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THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY
電子及計算機工程學系
DEPARTMENT OF ELECTRONIC & COMPUTER ENGINEERING

Introduction to Aerial Robotics
Lab Tutorial

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Linux Basis

- Be familiar with command line and some common commands and tools.
- Be familiar with the package management system and the file management system on Linux
- Install ROS and configure the environment on your laptop(go through with the tutorial on http://www.ros.org)

  Suggest software tool: terminator, vim, ssh, htop

ROS Basis

- The Robot Operating System (ROS) is a set of software libraries and tools that help you build robot applications. From drivers to state-of-the-art algorithms, and with powerful developer tools, ROS has what you need for your next robotics project.
- ROS is a open source communication framework with many useful tools.

About the 1st lab session

- Each group will be equipped with a Jetson TX2 computer, which can be mounted on the quadrotor. The computer is running a Ubuntu OS and has all necessary packages such as ROS or Eigen.

- The TX2 is connected with the router in the lab through an Ethernet cable. You can use “ssh XXX(host name)@xxx.xxx.xxx.xxx(host IP)” to remote login on TX2 form your laptop.

About the 1st lab session

- We will provide you all the necessary codes except the controller. You should write a controller which can be the same as the one you used in your simulator, but in C++...

- Do not just let it go after you finished your controller. We will teach you how to test and debug with your code before you start a flight. One group has **only one** quadrotor, be careful. And if it crash, you are responsible for repairing it.

Project 1 Phase 4

- Assemble quadrotor
- First flight of quadrotor
  - Flying under manual control
- Hovering automatically
  - Write your controller
- Following trajectory automatically
  - Write your trajectory generation

Assemble quadrotor

- Assemble quadrotor

4 legs
4 motors
4 propellers
4 electric speed controllers
Flight controller
Receiver
Battery

Quadrotor Equipment

- Main Elements List

Element	Number	Manufacturer	Price (HKD)	Reference Link
F330 structure	1		50	
N3 flight controller	1	DJI	2,999	www.dji.com/n3
Lightbridge 2	1	DJI	7,759	www.dji.com/lightbridge-2
mvBlueFOX MLC200wg	1	MATRIX VISION	3,500	www.matrix-vision.com/USB2.0-single-board-camera-mvbluefox-mlc.html
Jetson TX2	1	NVIDIA	3,588	www.nvidia.com/object/embedded-systems-dev-kits-modules.html
TX2 carrier board	1	DJI	2,400	
E310 Motors, ESCs	4	DJI	1,154	www.dji.com/e310

Be careful during your experiments because your robot cost more than **HK$ 21,000** !!!

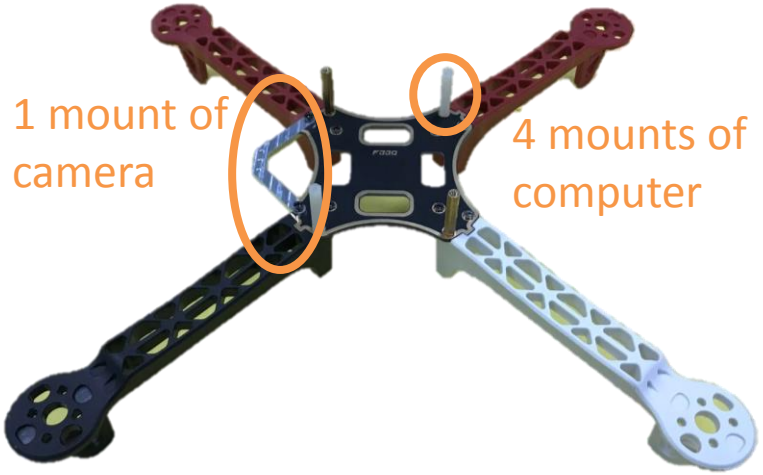
Assemble quadrotor

1. Check if your quadrotor main elements is correct and enough.
   - 4 legs
   - 4 motors
   - 4 propellers
   - 4 electric speed controllers
   - Flight controller
   - Receiver
   - Battery
   - …
2. Read some necessary documents of the main elements.
   Please check the Main Elements List reference link.

