

自動駕駛開源項目 Donkey Car

# 大綱

- Donkey Car 的歷史及社群
- Donkey Car 使用什麼硬件？
- 電池種類
- 鋰電池充電及安全



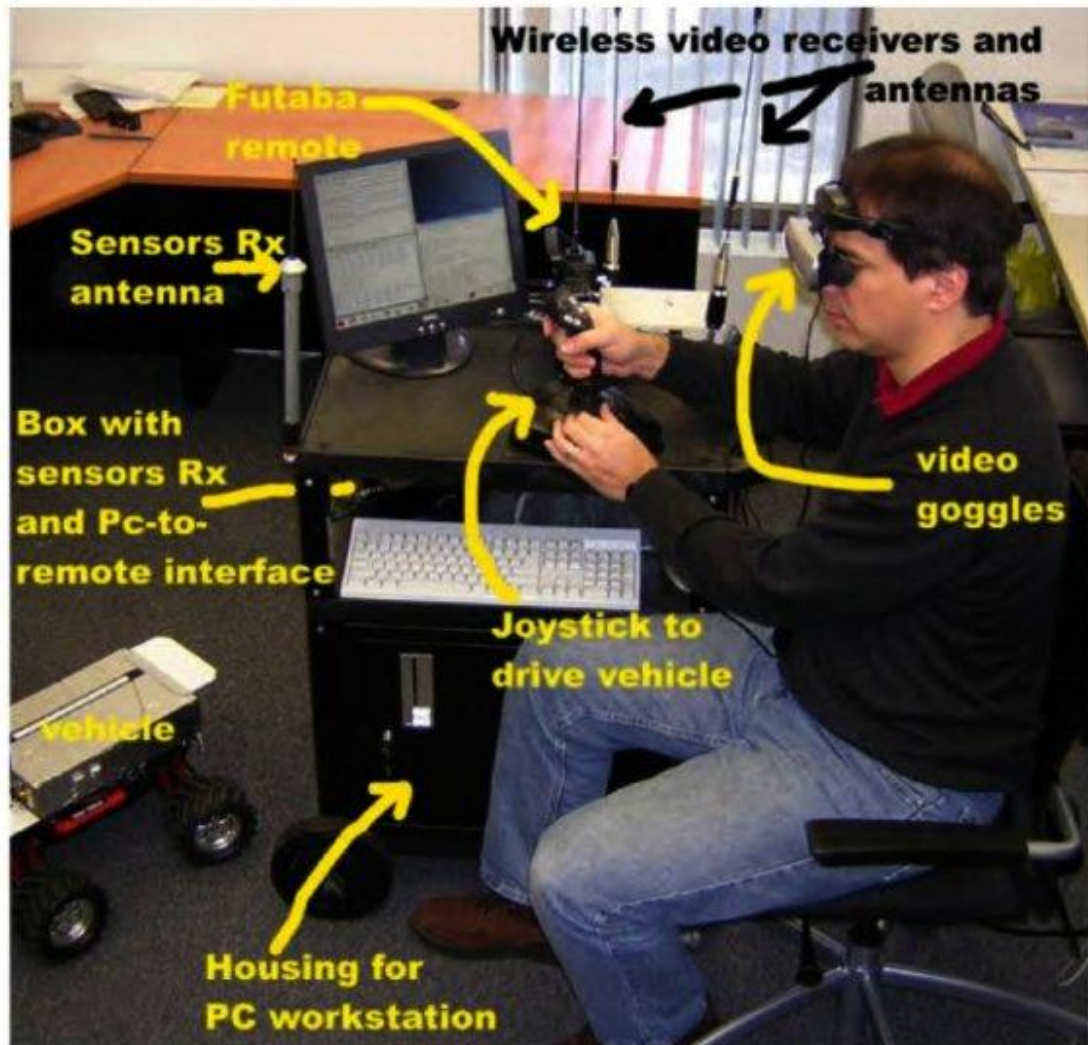
# Donkey Car 的歷史

- 2004年，國防高等研究計劃署(DARPA) 的 [DAVE](#)
  - End-to-end learning system to avoid obstacles solely from visual input
  - Runs at roughly 10 frames per second on a 1.4GHz AMD Athlon processor
  - Took 4 days to train
  - Mean distance between crashes was about 20 meters in complex environments

# DAVE

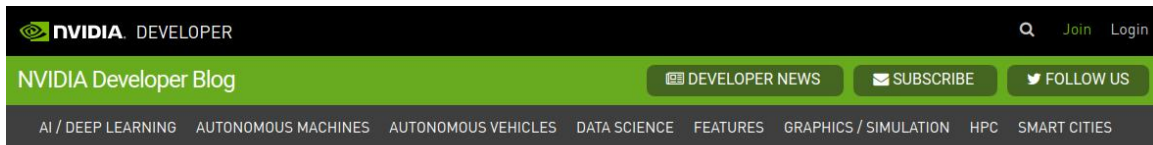


DAVE



# 10年後

- Nvidia 發佈了一篇文章及論文
  - End to End Deep Learning for Self-Driving Cars ([Blog](#), [Paper](#))



AUTONOMOUS VEHICLES AI / DEEP LEARNING

## End-to-End Deep Learning for Self-Driving Cars

By Mariusz Bojarski, Ben Firner, Beat Flepp, Larry Jackel, Urs Muller, Karol Zieba and Davide Del Testa | August 17, 2016

Tags: Automotive, Autonomous Vehicles, Deep Learning, DRIVE PX, Machine Learning and AI, Torch

In a new automotive application, we have used [convolutional neural networks](#) (CNNs) to map the raw pixels from a front-facing camera to the steering commands for a self-driving car. This powerful end-to-end approach means that with minimum training data from humans, the system learns to steer, with or without lane markings, on both local roads and highways. The system can also operate in areas with unclear visual guidance such as parking lots or unpaved roads. [Editor's Note: be sure to check out the new post "[Explaining How End-to-End Deep Learning Steers a Self-Driving Car](#)".]





# DIYRobocar

- Chris Anderson 在 2018 年發起了 [DIYRobocar](#) 這個組織



<https://youtu.be/EOygT9p4uvQ>

# Moving Hackathon 2019 Final Round



<https://youtu.be/TG-zaXDwfRw>



# Donkey Car autonomous RC car race 2020



# DIYRobocar

- 出現了很多不同款式的車子



# Donkey Car 的誕生

- 由於大部份工程師只專門於軟體或硬體的開發，並不是所有人都能製造自己的車子
- 所以 Adam Conway 和 Will Roscoe 就一起設計了名為”Donkey Car”的標準車子，讓所有人都可以在這個基礎上去改良

