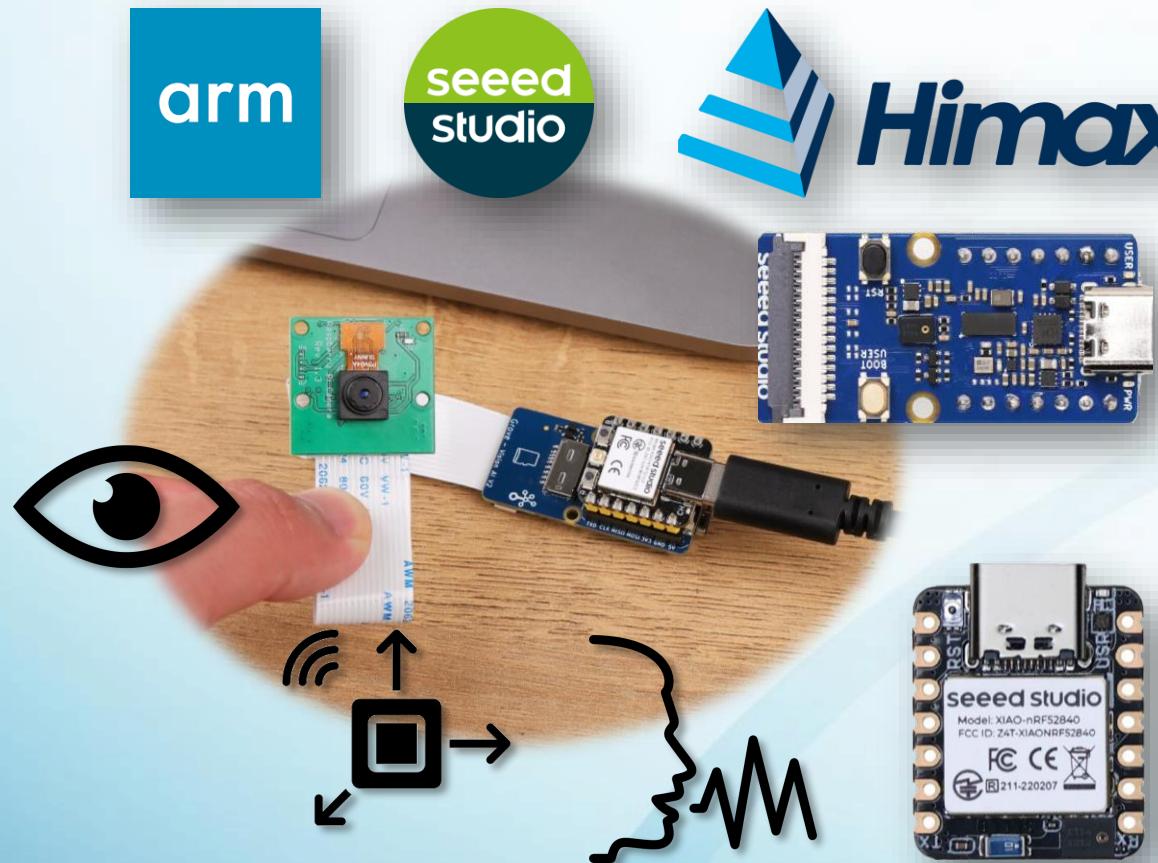


# OmniXRI TinyML 小學堂 2025



歡迎加入  
邊緣人俱樂部



沒有最邊



只有更邊

Cortex-M  
Processor

Ethos-U  
MicroNPU

## 【第 10 講】 影像應用—影像分類



歐尼克斯實境互動工作室 (OmniXRI Studio)  
許哲豪 (Jack Hsu)

# 簡報大綱



- 10.1. Seeed SenseCraft AI 開發環境建置
- 10.2. 影像資料集建置
- 10.3. 模型訓練與部署
- 10.4. 檢測結果輸出

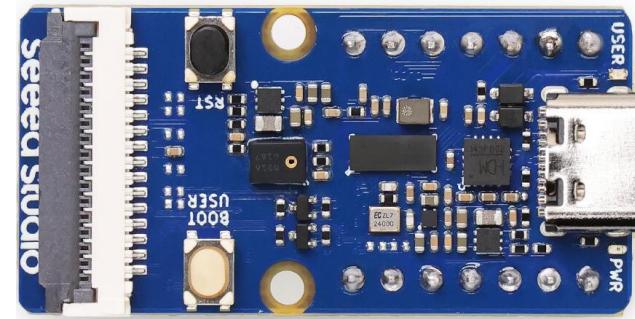
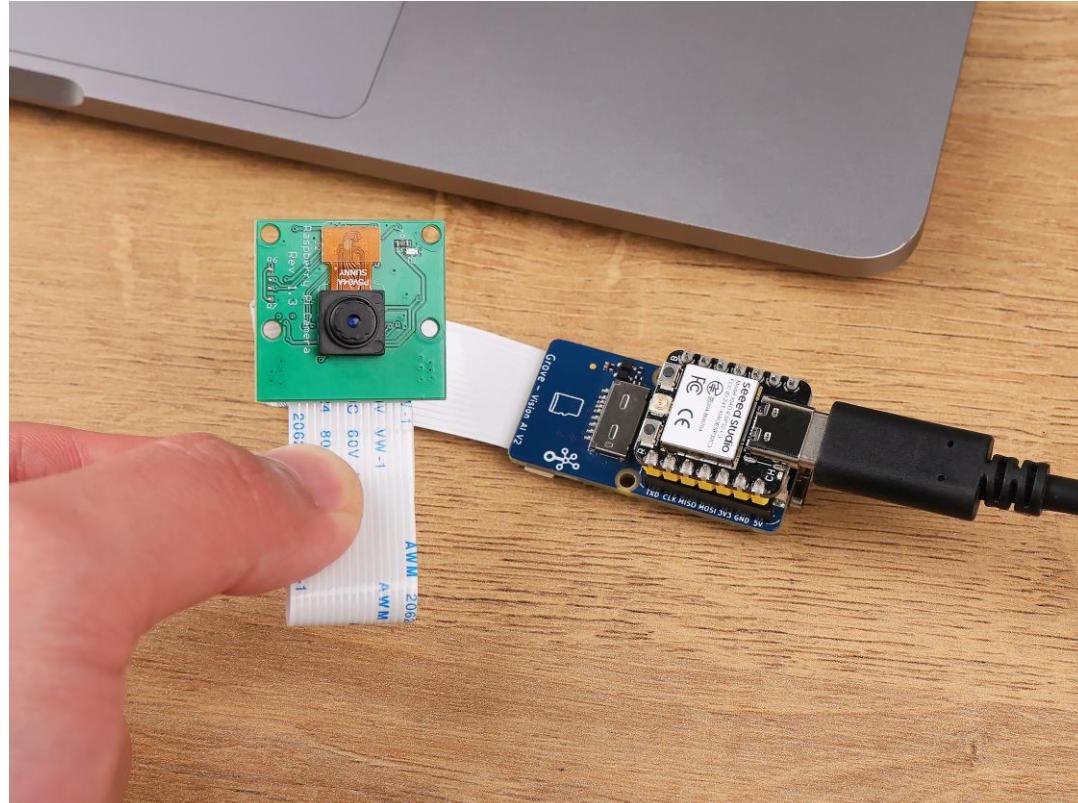
本課程完全免費，請勿移作商業用途！  
歡迎留言、訂閱、點讚、轉發，讓更多需要的朋友也能一起學習。

完整課程大綱：<https://omnixri.blogspot.com/2025/03/omnixri-tinyml-2025-0.html>  
課程直播清單：<https://www.youtube.com/@omnixri1784streams>

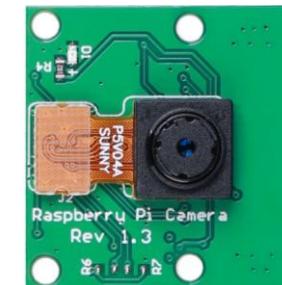


## 10.1. Seeed SenseCraft AI 開發環境建置

# Seeed Grove Vision AI V2 Kit



**Grove Vision AI  
Module V2  
(Himax WiseEye2  
HX6538)**



**OV5647-62  
Camera Module  
for Pi3B+4B  
(含軟排)**

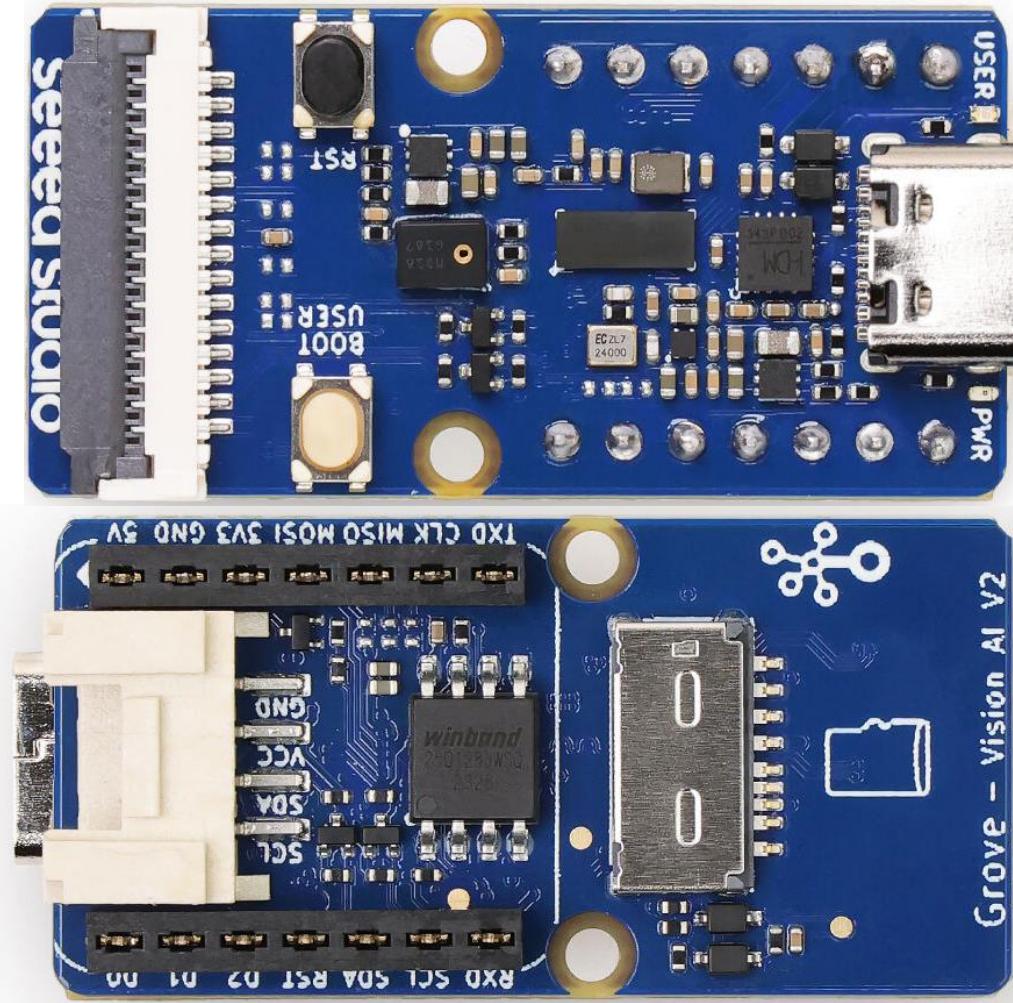
**2529 x 1944 (5MP)**

**Xiao ESP32C3  
(WIFI / BT5)  
(無線通訊用，選配)**



資料來源：[https://wiki.seeedstudio.com/grove\\_vision\\_ai\\_v2/](https://wiki.seeedstudio.com/grove_vision_ai_v2/)

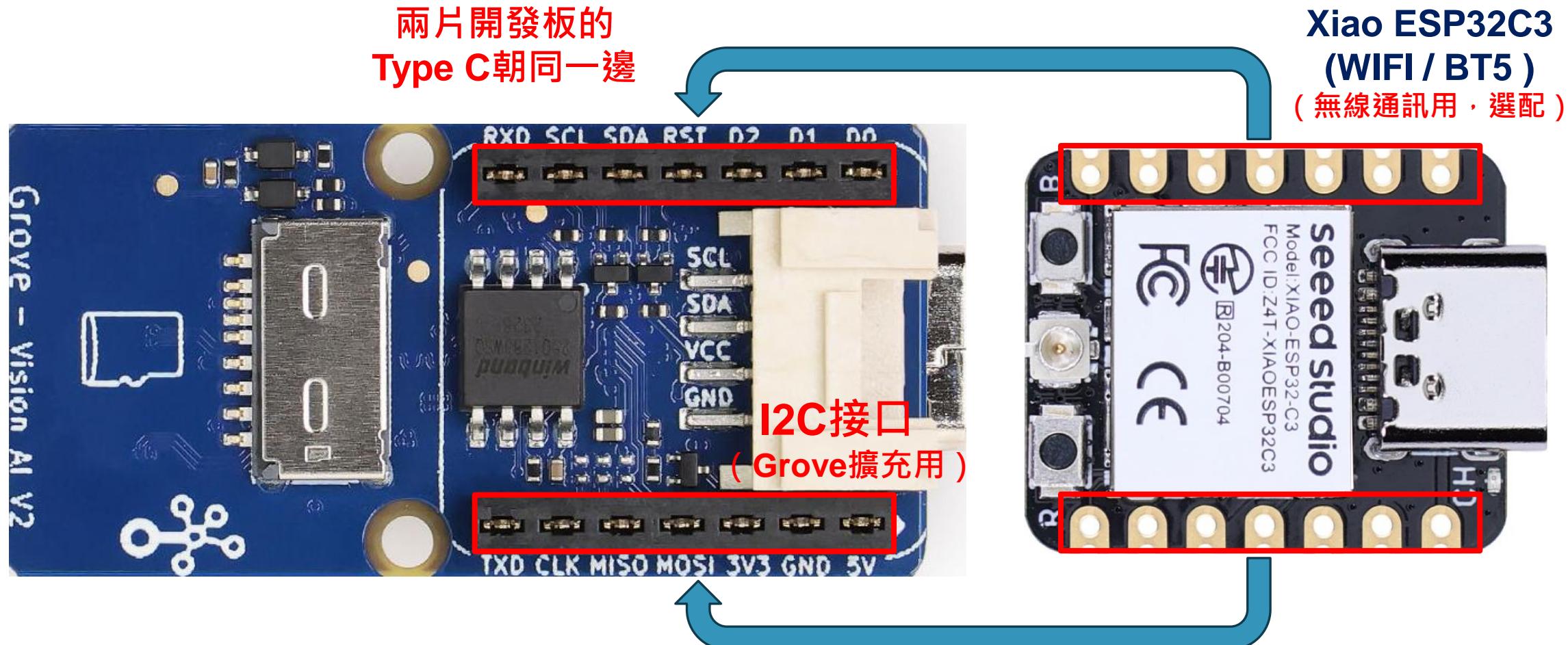
# Grove Vision AI Module V2 規格



資料來源：[https://wiki.seeedstudio.com/grove\\_vision\\_ai\\_v2/](https://wiki.seeedstudio.com/grove_vision_ai_v2/)

