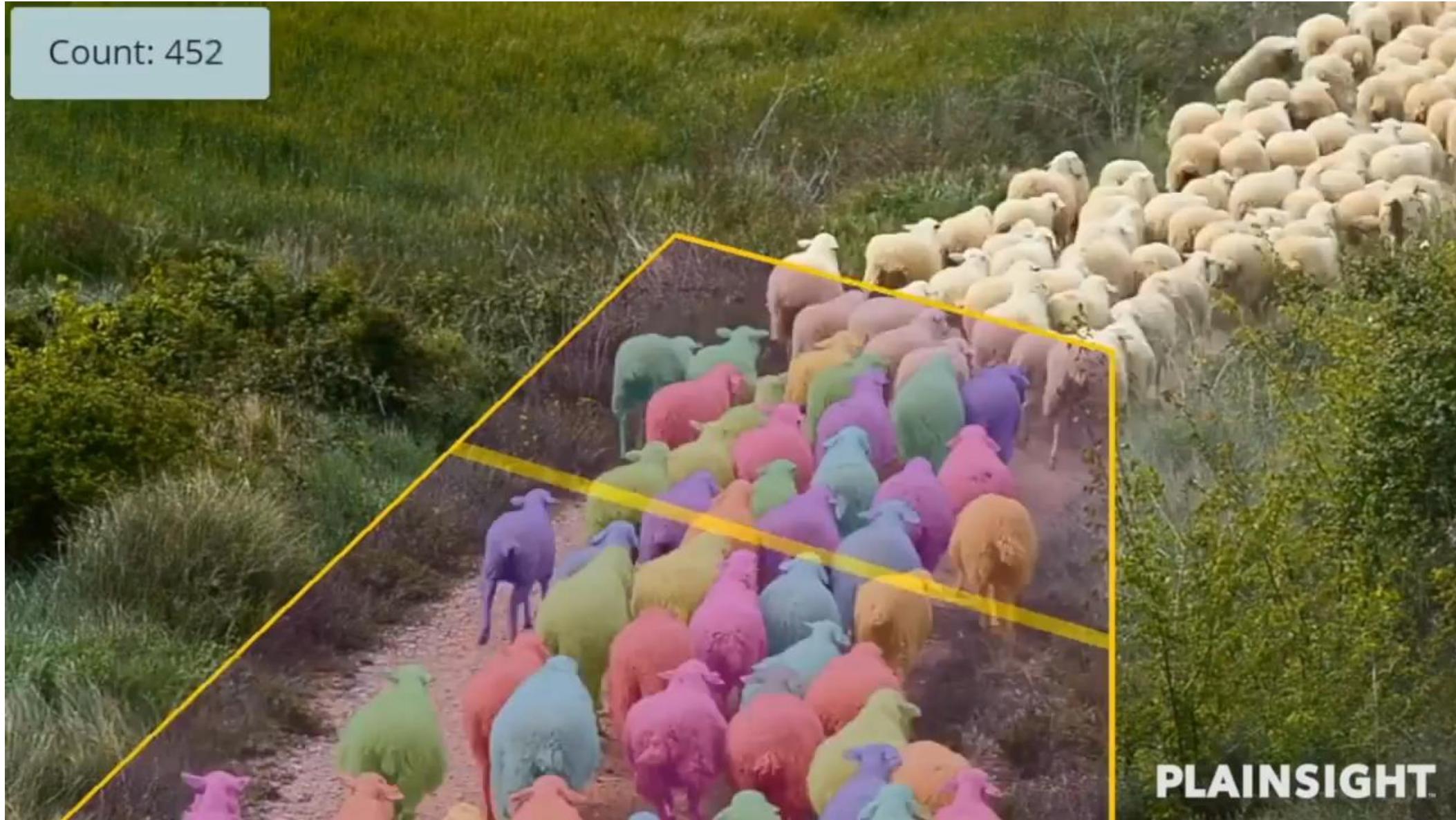


圖2. 簡易辨識結果

AIoTのAI?



<https://www.youtube.com/@PlainsightAI/videos>



AIoTのAI?

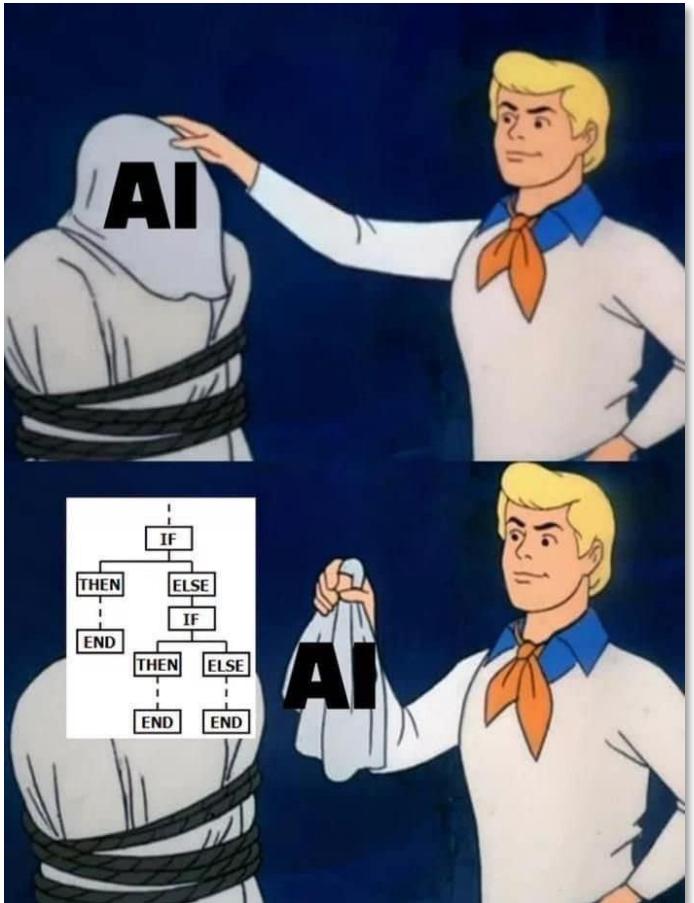


圖1.AI?

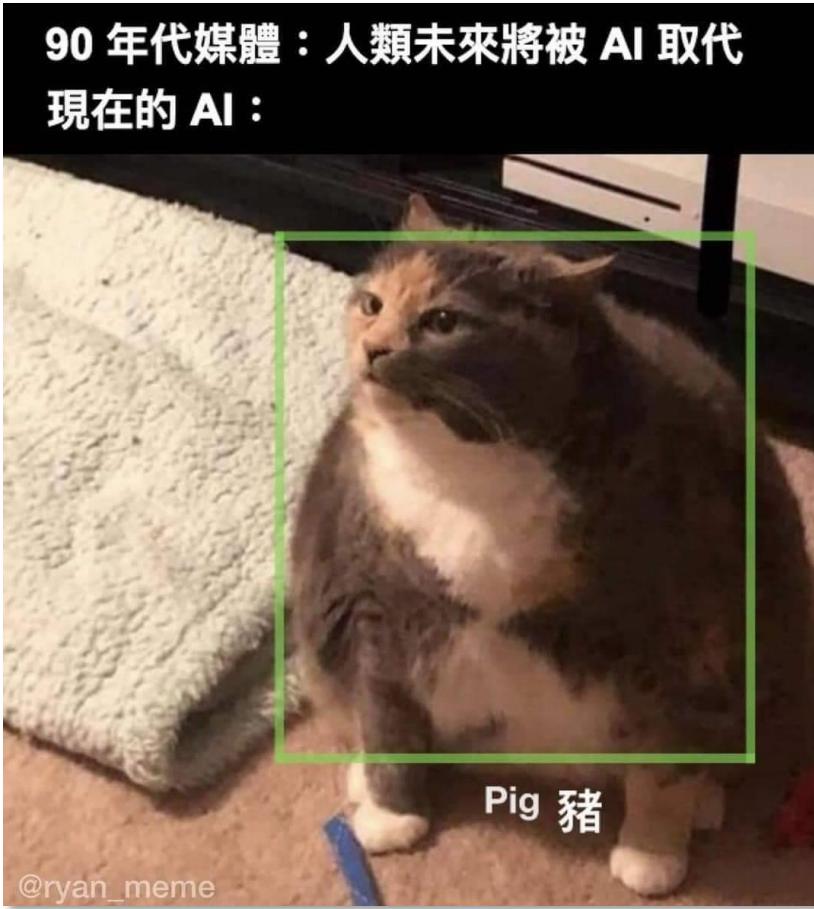


圖2.訓練資料



圖3. 產業變革

AIoTのAI?



