오픈소스SW를 활용한 엔젤스윙 드론제작기

Presenter : Won Nyoung Park

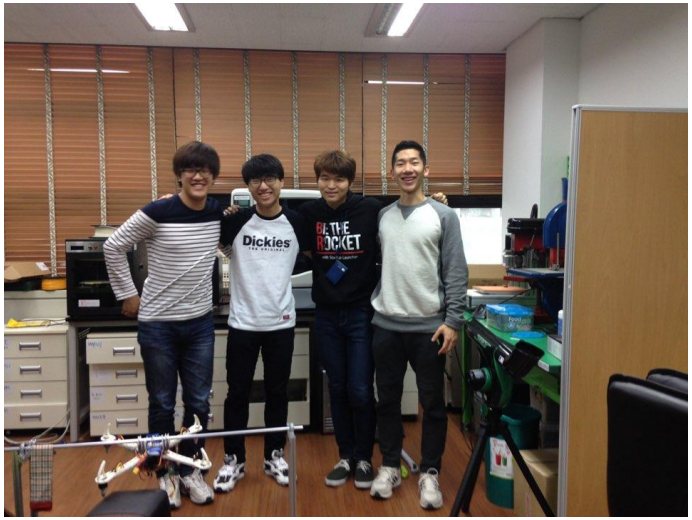
Georgia Institute of Technology

Team Members : Suli, Youbin, Taeyoon, YongHuk, SeungHyun, Bumsoo, Karen

Founder

ANGELSWING
Flight for cause

ThinktankTeam



Engineering Team


네팔, 그들에게 생명의 눈을 기부하세요
ANGELSWING
네팔을 위해 공대생이 만드는
지진피해지역 무인정찰기

네팔 프로젝트 크라우드 펀딩 모델

Georgia Tech

Kathmandu University

네팔지진피해지역

▼ 공대생들의 마음이 담긴 정찰용 드론으로

네팔 지진참사를 돕는 **착한 엔젤스윙** 프로젝트 보러가기 클릭!

공대생들이 만드는 네팔 정찰용 착한 드론, 엔젤스윙 프로젝트

공대생의 지식으로 재난, 환경파괴, 저개발과 같은 글로벌 이슈들을 해결할 수 없을까? 네팔 지진참사 원조를 시작으로, 사람과 환경에 필요한 무인항공기를 만들어 진정으로 필요한 곳에 전달하고자 하는 착한 드론 개발 프로젝트, 엔젤스윙!

엔젤스윙

WADIZ 크라우드펀딩프로젝트

3,309,000 KRW
(2,850 USD)

AngelSwing Projects

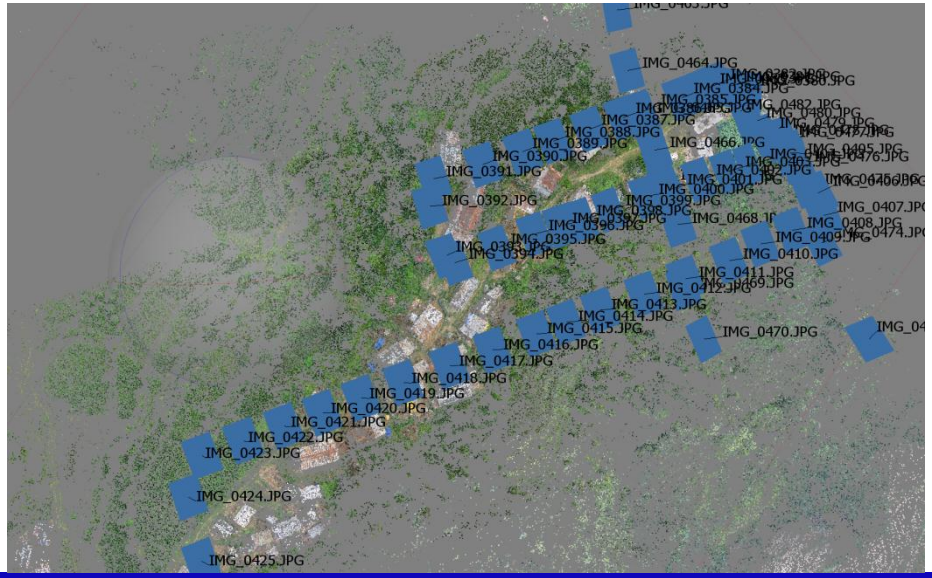


- Our first project in Nepal (August 3 ~ August 10)
  1. UAV demonstration and 2D/ 3D mapping of the disaster area
  2. 4 days UAV workshops and seminars(Sustainability of the project)
  3. Fixed wing UAV was donated to KU


Unmanned Aerial Vehicle
Design, Building and Flying Workshop
6th-9th August 2015
Organized by
KU Robotics Club
in Association with School of Engineering,
Kathmandu University
And
Angel Swing, Seoul National University
Institute for Global Social Responsibility and
Georgia Institute of Technology
SNU.IGSR
Georgia Tech
College of Engineering


ANGELSWING


ANGELSWING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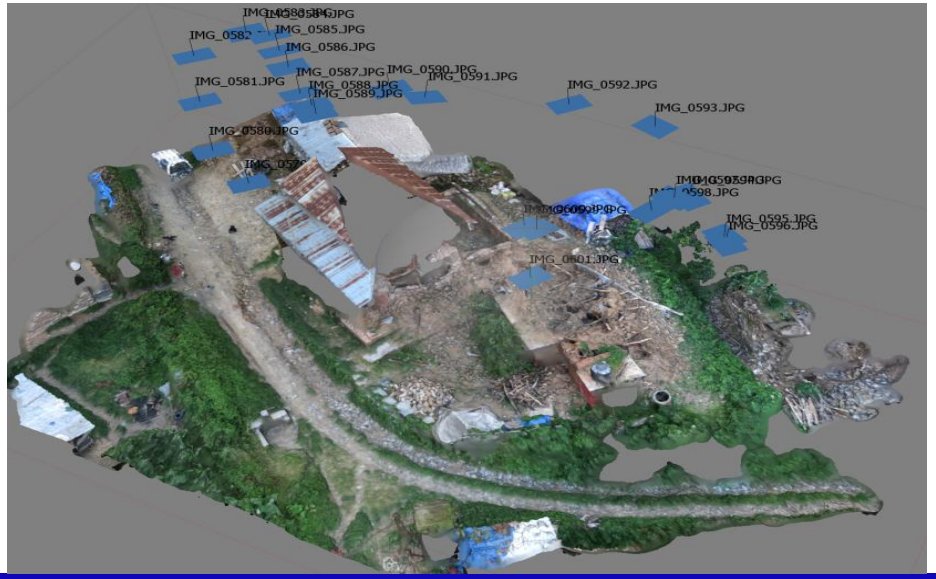
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IMG_0596.JPG
IMG_0601.JPG

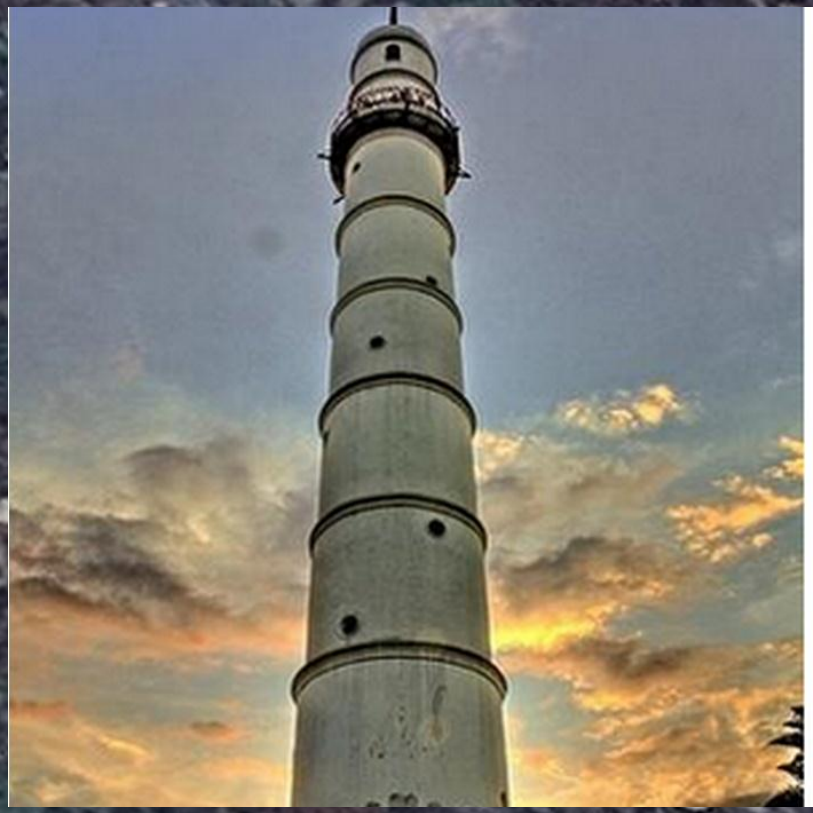
분석결과 및 조치

- 1. 2D,3D modeling 자료 카투만 대학교 및 마을 이장님 전달 예정
- 2. 격지 마을 및 산골 마을 지진 피해 복구 부진
- 3. 산사태 관련 위험 주거지 및 도로 표시 필요
- 4. 식수 문제 해결을 위한 방안 필요
- 5. 네팔 구호를 위한 새로운 크라우드 펀딩 런치 예정