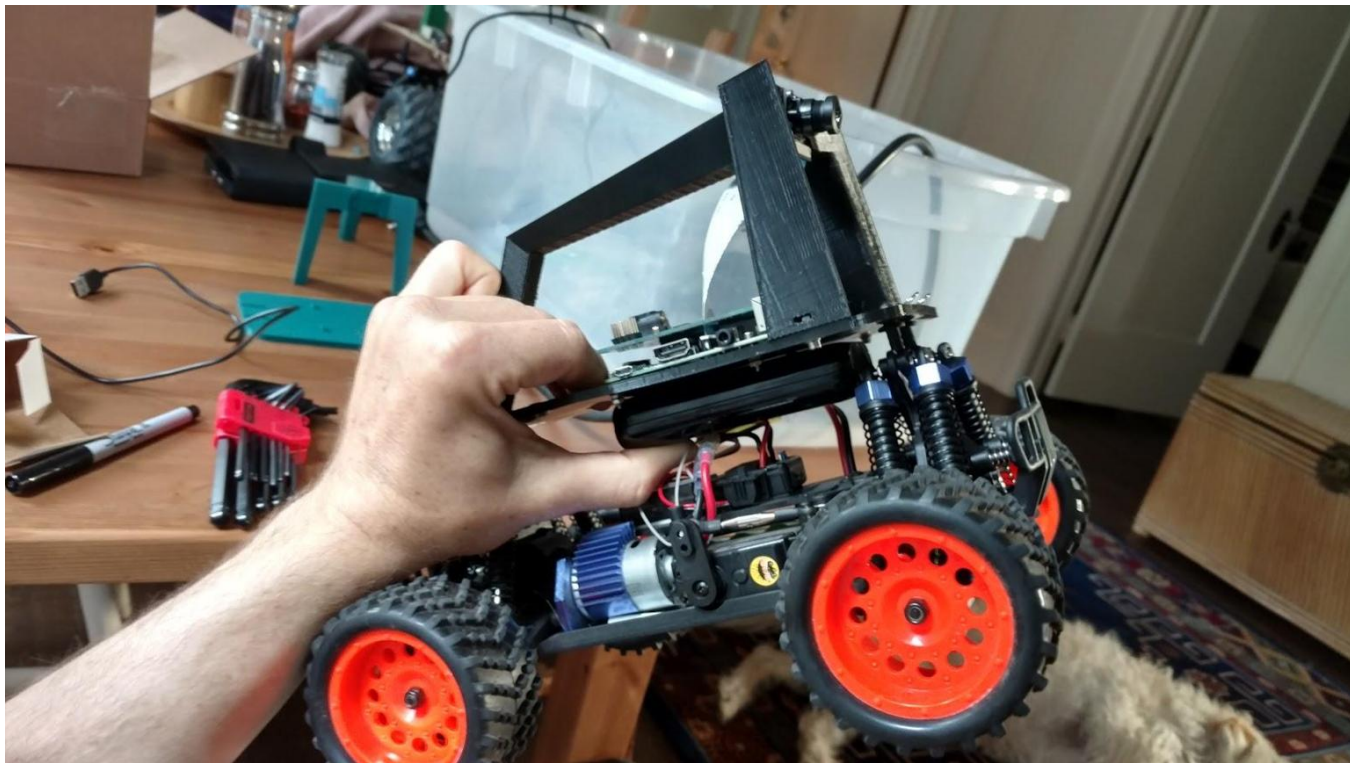
# Donkey Car 的誕生



**Will Roscoe**  
Software

**Adam Conway**  
Hardware

# Donkey Car 的誕生



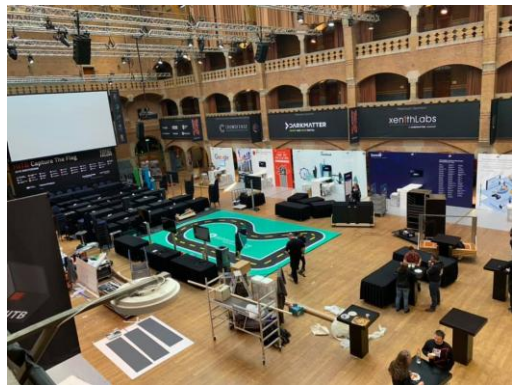
# Donkey Car S1





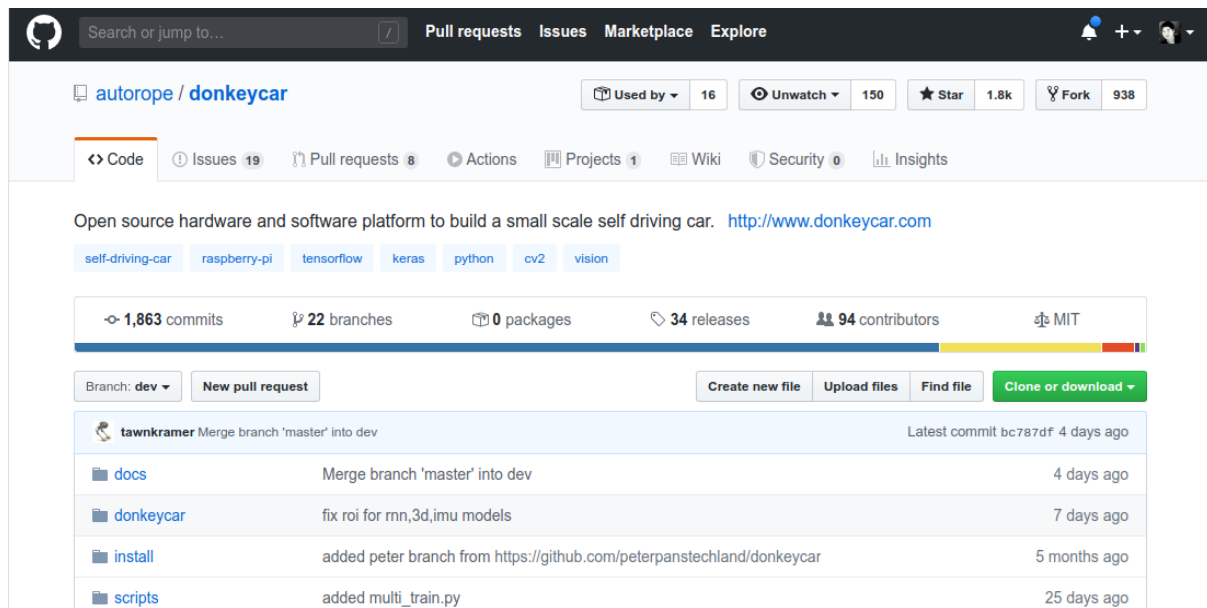
# Donkey Car 社群

- 遍佈世界各地



# Donkey Car Github

- 開源項目
- 超過2000星
- 每星期都有人更新



The screenshot shows the GitHub repository for 'donkeycar' by 'autorope'. The repository has 1.8k stars and 938 forks. It is described as an 'Open source hardware and software platform to build a small scale self driving car'. The repository includes 1,863 commits, 22 branches, 0 packages, 34 releases, and 94 contributors. The latest commit is by 'tawnkramer' merging 'master' into 'dev' 4 days ago. The repository structure includes folders for 'docs', 'donkeycar', 'install', and 'scripts'.

Search or jump to... Pull requests Issues Marketplace Explore

autorope / donkeycar

Used by 16 Unwatch 150 Star 1.8k Fork 938

Code Issues 19 Pull requests 8 Actions Projects 1 Wiki Security 0 Insights

Open source hardware and software platform to build a small scale self driving car. <http://www.donkeycar.com>

self-driving-car raspberry-pi tensorflow keras python cv2 vision

1,863 commits 22 branches 0 packages 34 releases 94 contributors MIT

Branch: dev New pull request Create new file Upload files Find file Clone or download

tawnkramer Merge branch 'master' into dev Latest commit bc787df 4 days ago

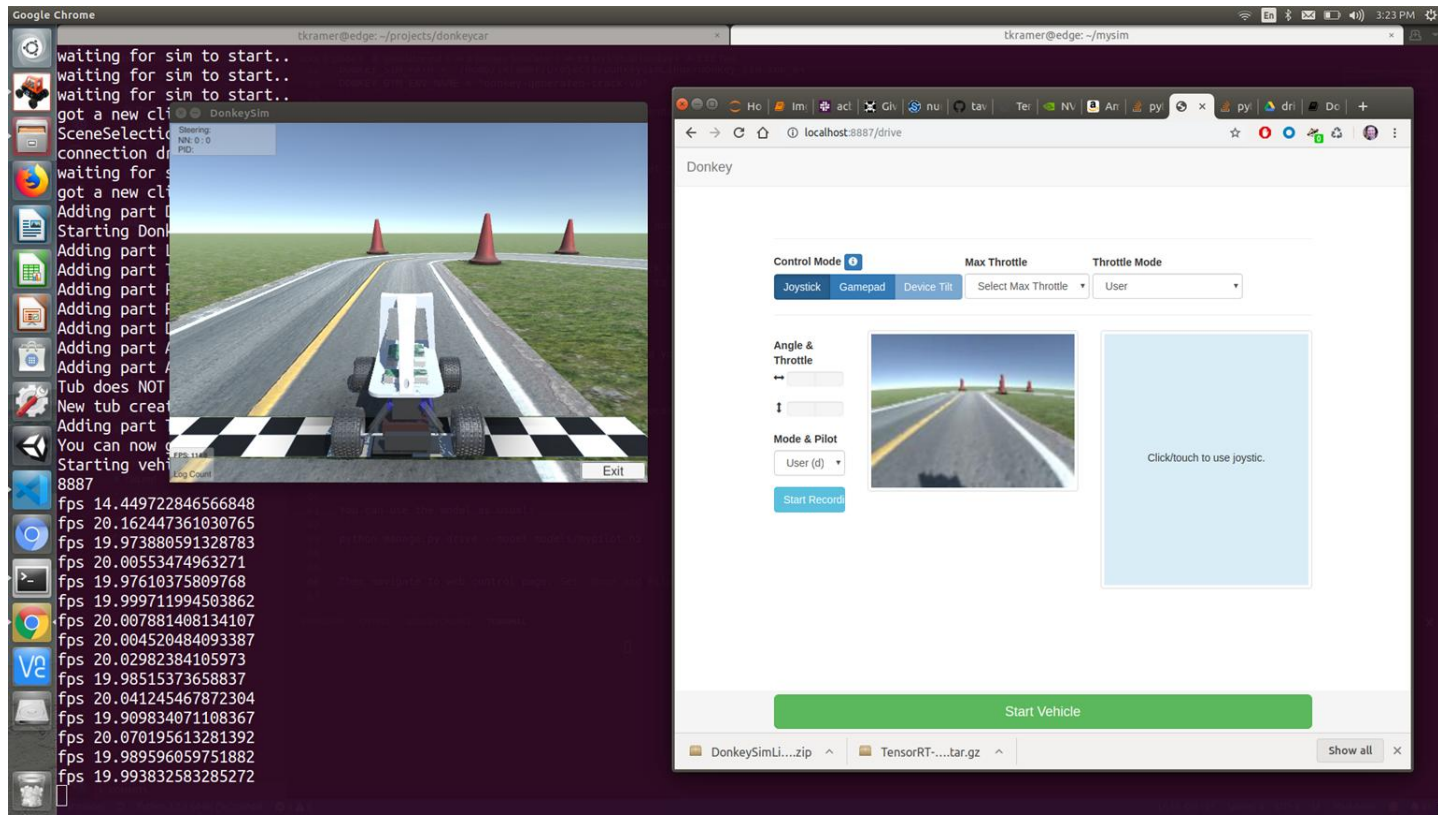
docs	Merge branch 'master' into dev	4 days ago
donkeycar	fix roi for rnn,3d,imu models	7 days ago
install	added peter branch from <a href="https://github.com/peterpanstechland/donkeycar">https://github.com/peterpanstechland/donkeycar</a>	5 months ago
scripts	added multi_train.py	25 days ago

# 開源項目



什麼是開源項目？  
開源項目有什麼好處？  
對我有什麼作用？

# Donkey Car 模擬器



# Donkey Car 虛擬比賽

- 每月舉辦一次
- 全球愛好者參與



# Donkey Car 社群

The screenshot shows the Donkey Car Discord server interface. The top bar includes the server name "Donkey Car", a search bar, and navigation icons. The left sidebar lists various text channels: # announcements, # events, # maintainers, # hardware, # software (selected), # simulation, # datasets, # dev, # github, # pictures, # tracks, # random, # resources, # education, and # algorithms. The main chat area displays a conversation:

- @JonathanTse** Hi @megannjones , can you post this question to <https://superuser.com/>?
- megannjones** Today at 7:03 AM  
Hi Johnathan! Yes I can do that!
- tomimudahberbaur** Today at 7:04 AM  
Hi everyone, anybody knows how to properly get pytorch to jetson xavier?  
I keep on getting errors

A code block is shared, showing a terminal output of a PyTorch installation attempt on a Jetson Xavier. The code includes commands like `pip install torch torchvision torchaudio` and `python -c "import torch; print(torch.cuda.is_available())"`. The output shows a successful installation but a warning about the CUDA version.