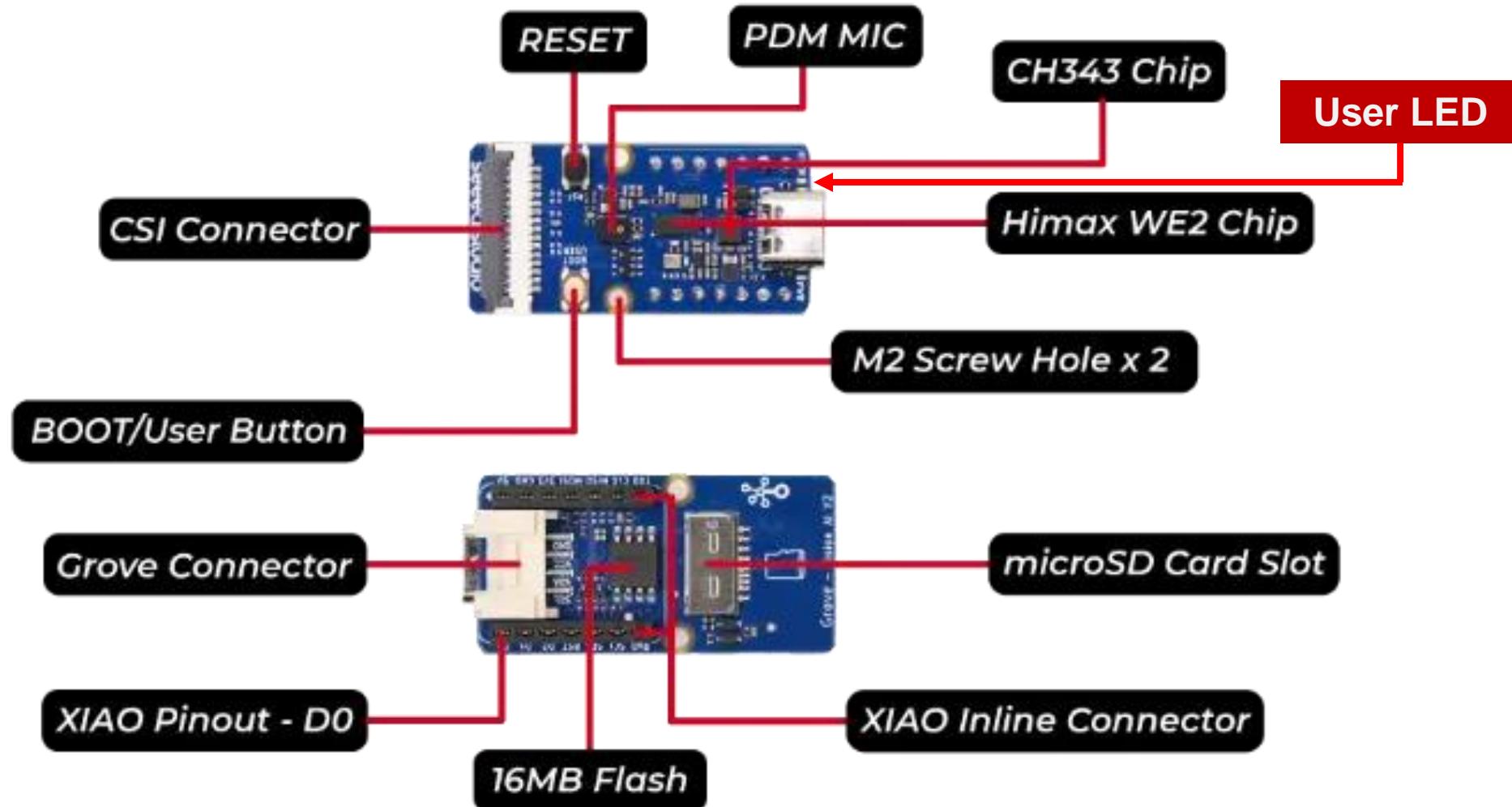
- **處理器**：Himax WiseEyes 2 HX6538
  - Arm Cortex-M55 (1x @400MHz, 1x @160MHz)
  - Arm Micro NPU Ethos-U55 (256MAC @400MHz)
  - 4K Boot ROM, 2432KB SRAM
- **GPIO**：User LED x1, CSI, IIC, UART, SPI, USB
- **尺寸**：13.6mm x 8.6mm
- **感測器**：PDM Micphone
- **外部記憶體**：miniSD Slot, 16MByte QSPI Flash
- **開發工具**：
  - Arduino, Seeed SenseCraft AI, Edge Impulse, GCC, arm Vela Compiler

# Grove Vision AI Module V2 接腳圖



資料來源：[https://wiki.seeedstudio.com/grove\\_vision\\_ai\\_v2/](https://wiki.seeedstudio.com/grove_vision_ai_v2/)

# Grove Vision AI Module V2 元件圖



資料來源：[https://wiki.seeedstudio.com/grove\\_vision\\_ai\\_v2/](https://wiki.seeedstudio.com/grove_vision_ai_v2/)

# Grove Vision AI Module V2 技術文件

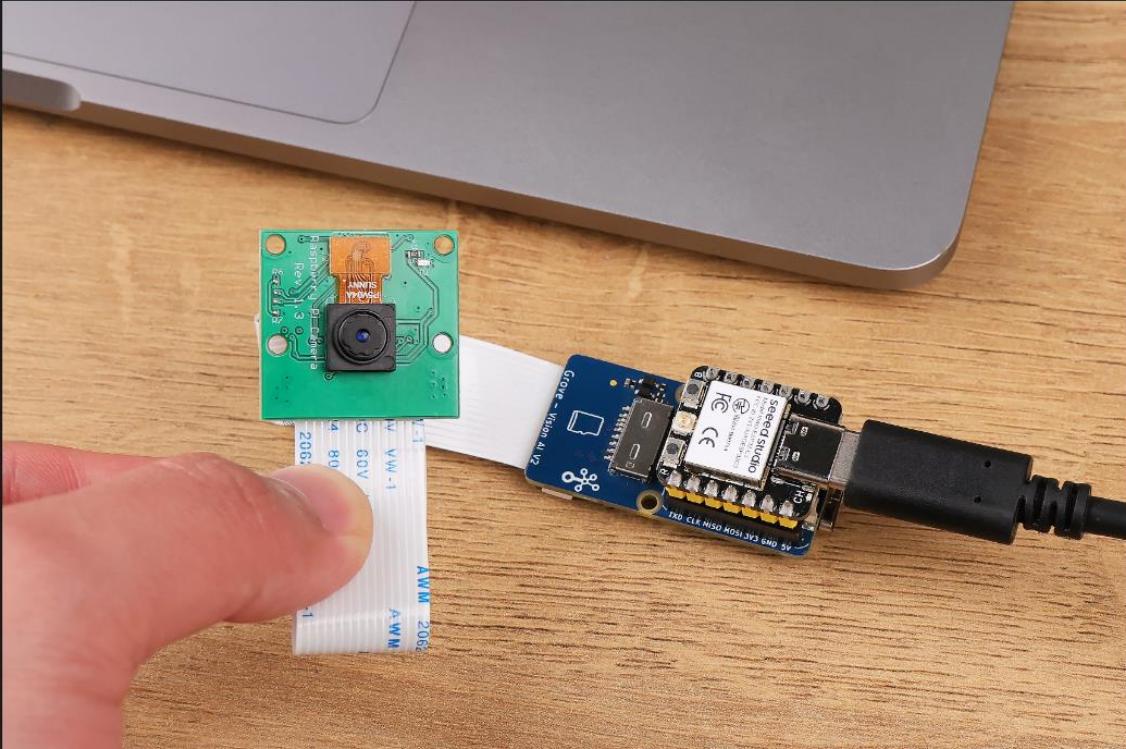
seeed studio Quick Links ▾ Explore with Topics ▾ FAQs ▾ Rangers ▾ Bazaar 🛍️ AI Bot 🤖 SenseCraft AI 🌱

Search CTRL K

Grove Sensor

- Multiple in one
- AI-powered
- Grove Vision AI
- Grove Vision AI V2**
- Software Support
- External Camera supported
- Deploying Models from Datasets to Grove Vision AI V2
- RS45 transmission of Vision AI V2 data
- Development
- Application
- Grove Smart IR Gesture Sensor (PAJ7660)

**Grove Vision AI Module V2**



Introduction

Features

Application

Hardware Overview

Connecting to a CSI interface camera

Boot / Reset / Flashed Driver

- Boot
- Reset
- Driver
- Bootloader Recovery
- Tool Manual
- Prerequisites
- Software Installation
- Hardware Connection
- Usage

Getting Started

[https://wiki.seeedstudio.com/grove\\_vision\\_ai\\_v2/](https://wiki.seeedstudio.com/grove_vision_ai_v2/)

# Xiao ESP32-C3 技術文件

seeed studio Quick Links ▾ Explore with Topics ▾ FAQs ▾ Rangers ▾ Bazaar 🛍 AI Bot 🤖 SenseCraft AI 🌱 🔍 Search CTRL K

XIAO RA4M1 >  
XIAO MG24 >  
XIAO RP2040 >  
XIAO RP2350 >  
XIAO nRF52840 Series >  
XIAO ESP32C3 >  
Getting Started with Seeed Studio XIAO ESP32C3  
Pin Multiplexing  
XIAO ESP32C3 With NuttX(RTOS)  
XIAO ESP32C3 with Zephyr(RTOS)  
Wireless Connection >  
Programming Language >  
Application >

## Getting Started with Seeed Studio XIAO ESP32C3

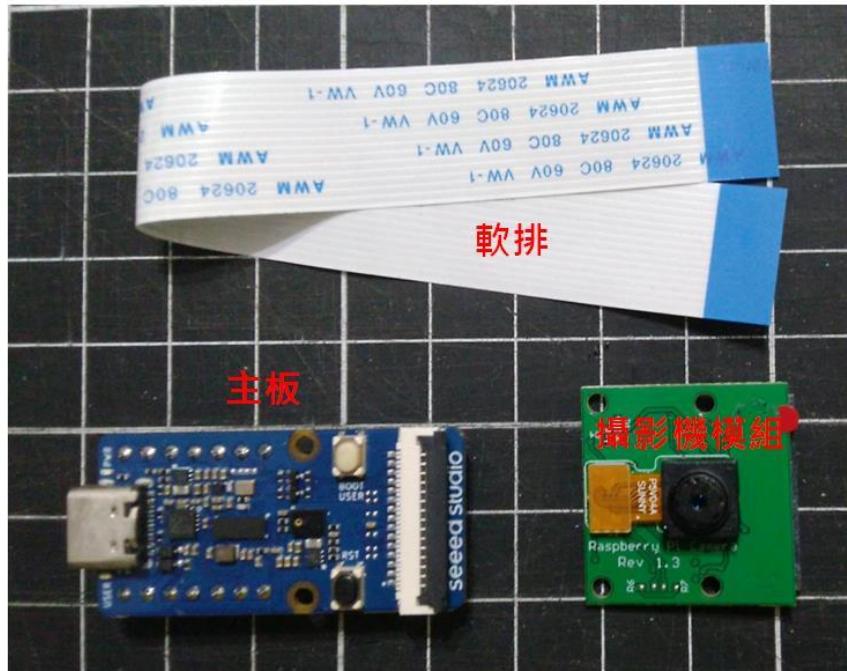


Introduction  
Specifications  
Features  
Hardware overview  
Power Pins  
Strapping Pins  
Getting started  
Hardware Preparation  
Software Preparation  
Run your first Blink program  
Battery Usage  
Check the battery voltage  
Deep sleep mode and wake-up  
Troubleshooting  
Q1: My Arduino IDE is

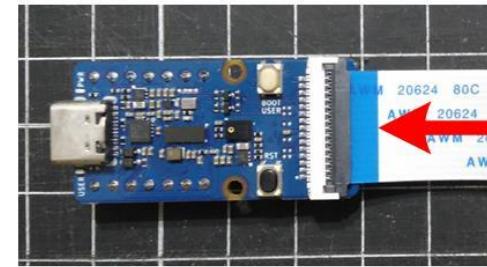
[https://wiki.seeedstudio.com/XIAO\\_ESP32C3\\_Getting\\_Started/](https://wiki.seeedstudio.com/XIAO_ESP32C3_Getting_Started/)

# 開發板組裝 – 連接攝影機

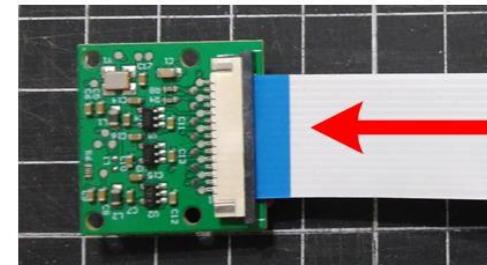
Seeed Grove Vision AI Module V2 & Camera



