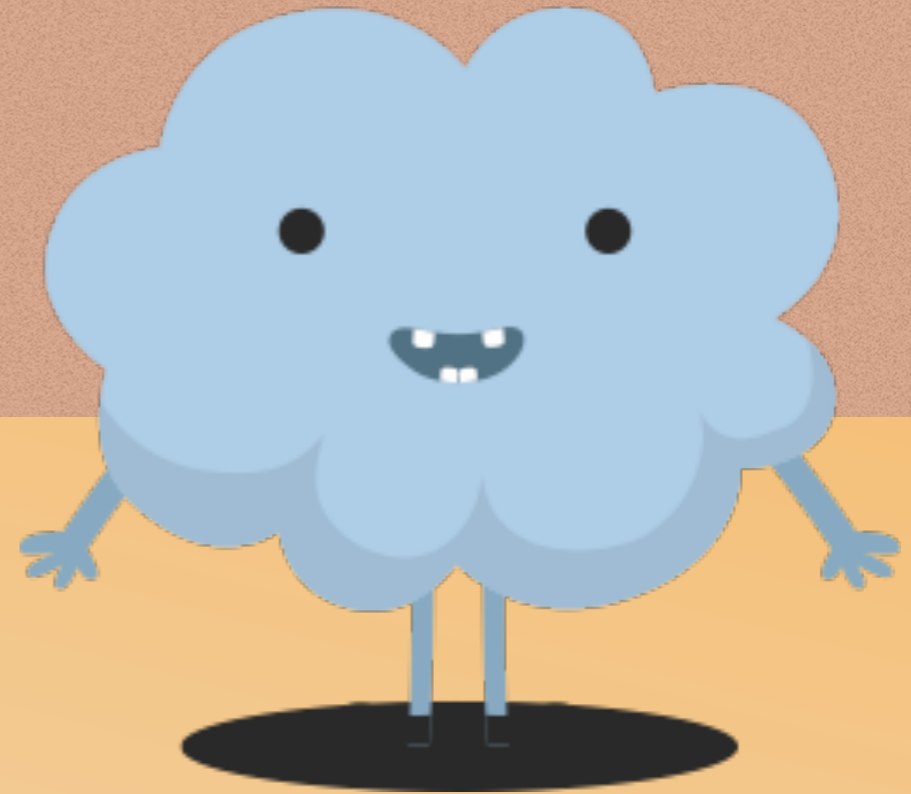


全域觀天儀設計比賽

Total Sky Imager Design Competition



<http://www.cs.hku.hk/~sky/>

Programming for Sky Images
寫程式 · 電腦觀天

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Hong Kong Meteorological Society

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Programming for Sky Images

寫程式 · 電腦觀天

Capturing total sky images
拍得全天域影像

What to do in the competition? 比賽做甚麼？

- ◆ Familiarise yourselves with the requirements!
<https://i.cs.hku.hk/~sky/Competition-English.php>
熟讀比賽規則及作品要求！
<https://i.cs.hku.hk/~sky/Competition-Chinese.php>
- ◆ Design and implement a total sky imager.
設計及製作全域觀天儀。



Image source: Hong Kong Observatory



Image source: EKO ASI-16 Operator Manual



What to do in the competition?

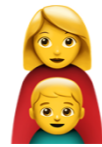
比賽做甚麼？

- ◆ Write report.
寫文字報告。
- ◆ (Primary School teams) Make time-lapse video.
(小學組) 全域影像縮時影片。
- ◆ (Secondary School teams) Store the images and analyse them for cloud cover in Okta.
(中學組) 儲存相片及分析雲量份數。
- ◆ Take Photos of the total sky imager.
拍攝全域觀天儀的作品相片。
- ◆ Make and do presentation.
製作及進行簡報。

Design considerations

設計考量

- ◆ Protect the equipment.
保護設備。



- ◆ Power supply.
電源供應。



- ◆ Night vision?
夜間看天？



- ◆ Data transfer and backup.
資料傳輸及備份。



- ◆ Analysis and visualisation.
分析與可視化。



What are needed to take a total sky image? 用甚麼來拍攝全域影像？

◆ An imaging device. 攝錄設備。



◆ Digital camera. 數碼相機。



◆ Smart phone. 手提電話。



◆ Web camera. 網絡相機。



◆ ... with the right lens. 要有適當鏡頭。



◆ Computer: regular, notebook, credit card-sized,.....
電腦：普通、手提、卡片式、.....