Below the code block, the conversation continues:

- Goose** Today at 8:39 AM  
**@TCIII** Hey there! I've searched for the "Illegal instruction (core dumped)" error and found your post from 12.03. I'm running into the same Error, yet couldn't figure out why. Your are using the Xavier too, is there a guide you can recommend for setting the whole thing up? I'm pretty new to Linux and all this AI stuff. I'm doing my master thesis on this autonomous driving topic, and decided to use the DonkeyCar. Thanks in advance!
- @tomimudahberbaur** I keep on getting errors
- TCIII** Today at 10:20 AM  
You might try installing PyTorch 1.7.0 -cp36 instead of 1.0.6. Worked for me on my Xavier NX.
- @Goose @TCIII** Hey there! I've searched for the "Illegal instruction (core dumped)" error and found your post from 12.03. I'm running into the ...
- TCIII** Today at 10:26 AM  
This DC Doc guide works for both the Nano and the Xavier NX:

The right sidebar shows a list of server members, including MechovationRobotics, melnimr, Milderf, MindSedate, Mk223, modulosa, Monster, nalsy, Nasuno, nathanbeveridge, Nehmo, Noatun, notgaret, nullified, nznk, ogsambone, okiu\_sanjiyo, and Osk.



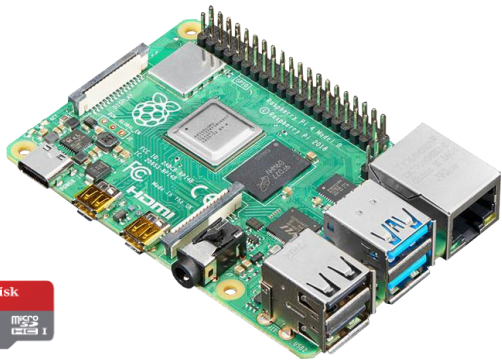
# Donkey Car 社群

- 官方網頁
  - <https://www.donkeycar.com/>
- Github
  - <https://github.com/autorope/donkeycar>
- 文檔
  - <https://docs.donkeycar.com/>
- 社群 Discord
  - <https://discord.gg/PN6kFeA>

Donkey Car 使用什麼硬件？



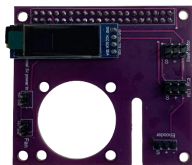
# Donkey Car 使用什麼硬件？



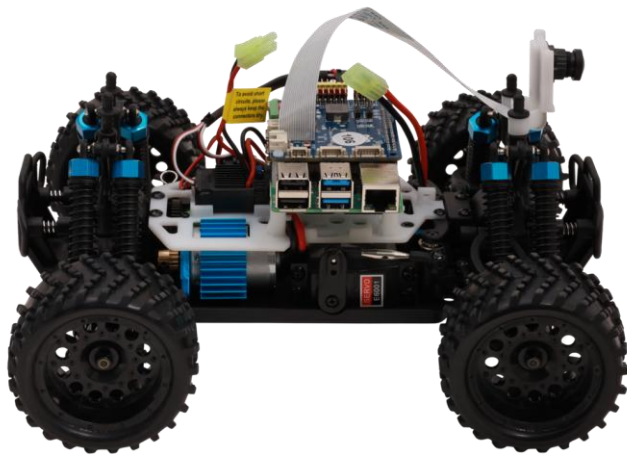
Raspberry Pi 4



SD 卡



Donkey HAT



電子變速器



廣角鏡頭



舵機

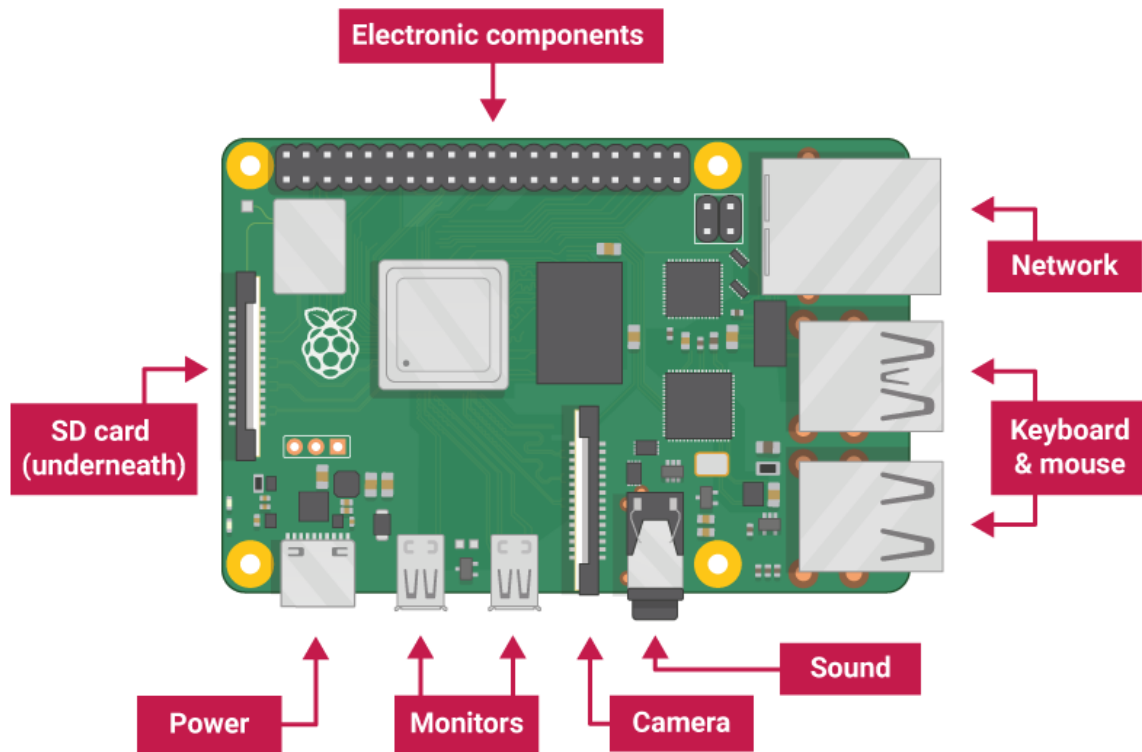
# Raspberry Pi 4

---

Your tiny, dual-display,  
desktop PC replacement.



# Raspberry Pi



# SD Card

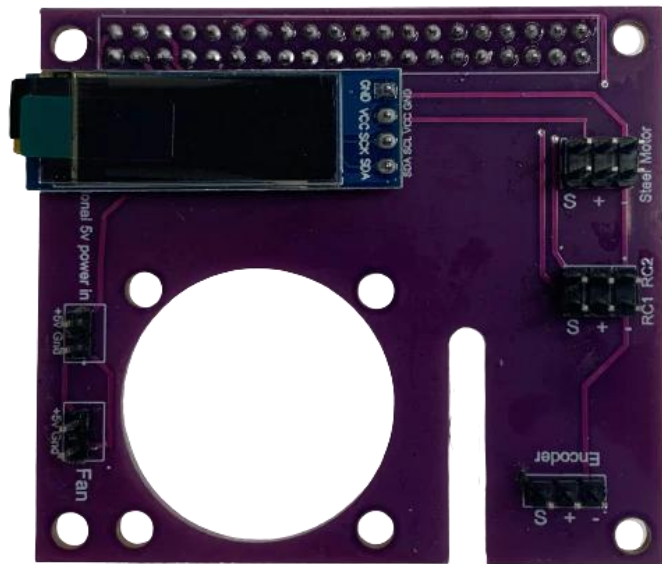
- Raspbian OS
- 已預先安裝 Donkey Car
- 請試試取出 SD Card 並放回