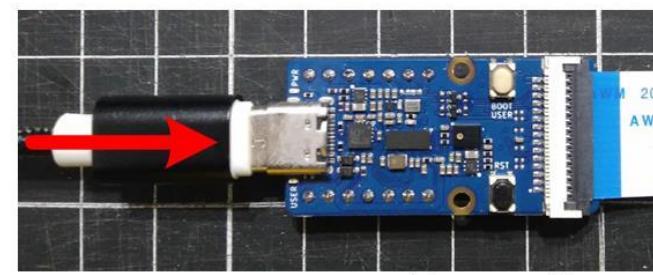
註：插入軟排時請注意正反面



1. 軟排插入  
主板



2. 軟排插入  
攝影機模組

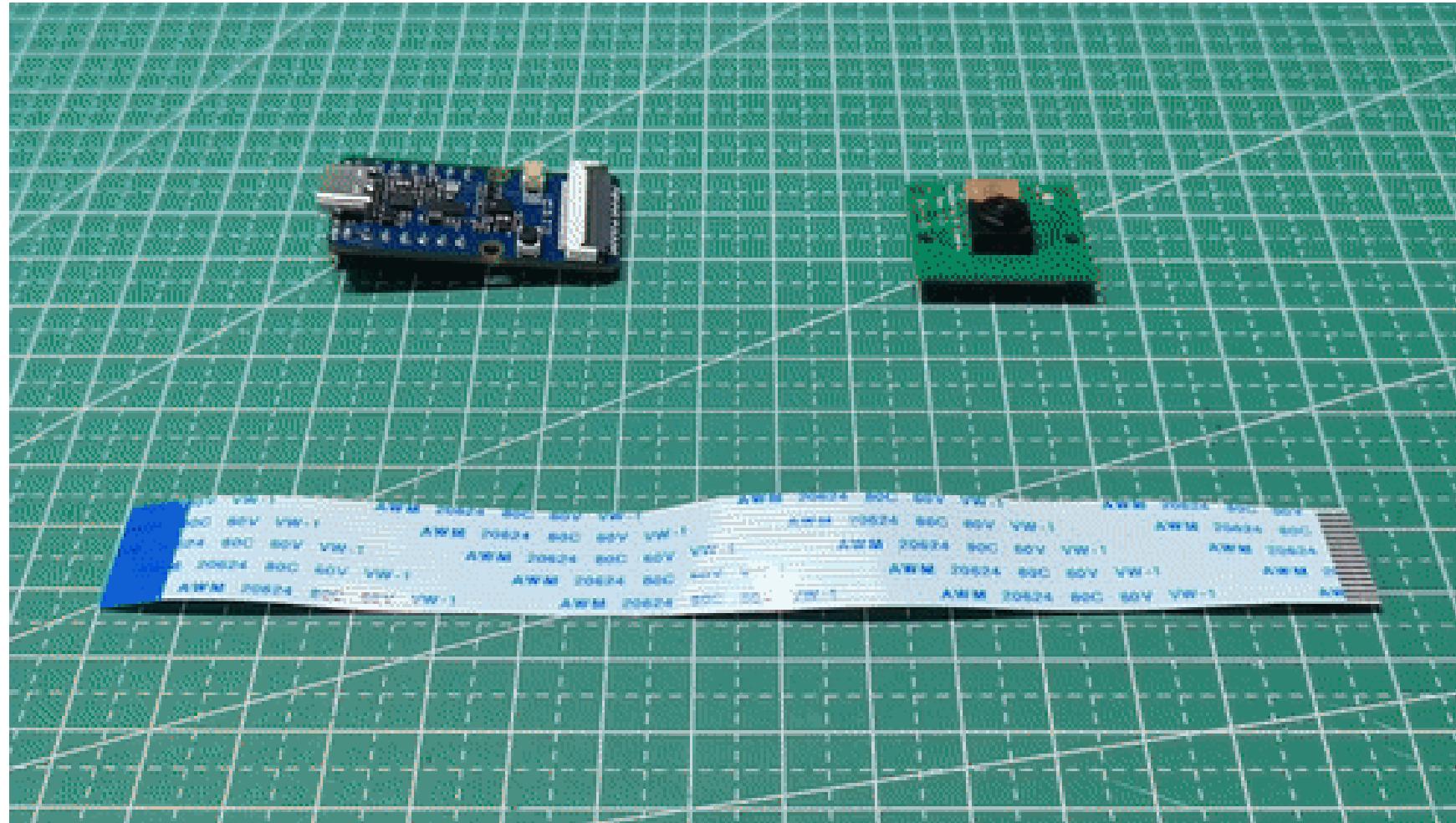


3. USB插入  
主板

OmniXRI 整理製作, 2024/07/15

資料來源：<https://omnixri.blogspot.com/2024/07/vmaker-edge-ai-19-mcunpu.html>

# 開發板組裝 – 連接攝影機（動畫）



注意板端連接器  
很脆弱要小力操作

AI模組板端  
翻蓋插入後再蓋回

攝影機模組端  
拉出插入後再壓入

注意軟排正反面

裸板操作手濕勿碰

請勿接觸到金屬  
以免造成電路短路

資料來源：[https://wiki.seeedstudio.com/grove\\_vision\\_ai\\_v2/](https://wiki.seeedstudio.com/grove_vision_ai_v2/)

# 安裝驅動程式 (USB – COM)

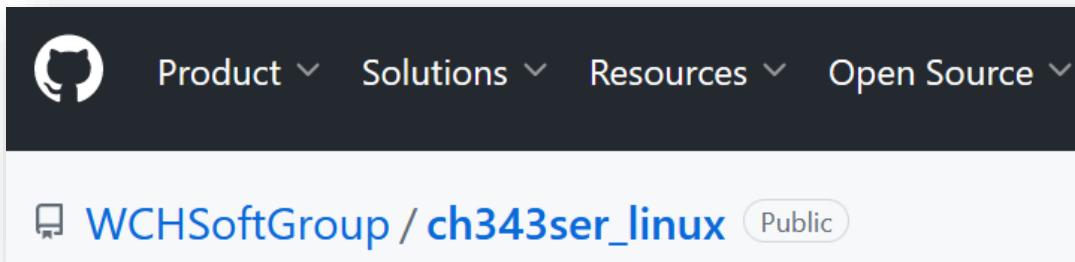
## Driver

If you find that the Grove Vision AI V2 is not recognised after connecting it to your computer. Then you may need to install the CH343 driver on your computer. Here are some links to download and install the CH343 driver.

- Windows Vendor VCP Driver One-Click Installer: [CH343SER.EXE](#)
- Windows Vendor VCP Driver: [CH343SER.ZIP](#)
- Windows CDC driver one-click installer: [CH343CDC.EXE](#)
- Windows CDC driver: [CH343CDC.ZIP](#)
- macOS Vendor VCP Driver: [CH34xSER\\_MAC.ZIP](#)



**Windows 環境** [https://wiki.seeedstudio.com/grove\\_vision\\_ai\\_v2/](https://wiki.seeedstudio.com/grove_vision_ai_v2/)

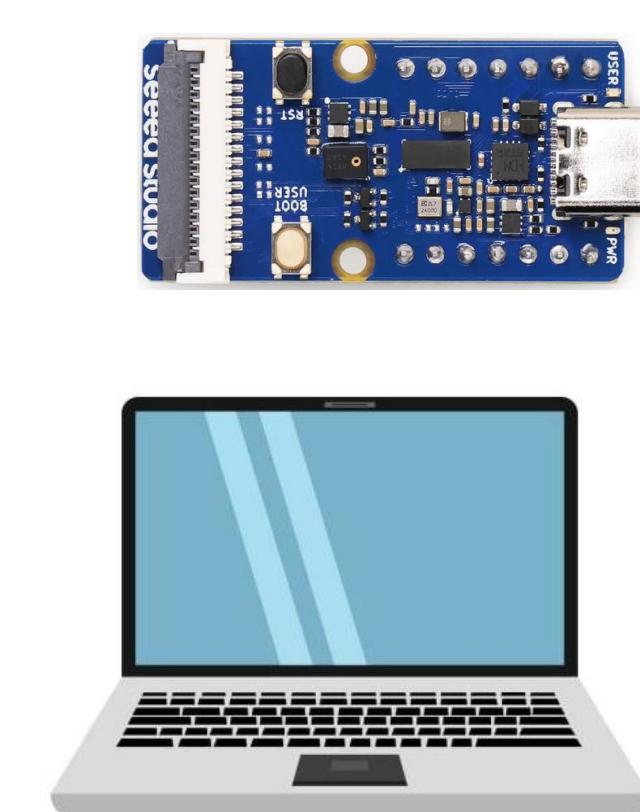
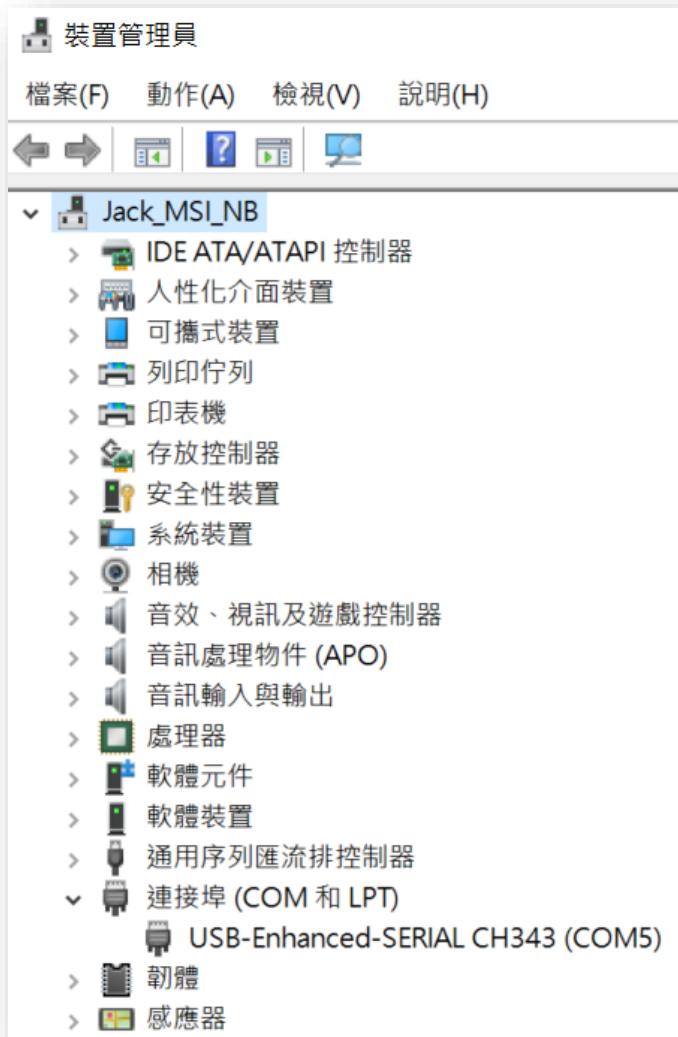


The screenshot shows the Seeed Studio website header with navigation links: Product, Solutions, Resources, and Open Source. Below the header, there is a GitHub repository card for "WCHSoftGroup / ch343ser\_linux" with the status "Public".

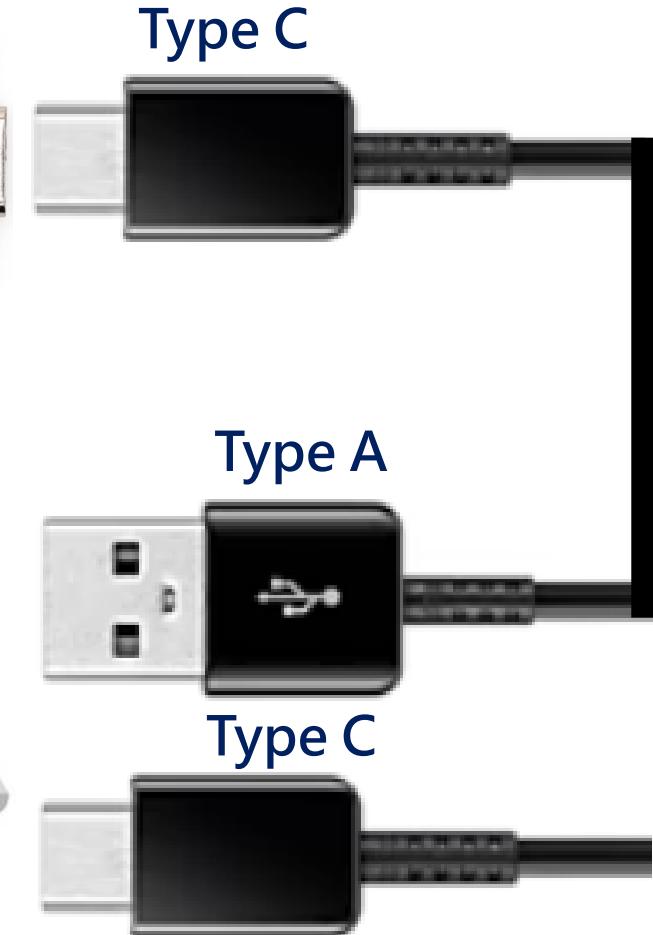
**Ubuntu (Linux) 環境**

[https://github.com/WCHSoftGroup/ch343ser\\_linux](https://github.com/WCHSoftGroup/ch343ser_linux)

# 開發板組裝 – 連接USB



COM 埠號會變  
請依自己電腦上埠號為準



# Seeed SenseCraft AI 功能概述



The screenshot displays the SenseCraft AI platform interface. It includes:

- Top Navigation Bar:** Includes links for Home, Pre-trained Models, Model Training, Visual Workspace, and About SenseCraft AI.
- Left Sidebar:** Shows a green banner with "三步构建视觉AI传感器" (Three steps to build a visual AI sensor). Below it are sections for "排序方式" (Sorting), "模型任务" (Model Tasks), and a preview of a "面条检测" (Noodle Detection) model.
- Central Content Area:**
  - Pre-trained Models:** Shows a search bar and a list of 401 models.
  - Model Training:** A detailed step-by-step guide for creating a classification model, including sections for "训练类型" (Training Type), "生成AI分类识别模型" (Create an AI classification model), "第一步: 分类数" (Step 1: Number of classes), "模型" (Model), "设备" (Device), "WIFI & MQTT" (WIFI & MQTT), and "设备日志" (Device Log).