AngelSwing Projects

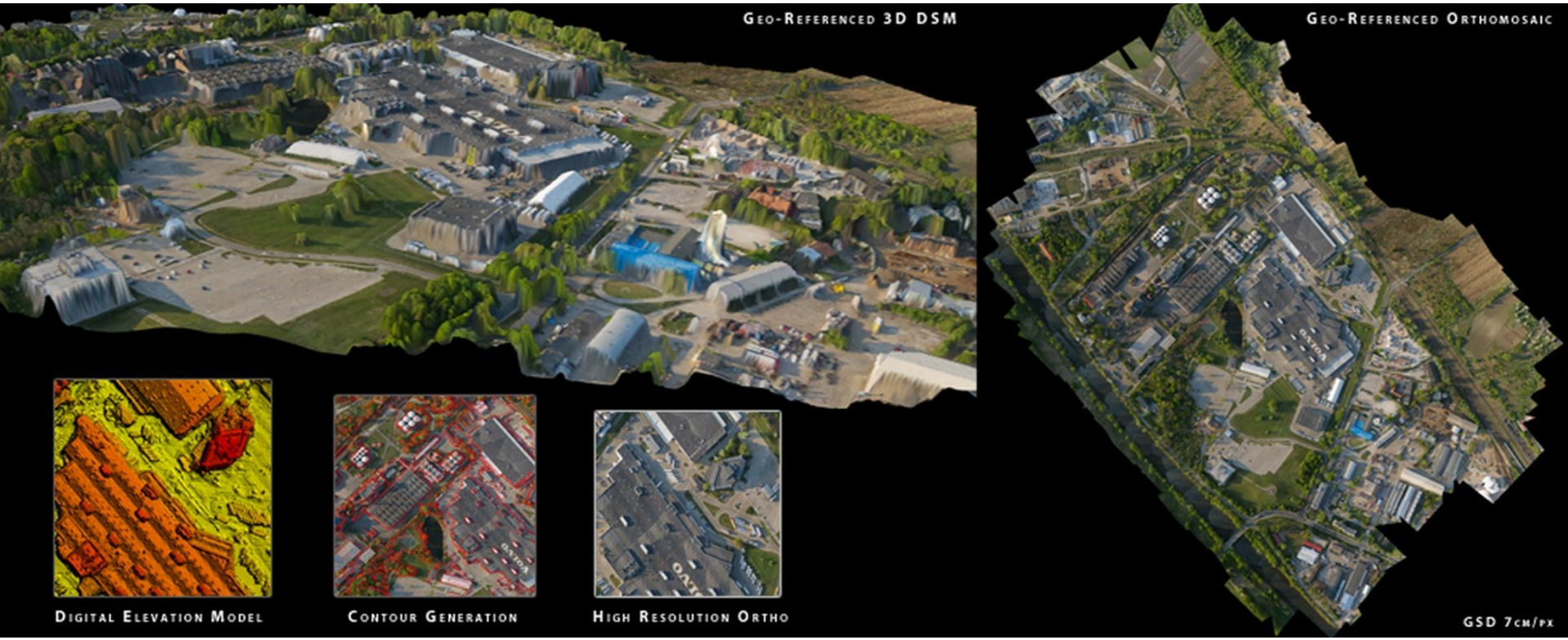
<Our Future Plans>

explore creative, paradigm-changing ways to deliver humanitarian aid in conflict zones or tuft terrain inaccessible place to traditional aid organizations using swarms of drones



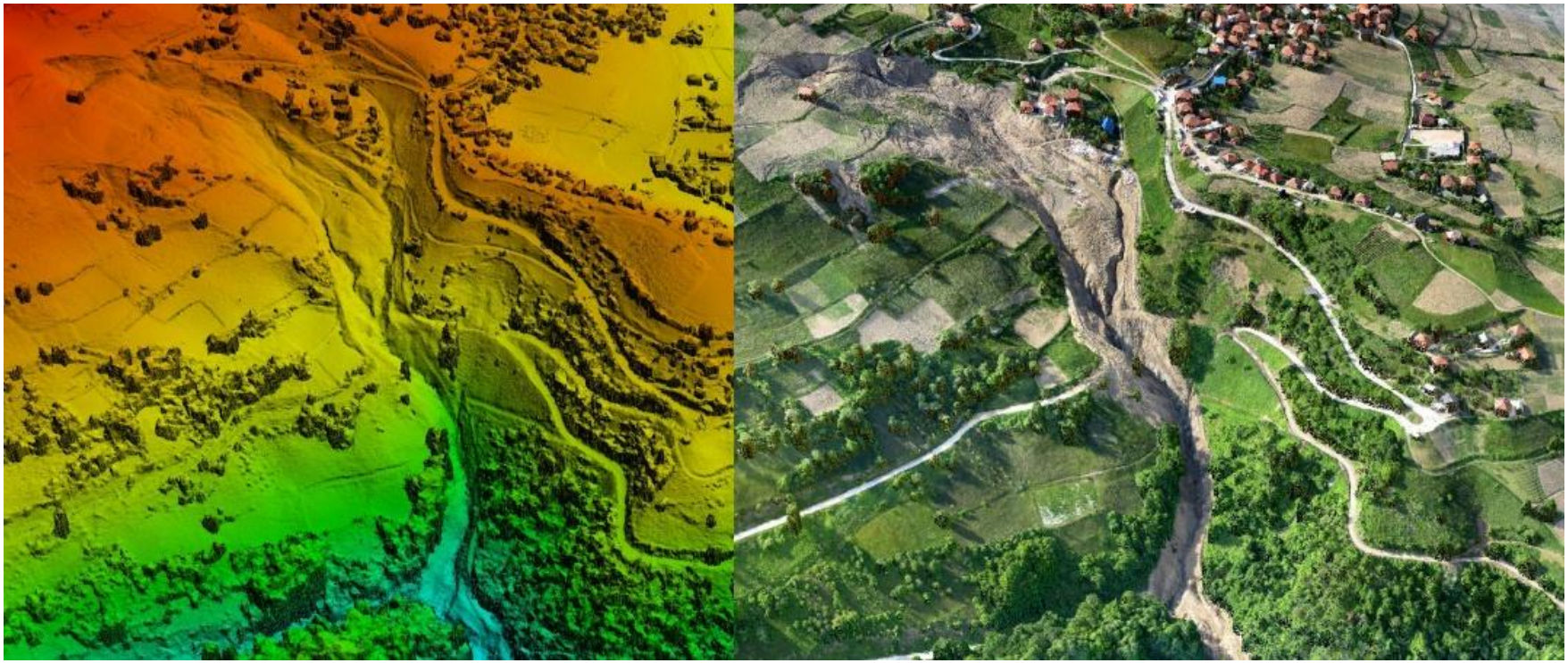
AnupKaphle

Compare to UAV mapping



1. . High Accuracy and Real-time mapping(4cm / pixcel ,flight 100m high)
2.Inexpensive, no Human danger
3. Fast disaster early response and continuous monitoring

Compare to UAV mapping



4. Elevation can be identfied
5. Use of many different simulation software to simulate flooding, earthquake response, constructions