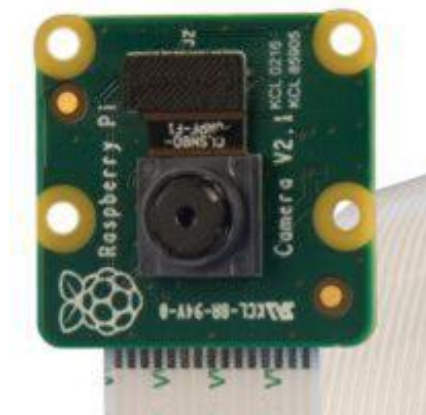
# Donkey HAT

- 特別為 Donkey Car 而設計的控制板
- 非常簡單的設計，沒有任何電子元件 (除OLED 外)
- 設有 OLED ，可顯示 IP 等資訊



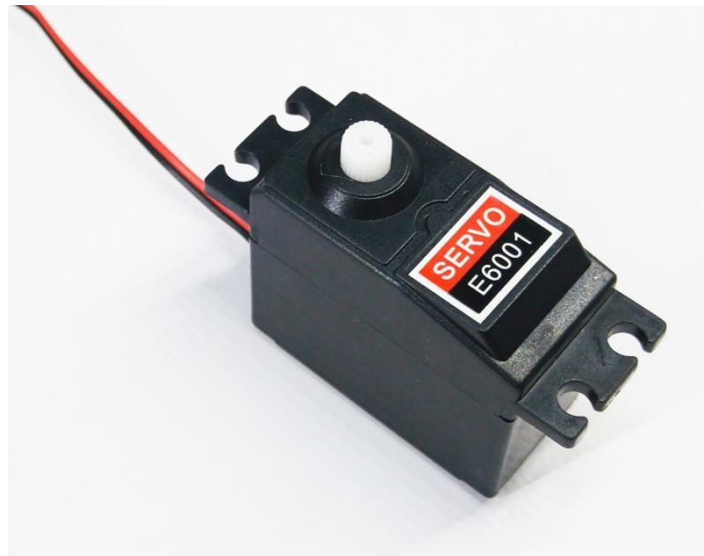
# 鏡頭

- 請問圖中的Pi Camera 跟你手上的 Donkey Car 鏡頭有什麼不同？



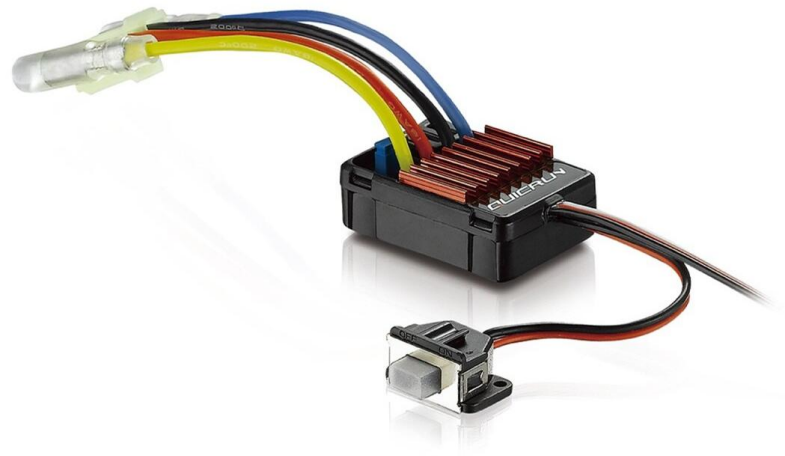
# 舵機

- 你認為這個舵機有什麼功能？



# 電子變速器 (ESC)

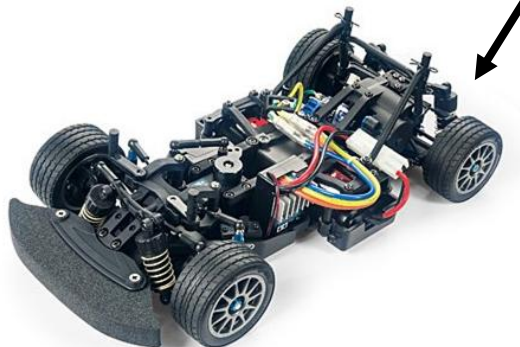
- 又稱電變，用以控制馬達及車速
- 你能看到 MM1 是如何與電變連接嗎？



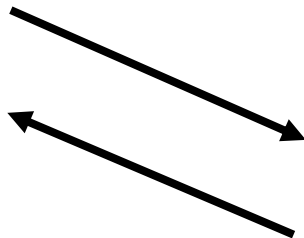
# 輸入 - 運算 - 輸出



輸入 - 感應器



輸出 - 動力及方向



運算

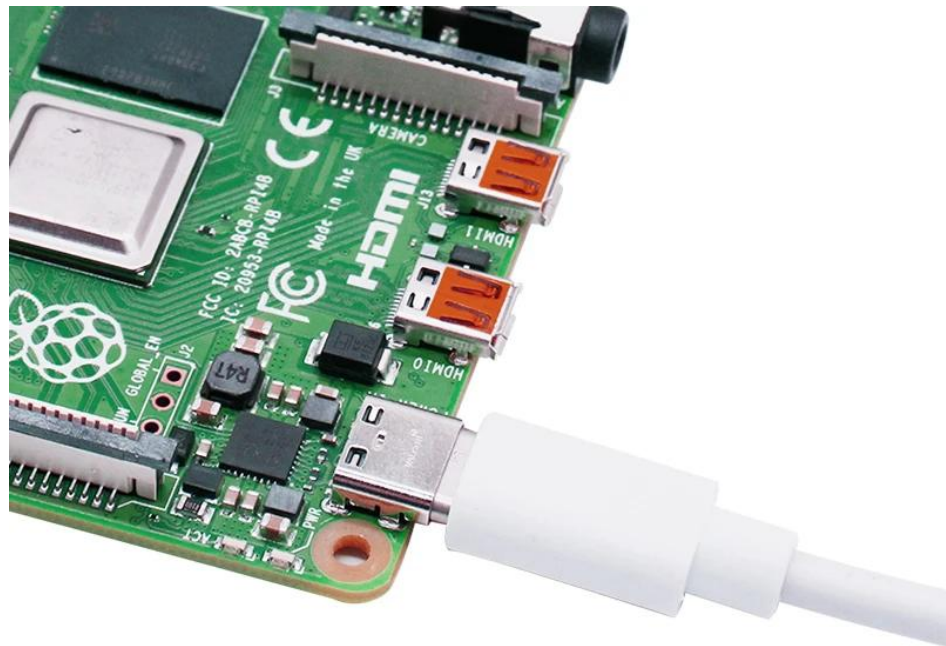
# 啟動 Raspberry Pi





# 啟動 Raspberry Pi

- Donkey Cart Starter Kit 有一條 USB A/C 線
- 將一端插入PC 或外置電源
- 另一端插入 Raspberry Pi
- 你會看到紅燈和綠燈不斷閃爍，大約 2 分鐘左右
- 如果電壓不足，紅燈會消失，Raspberry pi 可能因電壓不足而不停 reboot



# 關閉 Raspberry Pi

- 除 USB 外, 插或拔任何線必需先停止 Pi 的供電, 否則有可能做成短路, 燒左塊板
- 紅燈和綠燈停止閃爍後, 才可以拔除 USB-C 線

Donkey Car 是什麼？



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# Donkey Car autonomous RC car race 2020

<https://youtu.be/>





# DIYRobocar

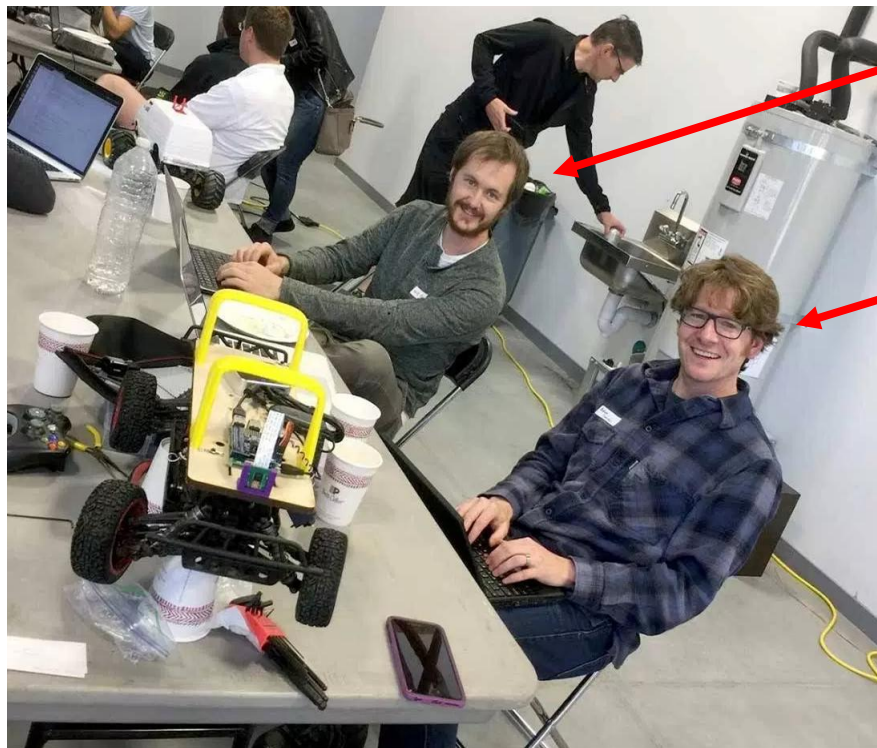
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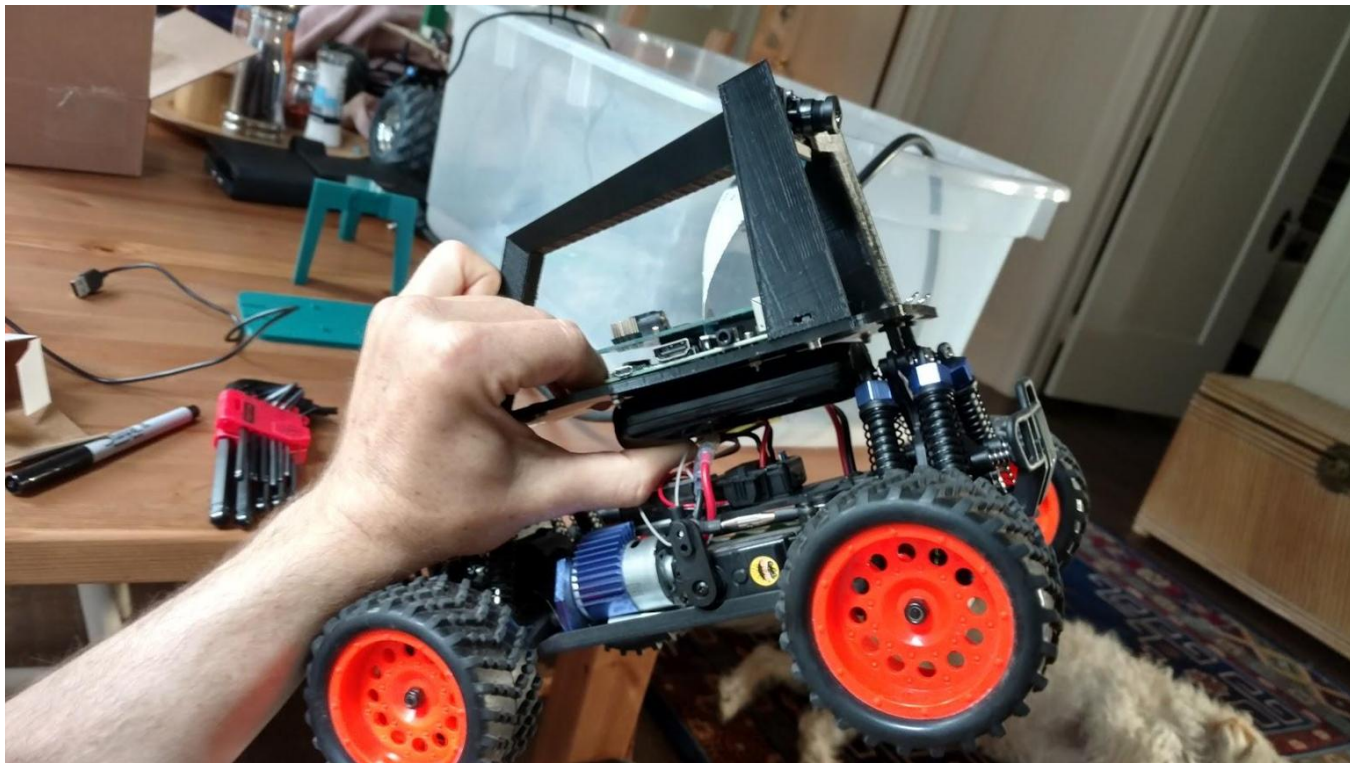
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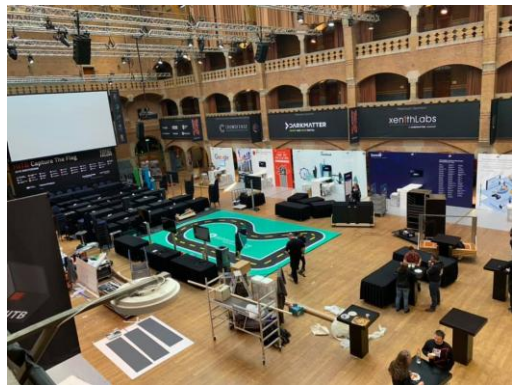
# Donkey Car S1