<https://sensecraft.seeed.cc/ai/>

模型任務：目標檢測、分類檢測、圖像分割、姿態檢測、生成式模型

支持設備：reComputer Jetson (Orin), XIAO ESP32S3 Sense,  
**Grove Vision AI V2**, SenseCAP Watcher, SenseCAP A1102, reCamera

建議使用 Chrome 或 Edge  
 瀏覽器，不要開啟隱私模式

# Seeed SenseCraft AI — 註冊與登錄

## 已註冊登錄

**登錄**

\* 邮件  
请输入邮箱  
请输入正确的邮箱地址

\* 密码  
请输入密码

忘记密码?

**登录 3**

**注册**

2   我已阅读并同意 [隐私政策](#)

1 

## 進行註冊

**注册**

从電郵中取得驗證碼並輸入 

1 

\* 用户名  
请输入用户名

\* 邮件  
请输入邮箱

\* 验证码  
从电邮中取得验证码并输入

\* 密码  
请输入密码

\* 确认密码  
确认密码

\* 职业  
请选择您的职业

工作地点  
请输入您的工作地点

国家  
请选择国家

区域  
区域

详细地址  
详细地址

官网地址  
官网地址

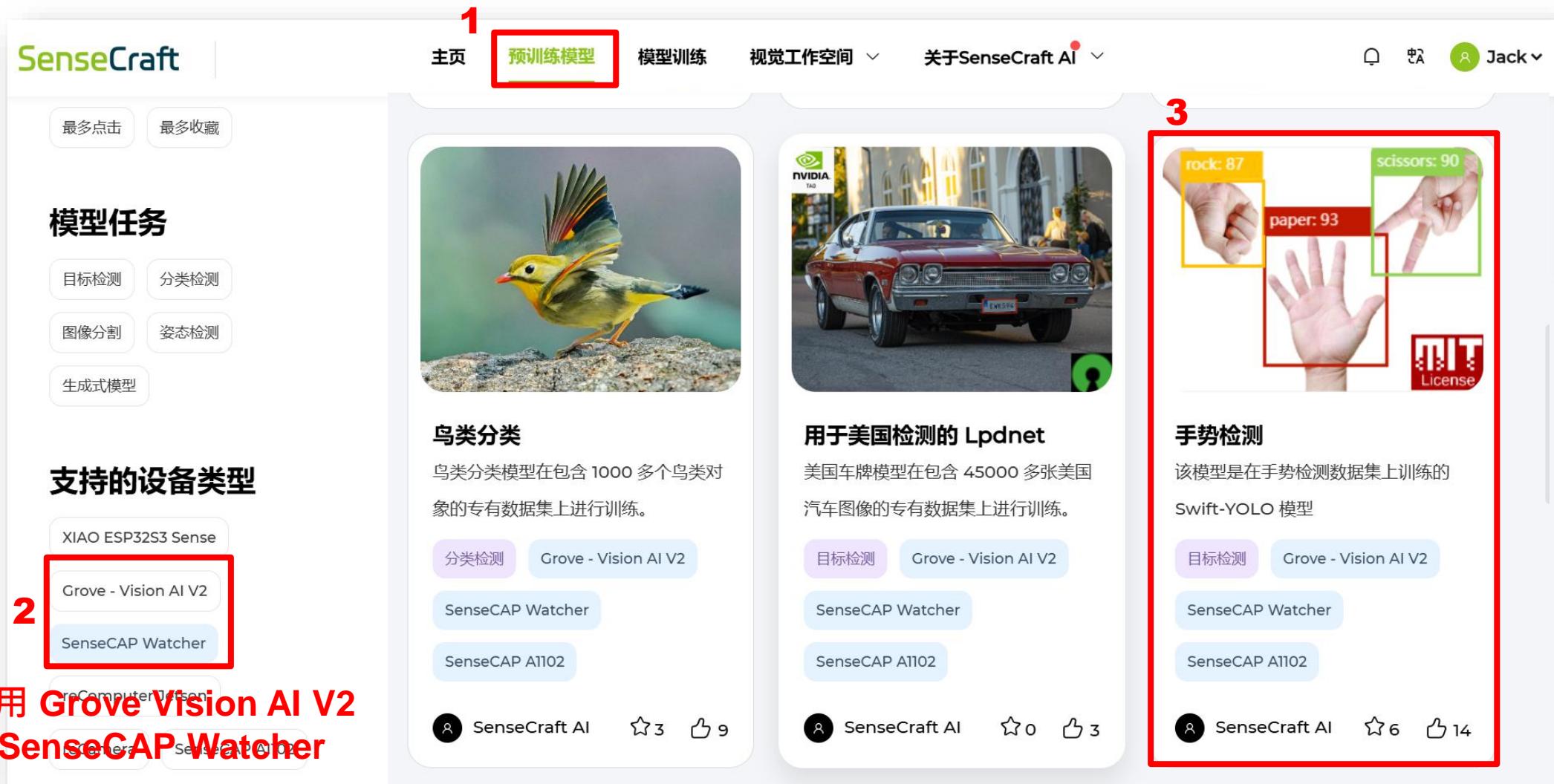
手机号  
请输入正确的手机号 0/11

**注册 3**

2   我已阅读并同意 [隐私政策](#)

\* 隐私政策

# Seeed SenseCraft AI – 預訓練模型

**1**  


SenseCraft

主页 预训练模型 模型训练 视觉工作空间 关于SenseCraft AI Jack

最多点击 最多收藏

**模型任务**

- 目标检测 分类检测
- 图像分割 姿态检测
- 生成式模型

**支持的设备类型**

- XIAO ESP32S3 Sense
- Grove - Vision AI V2**
- SenseCAP Watcher

**可選用 Grove Vision AI V2 或 SenseCAP Watcher**

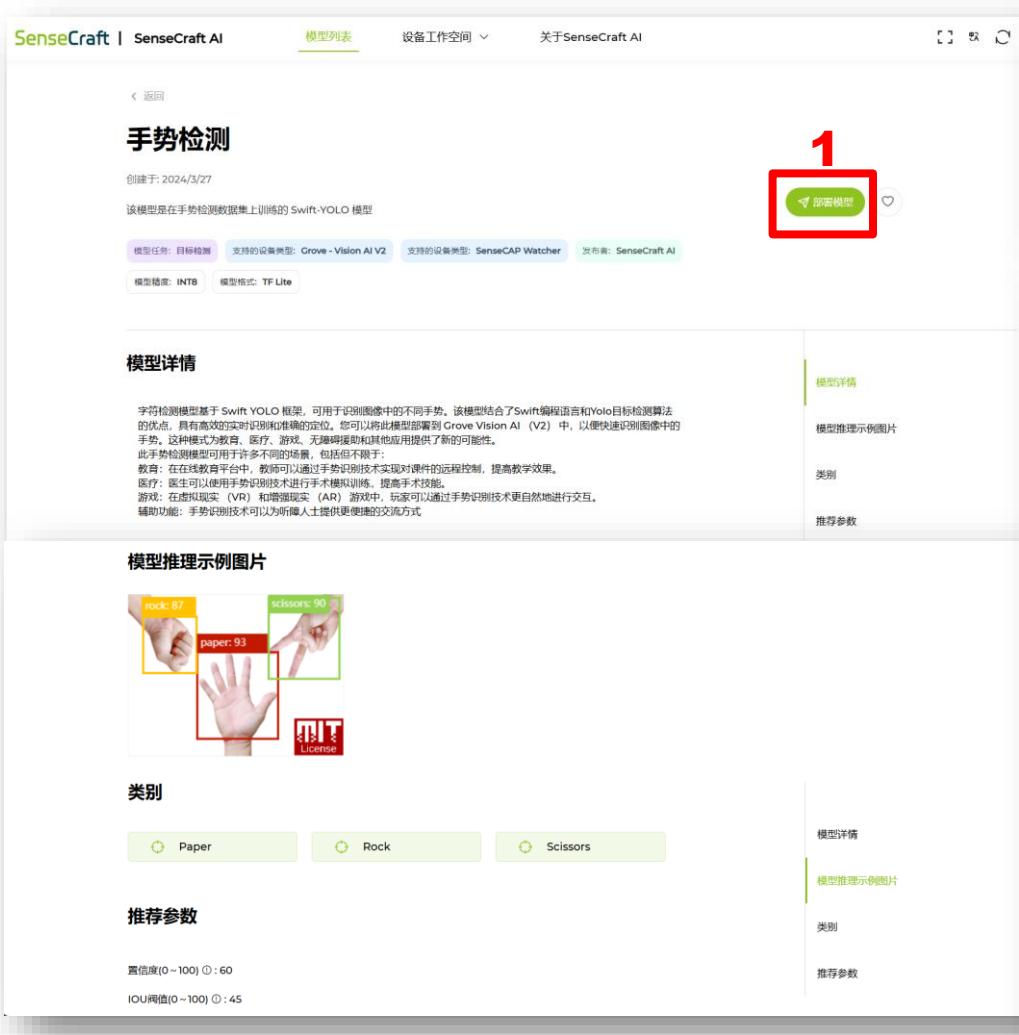


**1** 预训练模型

**2** Grove - Vision AI V2

**3** 手势检测

# Seeed SenseCraft AI – 部署模型



**1**

## 支持的设备类型

该模型可以部署在以下设备上，若您没有此类型的设备，可以点击下面的链接购买

Grove - Vision AI V2 | SenseCAP Watcher

## 连接设备

1. 连接 Grove - Vision AI V2 通过 CSI 连接线连接到摄像机
2. 通过USB将 Grove - Vision AI V2 连接到电脑
3. 选择USB Single/serial 调试器进行连接

**2**

**3**

确认要部署这个模型吗？

模型名称: 手势检测  
Model ID: 60111

**取消** **确认**

**4**

sensecraft.seeed.cc 想要連線到序列埠

USB Single Serial (COM5) - 已配對

**5**

連線 取消

已燒錄20.00%

**6**

**7**

**燒錄至100%後  
自動重啟**

**建議燒錄及測試時不要插  
ESP32-C3以免容易失敗。**

# Seeed SenseCraft AI — 執行推論



The screenshot shows the SenseCraft AI web interface. On the left, there's a sidebar with tabs for '设备信息' (Device Information), '网络配置' (Network Configuration), '数据输出' (Data Output), and '训练模型' (Train Model). The main area has tabs for '模型' (Model), '设备' (Device), and '设备日志' (Device Log). The '设备' tab is active, displaying device basic information: Device ID (330e0c07), Device Name (Grove Vision AI (V2)), Device Version (2024.06.27), IP Address (-), and Service Status (MQTT未初始化或未连接). Below this is a '设备日志' section showing a JSON log of inference results:

```

boxes: [[113,157,168,150,86,1]]
perf: {"preprocess": 7, "inference": 80, "postprocess": 0}
boxes: [[113,157,168,150,83,1]]
perf: {"preprocess": 7, "inference": 79, "postprocess": 1}
boxes: [[113,157,168,150,81,1]]
perf: {"preprocess": 7, "inference": 80, "postprocess": 0}
boxes: [[113,157,168,150,83,1]]
perf: {"preprocess": 7, "inference": 79, "postprocess": 1}
boxes: [[113,157,168,150,81,1]]
perf: {"preprocess": 7, "inference": 80, "postprocess": 0}
boxes: [[116,157,168,150,83,1]]
perf: {"preprocess": 7, "inference": 80, "postprocess": 0}
boxes: [[116,157,168,150,81,1]]
perf: {"preprocess": 7, "inference": 80, "postprocess": 0}
boxes: [[116,157,168,150,81,1]]
perf: {"preprocess": 7, "inference": 80, "postprocess": 0}
boxes: [[116,157,168,150,81,1]]
perf: {"preprocess": 7, "inference": 80, "postprocess": 0}
boxes: [[116,157,168,150,81,1]]
perf: {"preprocess": 7, "inference": 79, "postprocess": 1}
boxes: [[116,157,168,150,81,1]]
perf: {"preprocess": 7, "inference": 80, "postprocess": 0}
boxes: [[116,157,168,150,81,1]]

```

The '预览' (Preview) section shows a live video feed of a hand making a 'Rock' gesture. The gesture is labeled 'Rock: 81' with a green bounding box.

**測試時不要插ESP32-C3以免容易失敗。**

## 輸出結果 ( 設備日志 ) :

- **Preprocess** 前處理時間
- **Inference** 推論時間
- **Postprocess** 後處理時間
- **Box 物件框**
  - 左上 x,y 、右下 x,y 、
  - 置信度、物件編號
- 置信度高時較不易檢出
- 重疊區(IOU)高時  
容易誤判為多個物件

## 设置

置信度(0 ~ 100) ①



IOU阈值(0 ~ 100) ②



# Seeed SenseCraft AI — 數據輸出

SenseCraft | SenseCraft AI 模型列表 雷達圖 單元檢視 索引 關於 SenseCraft AI Jack\_OmniXRI

Grove Vision AI(V2) 斷開連接

設備信息 網絡配置 數據輸出 **訓練模型**

**條件**

對象	條件	置信度	操作
			<b>1</b> <input type="checkbox"/> 滿足事件條件時觸發操作

**只能設定一組條件**

**觸發操作** **3**

<input type="checkbox"/> ● 啓動LED燈
<input type="checkbox"/> ■ 保存圖片到SD卡

**刪除** **發送**

**觸發操作**

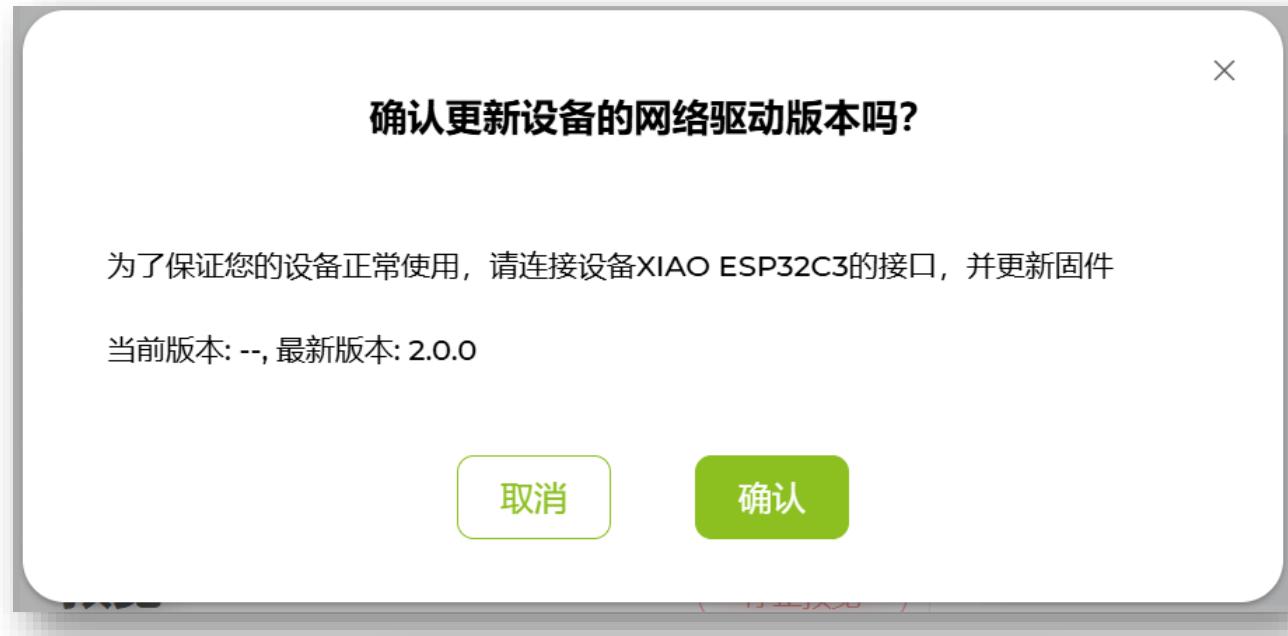
對象	條件	置信度
Paper	大於	<input type="range"/> 50