Assemble quadrotor

3. Assemble the main structure of the robot,4 legs and center board
   Skew: M2.5*8

4. Assemble the mount of camera and the mount of onboard computer.
   Skew: M2.5*8

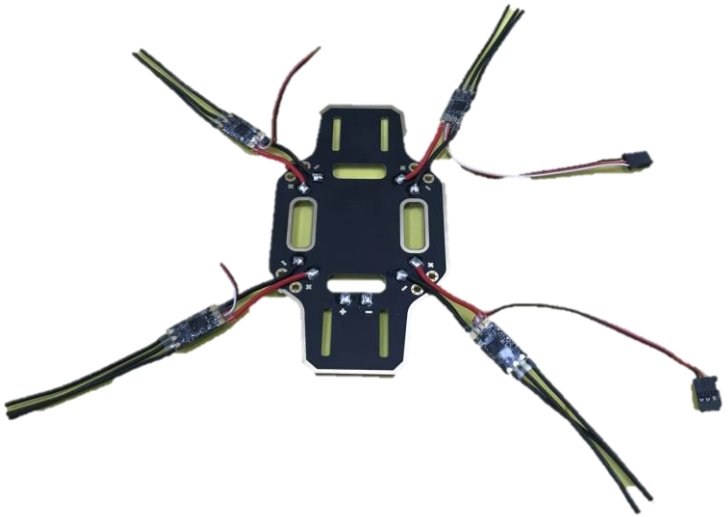


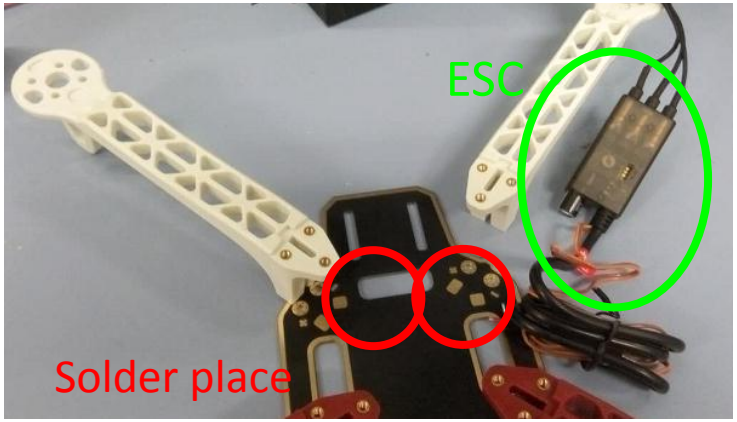
Assemble quadrotor

5. Solder the ESC.

   4 ESCs need to be soldered by electric iron

Be careful with the **hot** electric iron!!!





Assemble quadrotor

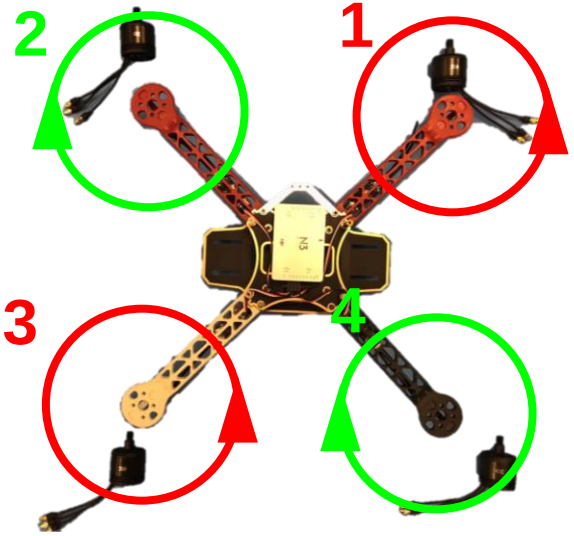
6. Install the N3 flight controller.
   3M Double-sided adhesive

   Be careful of the flight **direction**!!

   Be careful of the **axis** of FC!!! The different definition of DJI and ROS.

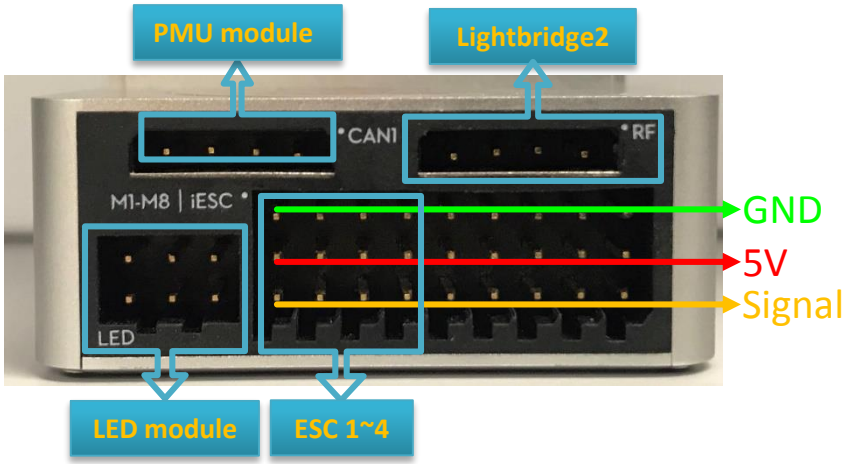
7. Install the motors.
   skew: M3

   Be careful of the spin direction, **CW** or **CCW**!!!

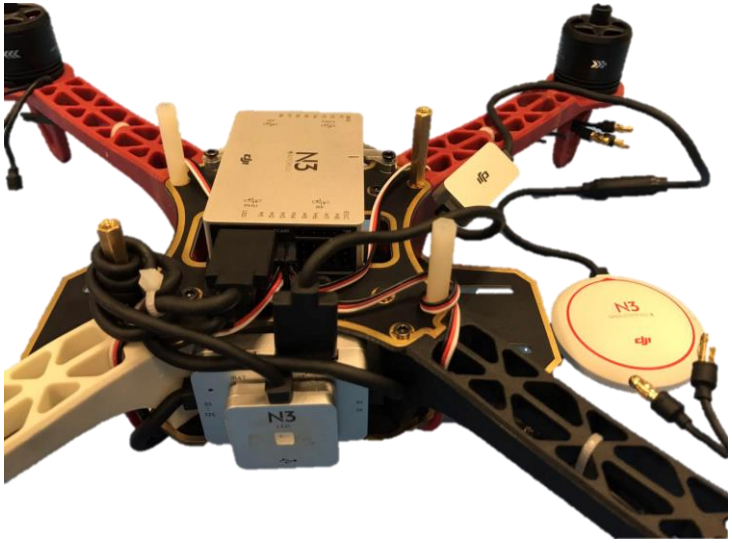


Assemble quadrotor

8. Connect the N3 flight controller and ESCs.
   Be careful of the Motor index (1~4)!!!



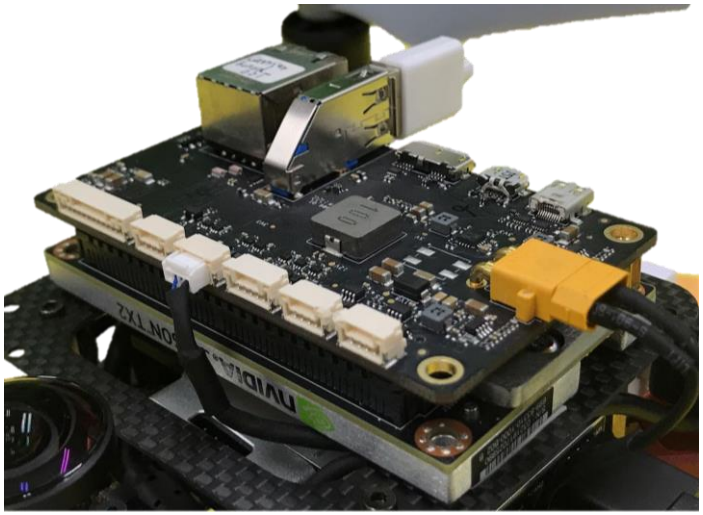
9. Connect the N3 flight controller and other modules of flight controller:
   PMU: power management unit
   GPS: GPS antenna and magnetic sensor
   LED: show FC states.
   3M Double-sided adhesive