UAV(Unmanned Aerial Vehicle)

- 카메라 등의 관측센서, GPS, FCC(Flight Control Computer), 통신 및 기타 장비가 탑재되어 있어서 비행 중에 원격 조종을 통해서 대상물을 관측하거나 자료를 처리하는 등 다양한 임무수행이 가능한 **비행체**

- 군수용 위주로 발전하여 원격정찰, 수송, 공격 등의 용도로 활발히 운용
- 최근, 민간부문에서 항공 촬영, 감시, 농약살포 등의 수요가 증가추세
- 아직까지는 단순한 사진촬영이나 동영상촬영 활용이 대부분을 차지하고 있으며, **공간정보에 적합한 형태로의 개발이 필요**

*Foss4G 박진우 참조

고정익(Fixed Wing) UAV = Plane

- 일반적인 비행기와 같이 **고정날개 형태**인 무인항공기 시스템
- 연료소모가 상대적으로 적어 **장기체공이 가능**하나 활주로나 넓은 개활지가 필요
- **주로 수직영상만 촬영**이 가능하고 정지체공상태에서의 동영상 촬영이나 경사촬영 등은 불가능

*Foss4G 박진우 참조

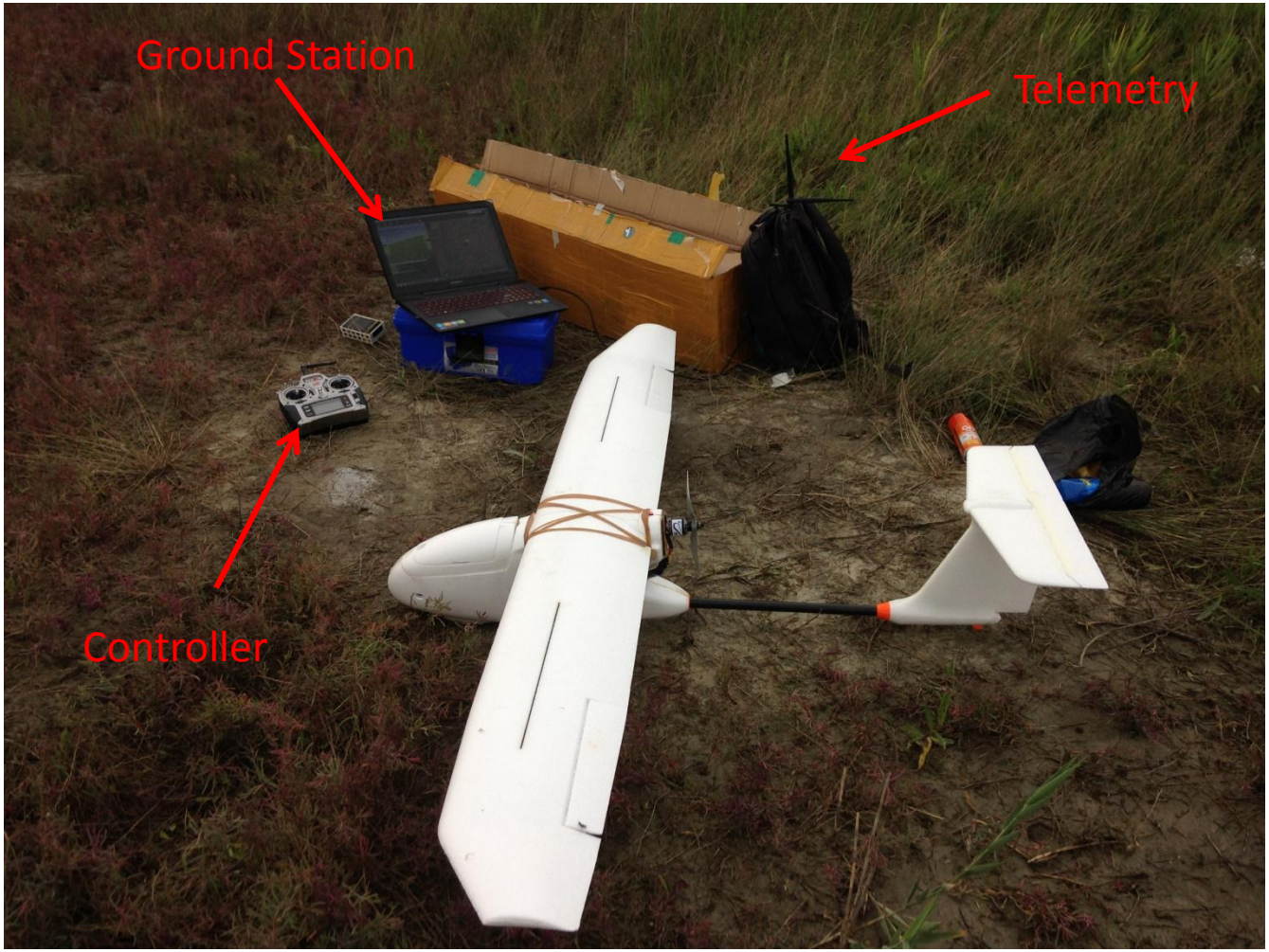
회전익(Rotary Wing) UAV = Multicopter

- 비행체가 **헬리콥터형**인 무인항공기 시스템
- **수직이착륙**이 가능하여 좁은 공간에서의 이착륙이 가능하고 공중에서 정지비행이 가능하고 상대적으로 급격한 선회가 가능
- 연료효율이 낮아 **장기체공이 제한적**
  → 산악지형과 선박 운용에 적합, 단거리 임무 및 기상의 변화가 많은 지역에 적합

FOSS4G
대한민국 2014

*Foss4G 박진우 참조

Fixed wing UAV develoment



Advantage
1. Long Range
2. Long Endurance

=cover large area

Disadvantage
1. Need take off an landing field
2. No hovering

= not easy to use

What Our UAV Can Do

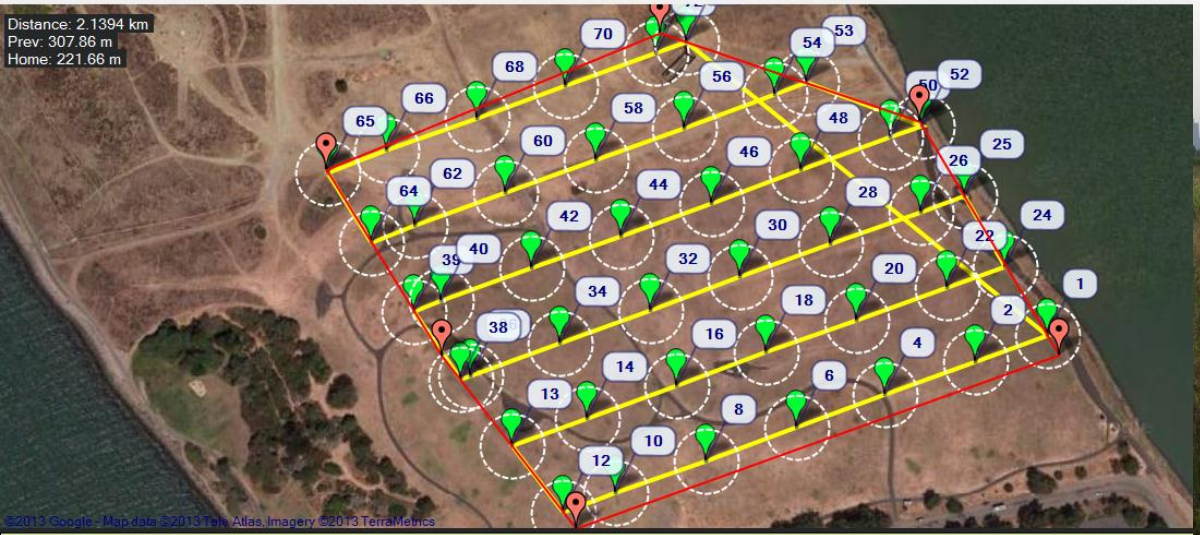
AngelSwing Drone can draw a geographic map of earthquake damaged districts to

◯ make supply of relief goods more effectively

◯ help reconstruction of buildings by creating 2D and 3D model

◯ Accurately monitoring post disaster development

Flight Data | Flight Planner | Configuration | Simulation | Firmware | Terminal | Help | Donate