How to take a total sky image? 如何拍攝全域影像？

- ◆ Lens that covers the sky 180°
180° 全域鏡頭
 - * Super wide angle lens 超廣角鏡
 - * Fish eye lens 魚眼鏡
- ◆ Check the readings, do they cover 180° in all dimensions?
是否全部方向都有180° 覆蓋？



Protect the equipments! 保護設備！



- ◆ There's rain..... 有雨……
 - * Shielding from rain without obstructing the sky.
擋雨不擋天。
 - * Rain drops may blur the image.
雨點會使影像變濛。
- ◆ There may be lightning too! 可能有閃電！
- ◆ Shielding and grounding facilities. 屏蔽和接地。

Protect the equipments! 保護設備！



◆ And the sun! 還有太陽！

- * Automatically covering the sun 自動遮擋太陽
- * Calculate sun position with latitude, longitude, date and time
有經緯度、日期和時間，可以計算太陽位置
- * Solar Calculation Details, Global Monitoring Laboratory, Earth System Research Laboratories.
<https://www.esrl.noaa.gov/gmd/grad/solcalc/calcdetails.html>
- * NOAA Solar Calculator
<https://www.esrl.noaa.gov/gmd/grad/solcalc/azel.html>
<https://www.esrl.noaa.gov/gmd/grad/solcalc/>

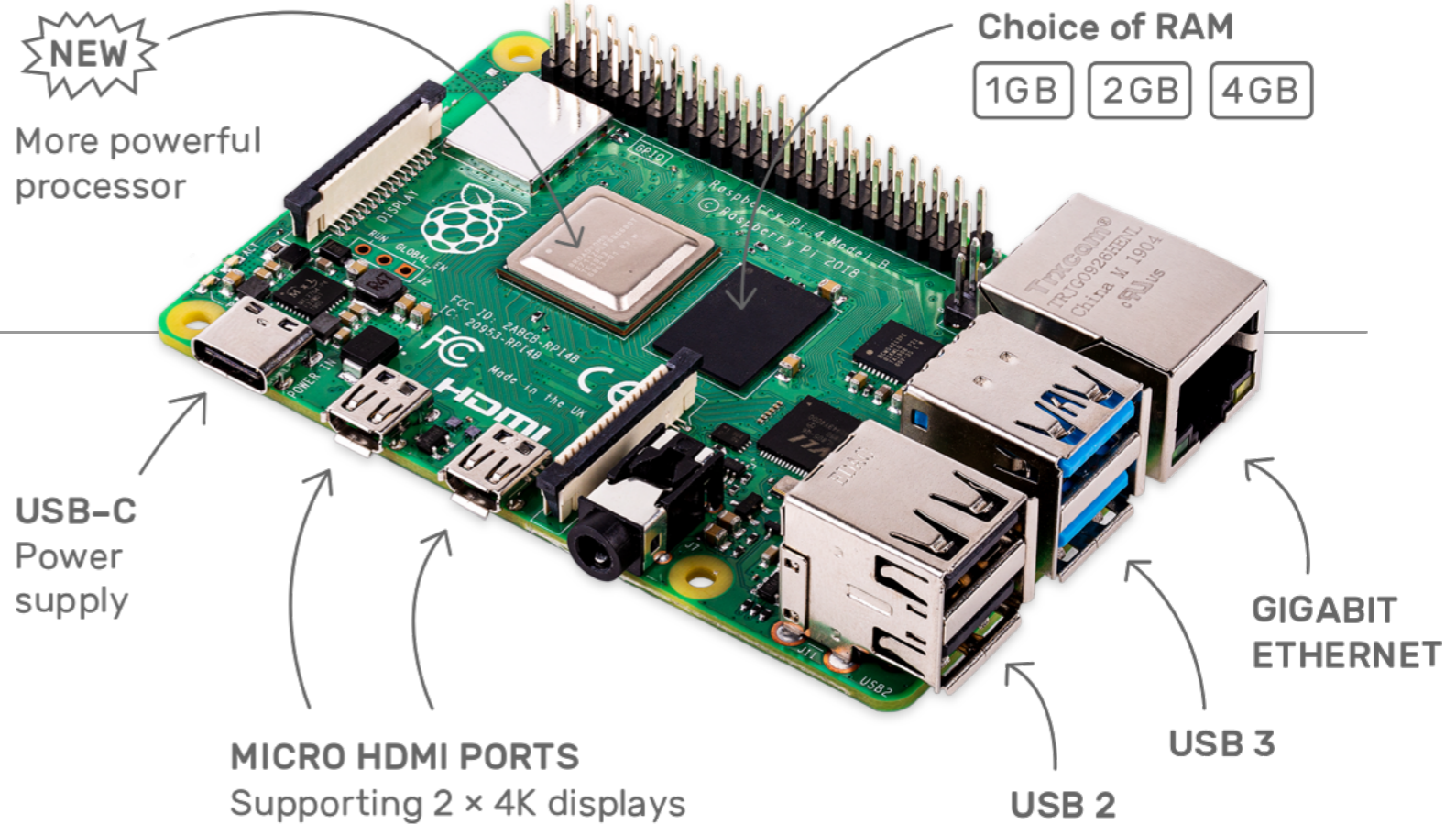


The sun! 太陽！

- ◆ Affects shutter speed and exposure.
影響快門速度及曝光。
- ◆ Lens flare. 鏡頭光暈。
- ◆ Block it!
擋住它吧！
- ◆ Does it work?
可行嗎？