Assemble quadrotor

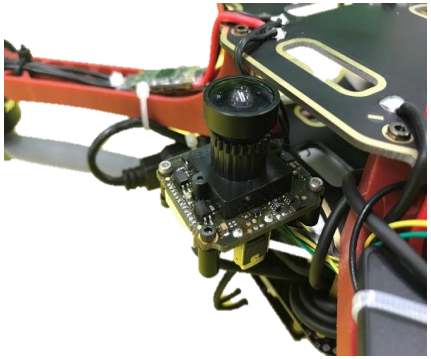
10. Assemble TX2 module.
    Copper pillars
    Skew: M3

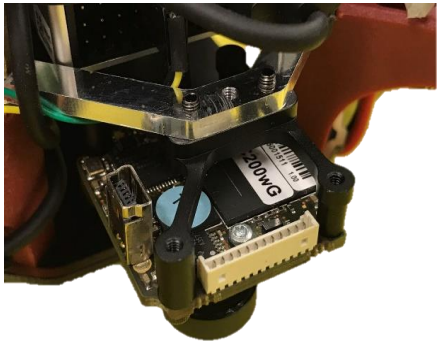
11. Assemble TX2 on the top of quadrotor, with a carbon fiber slice.
    3M Double-sided adhesive



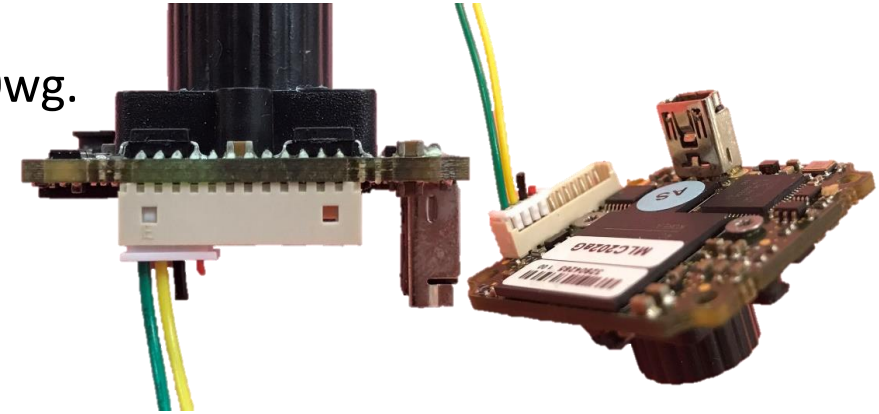
Assemble quadrotor

12. Assemble mvBlueFOX MLC200wg camera on the quadrotor.
    Skew: M2, M2.5



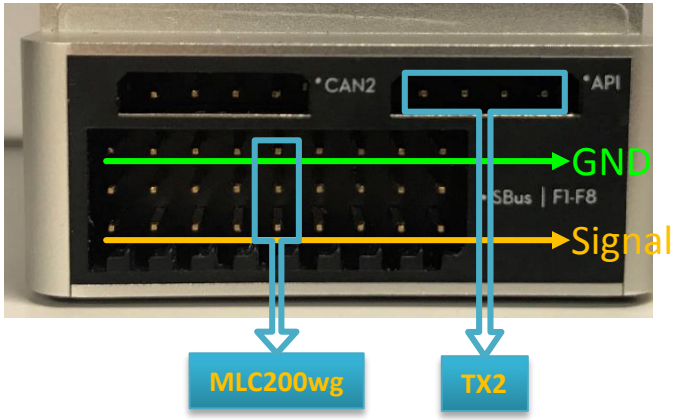


13. Connect the hardware synchronize trigger wire of mvBlueFOX MLC200wg.

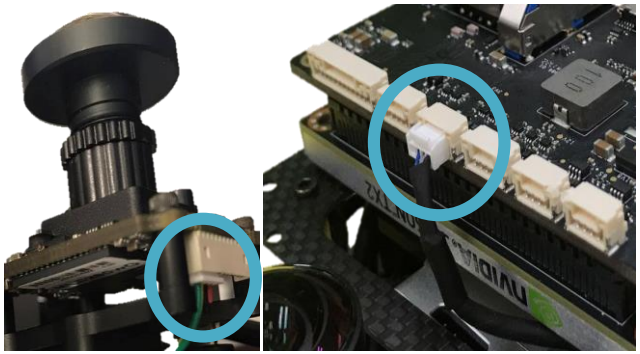


Assemble quadrotor

14. Connect the hardware synchronize port of N3 flight controller to mvBlueFOX MLC200wg.



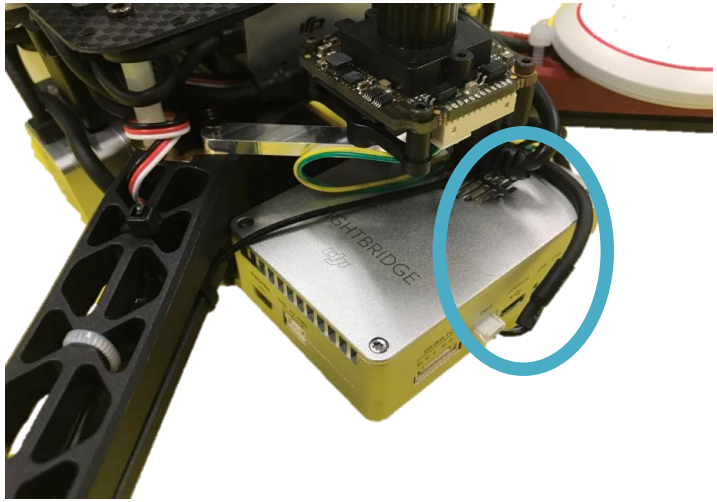
15. Connect the API port of N3 flight controller to TX2.