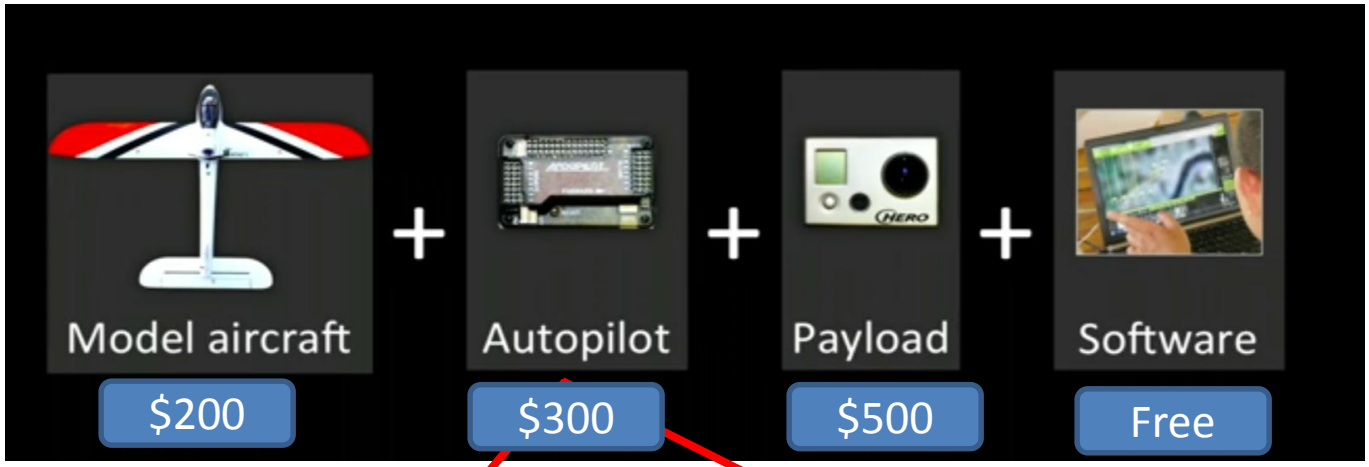
Waypoints

WP Radius 20 | Loiter Radius 45 | Default Alt 100 | RTL@def Alt | Verify Height | Add Below

	Command	Del	Hit		Yaw	Lat	Long	Alt	Delete	Up	Down
1	WAYPOINT	0	0	0	0	37.8713992	-122.3152423	100	X		

네팔 방문 3일전 …

Composition of our Cheap UAV

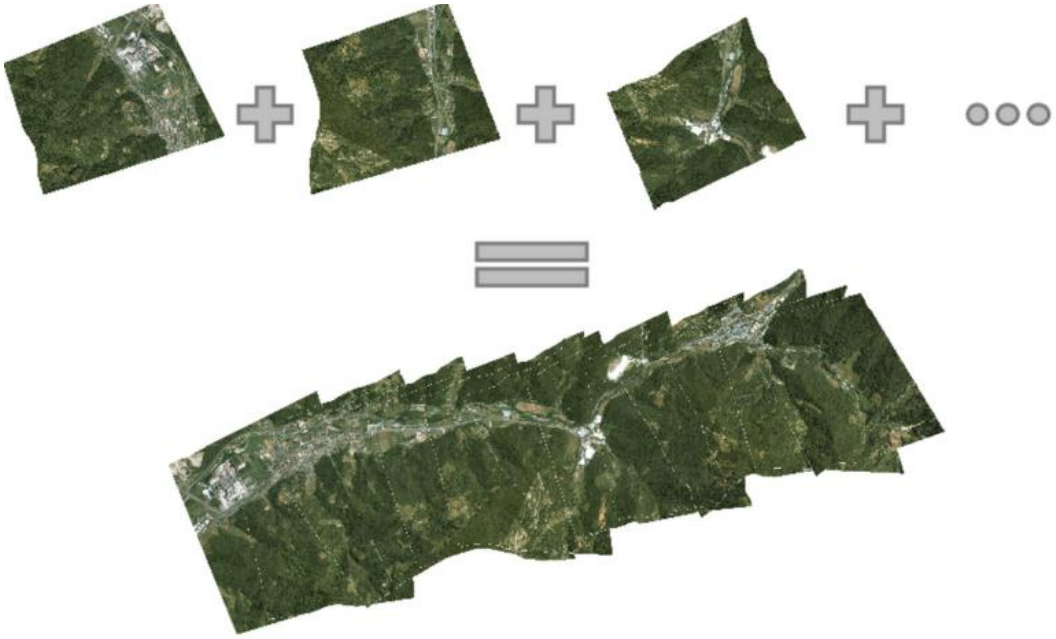


GIS UAV

APM 2.6 Board (Arduino based)

Pixhawk Board(ARM based)

Fixed wing UAV development



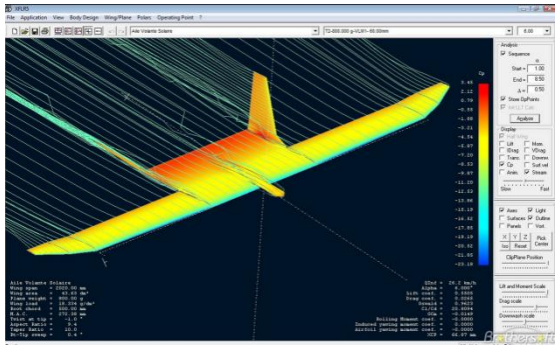
Our Requirement (Mission)

- Range : more than 60km
- Endurance : 60 min ~90min
- Payload : 1kg
- Mapping Area : 5km^2
- Build UAV that can generate 2D and 3D map of the area it is flying

Aircraft(aerodynamic) Optimization

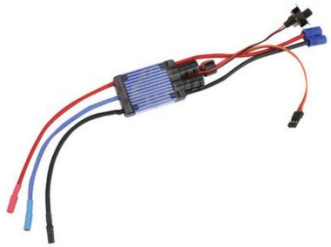
- 1. Build or select optimized UAV platform for your mission
  - Range ?
  - Endurance?
  - Speed?
  - Stability ?
  - Payload capacity ?

- 2. Using Xfoil for simple CFD
  - Tutorial



Power System Optimization

- 1. Fly the aircraft manually
- 2. Find the minimum throttle position
- 3. Measure the thrust
- 4. Measure the Amp and Wattage to achieve that thrust by
  - 1. Test different propellers
  - 2. Test different motors
- 5. Graph the results
- 6. Select the most efficient motors and propeller combination
- 7. Flight test again

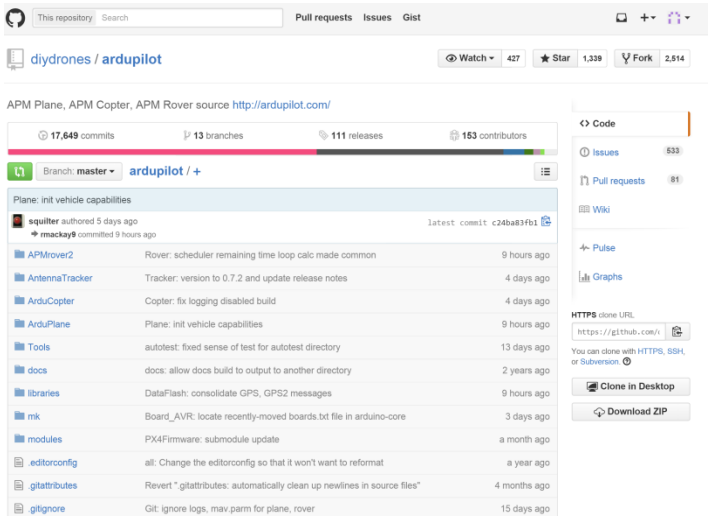


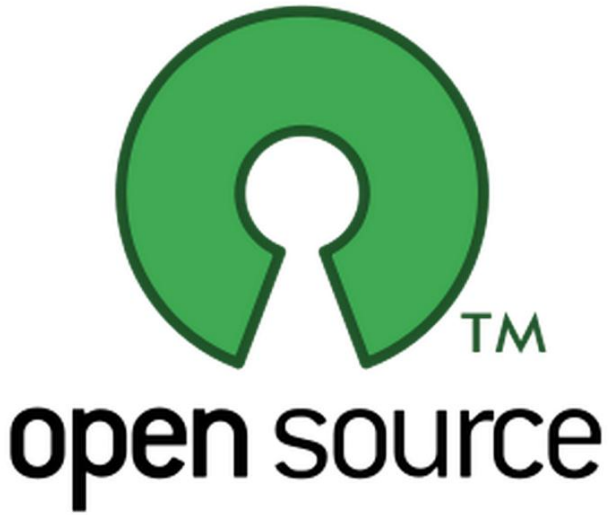
Battery Selection

- 0. Need to know how much Amp you are drawing (max, min, and cruse)
- 1. Cell
  - Depends on your electronic setting and motors
  - Higher cell is more efficient but need to be careful with compatibility with your electronics
- 2. Capacity
  - Higher capacity is better but check weight and discharge rate
- 3. Weight
  - Small Weight is better but need to be careful with CG
- 4. Discharge rate
  - Multiply by the capacity of the battery to check it meets your maximum Amp