Raspberry Pi 樹莓派



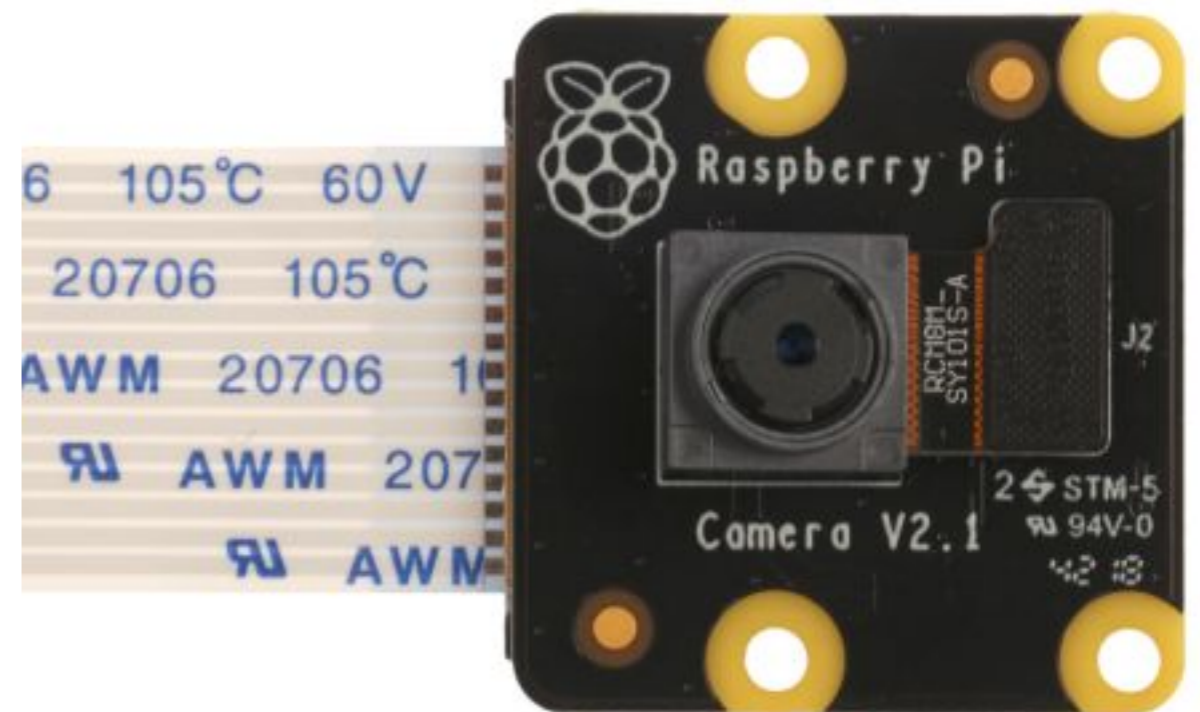
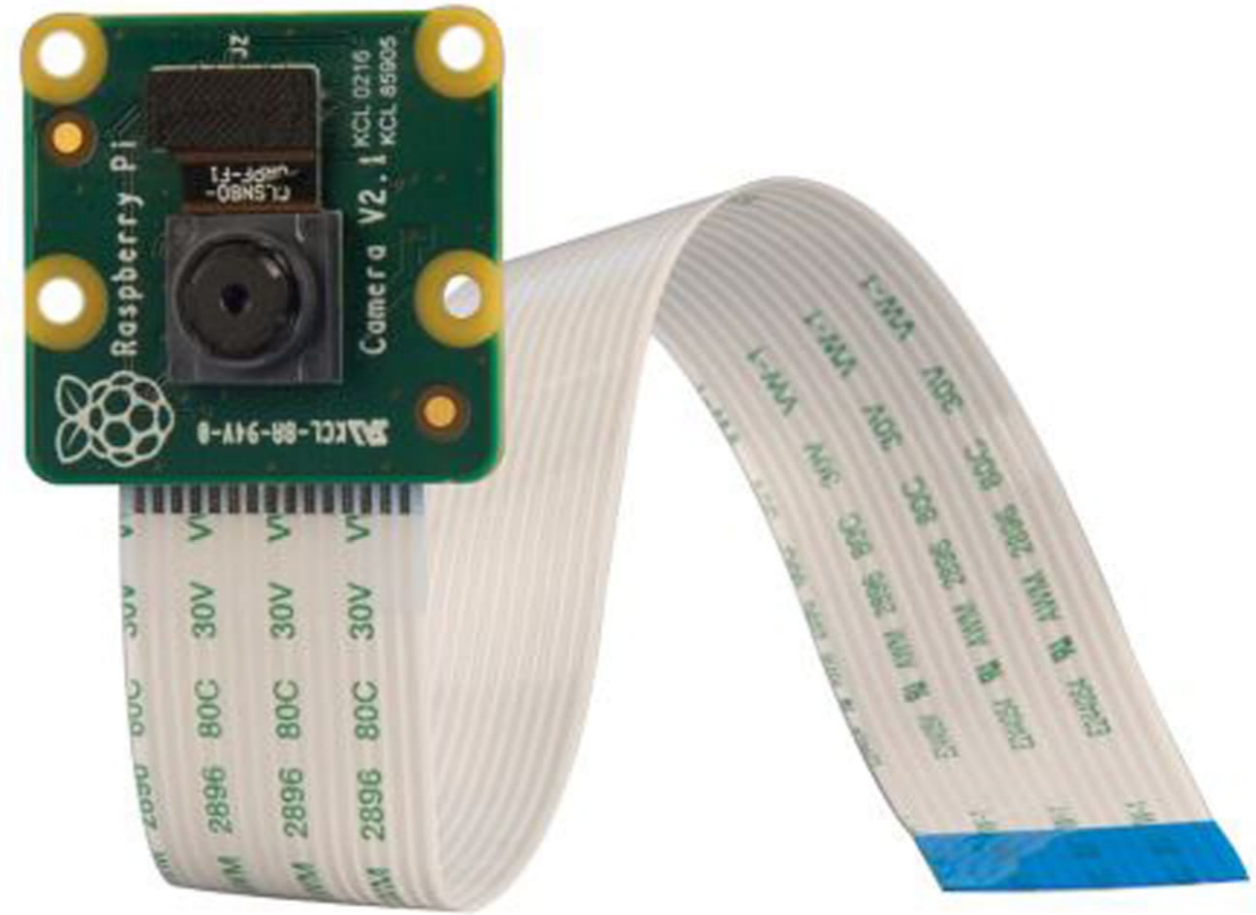
- ◆ Latest 最新版本：
Raspberry Pi 4.
- ◆ Built-in WiFi, BlueTooth.
內置 WiFi, BlueTooth.
- ◆ It's a computer running Linux. 是一部行Linux的電腦。
- ◆ Needs a microSD card to run. 需要一張microSD咭來運行。
- ◆ Supports two monitors. 支援兩台顯示器。
- ◆ Can connect to a camera module. 可連接攝像頭模組。
- ◆ About HKD440. 大約440元。