# Donkey Car 社群

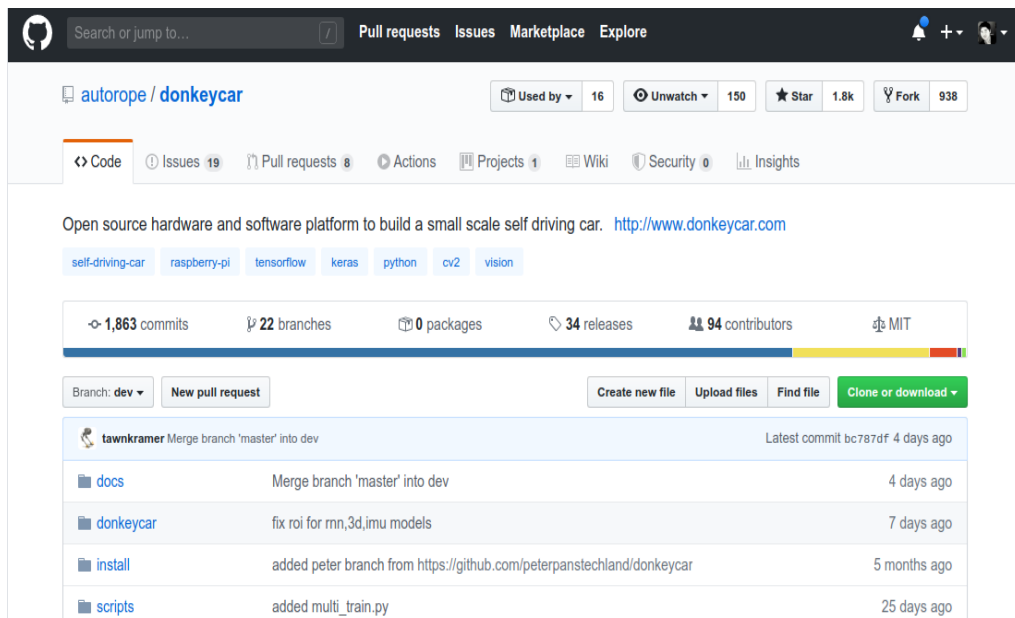
- 遍佈世界各地





# Donkey Car Github

- 開源項目
- 超過2000星
- 每星期都有人更新



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Pull requests Issues Marketplace Explore

Used by 16 Unwatch 150 Star 1.8k Fork 938

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self-driving-car raspberry-pi tensorflow keras python cv2 vision

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Branch: dev New pull request Create new file Upload files Find file Clone or download

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# 開源項目



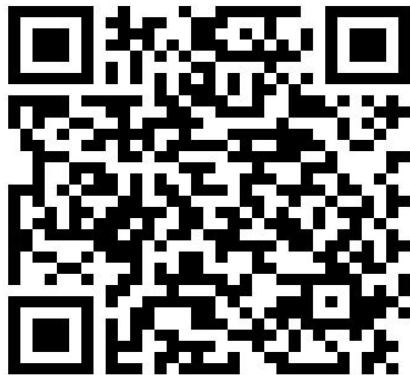
什麼是開源項目？  
開源項目有什麼好處？  
對我有什麼作用？

# 大綱

- 使用 Donkey Car App 連接 Donkey Car
- 開始駕駛
- 檢視數據
- 訓練模型
- 開始自動駕駛
- 計時賽



# 安裝 Mobile App



# 找出Donkeycar的IP地址

如果你使用 Donkey HAT, 會顯示:

1. Hostname - 主機名稱
2. IP - IP 地址
3. SSID: 現在連接的 Wifi 網絡



# 使用 Donkey Car App 連接 Donkey Car



# 搜尋車輛

- 請將電話連接至 Donkey Car 同一無線網絡
  - 如使用學校網絡，要確保網絡各主機能互相通訊
- 選擇 Skip Network Setup
- Mobile App 會自動搜索在網絡上的 Donkey Car
- 如果找不到，可以按 Refresh 再試一次
- 找到車輛後，按一下車子進入下一個版面