Open Source Ardupilot code

- https://github.com/diydrones/ardupilot



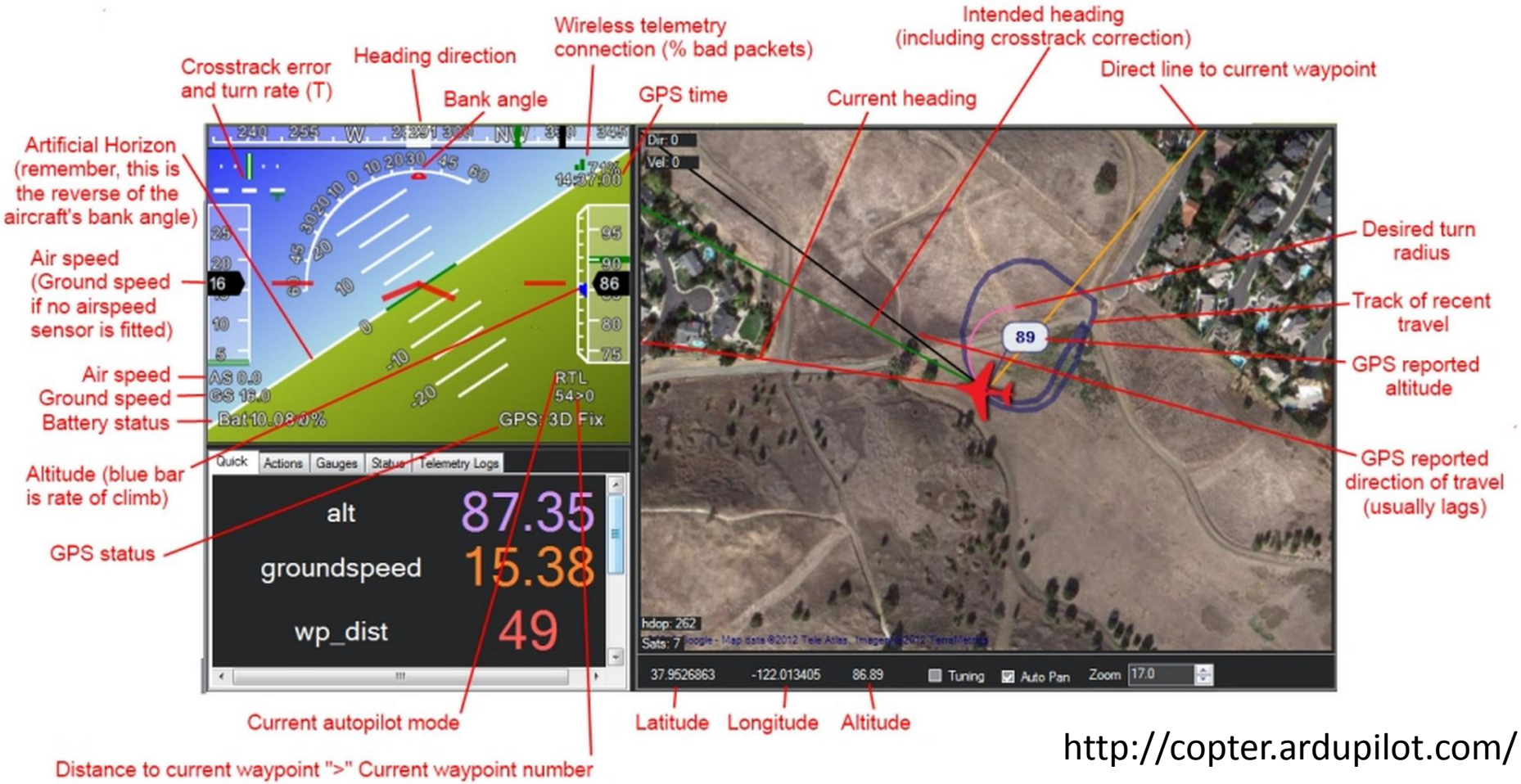


Open Source Ground Station Software

- 1. Mission Planner
  - Waypoint flying
  - Parameter changing
  - Software uploading
  - Calibration
  - Command and Analyze