**2** **取消** **確認**

**如果設備檢測到Paper 並且置信度為大於50, 則點亮設備的黃色LED燈**

**如果設備檢測到Paper 並且置信度為大於50, 然後將圖片保存到SD卡**

# 燒錄故障排除 – ESP32C3



有時按連接(Connect) Grove Vision AI V2 時會遇到左側訊息，此時請依下列順序動作。

1. 將 Xiao ESP32C3 開發板插到 Grove Vision AI V2 開發板上 (注意 Type C 在同一側)
2. 將 Type C 插頭拔起來插到 Xiao ESP32C3 開發板
3. 按下左側訊息欄中確認鍵，開始燒錄刷新韌體
4. 完成後將 Type C 插頭拔起來重新插回插到 Grove Vision AI V2 再按下【連接】鍵即可
5. 若再出現剛才訊息，不用插拔 Type C 直接按確認即可開始燒錄

# Seeed SenseCraft Web Toolkit

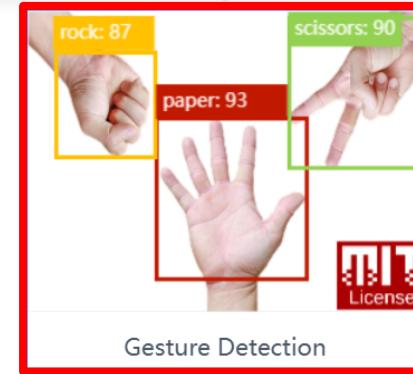
We apologize th  
<https://sensecraft.ai>

	Name	Gesture Detection
SenseCraft	Algorithm	Swift-YOLO power by SSCMA
	Category	Object Detection
	Model Type	TFLite
	License	MIT
	Version	1.0.0
	Description	The model is a Swift-YOLO model trained on the gesture detection dataset.
	Metrics	mAP(%) : 93

Process

- Configuration
- Output
- Tool

- 人員偵測
- 全身姿態偵測
- 手指姿態偵測
- 手勢偵測
- 人臉、性別偵測
- 寵物、口罩偵測
- 數字讀錶...



4

uld like to explore more models, please visit our website at <https://sensecraft.ai>

?

Grove Vision AI(V2)

Connect

Send

Confidence ②

50

1. 將USB Type C纜線插入開發板
2. 選擇開發板 Grove Vison AI (V2)
3. 按Connect連接開發板選擇COM埠
4. 點選AI模型按Send上傳模型到開發板

Preview

Invoke

(建議上傳時先將 ESP32C3 移除，待完成燒錄後再插回)

和 Seeed SenseCraft AI 官網類似，不需使用帳號登入。若遇到從官網無法順利燒錄時可改用此網頁版工具。

<https://seeed-studio.github.io/SenseCraft-Web-Toolkit/#/setup/process>



## 10.2. 影像資料集建置

# 資料集建置 - 分類識別 - 數據採集



# 資料集建置 – 分類識別 – 資料多樣態



攝影機取像品質（解析度、模糊度、自動白平衡等），資料集要接近實際取像。

- 多視角（平移、旋轉）
- 不同尺寸縮放
- 不同背景、亮度、對比
- 不同外形、色彩
- 局部遮蔽



## 10.3. 模型訓練與部署

# 資料集建置 – 分類識別 – 模型訓練部署



**1 開始訓練**

可使用預設值或自行調

預設會以 **MobileNet V2** 進行訓練

**2 產出模型檔及顯示辨識結果**

完成訓練後自動產生已經過 **Vela Compiler (NPU)** 處理過的 **TFLite** 格式

**3 保存到SenseCraft**

可選擇儲存設定到雲端平台

# 建立自定義模型 – 第一步基礎信息

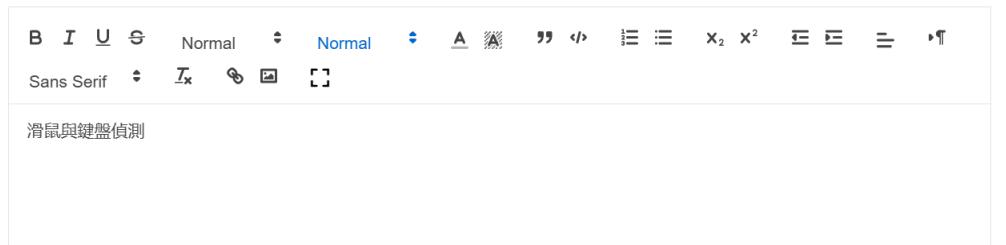
**添加模型**

1 基础信息      2 模型

\* 模型名称  
mouse\_keyboard\_detector

\* 模型简介  
滑鼠與鍵盤偵測

7/300

\* 模型详情  


滑鼠與鍵盤偵測

模型部署准备

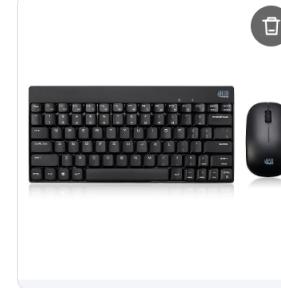
模型部署准备 +



**Grove– Vision AI V2, SenseCAP Watcher, SenseCAP A1102, 都是使用Himax WE2 模型可共用**

\* 模型推理示例图片(图片大小不能超过2MB)

上传图片



下一步

# 建立自定義模型 – 第二步模型

**1**

基础信息

\* 模型格式  
TF Lite

\* 模型任务  
模型任务

\* AI框架  
AI框架

**目標檢測、分類檢測、圖像分割、姿態檢測、生成式模型**

**YOLOV5, YOLOV8, FOMO, MobileNetV2, PFLD, Swift-YOLO(Power by SSCMA)**

\* 类别

0	Mouse	
1	Keyboard	-

+

**輸入类别編號及  
標籤名稱**

**2**

\* 模型文件(扩展名为.tflite的文件大小不超过100MB)

白上传文件

295.73 KB

自動帶入模型名稱亦可自行上傳

\* 模型版本  
1.0.0

\* 模型精度  
**INT8** FLOAT 16 FLOAT 32

置信度(0 ~ 100) (推荐值)  
给定預設置信度及重疊區閾值  
40

IOU閾值(0 ~ 100) (推荐值)  
50

返回 确认

申请发布模型到公共模型库

**勾選後可分享到公用模型區**

# 部署並執行自定義模型

1. 選擇開發板並連接



2. 選擇 COM 埠並確認



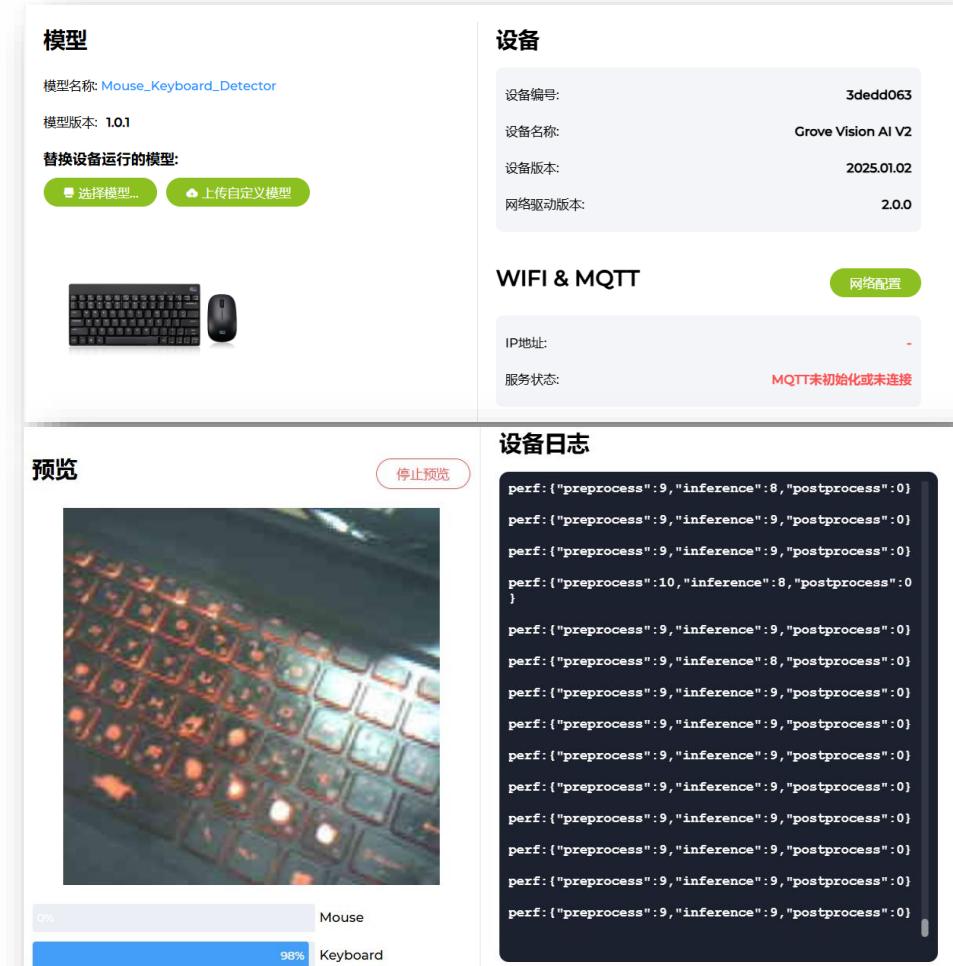
4. 確認上傳到開發板

确认要部署这个模型吗?  
(Mouse\_Keyboard\_Detector)

取消

确认

顯示分類結果並輸出字串



# 進階補充 – 更多自定義模型訓練方式

**seeed studio** Getting Started ▾ Technology ▾ FAQs ▾ Rangers ▾ Bazaar 🎁 AI Bot 🤖 SenseCraft AI 🗺

- Home Assistant >
- TinyML > **Object Detection**
- TinyML Workshop >
- ModelAssistant >
- Introduction >
- SenseCraft AI Model Assistant Overview
- Quick Start**
- Installation
- Tutorials >
- Config
- Datasets
- Training >
- Export >
- Development >

Model	Colab
Gender_Detection_Swift-YOLO_192	Open in Colab
Digital_Meter_Water_Swift-YOLO_192	Open in Colab
Apple_Detection_Swift-YOLO_192	Open in Colab
person_Detection_Swift-YOLO_192	Open in Colab
Face_Detection_Swift-YOLO_96	Open in Colab
COCO_Detection_Swift-YOLO_320	Open in Colab
Gesture_Detection_Swift-YOLO_192	Open in Colab
Digital_Meter_Electricity_Swift-YOLO_192	Open in Colab

← 物件偵測 影像分類 ↓

Image Classification	
Model	Colab
MNIST_Classification_MobileNetV2_0.5_Rep_32	Open in Colab
Gender_Classification_MobileNetV2_0.35_Rep_64	Open in Colab
Person_Classification_MobileNetV2_0.35_Rep_64	Open in Colab
Person_Classification_MobileNetV2_0.35_Rep_96	Open in Colab
Person_Classification_MobileNetV2_0.35_Rep_32	Open in Colab
CIFAR-10_Classification_MobileNetV2_0.35_Rep_32	Open in Colab