<https://hken.rs-online.com/web/p/processor-microcontroller-development-kits/1822096/>

Raspberry Pi Camera V2 Camera Module

樹莓派攝像頭模組

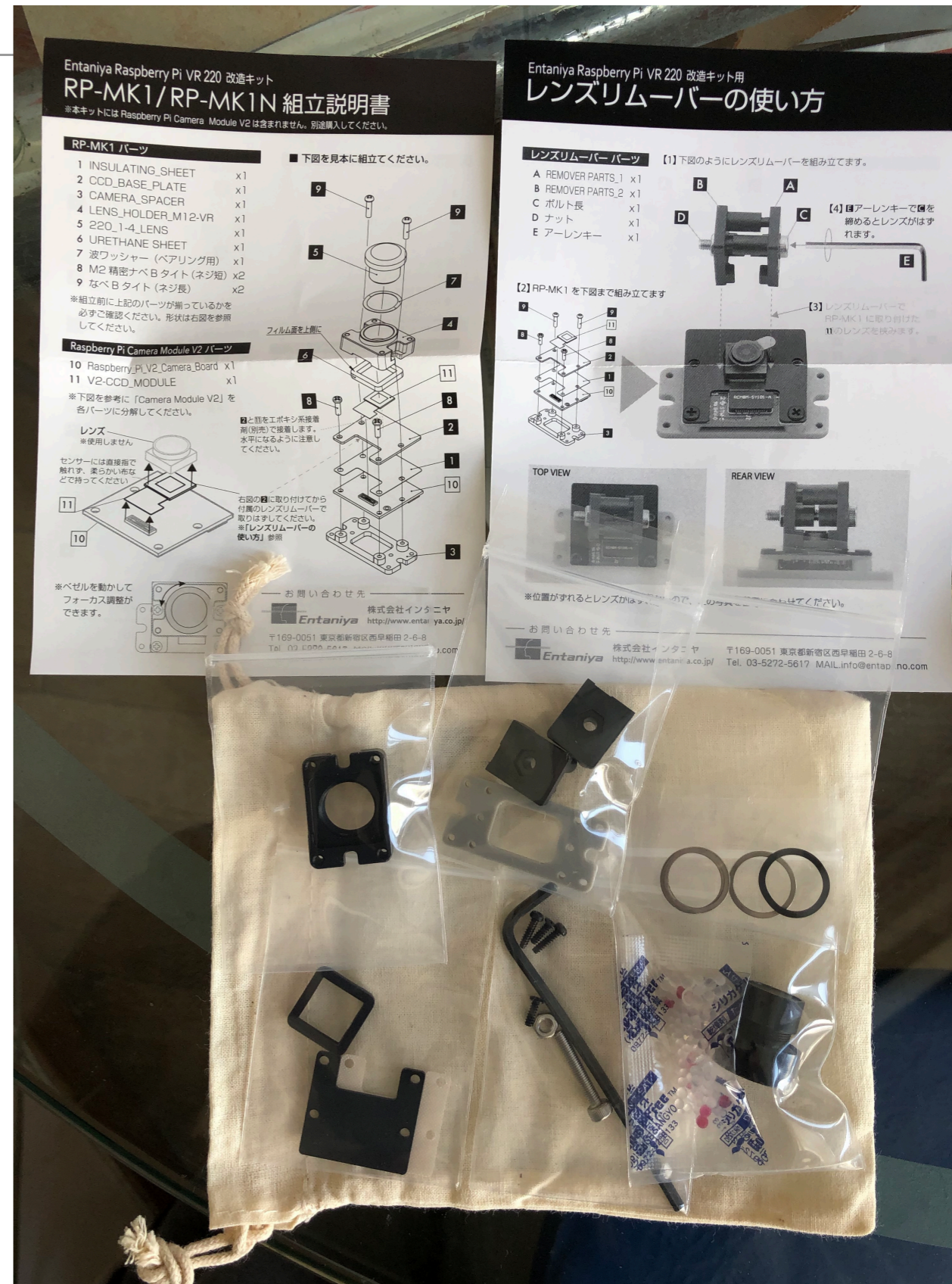
- ◆ Resolution 解像度：
3280x2464
- ◆ Other lower resolution
(1920x1080, 640x480)
models available.
也有其他解像度的模組。
- ◆ About HKD200 大約200元
<https://hken.rs-online.com/web/p/video-modules/1115551/>



Entaniya Raspberry Pi VR220 modification set