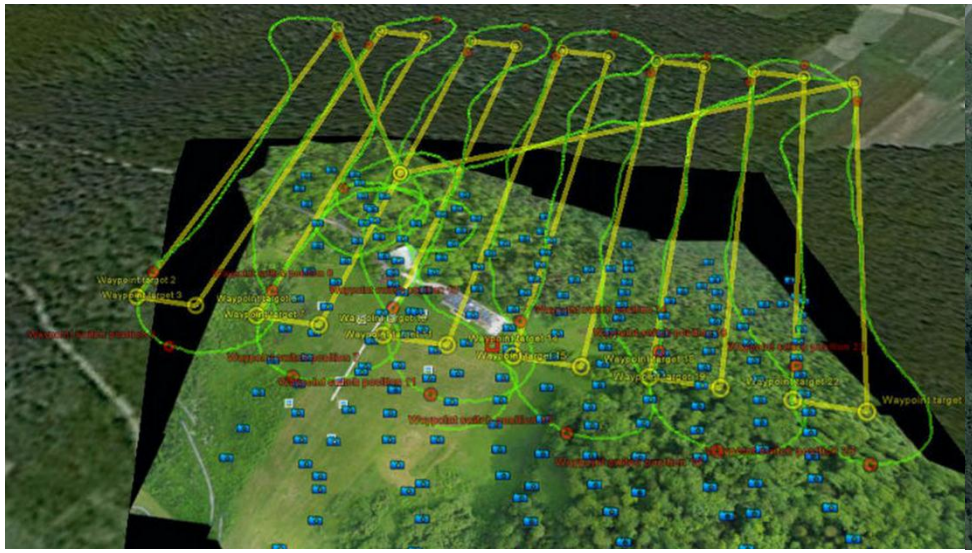
Open Source Ground Station Software

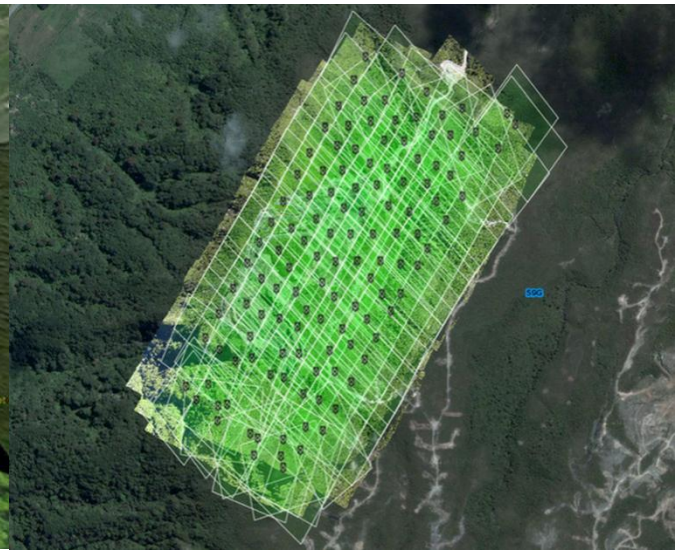
The GCS Flight Data Screen

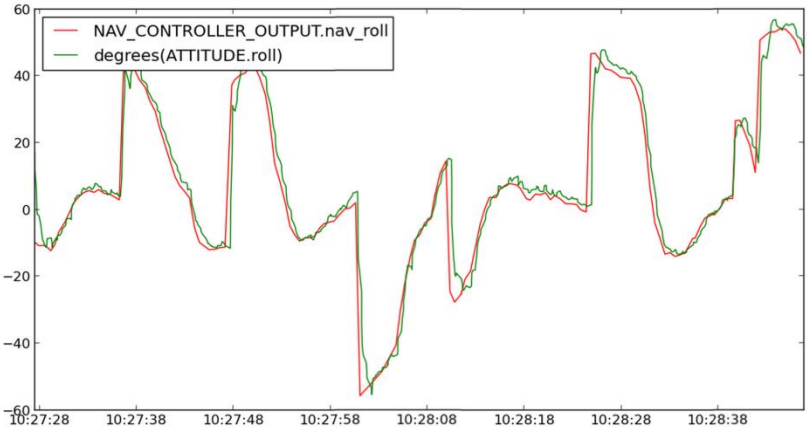


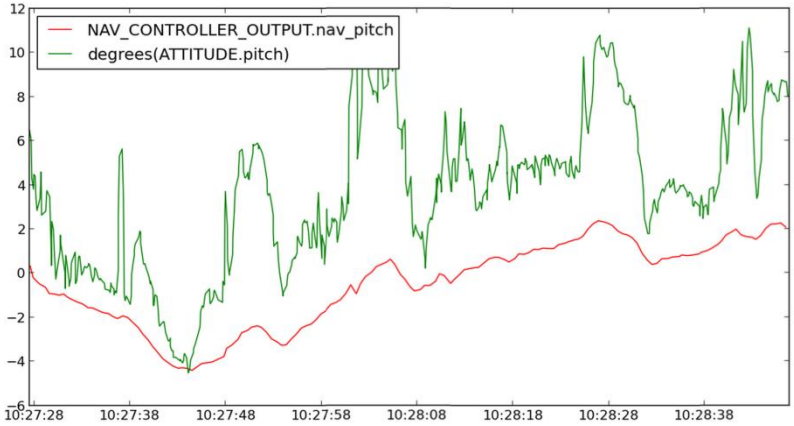
http://copter.ardupilot.com/

Flight path and optimization







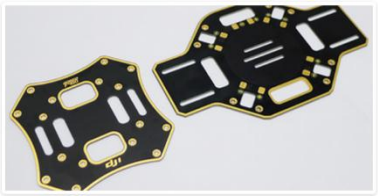


오픈소스SW로 쿼드콥터를 만들자

사용하게 될 프레임 : DJI F450
*하지만 목적에 맞게 다양한 종류의 프레임을 선택 할 수 있다.

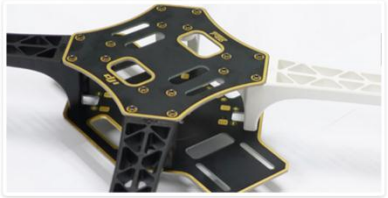
Ultrastrength Material

Frame Arms adopt PA66+30GF ultrastrength material design, providing better crashworthiness.



Integrated PCB Wiring

The use of high strength compound PCB frame board, makes wiring of ESCs and battery safer and easier.



Huge Assembly Space

Optimized frame design, which provides abundant assembly space for autopilot systems.

오픈소스SW로 쿼드콥터를 만들자

Model	Flame Wheel 450 (F450)
Frame Weight	282g
Diagonal Wheelbase	450mm
Takeoff Weight	800g ~ 1600g
Recommended Propeller	10 × 3.8in ; 8 × 4.5in
Recommended Battery	3S~4S LiPo
Recommended Motor	22 × 15mm or 22 × 12mm
Recommended ESC	15A OPTO

오픈소스 멀티콥터 시스템

자동항법장치 비교

Pixhawk

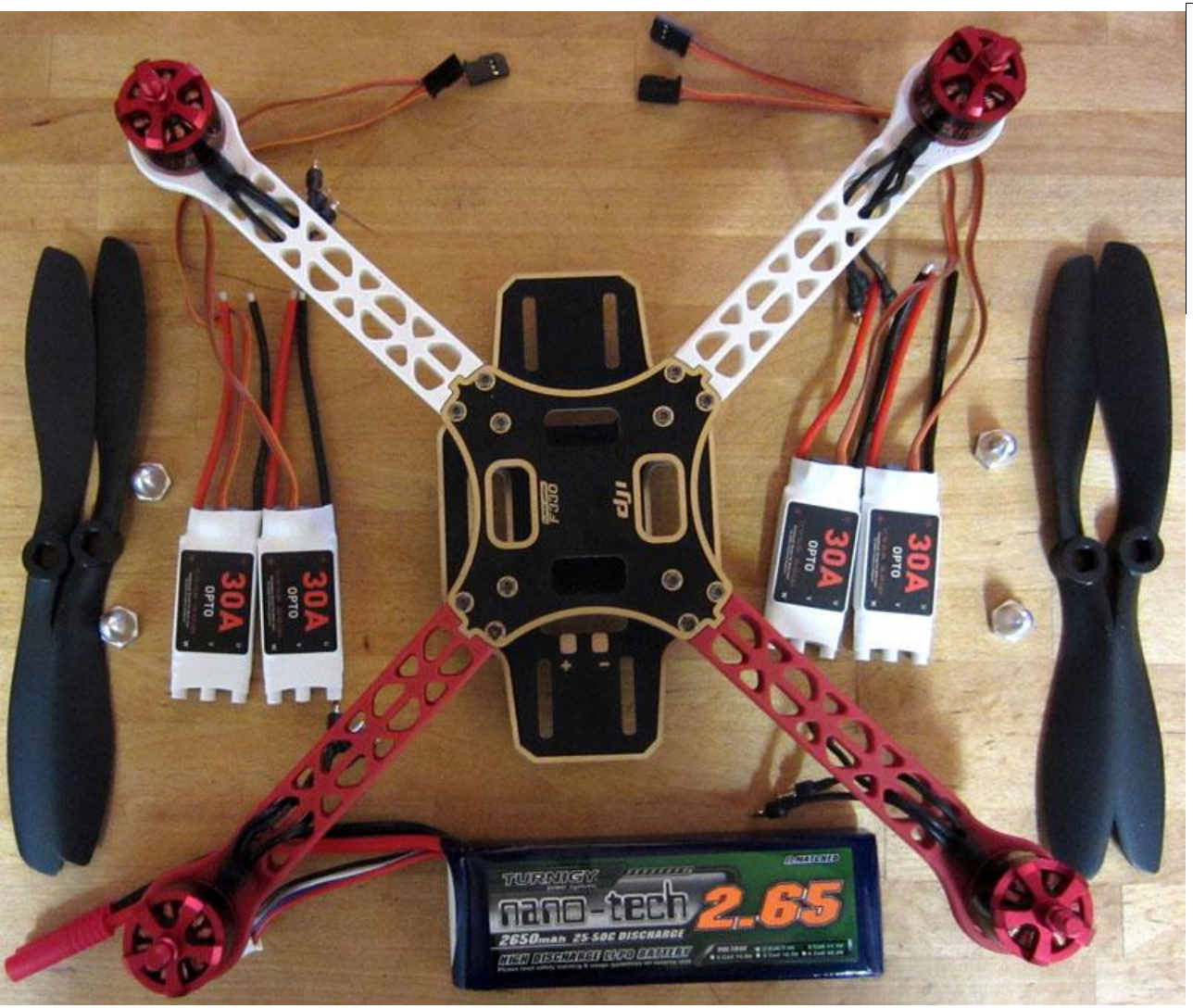
APM 2.6

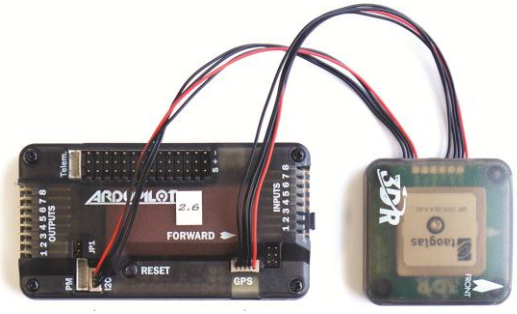
PX4

구분	Pixhawk	APM 2.6	PX4
설명	ARM CPU	AVR CPU based ardupilot flight controllers	ARM CPU
장점	최신, 계속되는 업데이트, 쉬운 사용법	싼가격, 아두이노 베이스	중량, 사이즈 작음
단점	비싼가격	업데이트 x	참고자료 부족