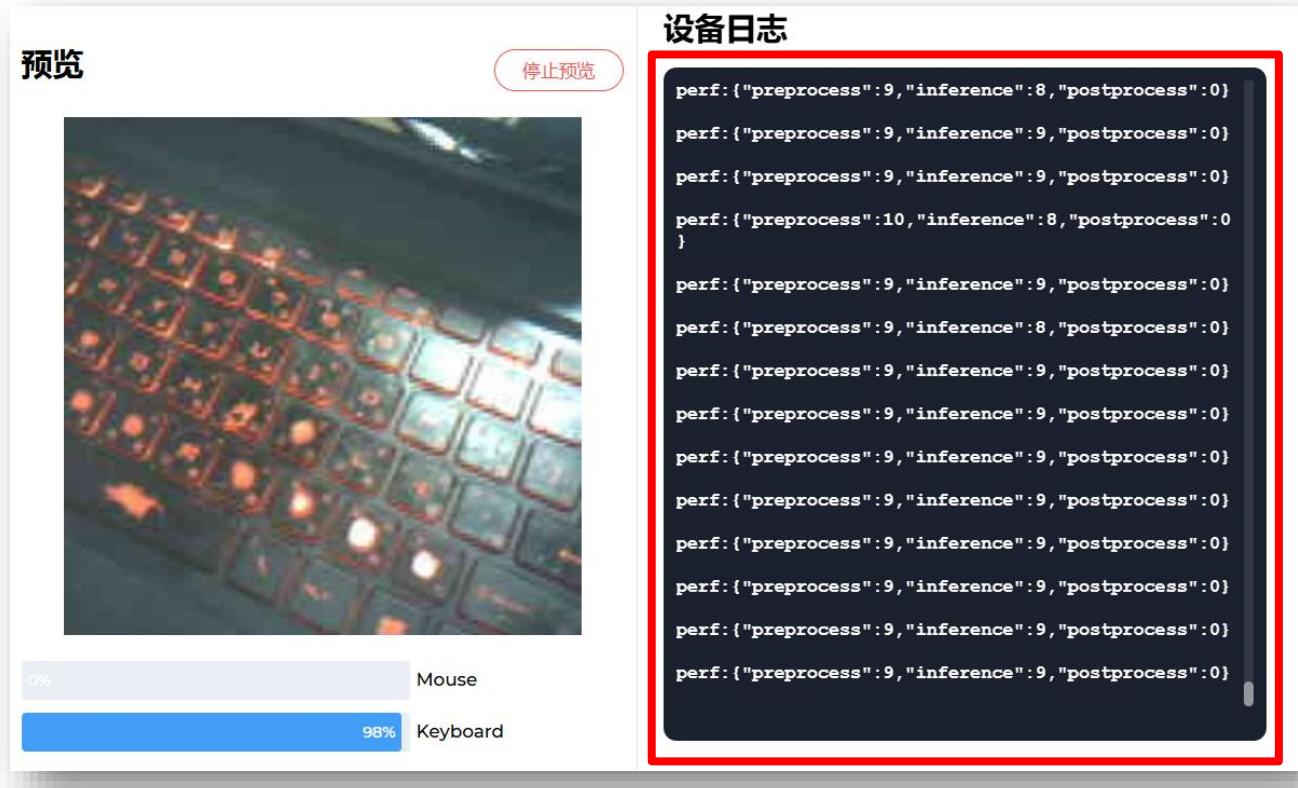
[https://wiki.seeedstudio.com/ModelAssistant\\_Introduce\\_Quick\\_Start/#model-training](https://wiki.seeedstudio.com/ModelAssistant_Introduce_Quick_Start/#model-training)



## 10.4. 檢測結果輸出

# 透過 Virtual-COM 以文字方式送出結果

在無 Xiao 或外接其它開發板時



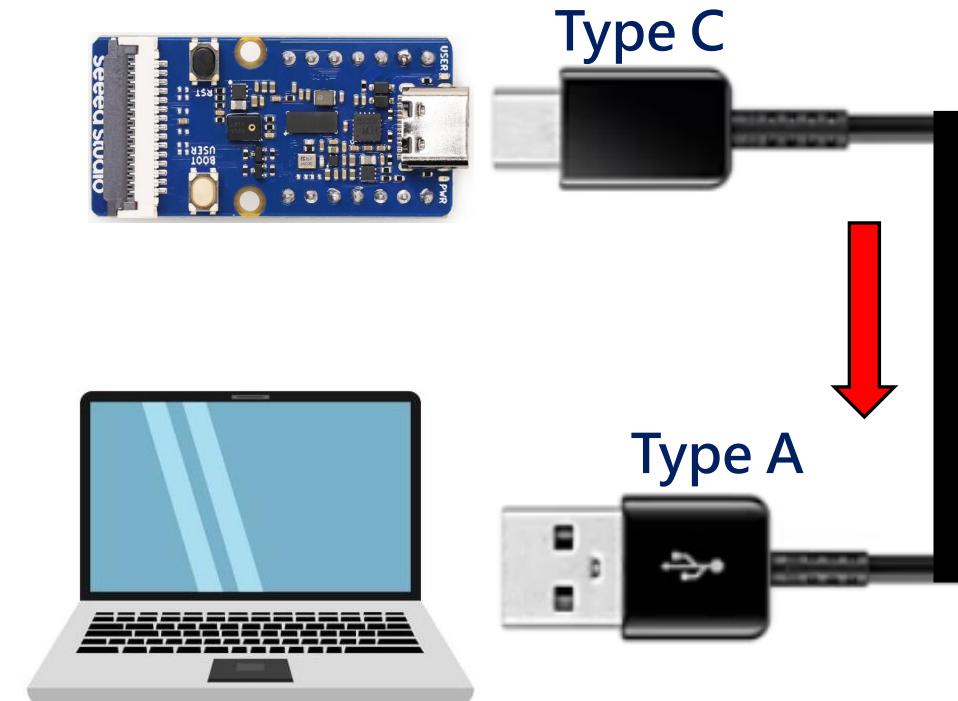
预览

停止预览

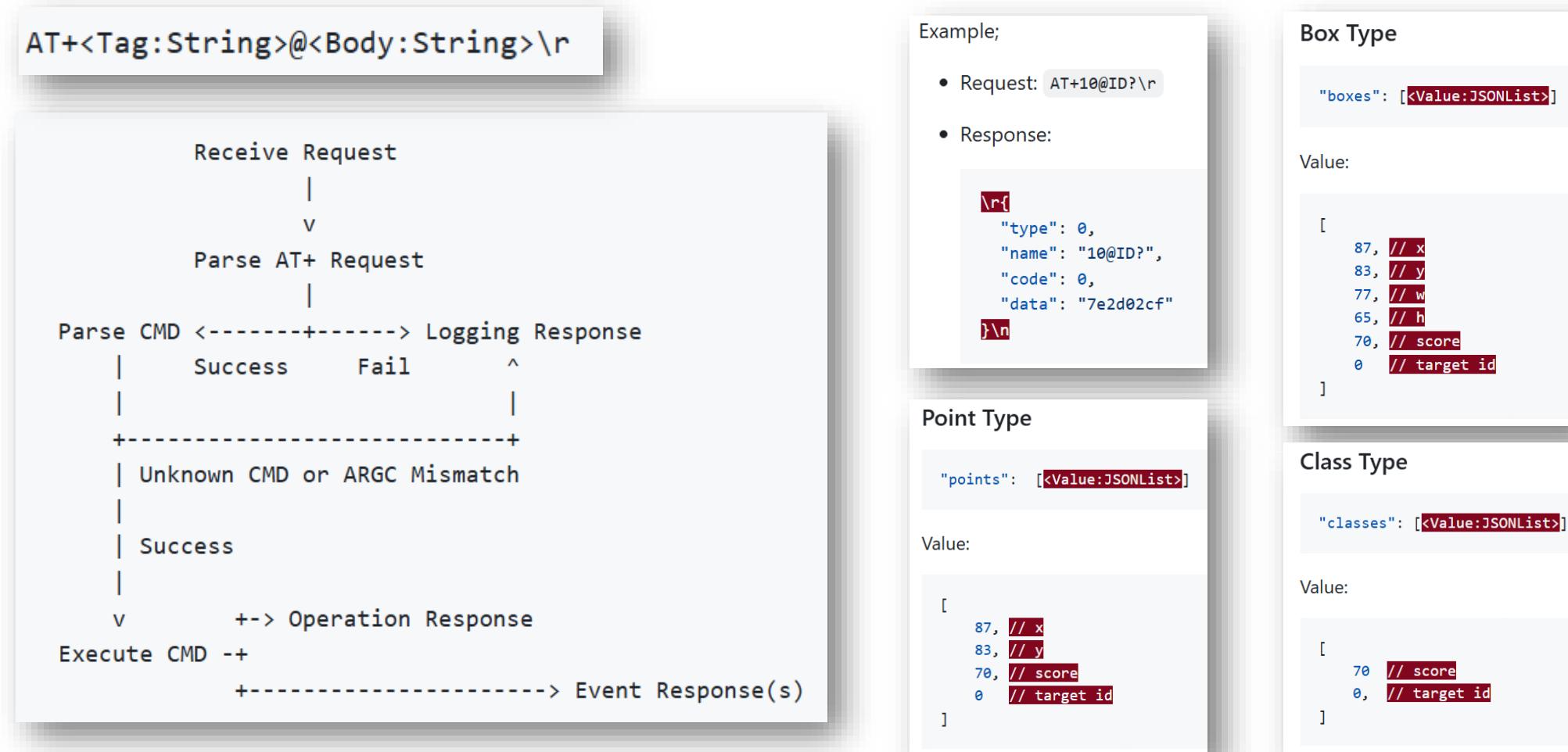
设备日志

```
perf:{"preprocess":9,"inference":8,"postprocess":0}
perf:{"preprocess":9,"inference":9,"postprocess":0}
perf: {"preprocess":9,"inference":9,"postprocess":0}
perf: {"preprocess":10,"inference":8,"postprocess":0}

perf: {"preprocess":9,"inference":9,"postprocess":0}
perf: {"preprocess":9,"inference":8,"postprocess":0}
perf: {"preprocess":9,"inference":9,"postprocess":0}
```



# UART AT Protocol JSON 輸出文字格式



[https://github.com/Seeed-Studio/SSCMA-Micro/blob/1.0.x/docs/protocol/at\\_protocol.md](https://github.com/Seeed-Studio/SSCMA-Micro/blob/1.0.x/docs/protocol/at_protocol.md)

# Arduino UART 接收結果範例

COM5

```

17:02:56.750 -> perf: prepocess=10, inference=45, postpocess=1
17:02:56.841 -> invoke success
17:02:56.841 -> perf: prepocess=10, inference=45, postpocess=0
17:02:56.978 -> invoke success
17:02:56.978 -> perf: prepocess=10, inference=45, postpocess=1
17:02:57.114 -> invoke success
17:02:57.114 -> perf: prepocess=10, inference=45, postpocess=1
17:02:57.114 -> Box[0] target=1, score=62, x=96, y=135, w=108, h=100
17:02:57.252 -> invoke success
17:02:57.252 -> perf: prepocess=10, inference=45, postpocess=1
17:02:57.252 -> Box[0] target=1, score=68, x=105, y=101, w=107, h=95
17:02:57.342 -> invoke success
17:02:57.342 -> perf: prepocess=10, inference=45, postpocess=1
17:02:57.481 -> invoke success
17:02:57.481 -> perf: prepocess=10, inference=46, postpocess=0
17:02:57.481 -> Box[0] target=1, score=67, x=120, y=91, w=95, h=100
17:02:57.618 -> invoke success
17:02:57.618 -> perf: prepocess=10, inference=45, postpocess=1
17:02:57.618 -> Box[0] target=1, score=77, x=118, y=95, w=95, h=85
17:02:57.709 -> invoke success
17:02:57.709 -> perf: prepocess=10, inference=46, postpocess=0
17:02:57.709 -> Box[0] target=1, score=68, x=111, y=96, w=95, h=85
17:02:57.847 -> invoke success
17:02:57.847 -> perf: prepocess=10, inference=45, postpocess=1
17:02:57.847 -> Box[0] target=1, score=68, x=107, y=105, w=95, h=85
17:02:57.983 -> invoke success
17:02:57.983 -> perf: prepocess=10, inference=45, postpocess=1

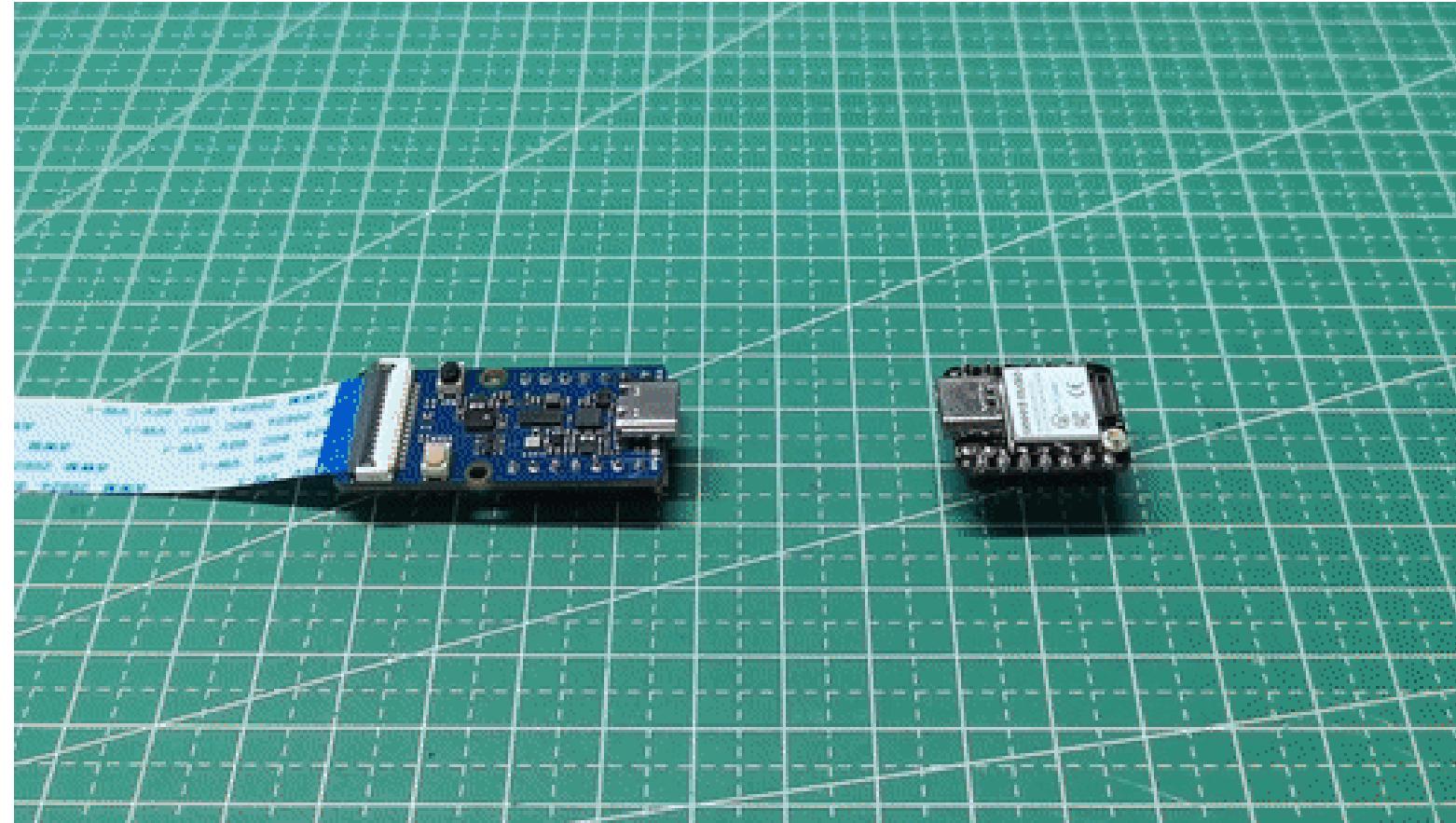
```