Entaniya 樹莓派 VR220 改裝套件

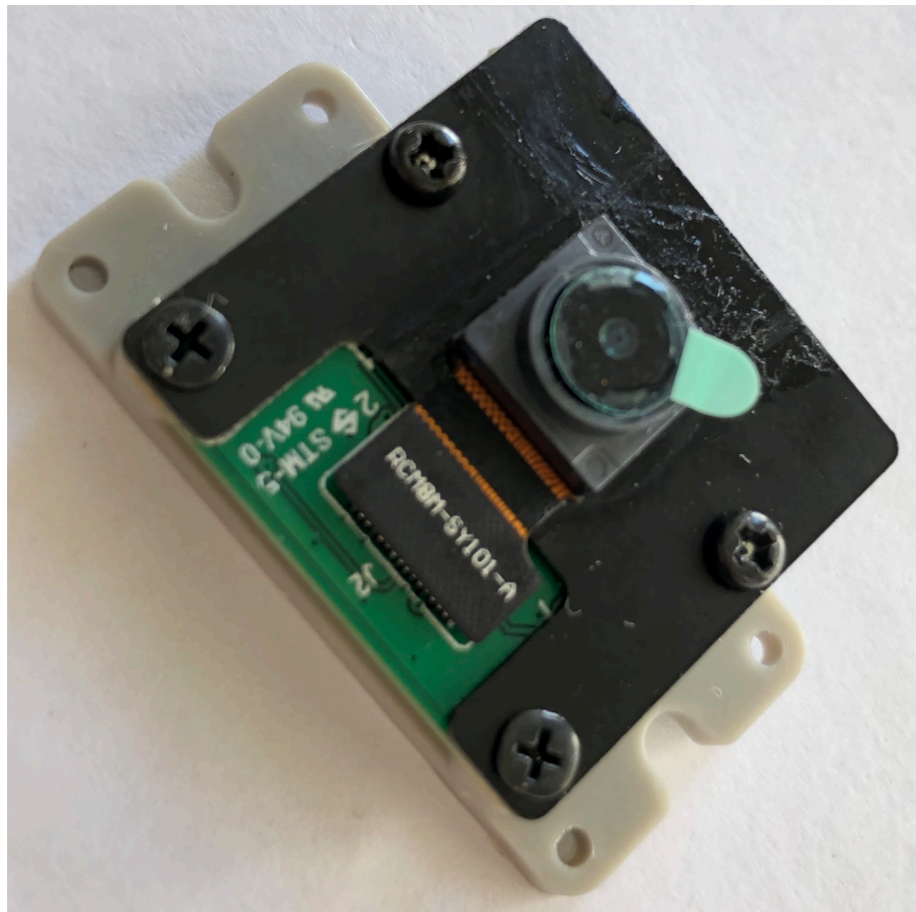
- ◆ Directly modify the Raspberry Pi Camera module for coupling with lens. 直接改造樹莓派攝像頭模組，使其可替換鏡頭。
- ◆ One of the lens is a "220° fish eye lens"! 其中一個鏡頭是「220°魚眼鏡」！
- ◆ <https://entaniya.co.jp/>
- ◆ <https://hken.rs-online.com/web/p/raspberry-pi-cameras/1675919/>
<https://hken.rs-online.com/web/p/raspberry-pi-cameras/1675921/>