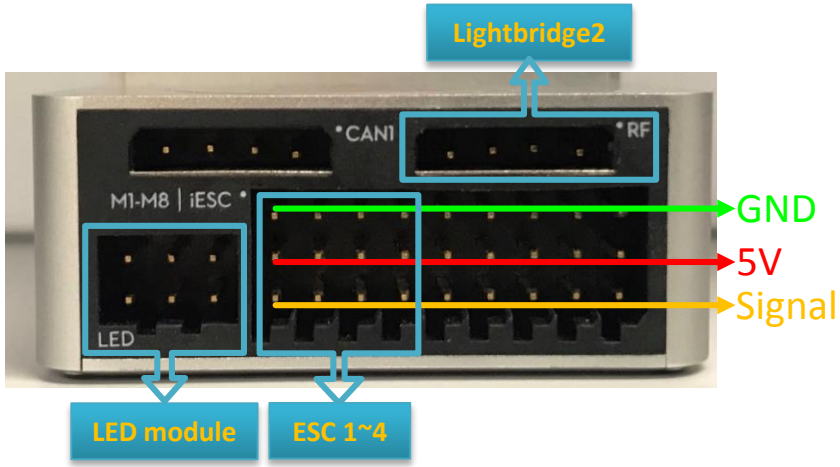
Assemble quadrotor

16. Assemble Lightbridge2 on the quadrotor.

    3M Double-sided adhesive

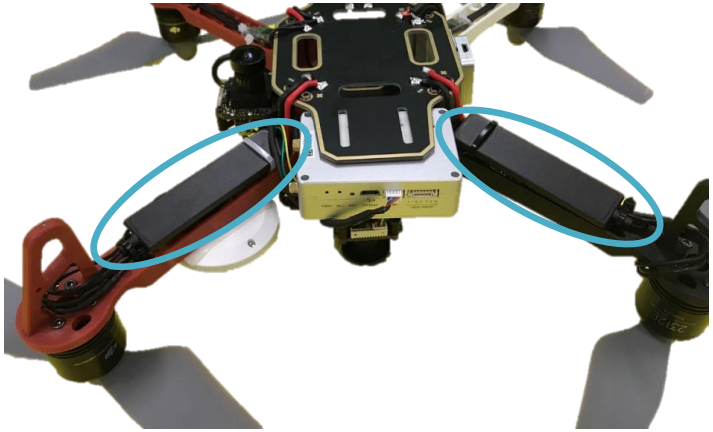


17. Connect the RF port of N3 flight controller to Lightbridge2.



Assemble quadrotor

18. Assemble and fix the antenna of Lightbridge2.
    nylon tie



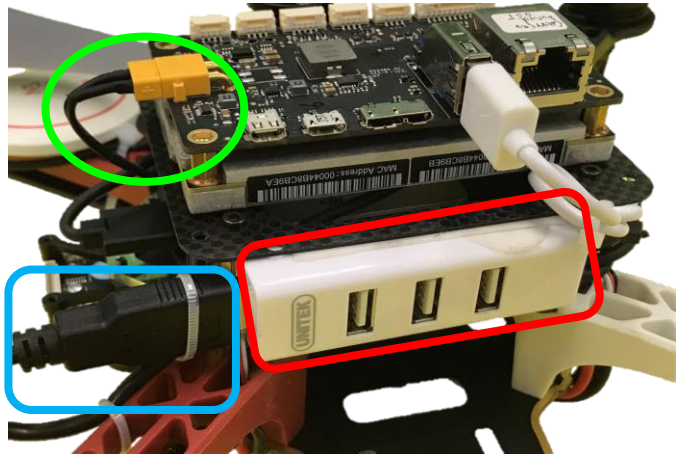
19. Assemble and fix the GPS module on the quadrotor.

    Be careful of the **flight direction**!!

    Be careful of the **magnetic interference**!!