Autoscroll  Show timestamp      Newline      9600 baud      Clear output

執行時間：預處理時間、推論時間、後處理時間

物件盒[編號]：目標編號、置信度、左上座標(X,Y)、物件大小(W,H)

# Xiao 開發板連接 Grove Vision AI V2 (動畫)

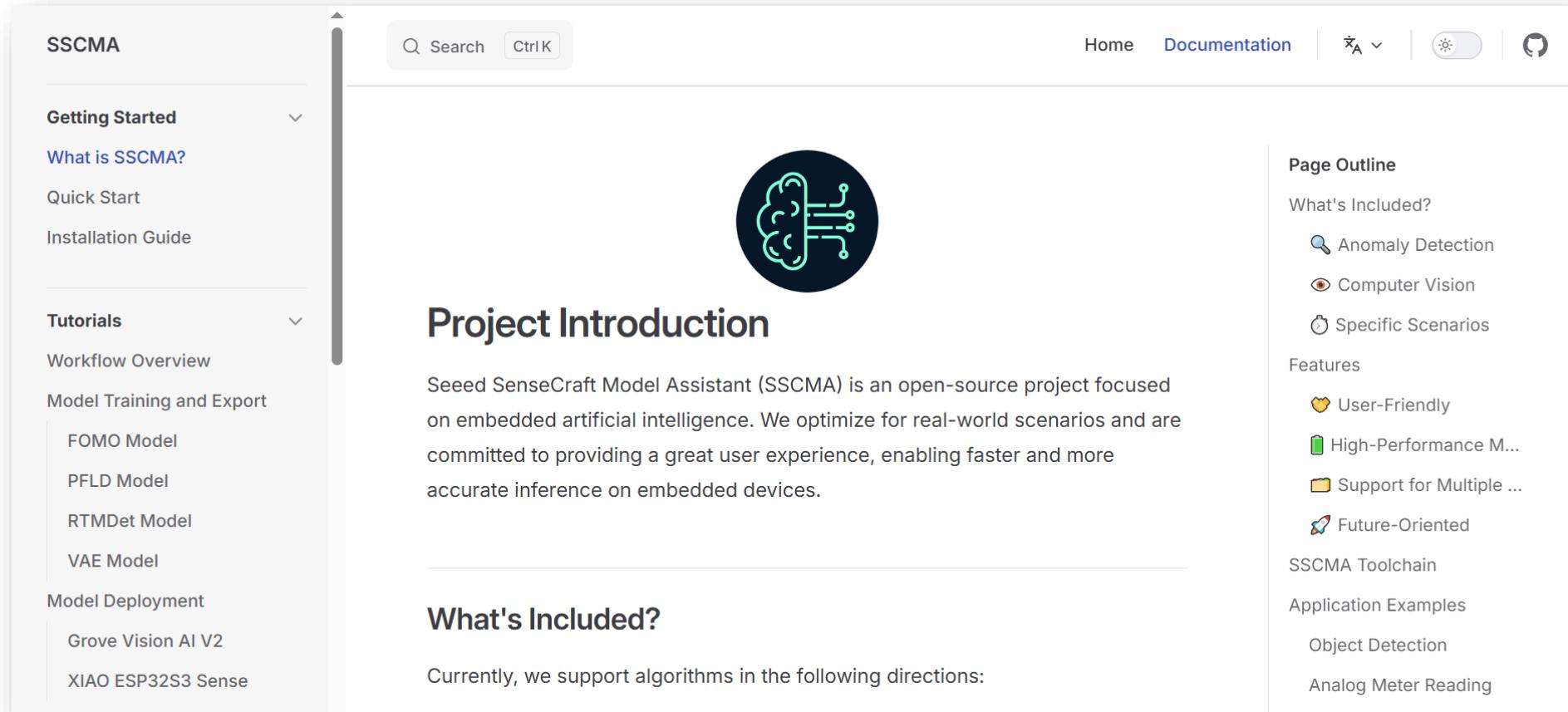


- 透過 Seeed Xiao 系列開發板UART 接收檢測結果，可再以無線傳出或根據結果直接控制 GPIO。
- 建議在未通電下插拔開發板。
- 兩塊開發的 Type C 接口在同一側，插反可能造成短路導致開發板損壞。

資料來源：[https://wiki.seeedstudio.com/grove\\_vision\\_ai\\_v2\\_software\\_support/](https://wiki.seeedstudio.com/grove_vision_ai_v2_software_support/)

# Seeed SSCMA 技術說明文件

## Seeed SenseCraft Model Assistant (SSCMA)

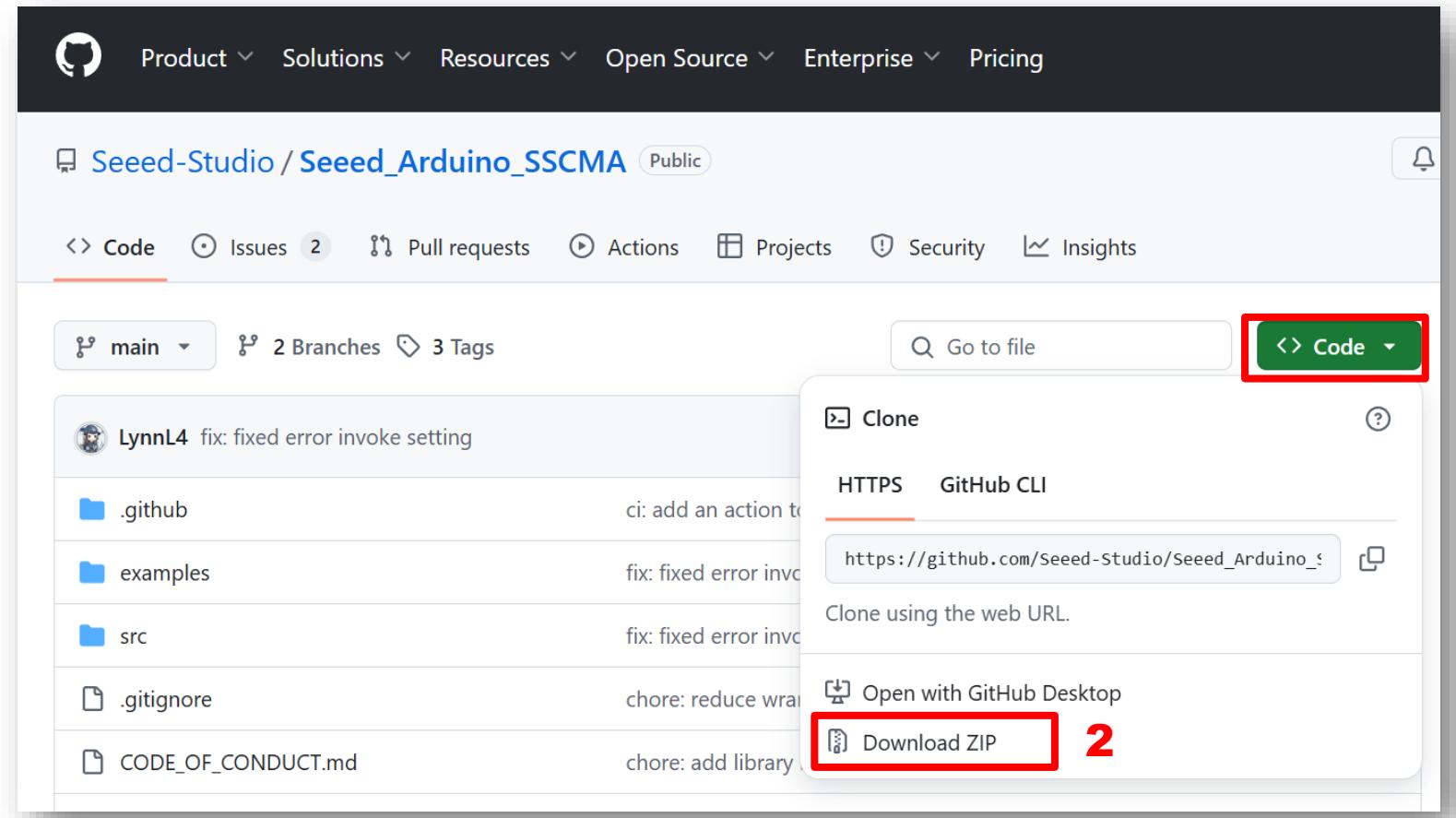


The screenshot shows the 'Project Introduction' page of the SSCMA documentation. The left sidebar contains navigation links for 'Getting Started' (What is SSCMA?, Quick Start, Installation Guide) and 'Tutorials' (Workflow Overview, Model Training and Export, FOMO Model, PFLD Model, RTMDet Model, VAE Model, Model Deployment, Grove Vision AI V2, XIAO ESP32S3 Sense). The main content area features a brain icon and the title 'Project Introduction'. It describes SSCMA as an open-source project focused on embedded artificial intelligence, optimizing for real-world scenarios. Below this is a 'What's Included?' section with a note about supporting algorithms in various directions. The right sidebar includes a 'Page Outline' with links to Anomaly Detection, Computer Vision, Specific Scenarios, and a 'Features' section with icons for User-Friendly, High-Performance, Support for Multiple, Future-Oriented, SSCMA Toolchain, Application Examples, Object Detection, and Analog Meter Reading.

[https://sensecraftma.seeed.cc/introduction/quick\\_start](https://sensecraftma.seeed.cc/introduction/quick_start)

# 下載 Seeed Arduino SSCMA

## Seeed SenseCraft Model Assistant (SSCMA)



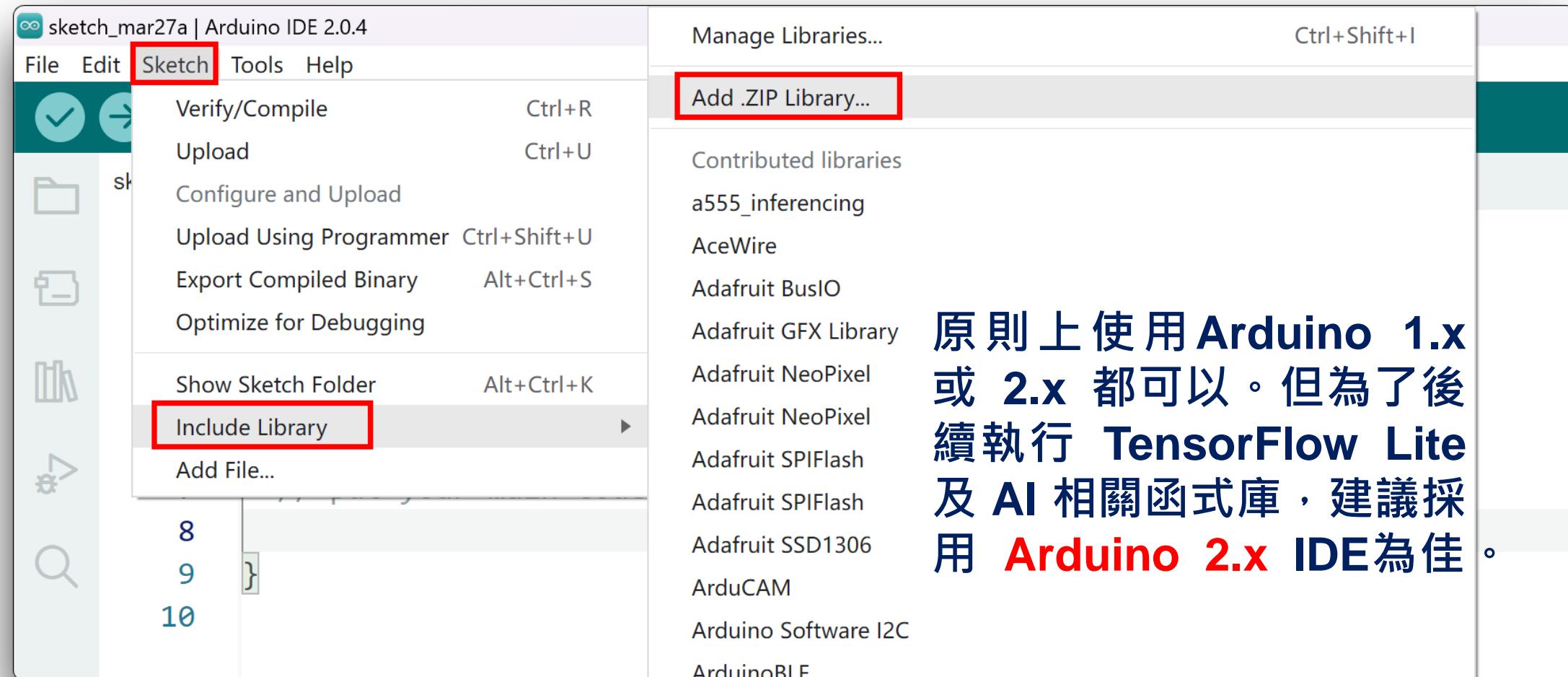
[https://github.com/Seeed-Studio/Seeed\\_Arduino\\_SSCMA/](https://github.com/Seeed-Studio/Seeed_Arduino_SSCMA/)

提供 Seeed Xiao 系列開發板於 Arduino 開發環境下連接 Grove AI Vision V2 及相關系列開發板。

Seeed Xiao

- SAMD21
- RP2040
- nRF52840
- ESP32C3
- ESP32S3

# Arudiuno 安裝 Seeed SSCMA



原則上使用 **Arduino 1.x** 或 **2.x** 都可以。但為了後續執行 **TensorFlow Lite** 及 **AI** 相關函式庫，建議採用 **Arduino 2.x IDE**為佳。