圖1. object detection & segmentation



圖2. 卵咪蒜瓣毛 & 冰淇淋

AI需要？

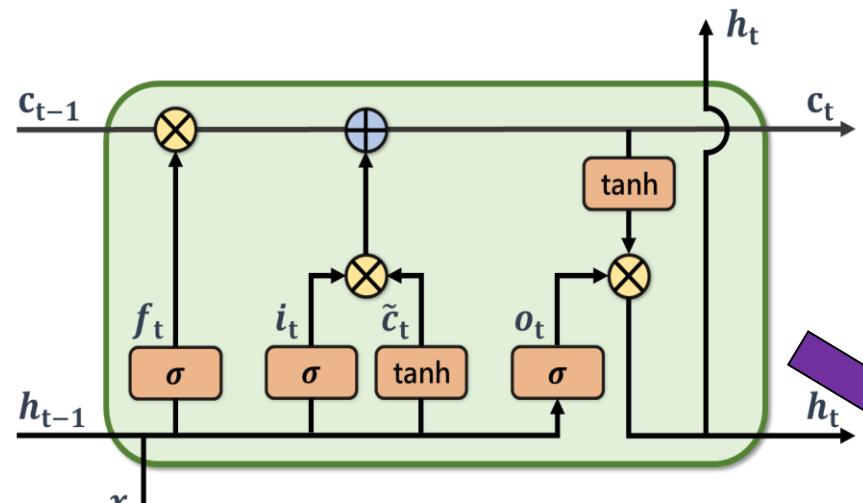


圖1-3. LSTM 單元模型架構

$$f_t = \sigma_g(W_f x_t + U_f h_{t-1} + b_f) \quad (1)$$

$$i_t = \sigma_g(W_i x_t + U_i h_{t-1} + b_i) \quad (2)$$

$$o_t = \sigma_g(W_o x_t + U_o h_{t-1} + b_o) \quad (3)$$

$$\tilde{c}_t = \sigma_h(W_c x_t + U_c h_{t-1} + b_c) \quad (4)$$

$$c_t = f_t \odot c_{t-1} + i_t \odot \tilde{c}_t \quad (5)$$

$$h_t = o_t \odot \sigma_h(c_t) \quad (6)$$

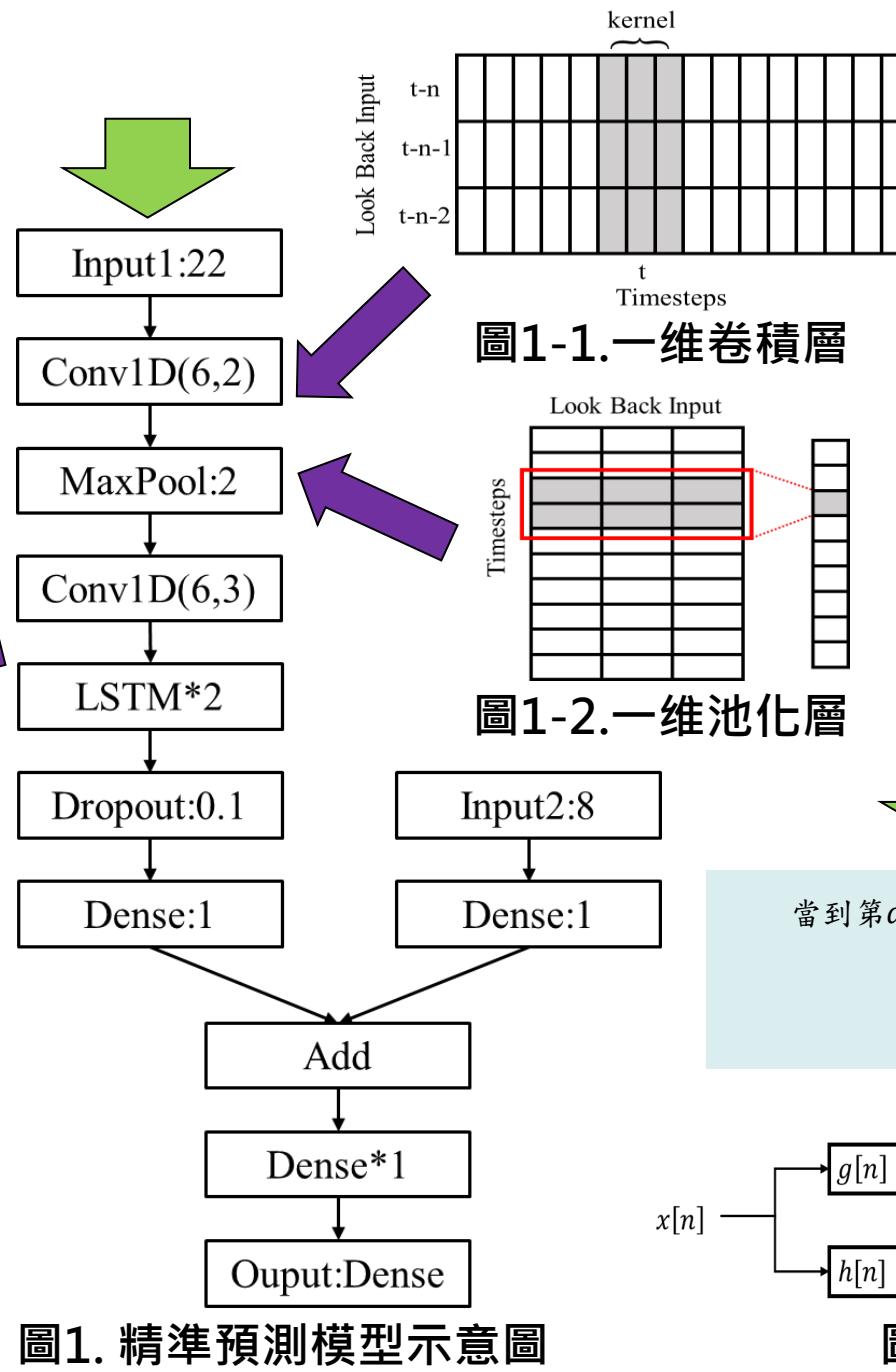


圖1. 精準預測模型示意圖

圖1-1. 一維卷積層

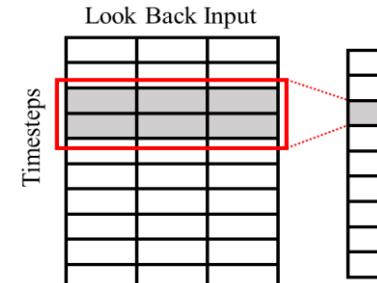


圖1-2. 一維池化層

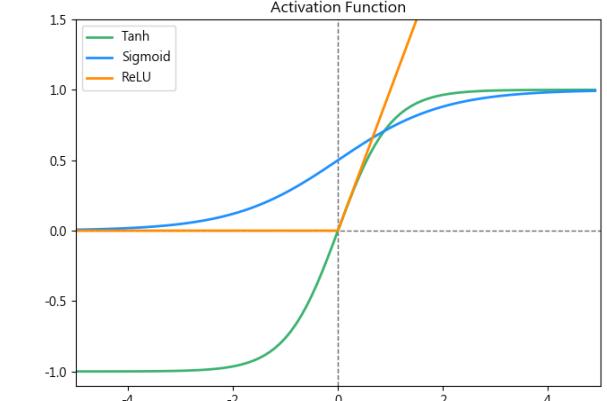


圖1-4. 啟動函數選擇

資料前處理
(時域、頻域轉換)

當到第 α 階層時:

$$x_{\alpha,L}[n] = \sum_{k=0}^{K-1} x_{\alpha-1,L}[2n-k]g[k] \quad (7)$$

$$x_{\alpha,H}[n] = \sum_{k=0}^{K-1} x_{\alpha-1,L}[2n-k]h[k] \quad (8)$$

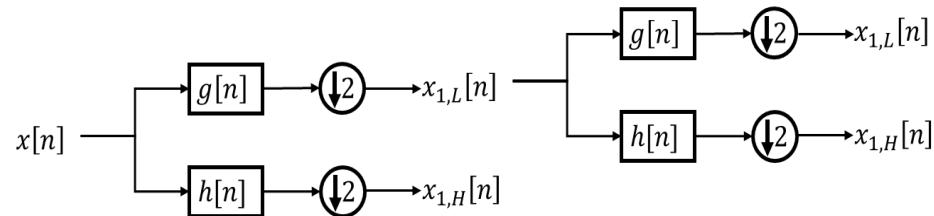
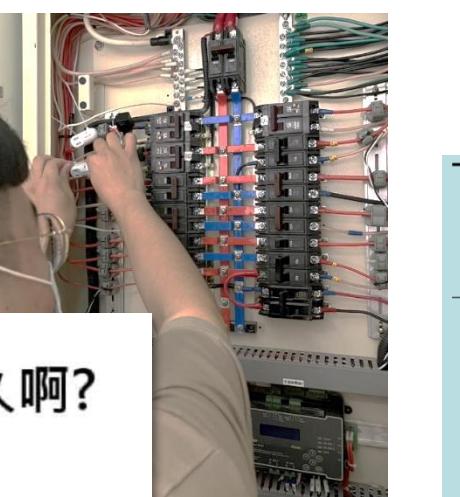