Assemble quadrotor

20. Assemble necessary tools and connections:
    - USB2.0-miniUSB cable
    - USB hub
    - power support cable



21. Fix all of cables.
    - nylon tie

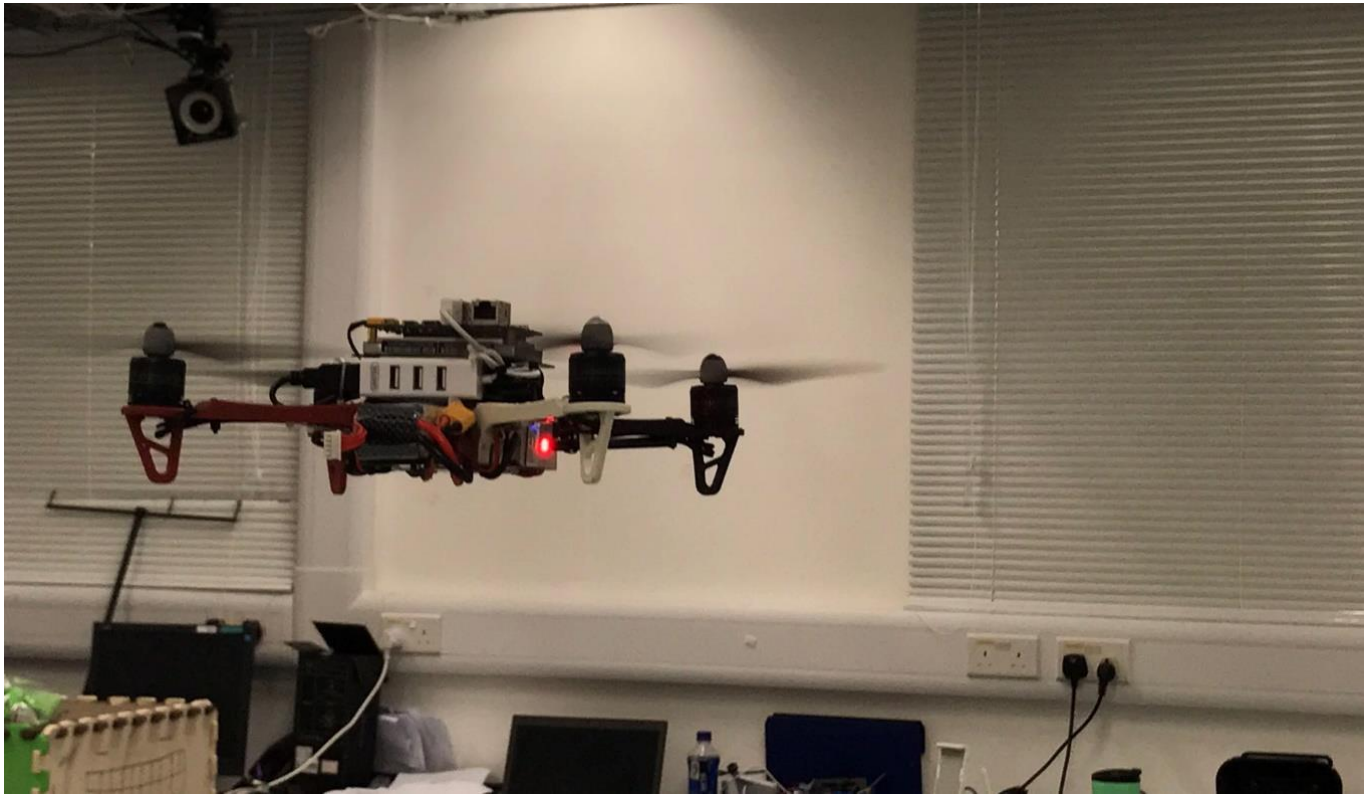
Do **not** install propellers!

Assemble quadrotor

Finish quadrotor assembly.
Congratulations!

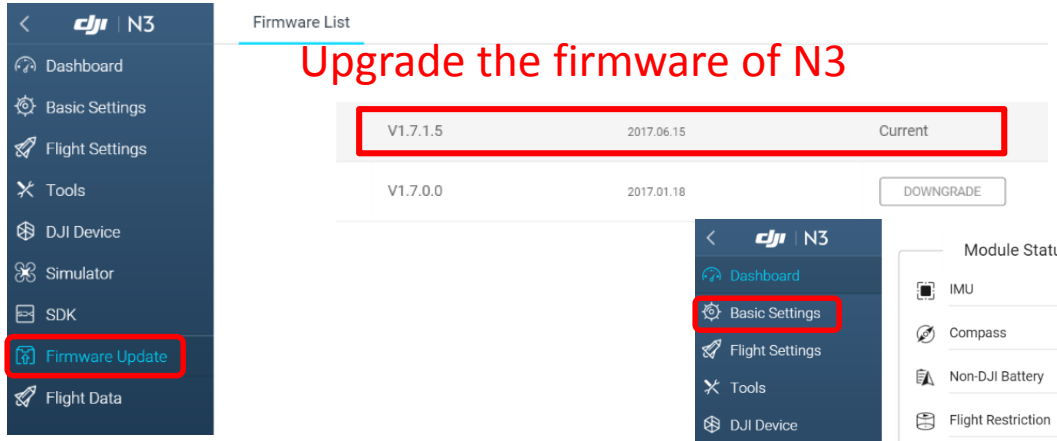
First flight of quadrotor

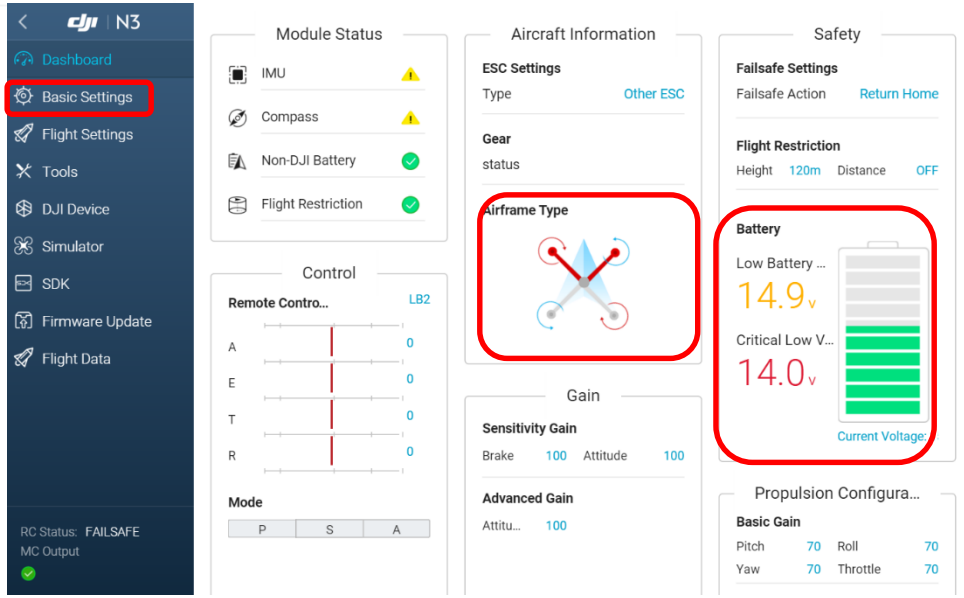
- First flight of quadrotor
  - Flying under manual control