RPi camera module being modified

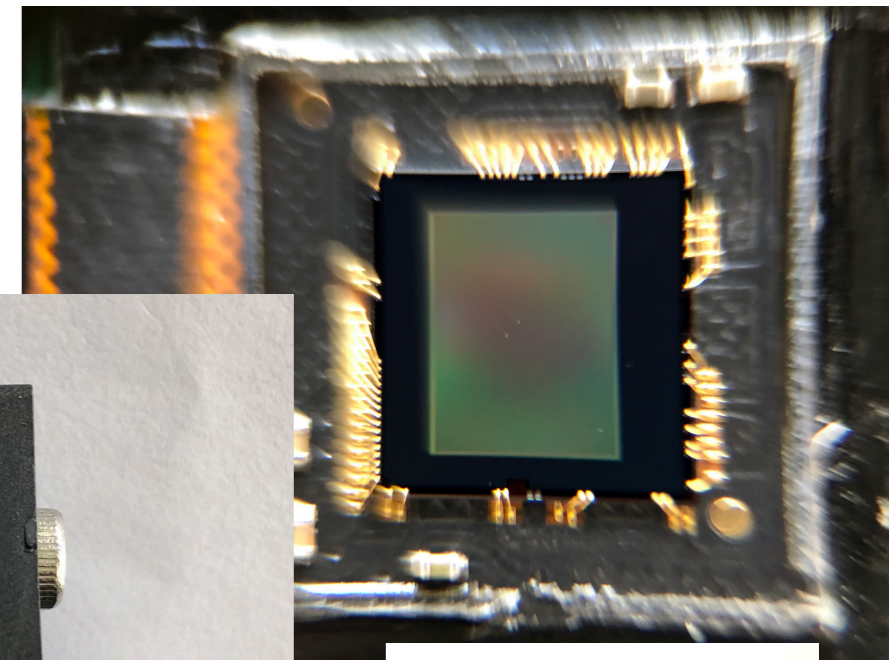
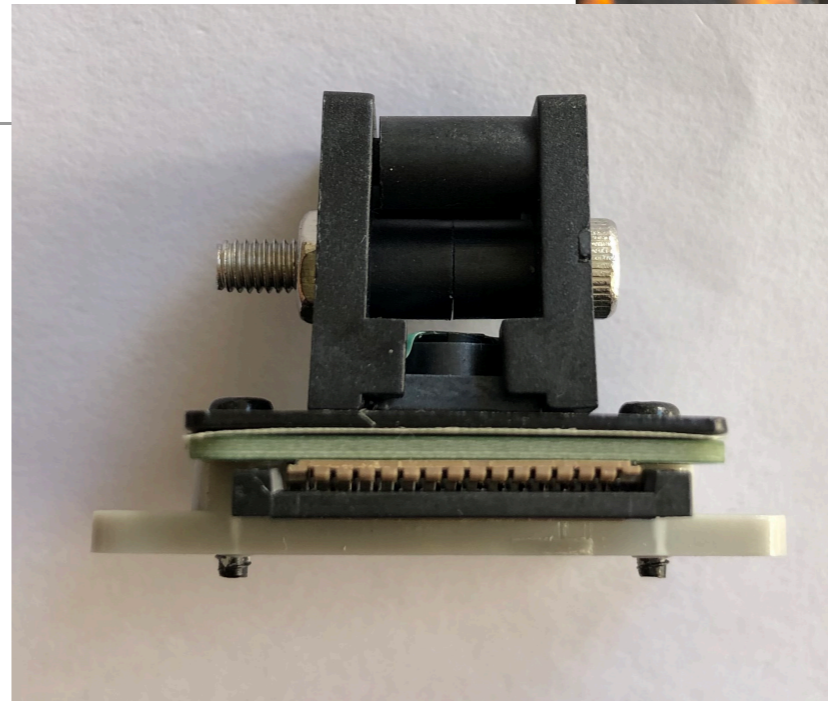
改裝樹莓派攝像頭模組中