圖1-5. 多階離散小波轉換

我的學術垃圾



圖1. 結合氣象站太陽能發電
精準預測模型



安裝電錶

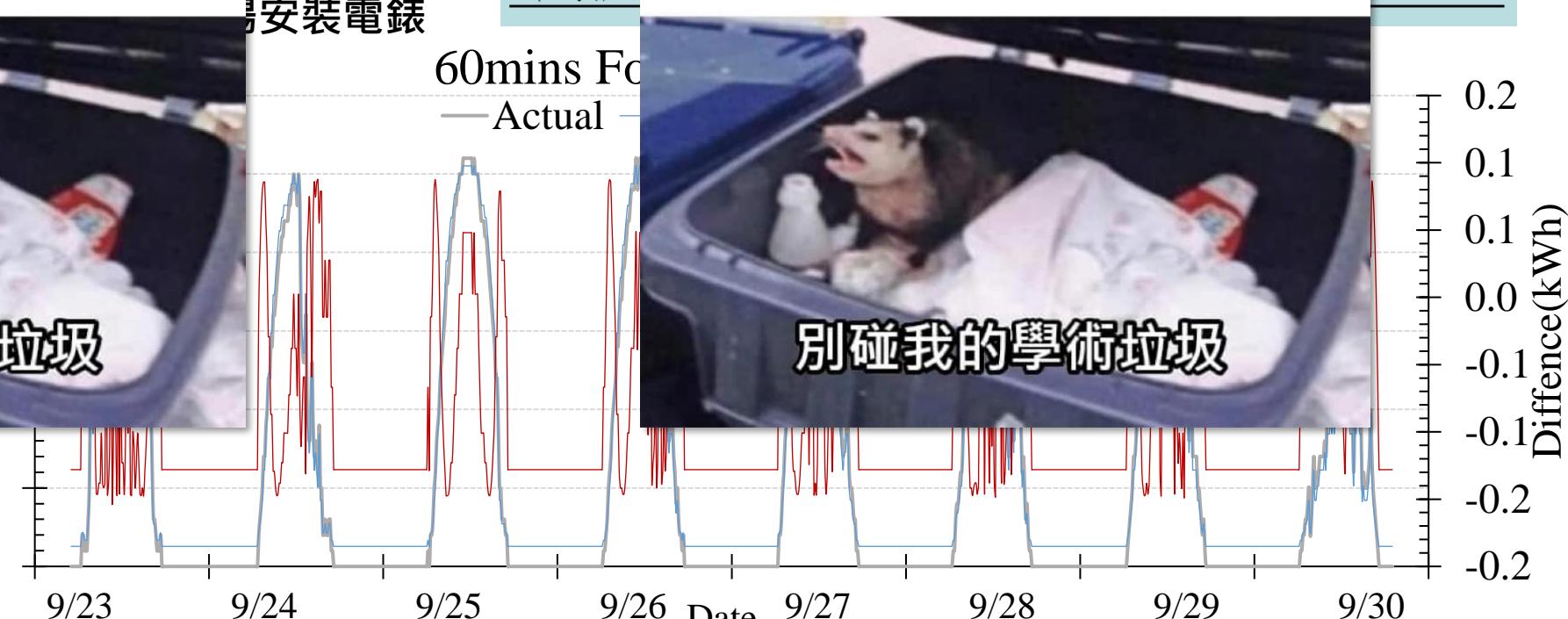
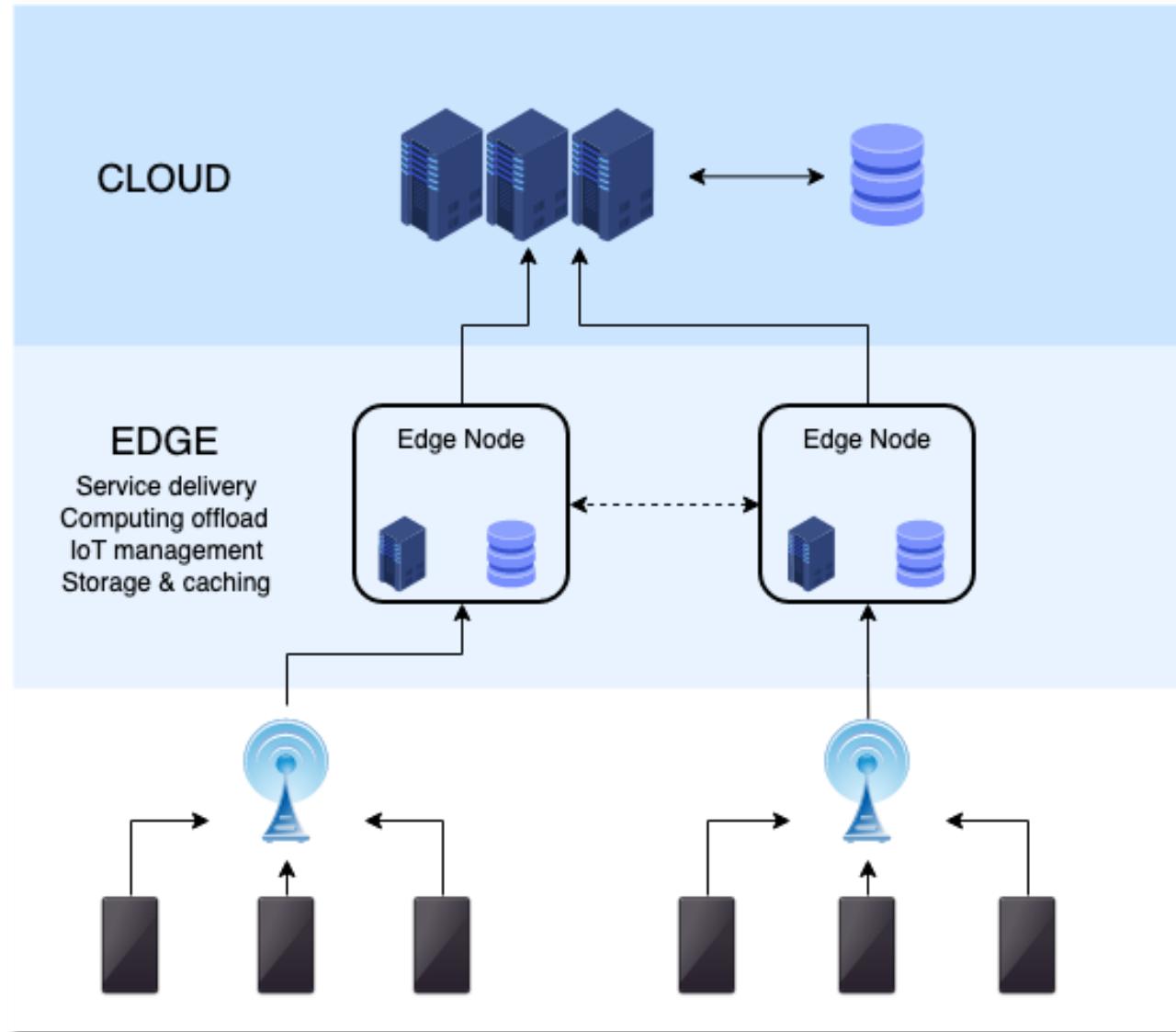


圖3. 1小時後精準預測結果

章育銘 (2021)。應用深度學習於太陽能發電量預測。碩士論文。國立臺北科技大學，臺灣博碩士論文知識加值系統。<https://hdl.handle.net/11296/bbmkv4>

Edge computing

https://en.wikipedia.org/wiki/Edge_computing



ARM MCU等級晶片 智慧運算能力與適用情境

MCU等級跨度大
以Arm Cortex-M為例
M0+, M3, M4, M7, M55

非影像類 智慧感測器

- Cortex-M today: 振動偵測 (Vibration detection), 感測器融合 (Sensor fusion), 關鍵字偵測 (Keyword detection)
- Cortex-M55: 異常偵測 (Abnormal detection), 物件偵測 (Object detection), 手勢偵測 (Gesture detection)
- Cortex-M and Ethos-USS: 生物識別 (Biometric awareness), 語音辨識 (Speech recognition)
- Cortex-A, Mali and Ethos-N: 物件分類 (Object classification), 即時辨識 (Real-time recognition)

資料輸入量

指令速度從數十MHz到數百MHz
程式碼儲存空間從數KB到數MB
SRAM從數KM到數MB

圖片來源：<https://www.arm.com/blogs/blueprint/ai-for-iot-devices>

2022/11/10

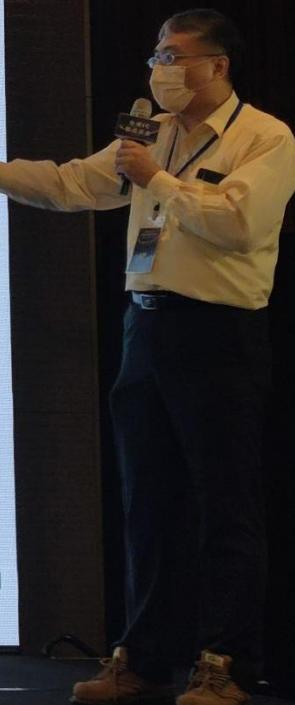
台灣IC智造年會_AIoT與tinyML生態系國際發展趨勢與國產IC未來方向_OmniXRI_Jack Hsu

MCU等級tinyML

- 優點**
 - 低單價、功耗
 - 低延時(反應快)
 - 高隱私(免上網)
 - 易連接各式感測器及通訊模組
- 缺點**
 - 速度、算力不足
 - 記憶體不足
 - 儲存能力小
 - 難以在線訓練

9

OmniXRI
歐尼克斯實境互動



<https://www.youtube.com/watch?t=1049&v=S3UudNBkZyo>

tinyML?