First flight of quadrotor

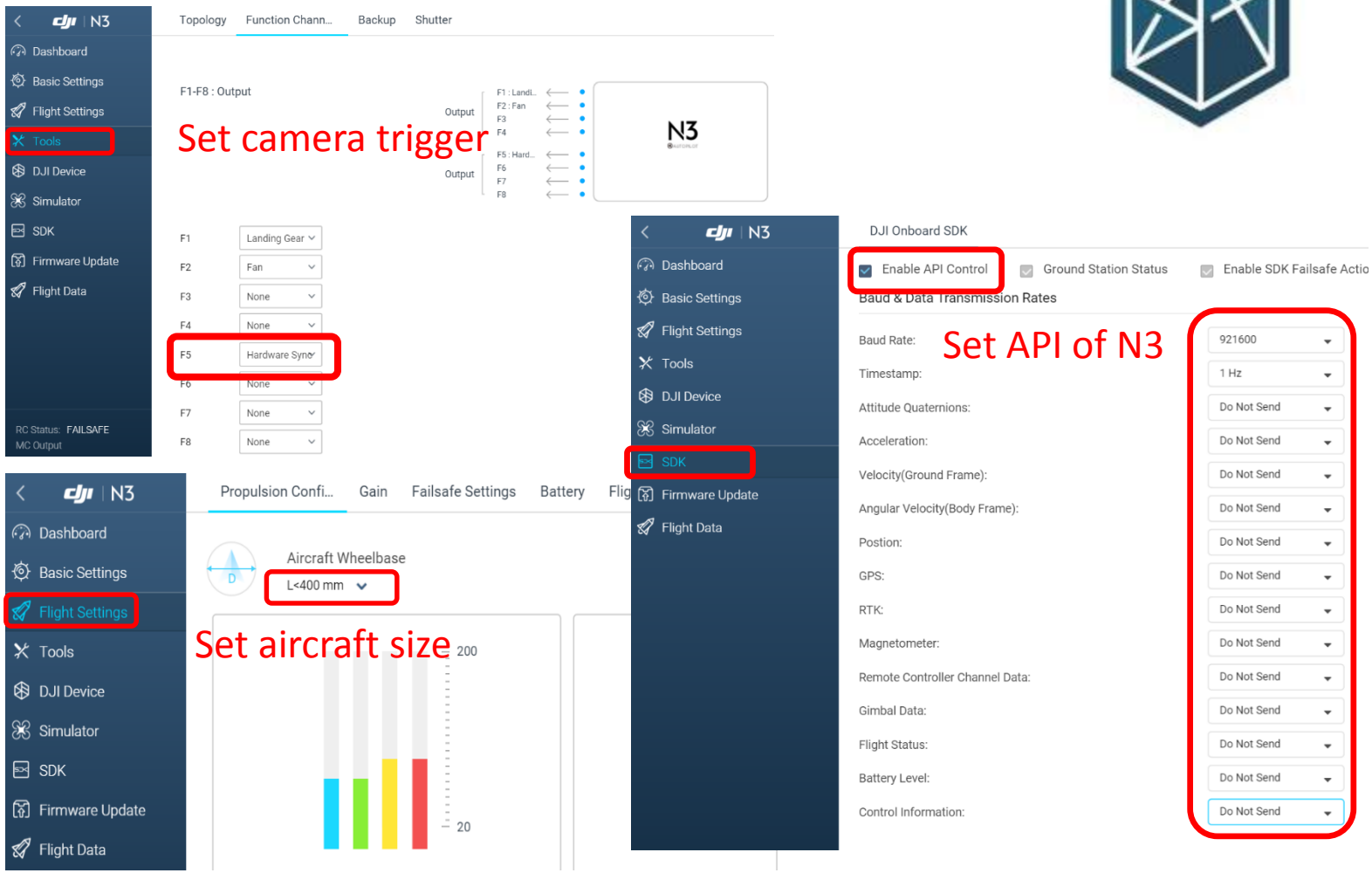
1. Setup and check your aerial robot.
   computer with Windows system
   DJI Assistant 2
   USB cable