5:02




Please select the  
Donkeycar

Favourite Car  
No Favourite Car

Available Cars

Refresh

 Racer1  
192.168.3.19:8000  
docker



# 主畫面

- 進入車子後，你會見到這個主畫面

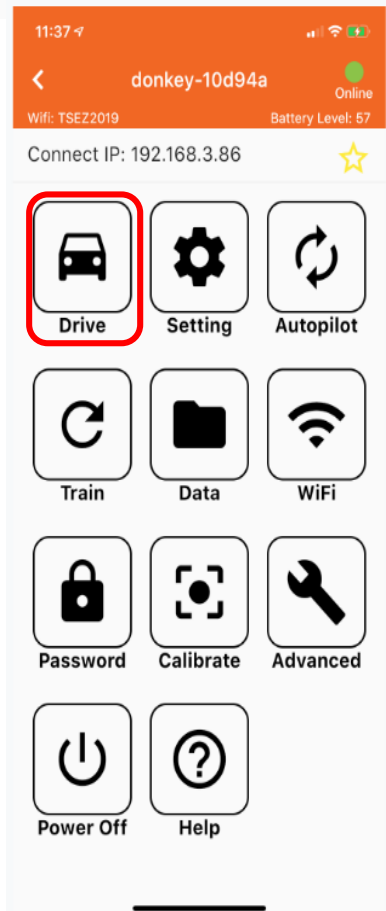


開始駕駛



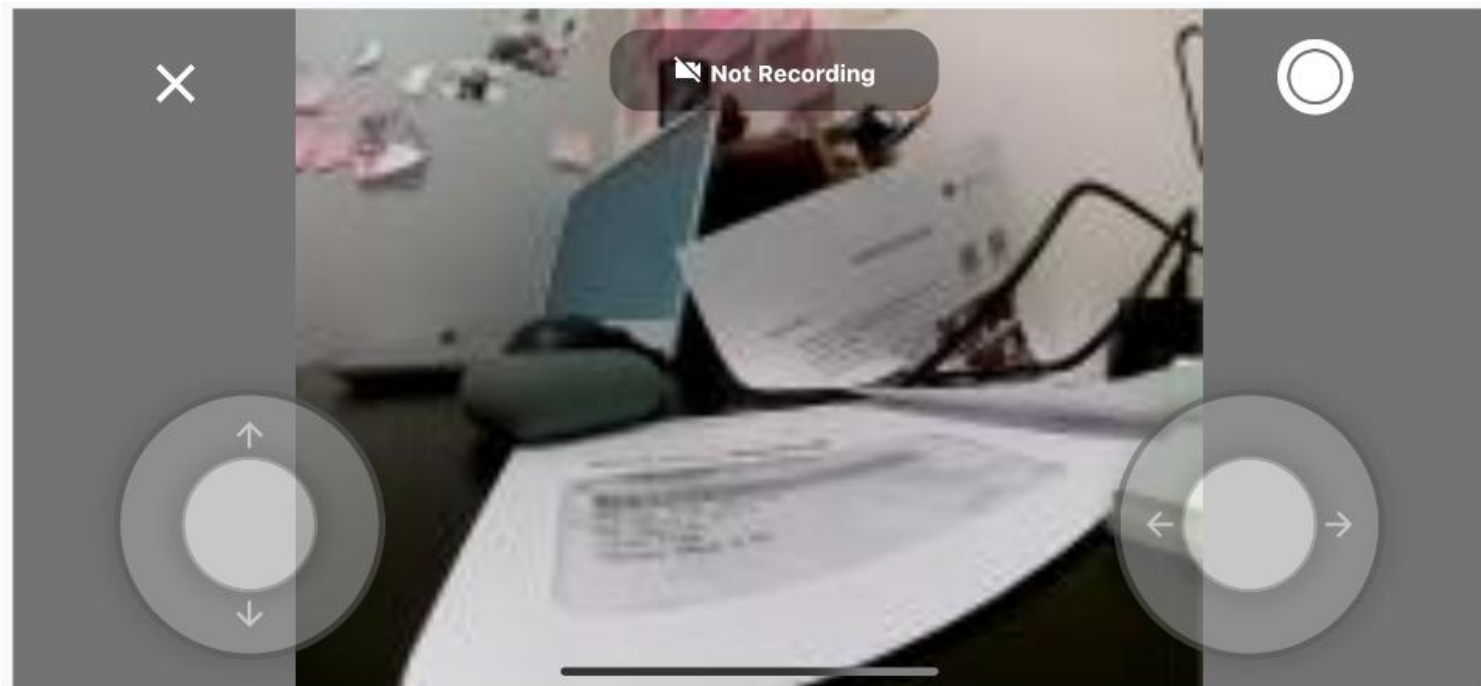
# 主畫面

- 選擇 Drive 進行駕駛
  - 選 Virtual Controller 使用 Mobile App 控制車輛



## 駕駛介面

- 等待一會，你會看到駕駛畫面



警告

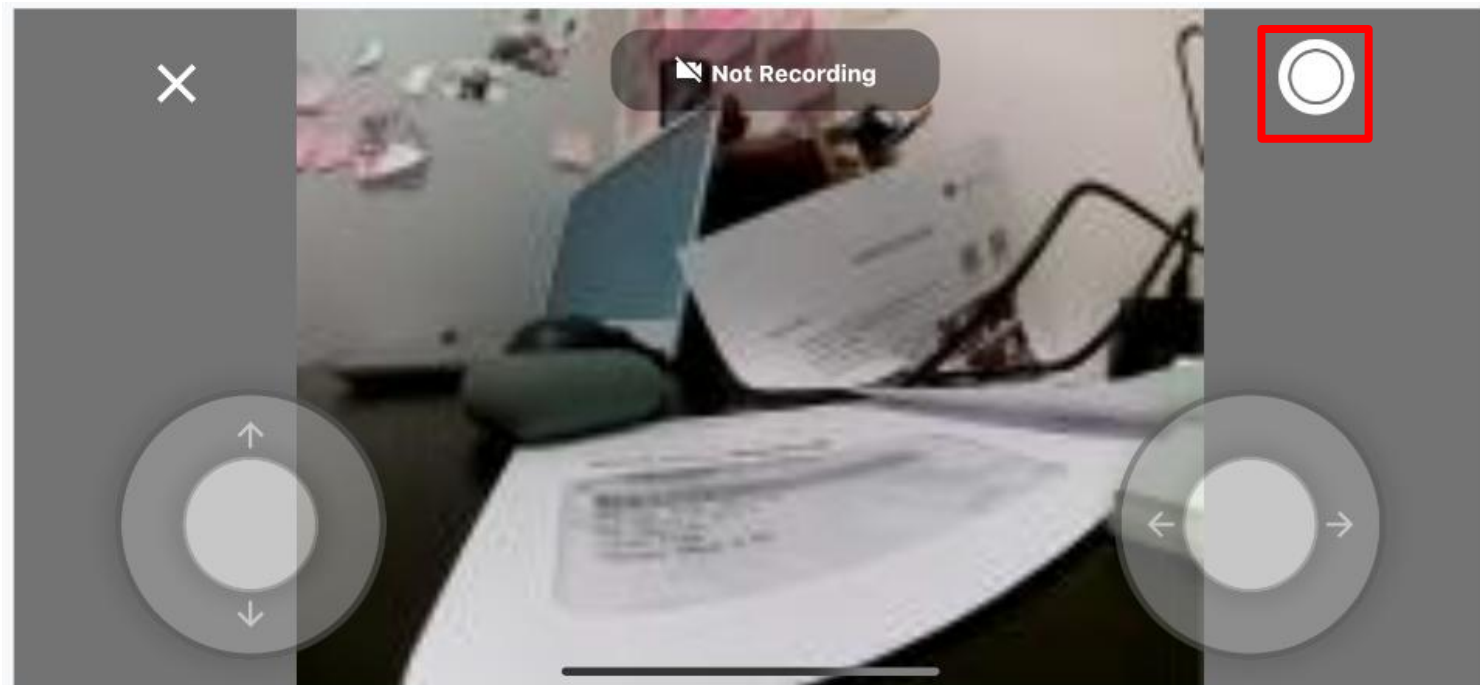
開始駕駛前  
先把車放在地上  
以免車輛掉下損毀

# 駕駛介面 (Drive UI)

- 使用下方兩個控制桿操控車輛
  - 左: 控制速度
  - 右: 控制方向
- 用一點時間熟習操控車輛
- 如果你已經預備好，就可以按右上方的按鈕開始錄影
- 至少收集 4000-5000 張圖片
- 完成後按左上方的 X 結束