tinyML案例分享（以技術分類）



資料來源：https://hackmd.io/@OmniXRI-Jack/tinyML_projects

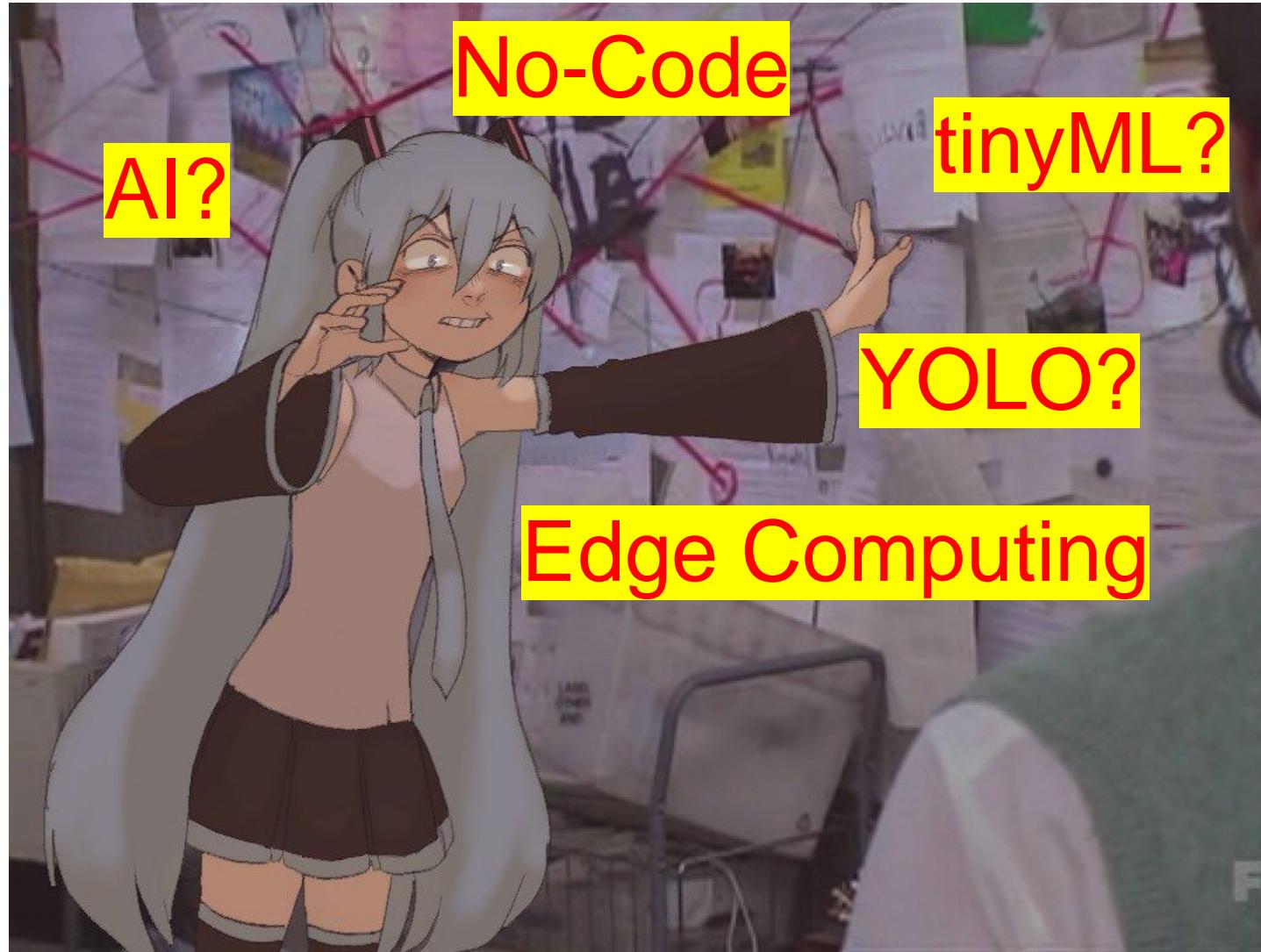
2022/11/10

台灣IC智造年會_AIoT與tinyML生態系國際發展趨勢與國產IC未來方向_OmniXRI_Jack Hsu

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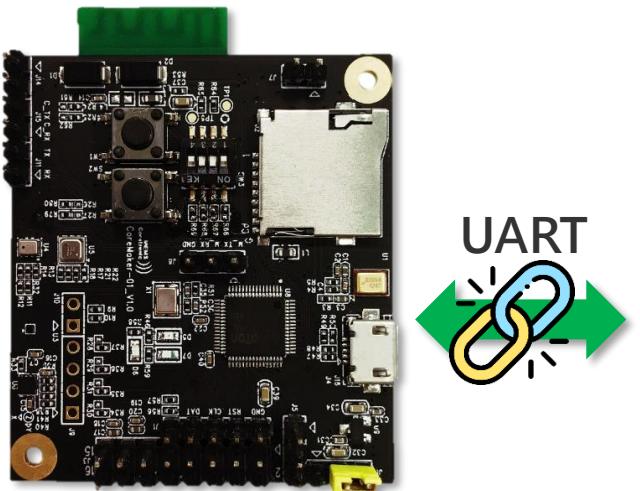
MEME



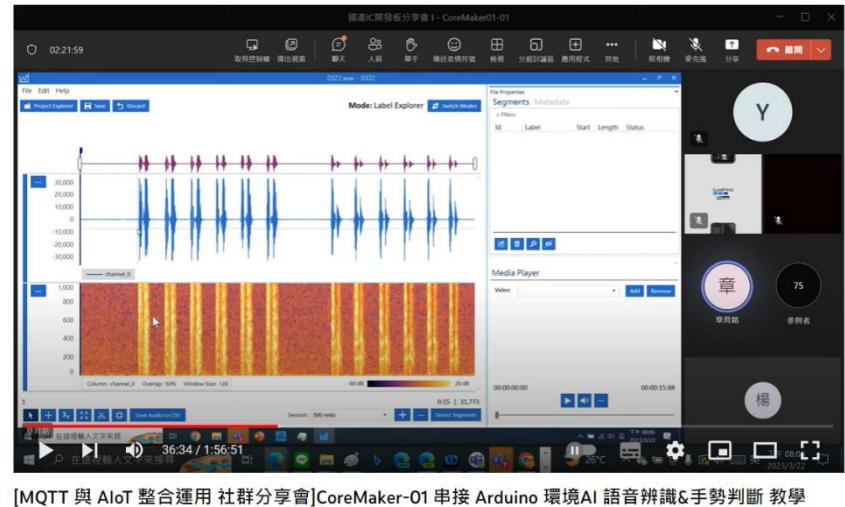
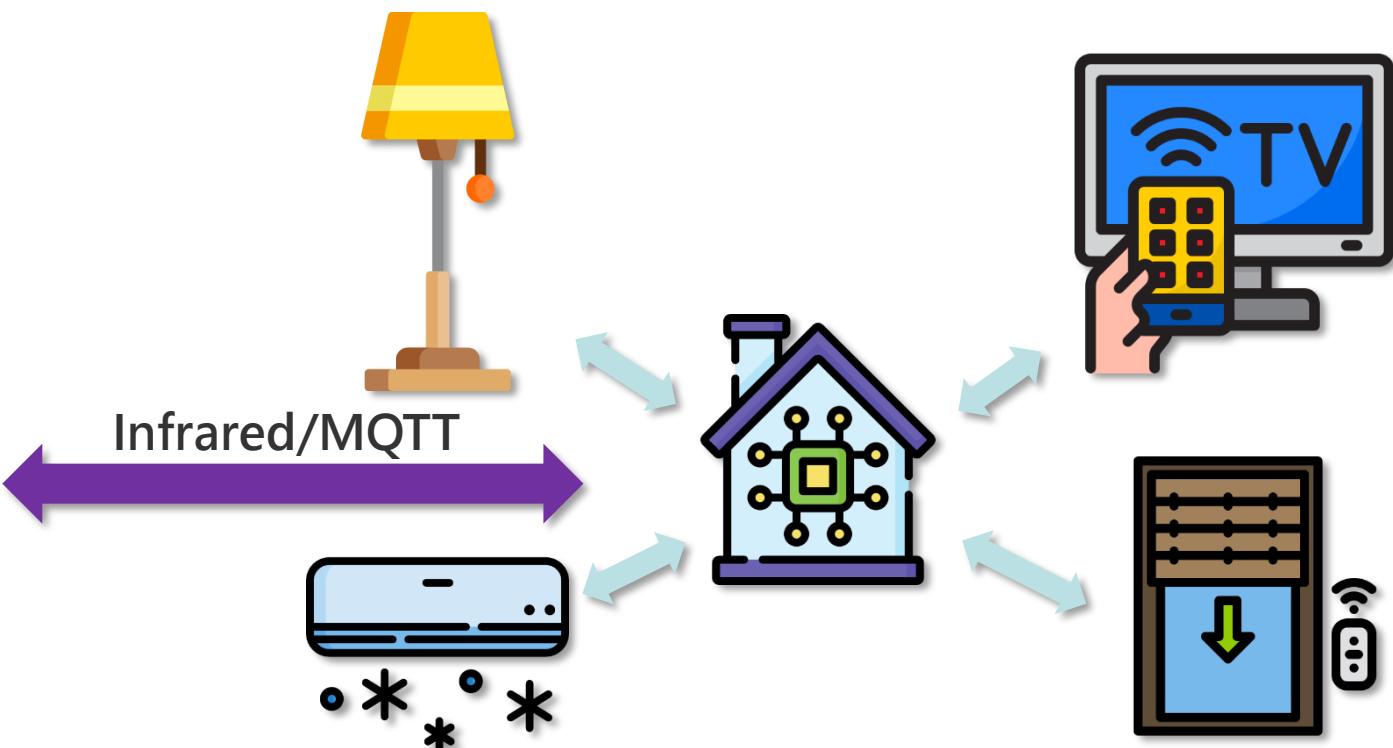
就像跟別人解釋fate的世界線