First flight of quadrotor

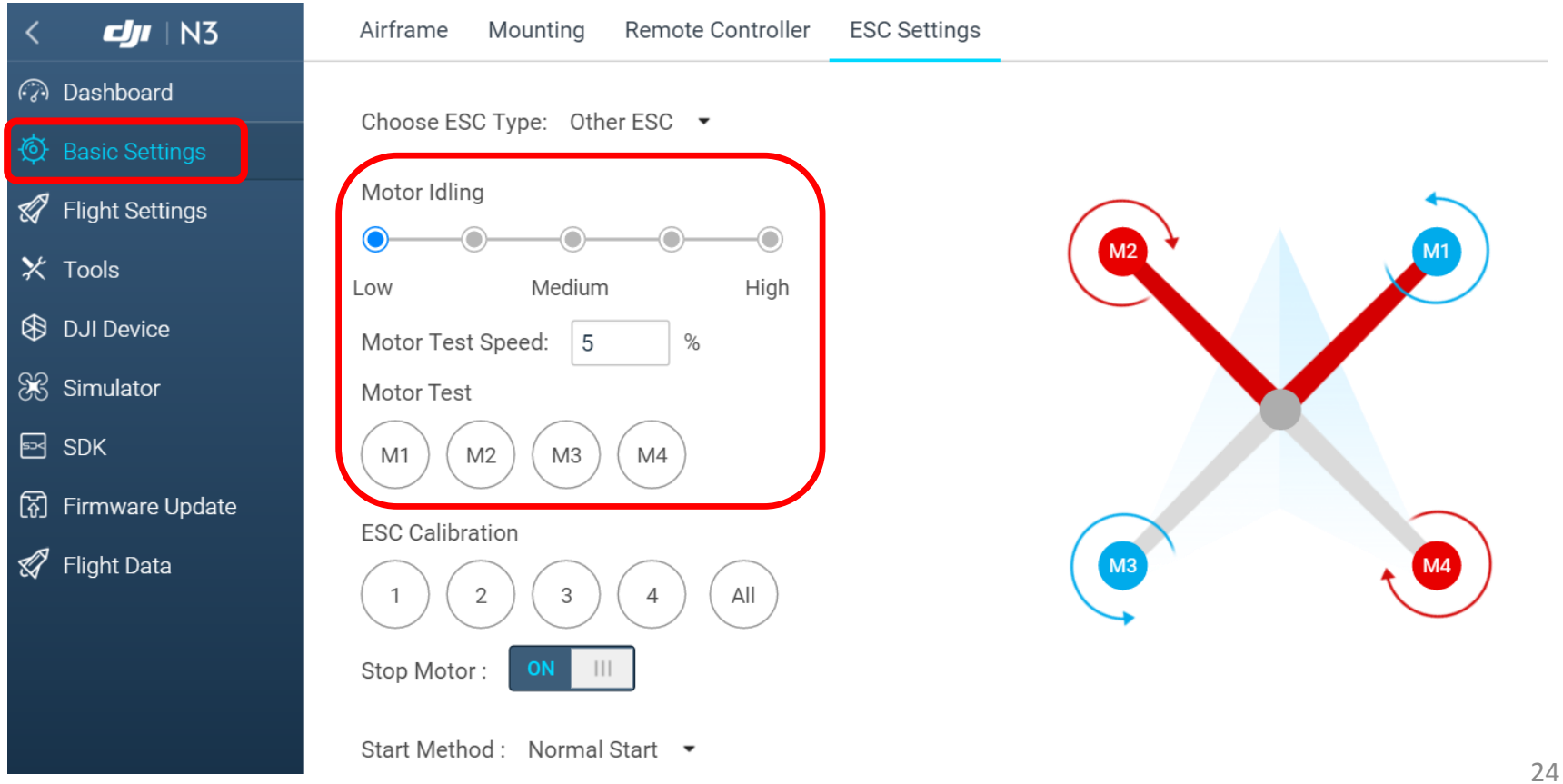
1. Setup and check your aerial robot.



First flight of quadrotor

2. Connect each motor and ESC. Test the spin rotation.
   DJI Assistant 2

   Do **not** install propellers!



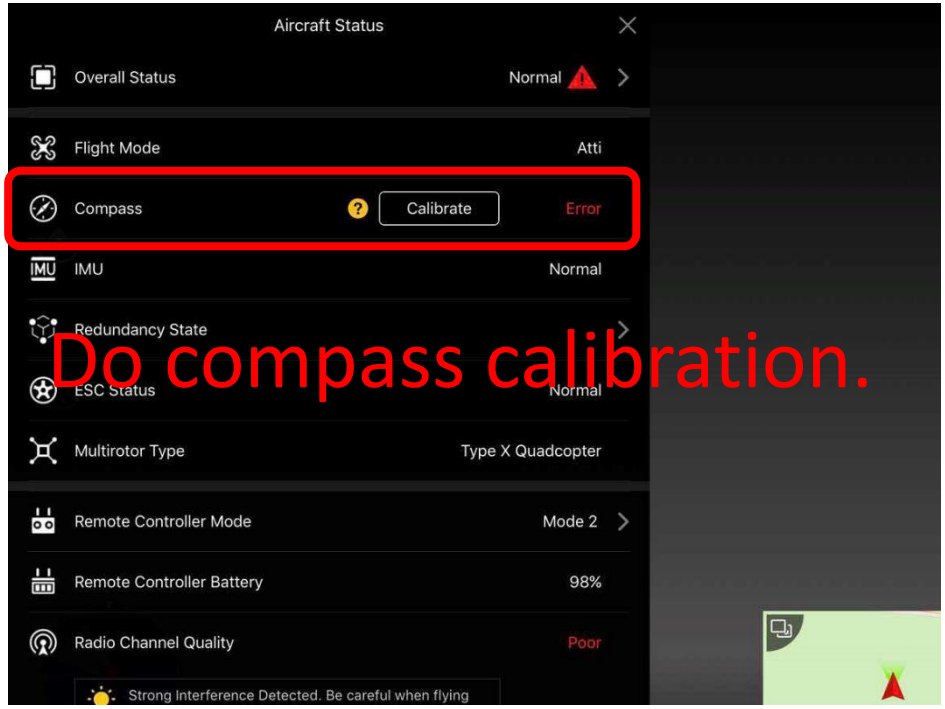
First flight of quadrotor

3. Setup and check your aerial robot.

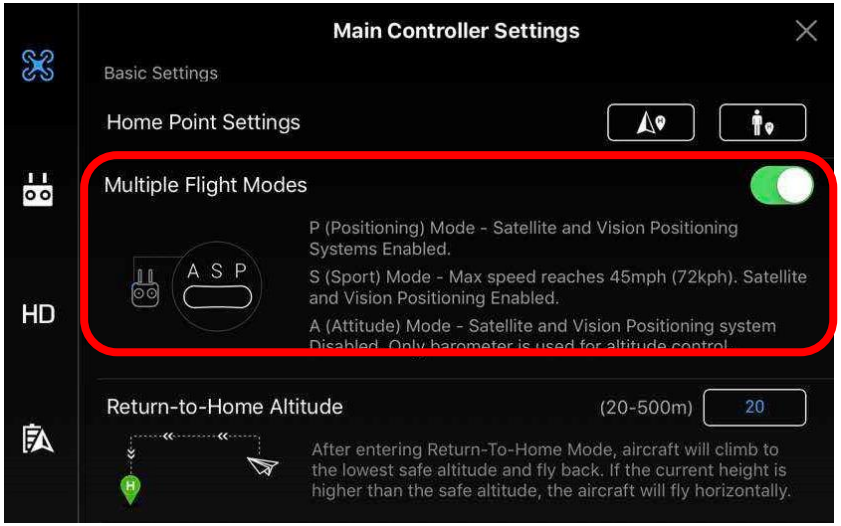
   Your Mobile device, both IOS and Android are suitable

   DJI GO

   Now you can install propellers.