- ◆ Needs to stick the camera to the components in the modification kit. 須將鏡頭貼到改裝套件的零件上。
- ◆ Epoxy resin suggested in manual; okay to use superglue. 說明書建議用環氧樹脂。用超能膠亦可。

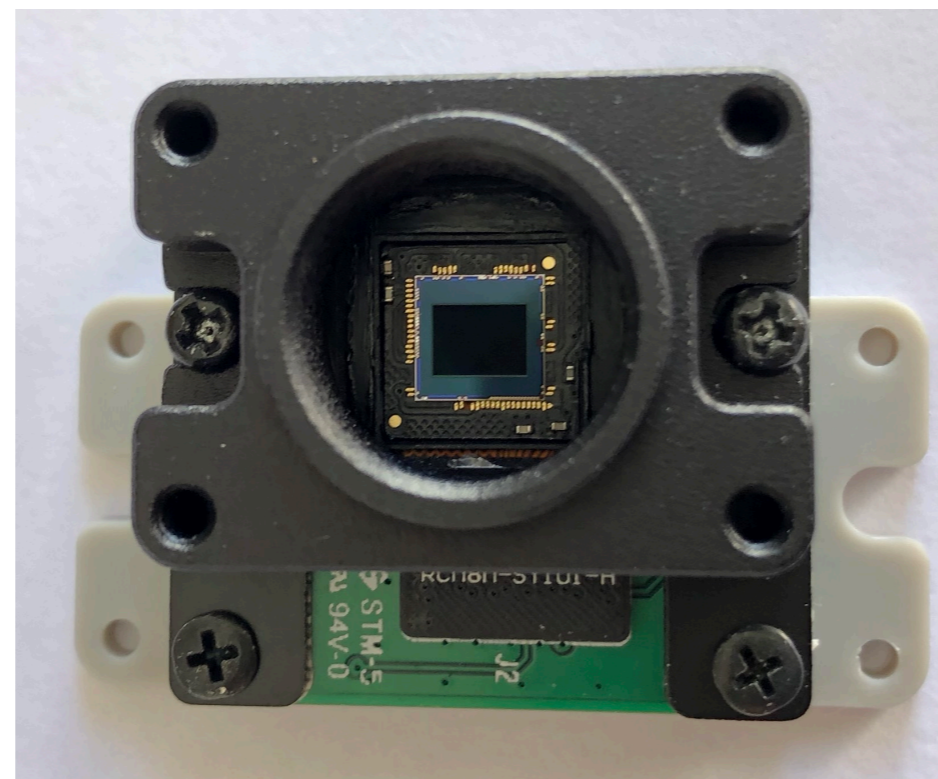


RPi camera module being modified 改裝樹莓派攝像頭模組中

- ◆ There's a tool to remove the original lens.
套件內有工具拆除原本的鏡頭。



- ◆ Be careful!
小心！



Capture the image

擷取映像

◆ Raspberry Pi command to capture image: `raspistill`

樹莓派拍照指令：`raspistill`

* Example 例：

```
raspistill -o photo.jpg
```

What about at night?

夜晚怎樣？

- ◆ Camera modules usually have a NoIR variant.
很多時，有NoIR版本攝像頭模組可供選擇。
- ◆ They do not have infrared filter, and is suitable for shooting at night.
這類模組沒有紅外線濾鏡，適用於夜視環境。
- ◆ Note that camera module modification kits also have NoIR variant.
注意：改鏡套件亦有NoIR版本。

No lens!

沒有鏡頭啊！

◆ Can do without adding lens!

沒有全域鏡頭也可！

* How? 如何做？

◆ Use a camera to scan the space.

用可上下左右轉動的攝像機掃描空間。



* Calculate cloud cover while scanning. 掃描時計算雲量。

* Stitch the video to form one image and analyse.