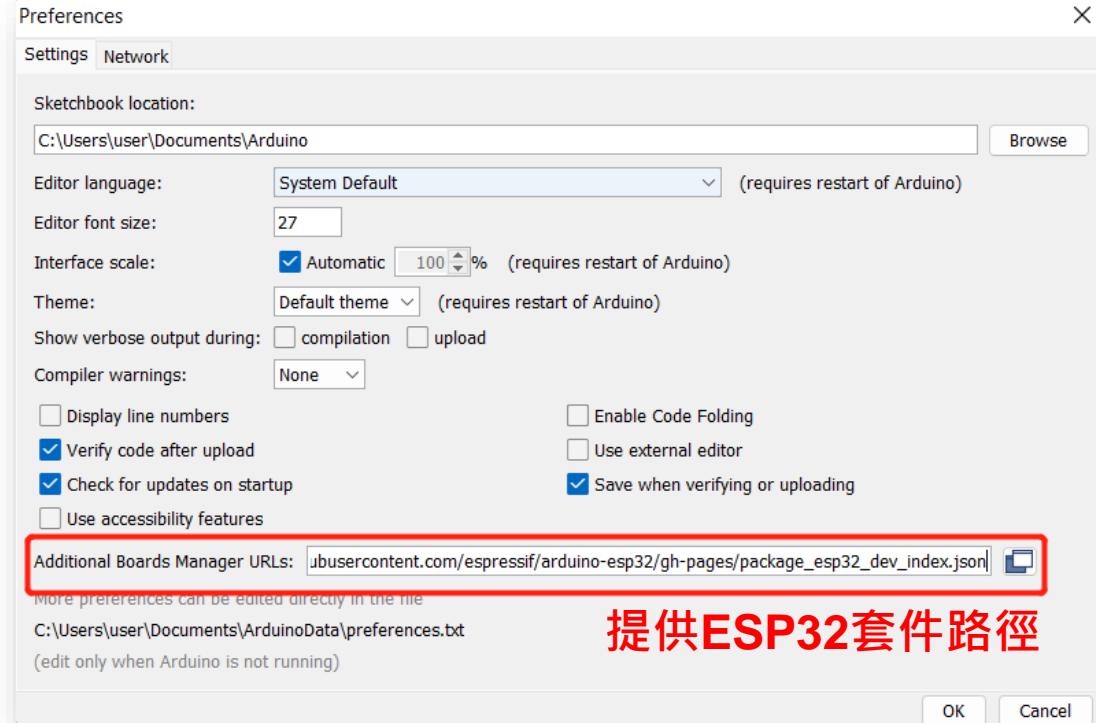
資料來源：[https://wiki.seeedstudio.com/grove\\_vision\\_ai\\_v2\\_software\\_support/](https://wiki.seeedstudio.com/grove_vision_ai_v2_software_support/)

# Arduino 安裝 ArduinoJSON

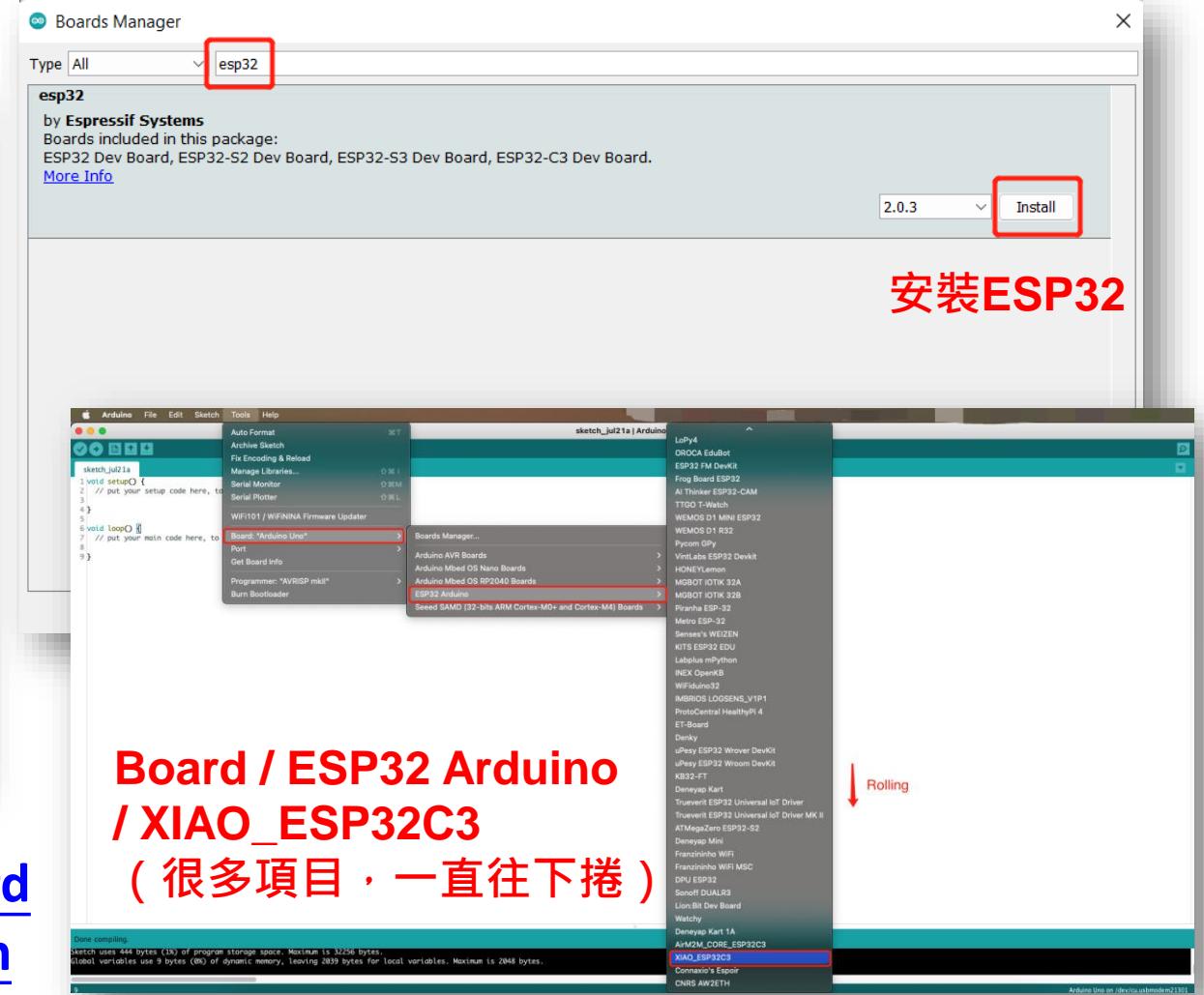


資料來源：[https://wiki.seeedstudio.com/grove\\_vision\\_ai\\_v2\\_software\\_support/](https://wiki.seeedstudio.com/grove_vision_ai_v2_software_support/)

# Arduino 新增 Xiao ESP32C3 開發板



[https://raw.githubusercontent.com/espressif/arduino-esp32/gh-pages/package\\_esp32\\_index.json](https://raw.githubusercontent.com/espressif/arduino-esp32/gh-pages/package_esp32_index.json)



# Xiao ESP32C3 讀取結果範例程式

引入SSCMA頭文件  
宣告SSCMA物件

初始化SSCMA  
初始化UART 為  
9600 bps

列印出執行時間，  
前處理、推論及後  
處理時間 (單位ms)

列印出物件盒資訊，  
物件盒[編號]：目標  
編號，置信度，左  
上座標(X,Y)・物件  
大小(W,H)

```
#include <Seeed_Arduino_SSCMA.h>

SSCMA AI;

void setup()
{
    AI.begin();
    Serial.begin(9600);
}

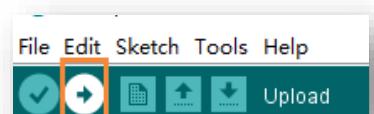
void loop()
{
    if (!AI.invoke())
    {
        Serial.println("invoke success");
        Serial.print("perf: preprocess=");
        Serial.print(AI.perf().preprocess);
        Serial.print(", inference=");
        Serial.print(AI.perf().inference);
        Serial.print(", postprocess=");
        Serial.println(AI.perf().postprocess);

        for (int i = 0; i < AI.boxes().size(); i++)
        {
            Serial.print("Box[");
            Serial.print(i);
            Serial.print("] target=");
            Serial.print(AI.boxes()[i].target);
            Serial.print(", score=");
            Serial.print(AI.boxes()[i].score);
            Serial.print(", x=");
            Serial.print(AI.boxes()[i].x);
            Serial.print(", y=");
            Serial.print(AI.boxes()[i].y);
        }
    }
}
```

```
Serial.print(", w=");
Serial.print(AI.boxes()[i].w);
Serial.print(", h=");
Serial.println(AI.boxes()[i].h);
}
for (int i = 0; i < AI.classes().size(); i++)
{
    Serial.print("Class[");
    Serial.print(i);
    Serial.print("] target=");
    Serial.print(AI.classes()[i].target);
    Serial.print(", score=");
    Serial.println(AI.classes()[i].score);
}
for (int i = 0; i < AI.points().size(); i++)
{
    Serial.print("Point[");
    Serial.print(i);
    Serial.print("] target=");
    Serial.print(AI.points()[i].target);
    Serial.print(", score=");
    Serial.print(AI.points()[i].score);
    Serial.print(", x=");
    Serial.print(AI.points()[i].x);
    Serial.print(", y=");
    Serial.println(AI.points()[i].y);
}
}
```

列印出分類資訊，  
分類編號，目標編  
號，置信度

列印出點資訊，  
點編號，目標編號，  
置信度，座標(X,Y)



開啟Arduino IDE，連接ESP32C3，開新程式，  
複製以上程式，全部貼入，編譯後上傳。

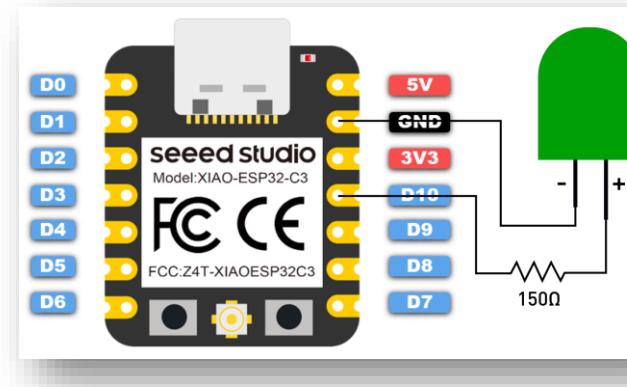
資料來源：[https://wiki.seeedstudio.com/grove\\_vision\\_ai\\_v2\\_software\\_support/](https://wiki.seeedstudio.com/grove_vision_ai_v2_software_support/)

# Xiao ESP32C3 控制 GPIO

```

for (int i = 0; i < AI.boxes().size(); i++)
{
    Serial.print("Box[");
    Serial.print(i);
    Serial.print("] target=");
    Serial.print(AI.boxes()[i].target);
    Serial.print(", score=");
    Serial.print(AI.boxes()[i].score);
    Serial.print(", x=");
    Serial.print(AI.boxes()[i].x);
    Serial.print(", y=");
    Serial.print(AI.boxes()[i].y);
    Serial.print(", w=");
    Serial.print(AI.boxes()[i].w);
    Serial.print(", h=");
    Serial.println(AI.boxes()[i].h);
}

```



**ESP32C3** 板上  
沒 有 使 用 者  
LED 須 另 外 接 。

若目標物件編號為0（可指定任意值）  
且置信度大於50（0~100）則執行指  
定動作。

If ( (AI.boxes()[i].target == 0) &&  
 (AI.boxes()[i].score >= 50) ) {  
 執行 GPIO 或指定動作  
}

# 參考文獻

- 許哲豪，臺灣科技大學資訊工程系「人工智慧與邊緣運算實務」(2021~2023)  
<https://omnixri.blogspot.com/p/ntust-edge-ai.html>
- 許哲豪，OmniXRI's Edge AI & TinyML 小學堂 Youtube 直播課程總結  
<https://omnixri.blogspot.com/2024/06/omnixris-edge-ai-tinyml-youtube.html>
- 許哲豪，歐尼克斯實境互動工作室系列發文—TinyML(MCU AI)系列  
<https://hackmd.io/1PK1URhIQ7GutcWgpgsWbg#TinyMLMCU-AI%E7%B3%BB%E5%88%97>
- Seeed SenseCraft AI  
<https://sensecraft.seeed.cc/ai/home>

# 延伸閱讀

---

- Seeed Studio Grove Vision AI Module V2

[https://wiki.seeedstudio.com/grove\\_vision\\_ai\\_v2/](https://wiki.seeedstudio.com/grove_vision_ai_v2/)

- Seeed Studio XIAO ESP32C3

[https://wiki.seeedstudio.com/XIAO\\_ESP32C3\\_Getting\\_Started/](https://wiki.seeedstudio.com/XIAO_ESP32C3_Getting_Started/)

- Seeed SenseCraft Web Toolkit

<https://seeed-studio.github.io/SenseCraft-Web-Toolkit/#/setup/process>

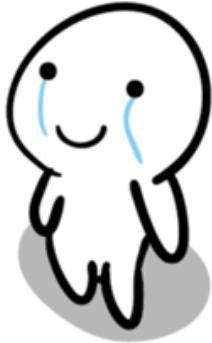
- Seeed SSCMA – Getting Started

[https://sensecraftma.seeed.cc/introduction/quick\\_start](https://sensecraftma.seeed.cc/introduction/quick_start)

- Github Seeed-Studio / SSCMA-Micro – AT Protocol Specification

[https://github.com/Seeed-Studio/SSCMA-Micro/blob/1.0.x/docs/protocol/at\\_protocol.md](https://github.com/Seeed-Studio/SSCMA-Micro/blob/1.0.x/docs/protocol/at_protocol.md)

沒有最邊



只有更邊



歡迎加入  
邊緣人俱樂部



**YOUTUBE 直播 :** <https://www.youtube.com/@omnixri1784streams>



歐尼克斯實境互動工作室  
(OmniXRI Studio)

許哲豪 (Jack Hsu )

[Facebook : Jack Omnixri](#)

[FB社團 : Edge AI Taiwan 邊緣智能交流區](#)

[電子郵件 : omnixri@gmail.com](#)

[部落格 : https://omnixri.blogspot.tw](#)

[開 源 : https://github.com/OmniXRI](#)