CoreMaker-01 應用場景

- 聲控家電、電燈、大門,
- [關閉窗簾, 開電視, 開冷氣28度] 指令,
- 本案將國產開發晶片結合智慧居家,
- 遠端控制、智慧聲控。



UART
↓



[MQTT 與 AIoT 整合運用 社群分享會]CoreMaker-01 串接 Arduino 環境AI 語音辨識&手勢判斷 教學

CoreMaker-01 晶片介紹

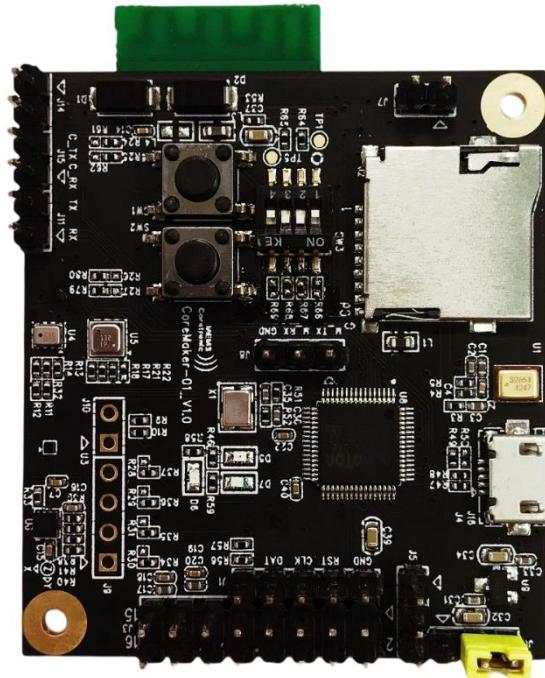


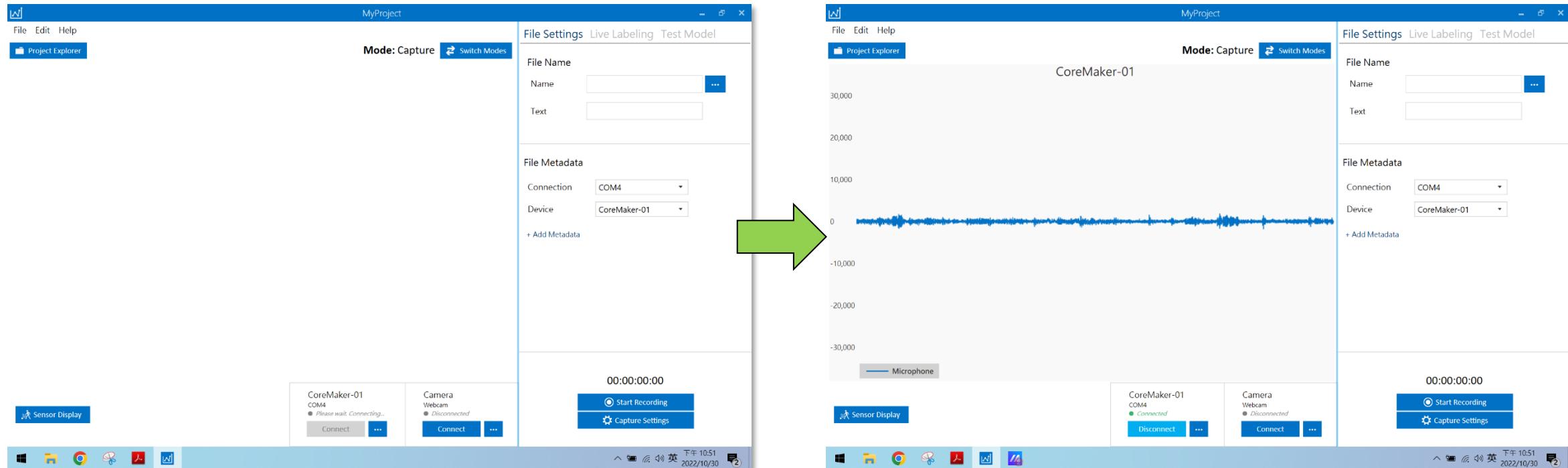
圖1、CoreMaker-01 晶片

尺寸	55mm x 45mm
特色	採用 新唐/M484SIDAE CoreMaker-01與您一起開拓AIoT進化路
介紹	晶片原廠: 中光電 智能感測Coretronicmems 官網 : https://www.coretronicmems.com/ CoreMaker-01使用新唐M484，以Arm® Cortex®-M4F為核心，帶有DSP指令集的高效能低功耗微控制器，支援可程設 UART / SPI / I²C。開發人員可運用ARM Mbed物聯網裝置平台，一款結合網際網路協定、資安與標準化管理的單一整合式解決方案，專門針對耗能與定價特別敏感的物聯網裝置所設計。 透過多維度感測模組，以Device AI概念打造高性價比AIoT方案，客戶可自行開發或委由CMC協助開發AI模型，燒錄至CoreMaker-01 MCU，即可完成一款具 AI功能 之裝置。



一、蒐集數據

<https://app.sensiml.cloud>



點選頁面下方CoreMaker-01 的Connect 按鈕，當狀態列出現Retrieving Configuration 時，按壓CoreMaker-01 上的SW2 按鍵即可連線。連線成功後，
頁面中間會顯示輸入資料的波型圖。

二、分類標註



三、編譯與燒入 Coremaker-01



Step1. 輸入指令:

> mbed-tools compile -m AIOT2101 -t GCC_ARM

WE-I Plus 系統介紹

利用台達溫控器做為簡易範例

WE-I Plus開發晶片架設於錶頭前，
將辨識數值判斷後輸出。

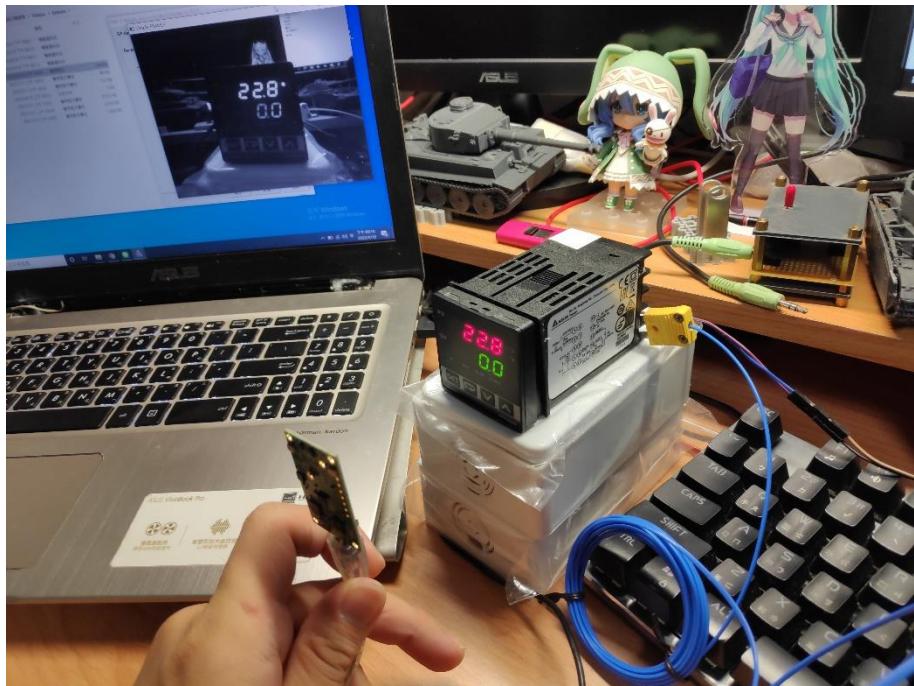
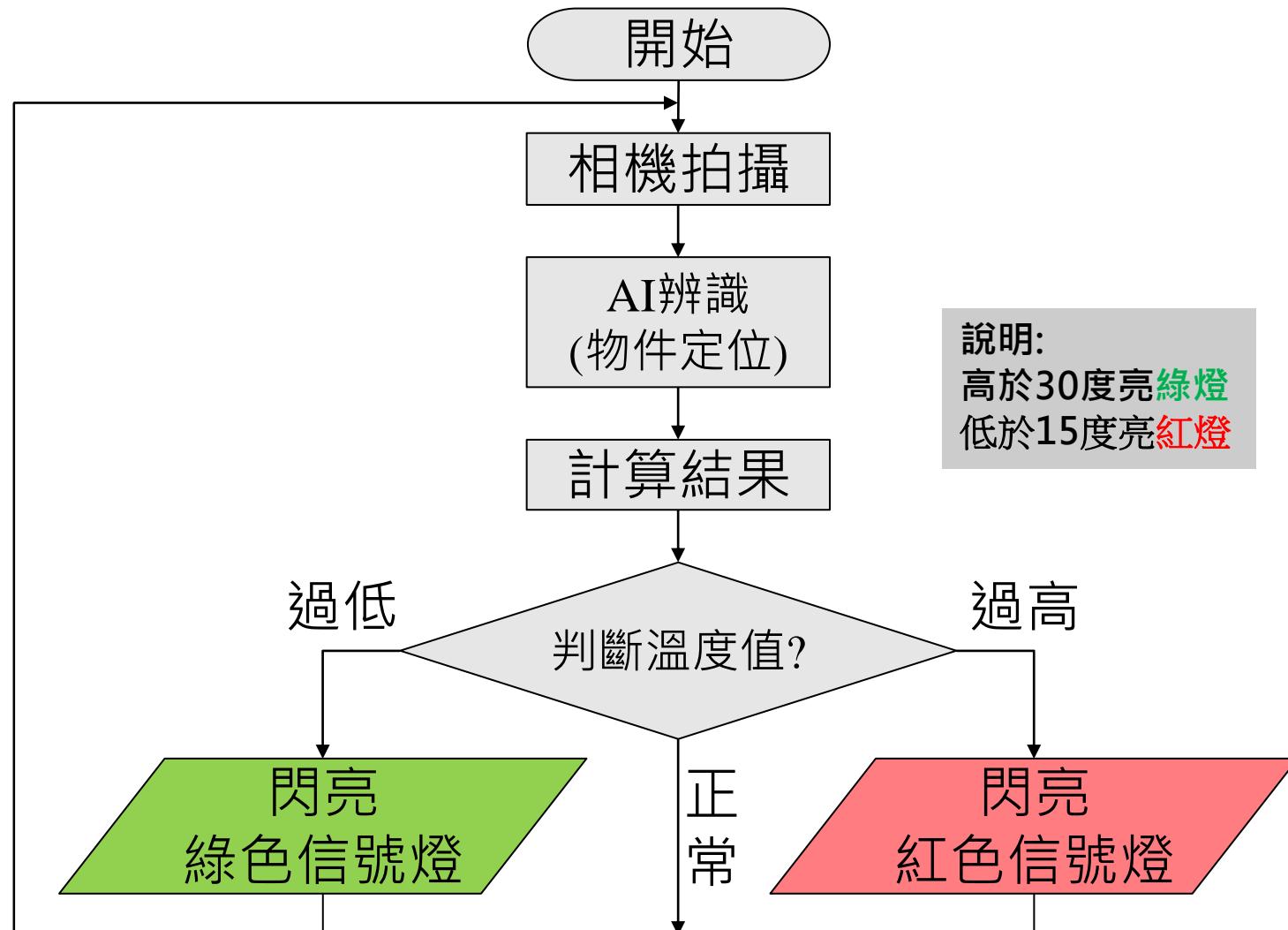


圖 1.案例運用示意圖



WE-I Plus 訓練數據蒐集

燒入WE-I Plus開發版

Step1.下載檔案

Step2.開啟HMX_FT4222H_GUI.exe

Step3.設定圖片大小以及格式

Step4.點選開始按鈕，
圖片會自動記錄於資料夾內

註:不能於虛擬主機內執行之,會因延遲破圖



圖 1. git下載操作

Windows 檔案位置:

https://github.com/HimaxWiseEyePlus/WE_I_Plus_User_Examples/releases/download/v1.0/PC_TOOL_Win.zip

Linux 版本檔案位置:

https://github.com/HimaxWiseEyePlus/WE_I_Plus_User_Examples/releases/download/v1.0/PC_TOOL_Linux

確認資料上傳完畢後，
開始標註圖片
(要跟電腦說這是'0'、'1'...)

Training data Test data | Labeling queue (2741) Export data

Did you know? You can capture data from any device or development board, or upload your own images.

DATA COLLECTED	TRAIN / TEST SPLIT
Collected data	
SAMPLE NAME	LABELS
1547	-
1546	-
1545	-
1544	-
1541	-
1543	-
1538	-