將短片拼接成一張圖再分析。

* That's the idea of radars! 這就是雷達的原理！

IP camera: beware

IP 網絡鏡頭：小心！

◆ IP cameras are fraud with security problems.

IP 網絡攝像機有不少安全隱患。

* <https://www.computerworld.com/article/2496537/wireless-ip-cameras-open-to-hijacking-over-the-internet--researchers-say.html>

* <https://www.tomsguide.com/us/security-cameras-easy-hack,news-23985.html>

* <https://www.tomsguide.com/us/cheap-camera-flaws,news-25595.html>

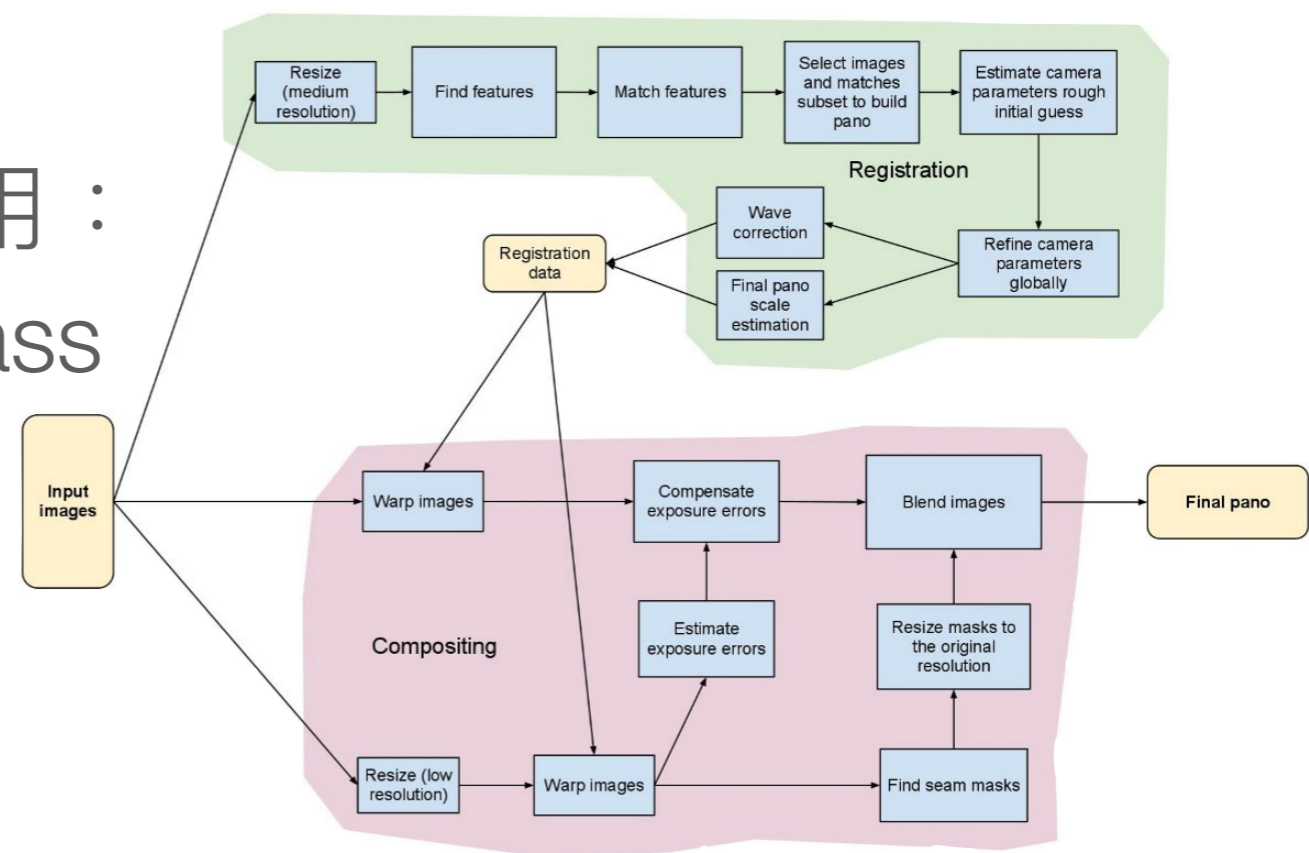
How to stitch? 如何拼接？

◆ Photo stitcher software 相片拼接軟件

* Hugin <http://hugin.sourceforge.net/>

* AutoStitch <http://matthewwalunbrown.com/autostitch/autostitch.html>

◆ Programmatically 編程用： OpenCV `cv::Stitcher` class



Question-and-answer time

問答時間