http://copter.ardupilot.com/

오픈소스 쿼드콥터 재료

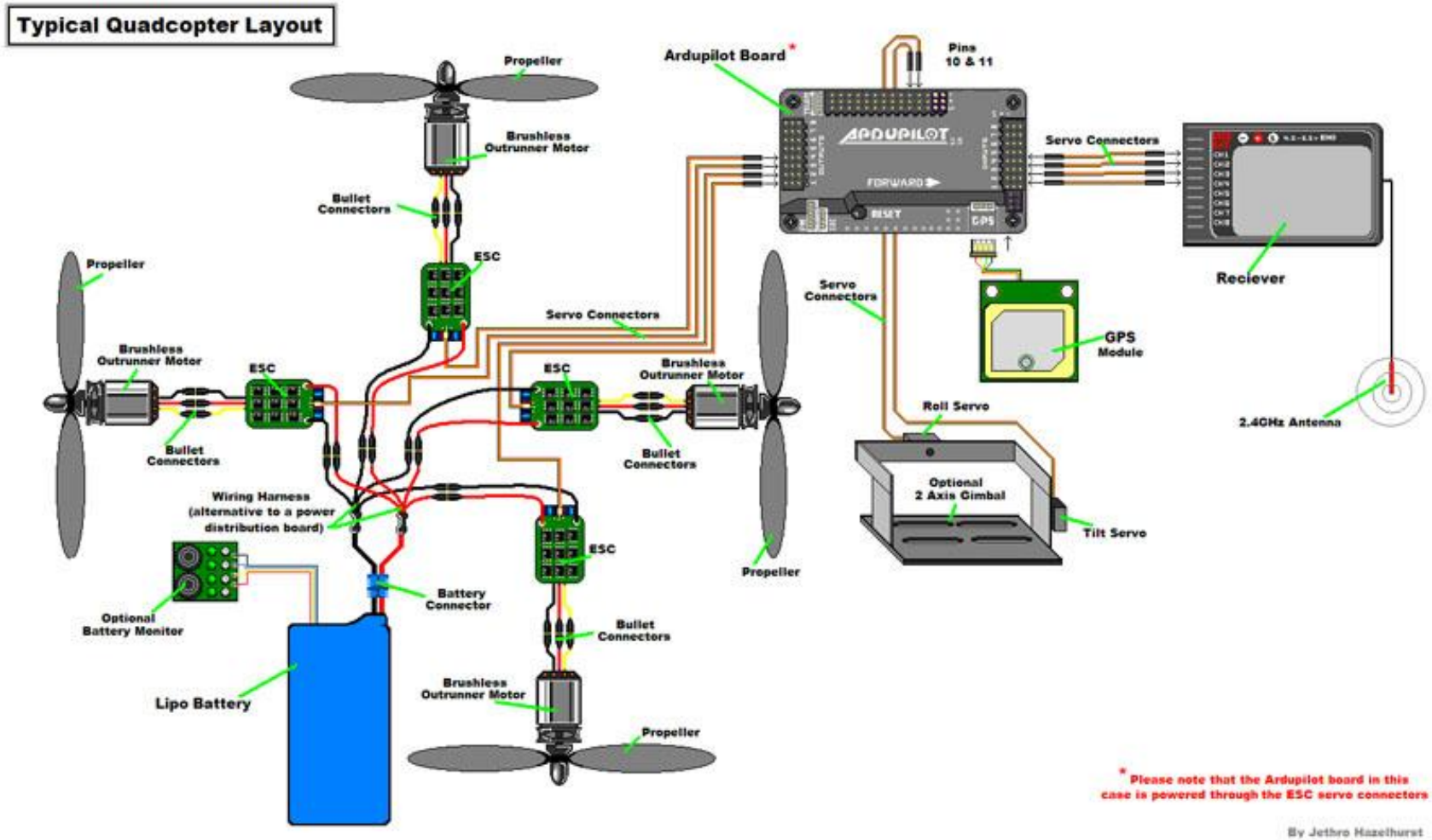




자동항법장치 +GPS센서

GCS통신장치

일반적인 쿼드콥터 레이아웃



http://copter.ardupilot.com/

ANGELSWING
Flight for cause

Pixhawk 자동항법장치를
이용한 레이아웃

*http://copter.ardupilot.com/

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*https://eastskykang.wordpress.com

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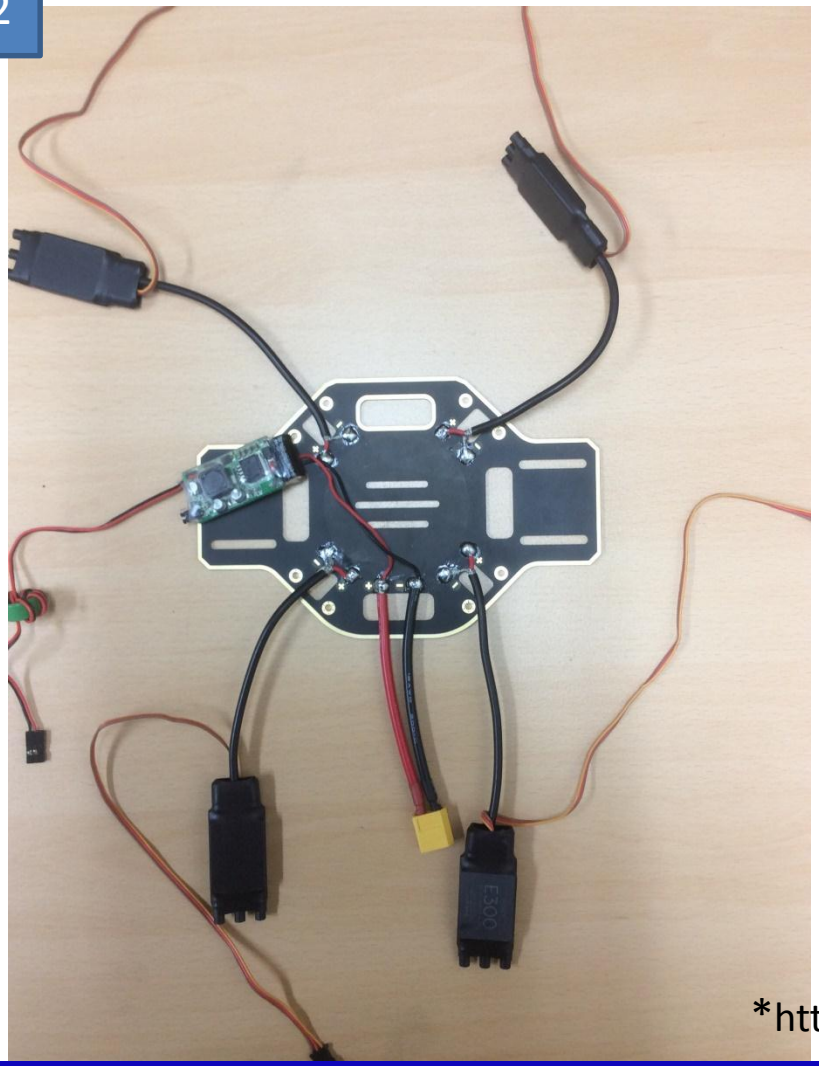