## 錄影以收集數據



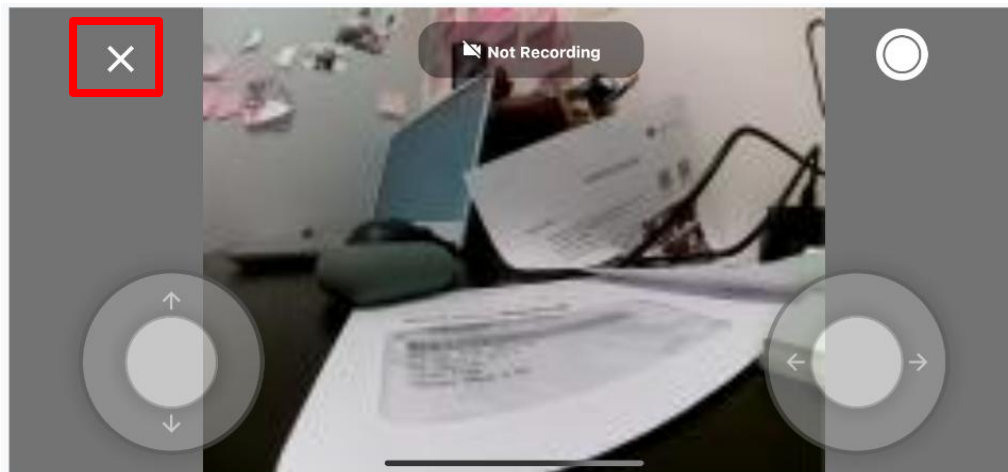


## 收集數據

收集 4000 - 5000 張圖片

# 完成駕駛

## 離開駕駛畫面



## 收集數據嘅 Tips

維持速度  
唔好停車

慢慢揸車

熟習左架車先開始錄影

# 駕駛總結



← 收集相片的數量

# 檢視數據



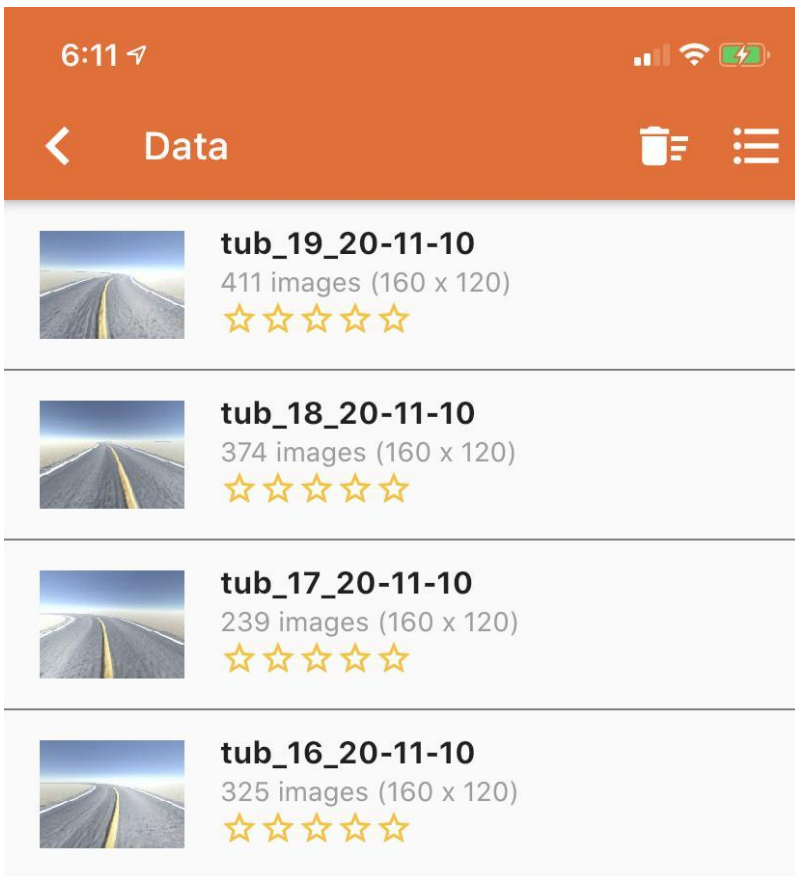
# 檢查收集的收據

- 回到主畫面
- 按 Data 按鈕



# 檢查收集的收據

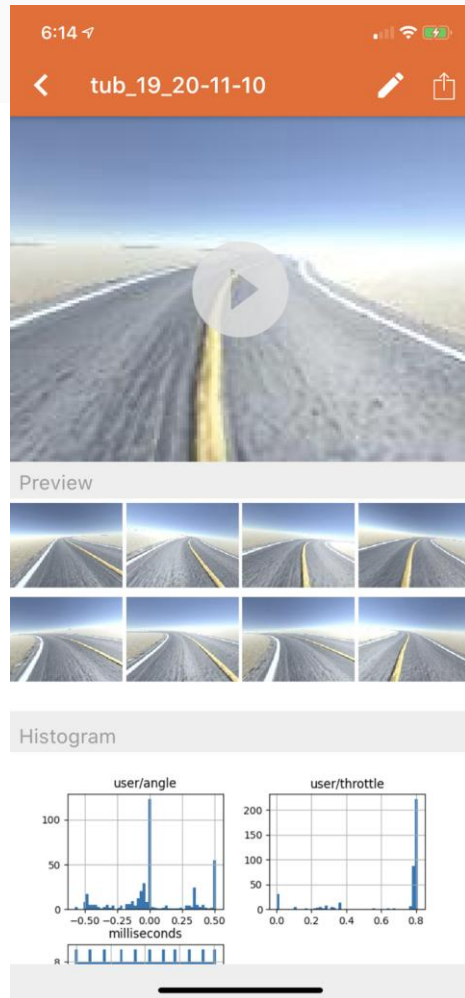
- 選擇剛才收集的圖片





# 檢查收集的收據

- 可按影片的 Play 按鈕回顧收集的數據
- 也可以檢查 histogram

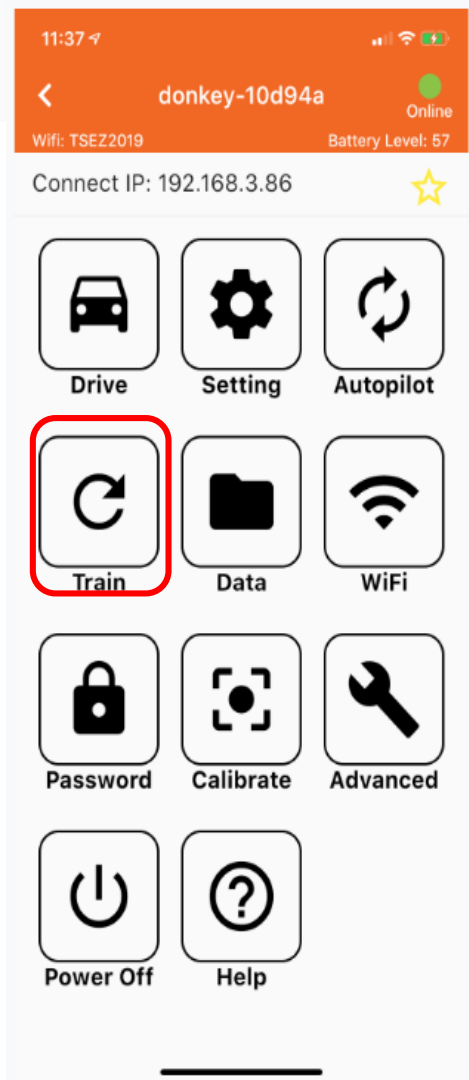


# 訓練模型



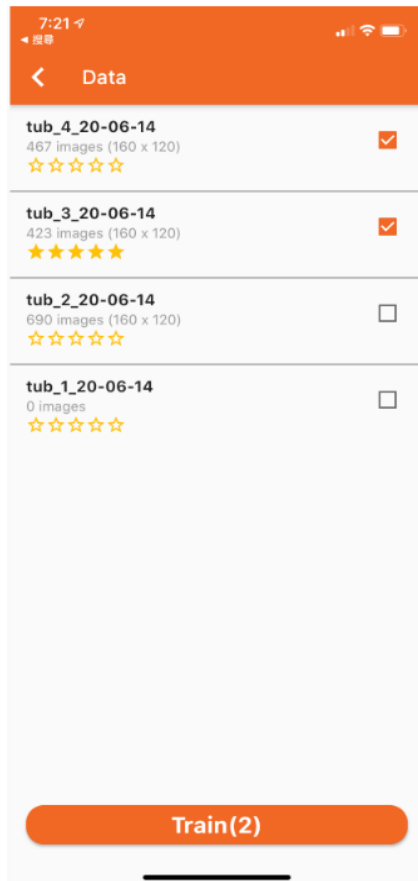
# 訓練模型 (Training)

- 回到主畫面
- 按 Train 按鈕



# 訓練模型

- 訓練模型就好似訓練人工大腦咁
- 你俾本書 (tub) 佢睇，個大腦就慢慢學習相關既動作(加速/方向)
- 每次訓練最少要提供 2000 張相。如果少於 2000 張相，訓練會失敗。

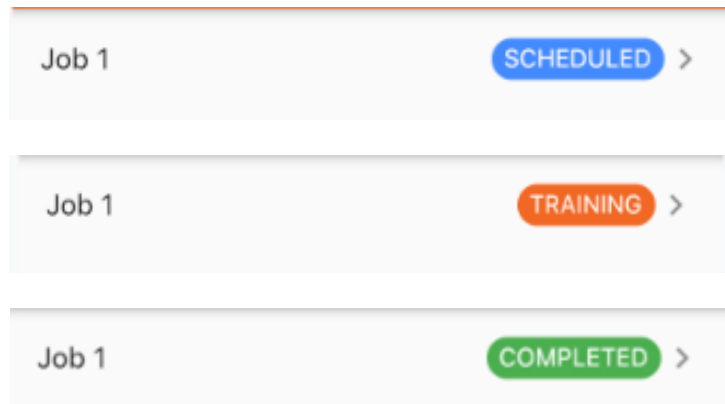


# 訓練模型

- App 會將相片上傳到我們的 server 進行訓練
- 你可以用自己既電腦進行訓練，無 GPU 的話大約要 30 分鐘

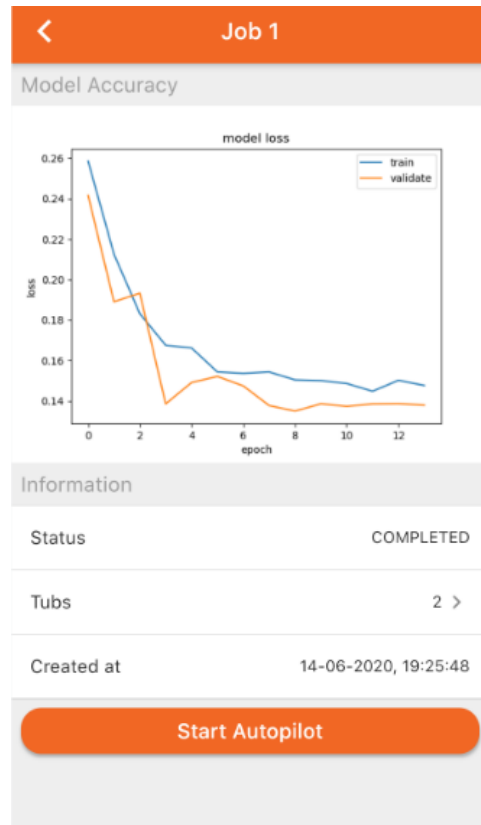
# 訓練模型

- 上傳成功後，你會睇到以下狀態
  - Scheduled — 排緊隊等 Training
  - Training - 正在訓練
  - Completed - 訓練完成
  - No Capacity - 暫時未能訓練。如果遇到呢個情況，可以告訴老師及重新訓練一次



# 訓練模型

- 訓練成功後，你會見到呢個畫面

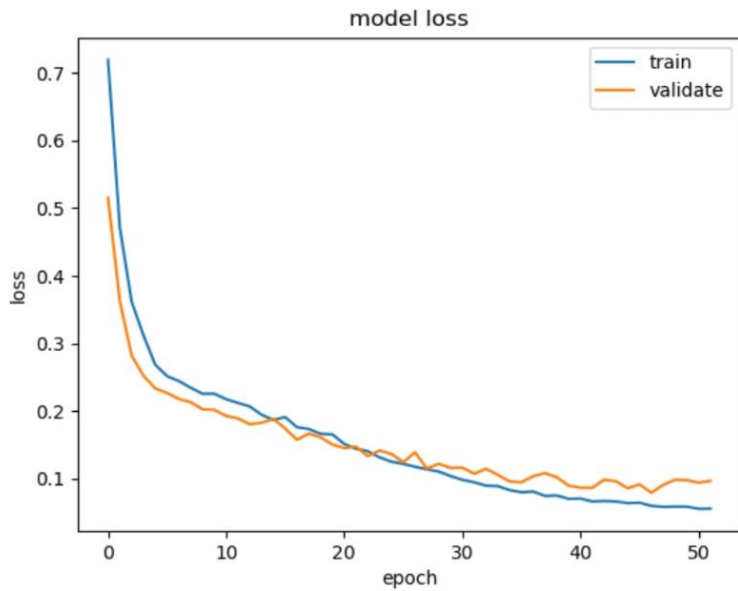




# 訓練模型

← Job 33

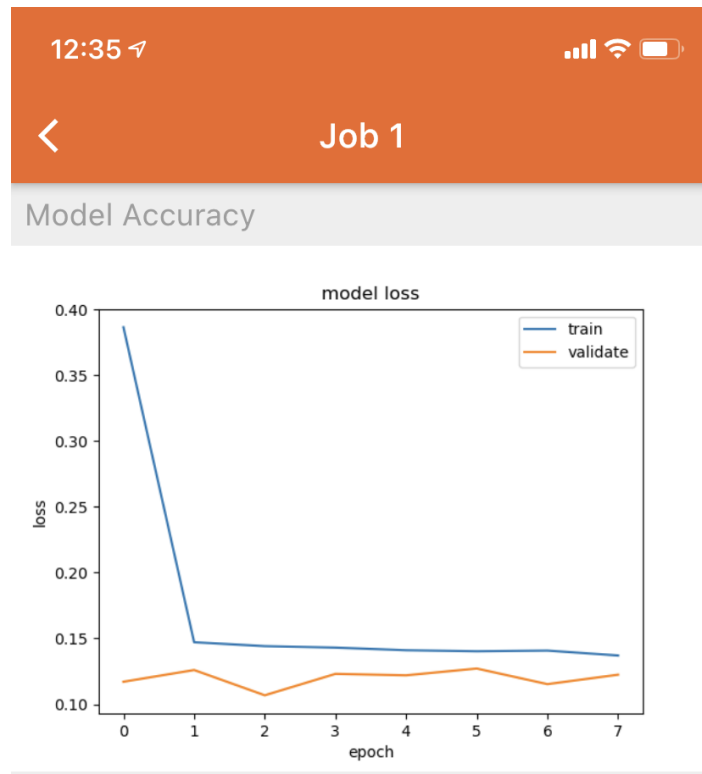
Model Accuracy



- X-軸 (Epoch): 重覆使用數據訓練的次數
- Y-軸 (Loss): 損失值 (越低越好)
- 藍色線: 訓練集(training set)
- 橙色線: 驗證集 (validation set)