Step.7

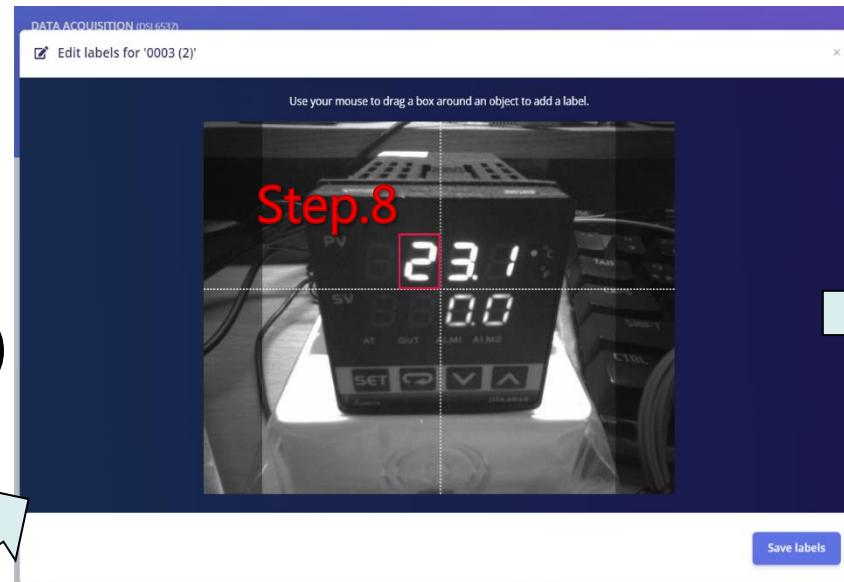


圖 2. 框起物件範圍

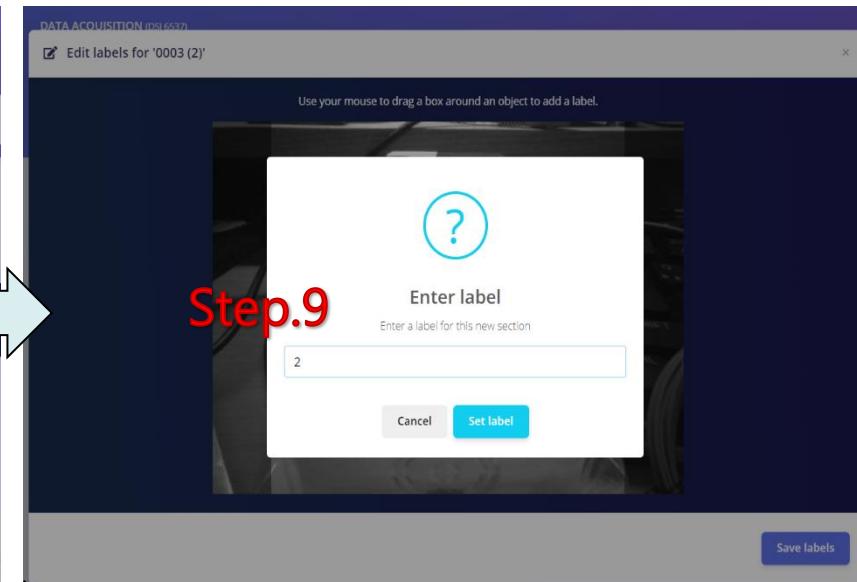


圖 3. 輸入標籤類別

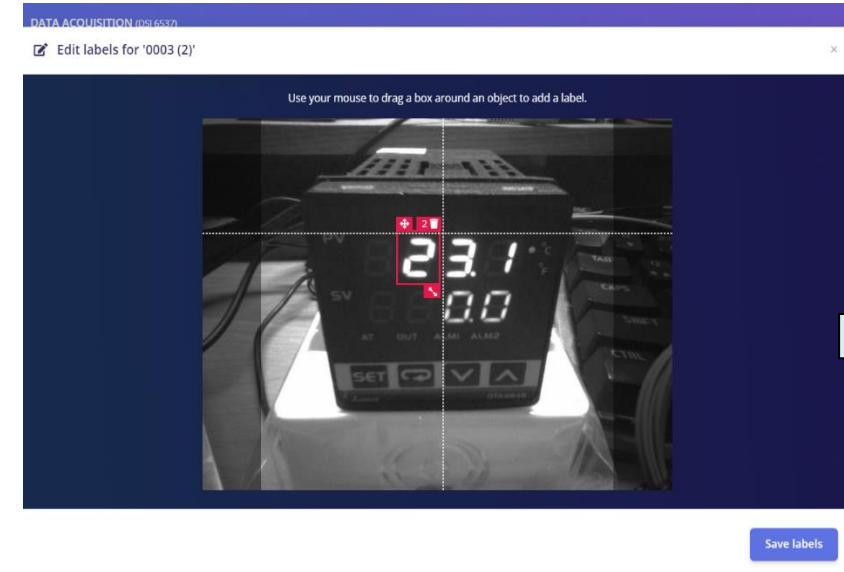


圖 4. 框選完成

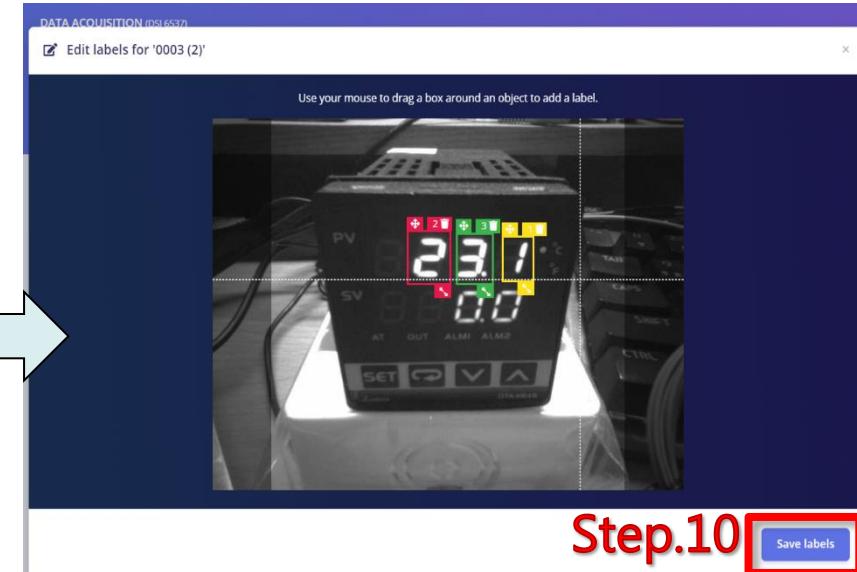


圖 5. 依序製作

圖 1. 對照片點選編輯標籤

WE-I Plus AI模型製作

模型匯出。

The screenshot shows the TensorFlow.js Model Zoo interface. On the left, the 'FOMO (Faster Objects, More Objects) MobileNetV2 0.35' model is selected. It displays the input layer (102,400 features) and output layer (10 classes). A red box highlights the 'Start training' button. On the right, the 'Model' section shows the last training performance (validation set) with an F1 score of 90.1% and a confusion matrix. The confusion matrix table is as follows:

	BACKGROUNDS	0	1	2	3	4	5	6	7	8	9
BACKGROUNDS	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
0	11.1%	88.9%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%
2	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%
3	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%
4	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%
5	75%	0%	0%	0%	0%	0%	25%	0%	0%	0%	0%
6	20%	0%	0%	0%	0%	0%	80%	0%	0%	0%	0%
7	7.7%	0%	0%	0%	0%	0%	0%	92.3%	0%	0%	0%
8	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%
9	16.7%	0%	0%	0%	0%	0%	0%	0%	0%	0%	83.3%
F1 SCORE	1.00	0.89	0.98	0.88	0.89	0.86	0.40	0.89	0.96	1.00	0.77

On the right, there's also an 'On-device performance' section with metrics like inferencing time, peak RAM usage (2.4M), and flash usage (8.0K).

圖 1. 確認測試集所輸出混淆矩陣以及準確度,即可匯出模型

EDGE IMPULSE

Dashboard

Devices

Data acquisition

Impulse design

- Create impulse
- Image
- Object detection

EON Tuner

Retrain model

Live classification

Model testing

Versioning

Deployment

Deploy your impulse

You can deploy your impulse to any device. This makes the model run without an internet connection, minimizes latency, and runs with minimal power consumption. [Read more.](#)

Step 17

The following table lists all the deployment source code that you can run on any device.

 C++ library	 Arduino library	 Cube.MX CMSIS-PACK
 WebAssembly	 TensorRT library	 OpenMV library

Build firmware

Get a ready-to-go binary for your development board that includes your impulse.

		
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圖 2. 選擇C++庫

Step.18

Select optimizations (optional)

Model optimizations can increase on-device performance but may require more memory. Click here to analyze optimizations and see the recommended choices for your model. You can always use the currently selected options.

Step.19

Enable EON™ Compiler

Enable the EON™ Compiler to achieve up to 50% less memory. Open source.

Step.20

Available optimizations for Object detection

Quantized (int8)	RAM USAGE 630.9K	LATENCY -
Currently selected	FLASH USAGI 78.0K	ACCURACY -
This optimization is recommended for best performance.		
Unoptimized (float32)	RAM USAGE 2.4M	LATENCY -
Click to select	FLASH USAGI 112.6K	ACCURACY -
Estimate for Cortex-M7 216MHz		

Build output

Creating job... OK (ID: 2665789)

Generating features for Image...

Not generating new features: features already generated and no option or files have changed.

Generating features for Image OK

Classifying data for Object detection...

Copying features from processing blocks...

Scheduling job in cluster...

Job started

Copying Features from DSP block...

Copying Features from DSP block OK

Copying features from processing blocks OK

Classifying data for float32 model...

Classifying data for int8 model...

Scheduling job in cluster...

Job started

Job started

Classifying data for Object detection OK

Job completed

圖 3. 點選建立

WE-I Plus 結果展示

上述可以利用Himax範例將辨識結果輸出，以115200鮑率輸出至下位控制器



圖 1. 序列傳出輸出結果至電腦

格式為：

```
(" %d score: (%u) [ x: %u, y: %u]\r\n"
algoresult.ht[i].upper_body_label,
algoresult.ht[i].upper_body_score,
algoresult.ht[i].upper_body_bbox.x,
algoresult.ht[i].upper_body_bbox.y);
```