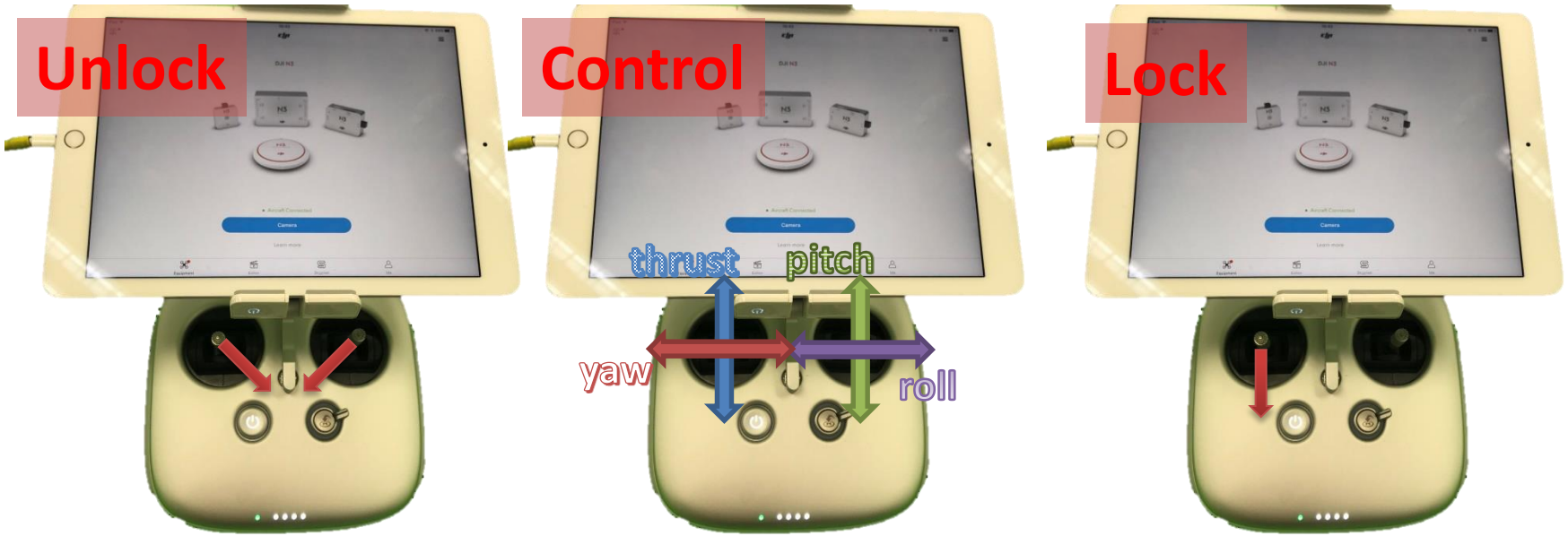
Do compass calibration.



First flight of quadrotor

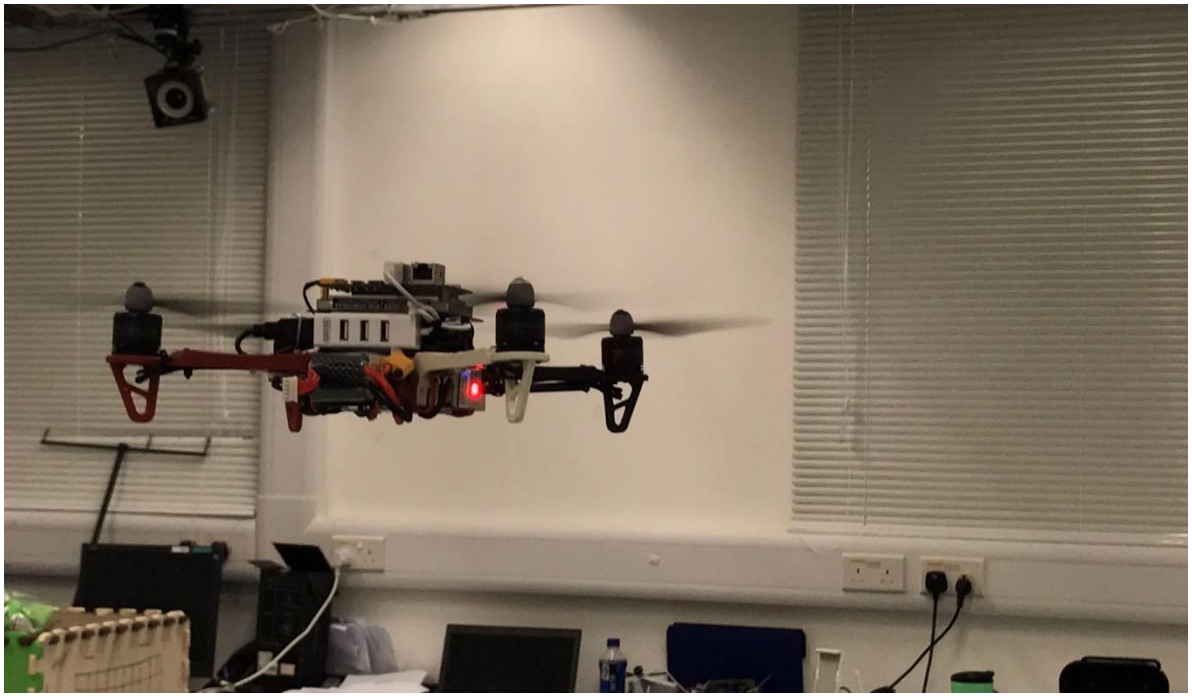
5. Unlock the quadrotor.

6. Control and have fun.



First flight of quadrotor

Enjoy it~



Note again: Be careful during your experiments because your robot cost more than **HK$ 21,000** !!!