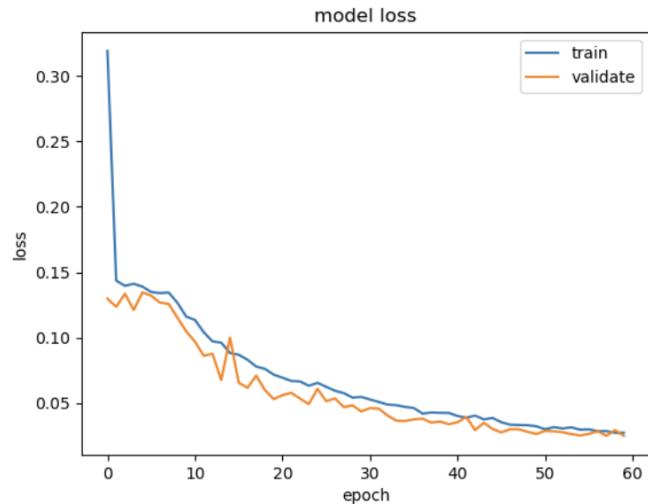
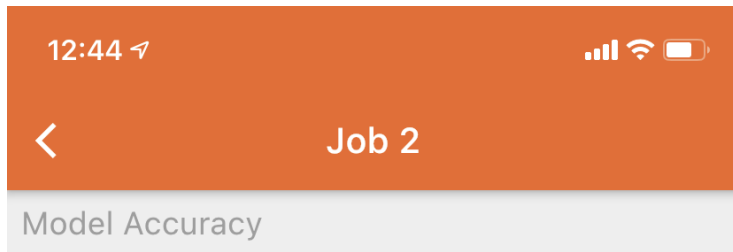
# 訓練模型

- 這幅圖(Job 1)有什麼問題？



# 訓練模型

- Job 2 和 Job 1 有什麼分別？
- 為何會有這種情況發生？

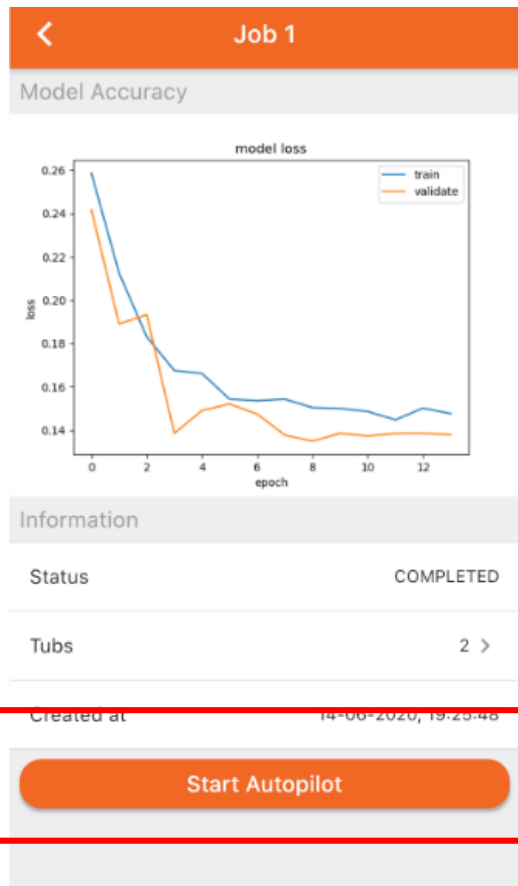


開始自動駕駛



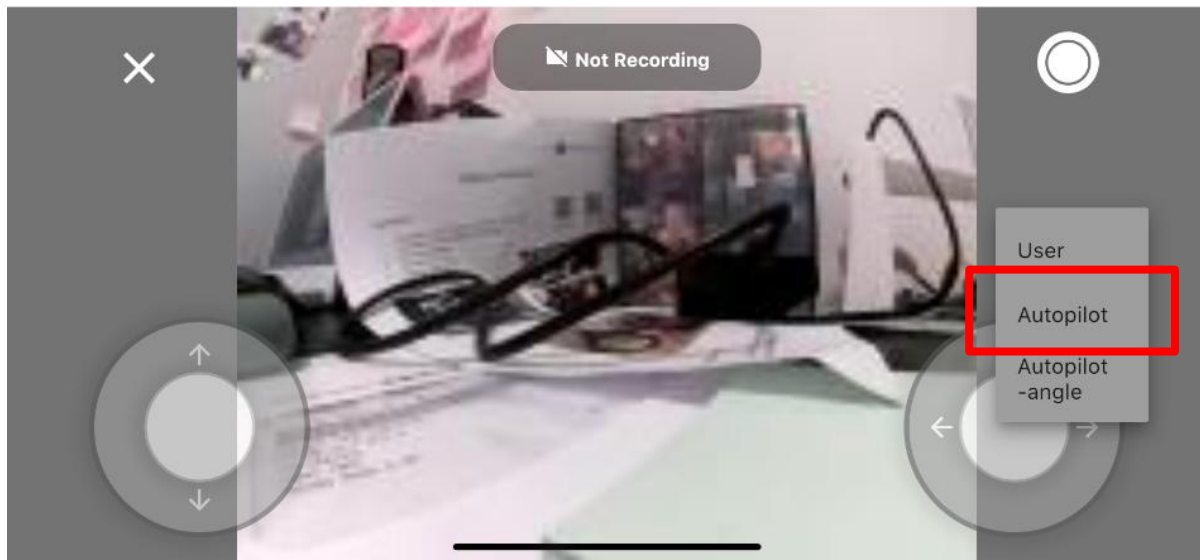
# 開始自動駕駛

- 按 Start Autopilot 開始無人駕駛模式



# 自動駕駛

- 同樣我們會進入駕駛介面 (Drive UI)
- 選擇 Autopilot，就會開始自動駕駛



# 緊急停車



# 自動駕駛



你的車能順暢地在賽道駕駛嗎？



# 自動駕駛



你的模型能反方向行走嗎？

# 計時賽



# 計時賽規則

- 最快完成一圈為之勝利
- 如果賽車在賽道之外行駛，並且在3 秒鐘內沒有回來，將被取消比賽資格

遇到問題

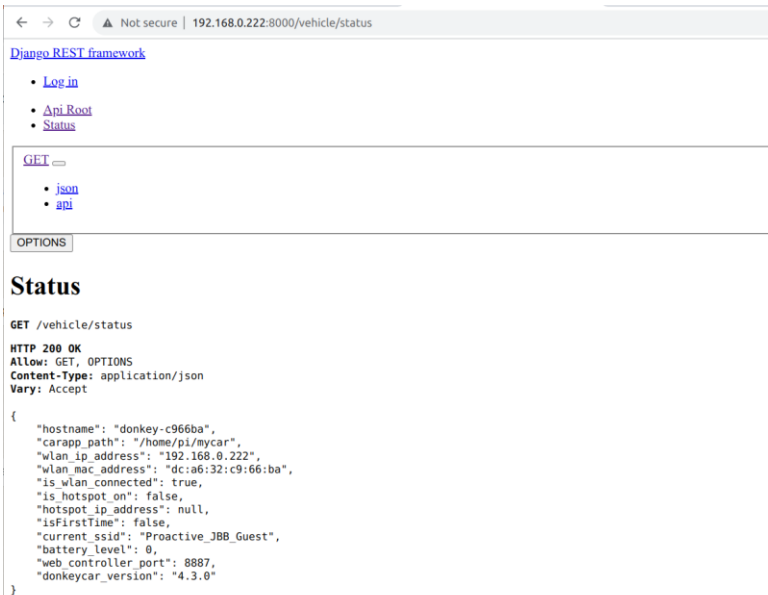




為什麼 Donkey Car App 找不到  
我的車輛？

# 為何 App 找不到 Donkey Car?

- 確保 Donkey Car API 正常
  - 利用手機或 PC 連接 `http://<donkeycar-ip>:8000/vehicle/status`
  - 正常的話會看到這個畫面



# 為何 App 未能找到 Donkey Car?

- 確定 Raspberry Pi 已經啟動
- 確定手機並沒有特別設定 (如防火牆) 阻擋連接至 Donkey Car
- 確定手機跟 Donkey Car 連上同一 Wifi 網絡

# 自動駕駛越行越慢？

- 車速會隨電池電量而減弱
- 可適量調高 THROTTLE\_FORWARD\_PWM 值
- myconfig.py 還有很多其他可以調校的參數
  - AI\_THROTTLE\_MULT