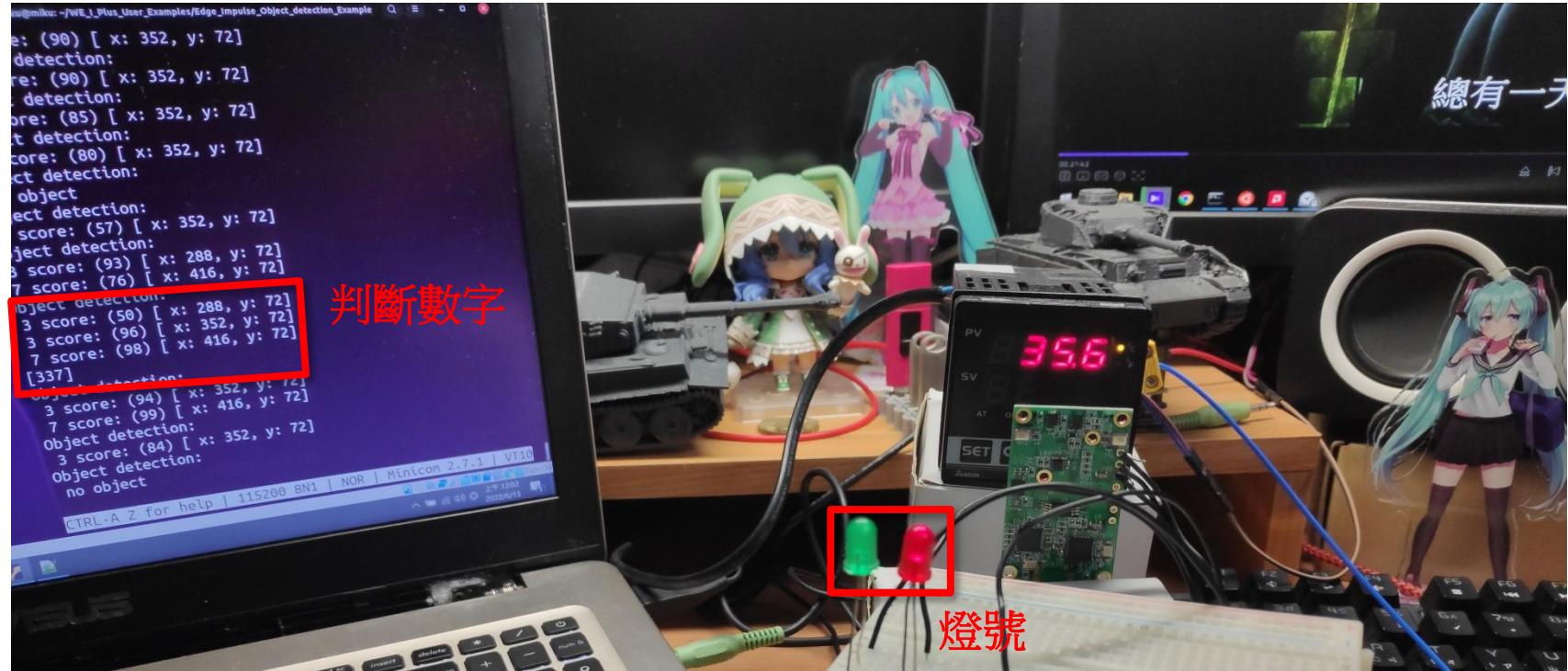


圖 2. 打印傳出部分

下位控制器可依照結果判斷使用

六、結果展示

Demo時間



Demo影片：

https://www.youtube.com/watch?v=11M_7ykM77M

程式位置：

<https://github.com/wildman8606/WE-I-Plus-Internet-of-Gauge/blob/main/main.cc>

講師聯絡：

<https://www.facebook.com/peter8606/>

電路圖

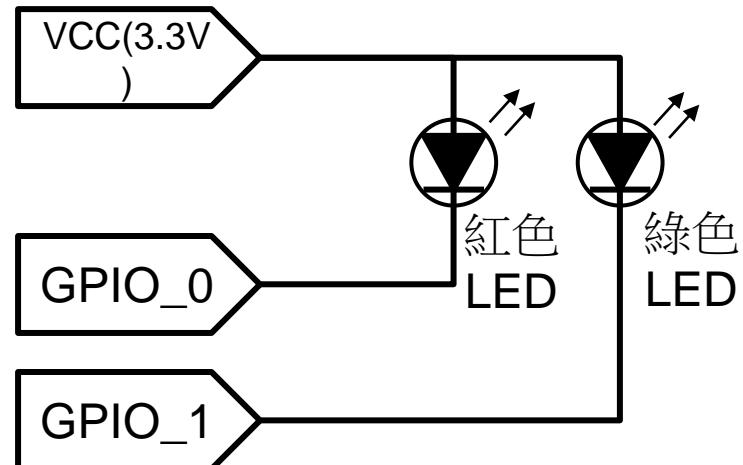


圖 2. 電路圖

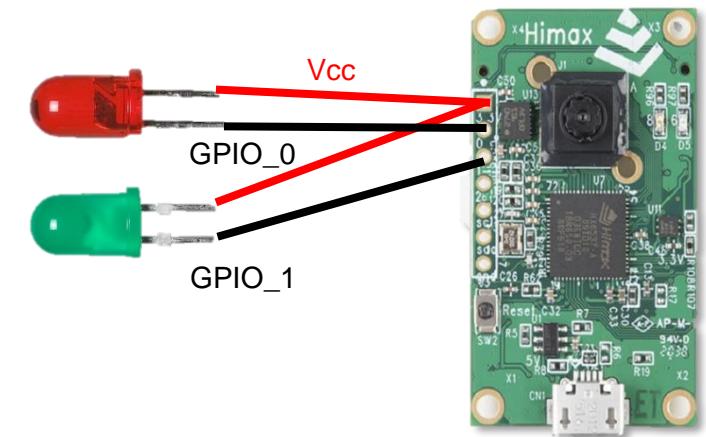


圖 3. 實體圖

補充資料

DSI2598+ 晶片介紹

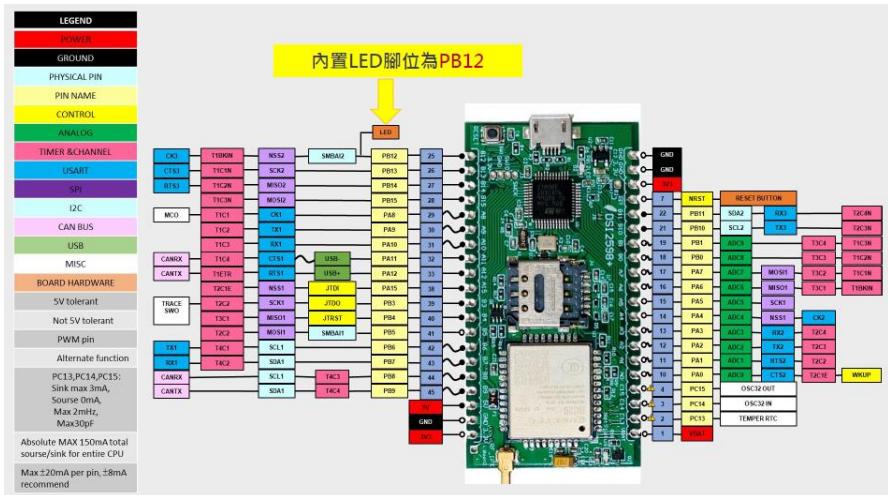


圖1、DSI 2598+ 晶片

1. STM32duino bootloader- USB燒錄
 2. Serial - FTDI工具
 3. STLink - STLink工具

尺寸	60mm x 30mm
特色	全台首款小型Arduino NB-IoT開發板
介紹	DSI2598+使用聯發科NB-IoT晶片-MT2625模組，搭配STM32 F103核心，有著PWM、I2C、SPI、ADC、UART等腳位功能，簡單但完整且有極佳運算能力，可讓使用者無縫接軌大部分Arduino程式庫，進行各項功能程式開發，尺寸僅6.0x3.0cm，是國內第一款小型NB-IoT開發板。
產品案例	<ul style="list-style-type: none">• O-Care 共享機車自動消毒劑• 發電機/空壓機/活氧機遠端監控裝置• 社區型快扣式淹水預警系統• 瓦斯鋼瓶液位偵測裝置• 農業大數據擷取平台• SimuGro水耕系統• 家禽健康監控儀器

廣告

IDEAS Hatch

<https://www.ideas-hatch.com/>

<https://www.facebook.com/iiiideashatch>

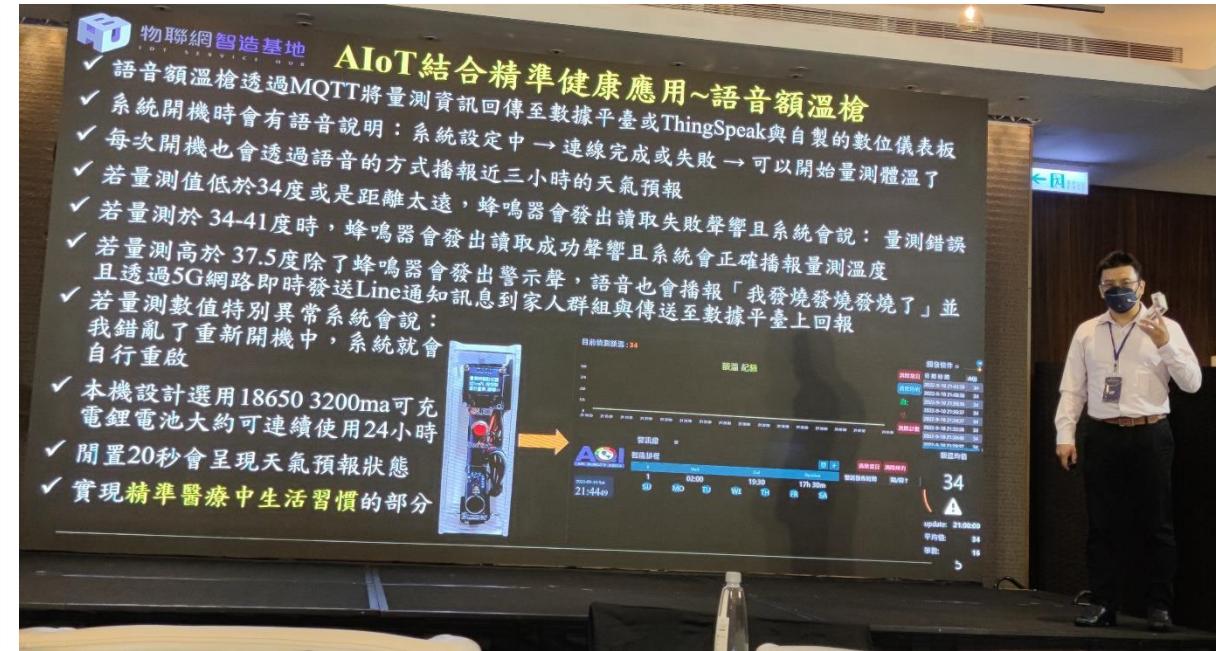
The screenshot shows the IDEAS Hatch website. At the top, there is a navigation bar with links: '關於黑趣' (About), '黑趣活動' (Events), '黑趣媒導' (Media), '黑趣市集' (Marketplace), and '物聯網智造基地' (Internet of Things Manufacturing Base). The main visual is a photograph of four small toy figures (three men and one woman) working on a large integrated circuit chip. One figure is using a red screwdriver, another is holding a red shovel-like tool, and the others are looking on. The background is a dark teal color. To the right of the image, the text 'ideas Hatch' and '智造創業加速器' (Manufacturing and Entrepreneurship Accelerator) is displayed.





15分鐘

應用案例

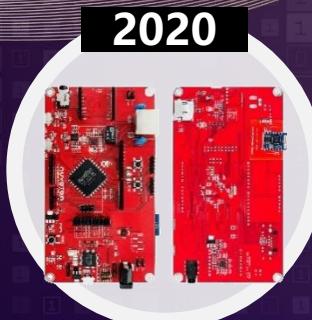


<https://iforum.ideaschain.com.tw/iforum/techmatch/list.do>

從無到有、持續累積 國產IC公板



DSI 5168



NuMaker-IoT-M487



WE-I PLUS



Filogic 130



HUB 5168+



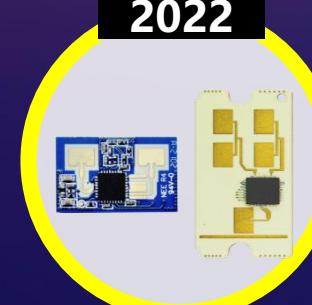
DSI 2598+



OPL1000 EVB



CoreMaker-01



PU02/PH12



HUB 8735

今日議程檔案

講師: 章育銘

網址:

Thank you

<https://github.com/wildman8606/coscup2023>

OR

<https://reurl.cc/dDo05M>

QA 時間