*https://eastskykang.wordpress.com

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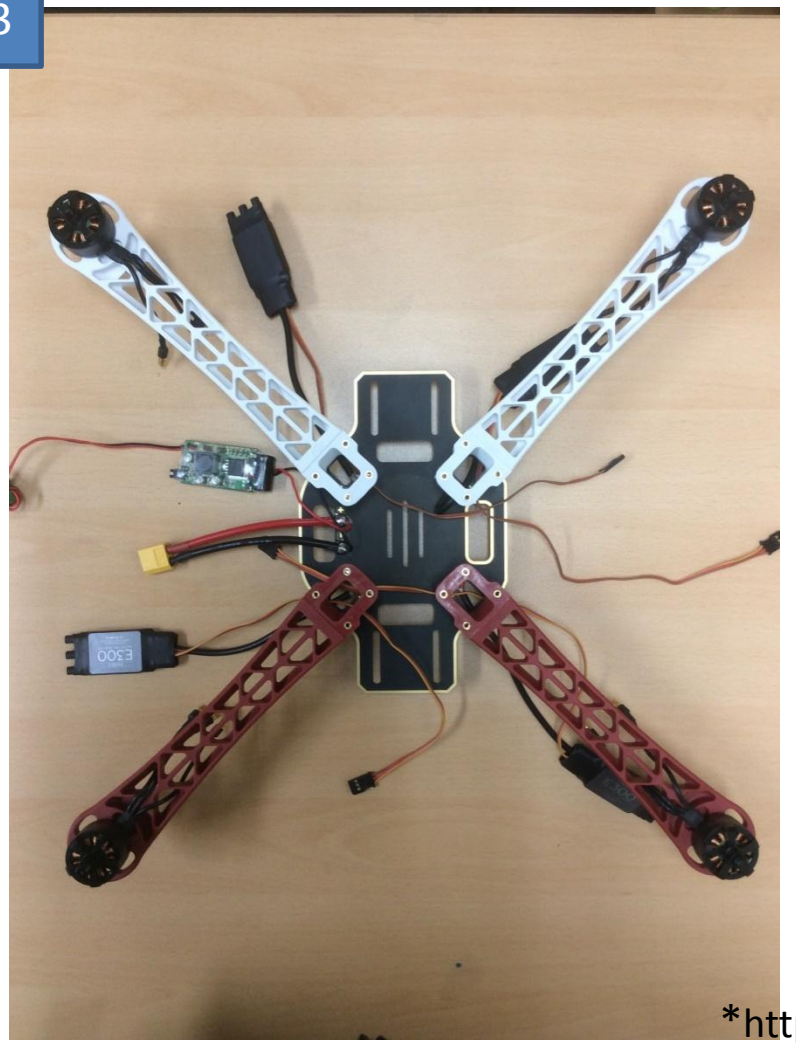

*https://eastskykang.wordpress.com

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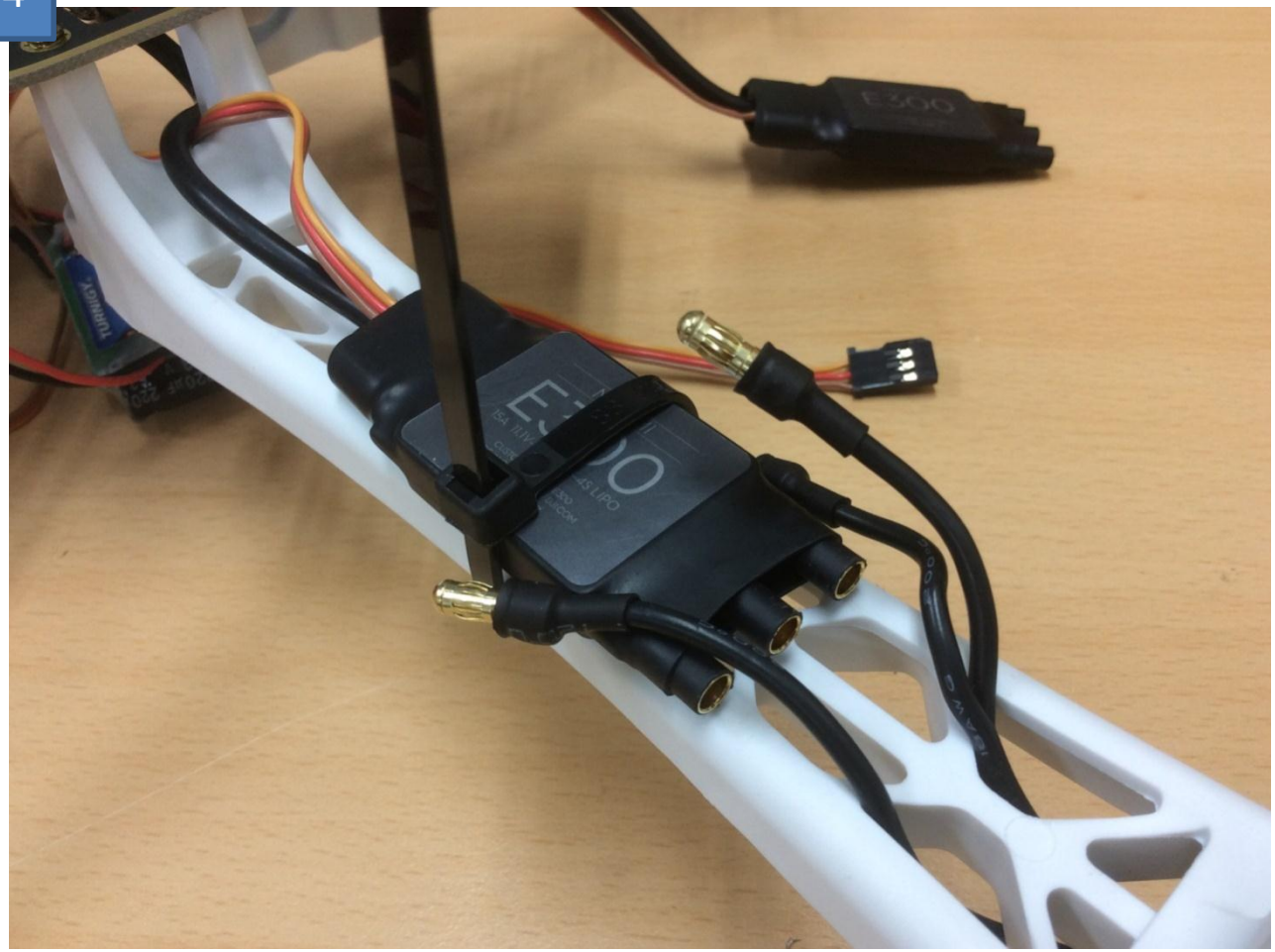

*https://eastskykang.wordpress.com

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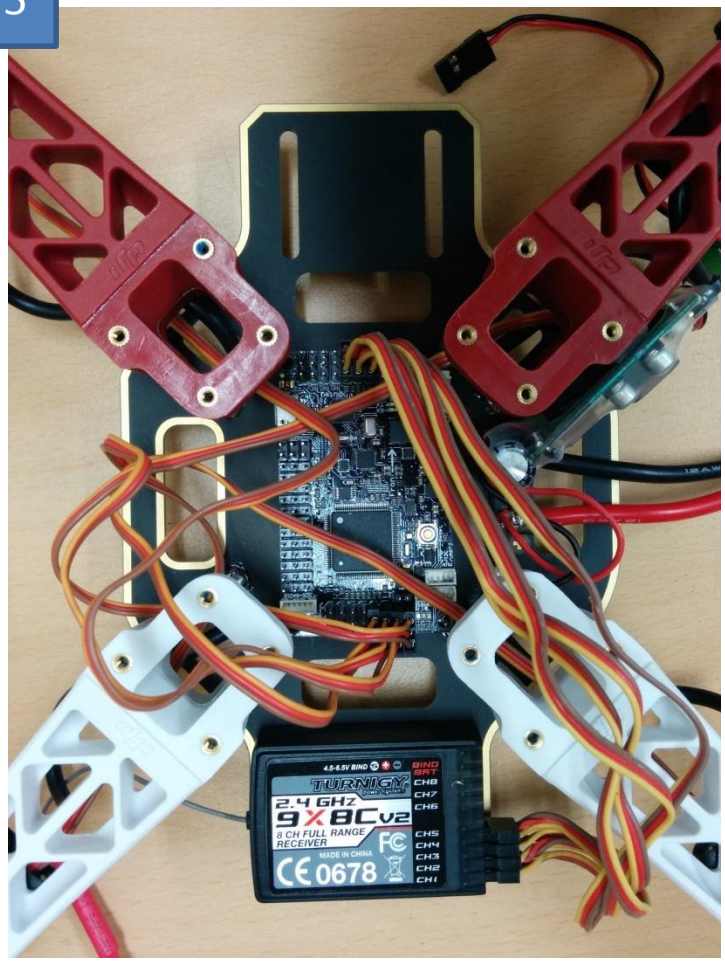
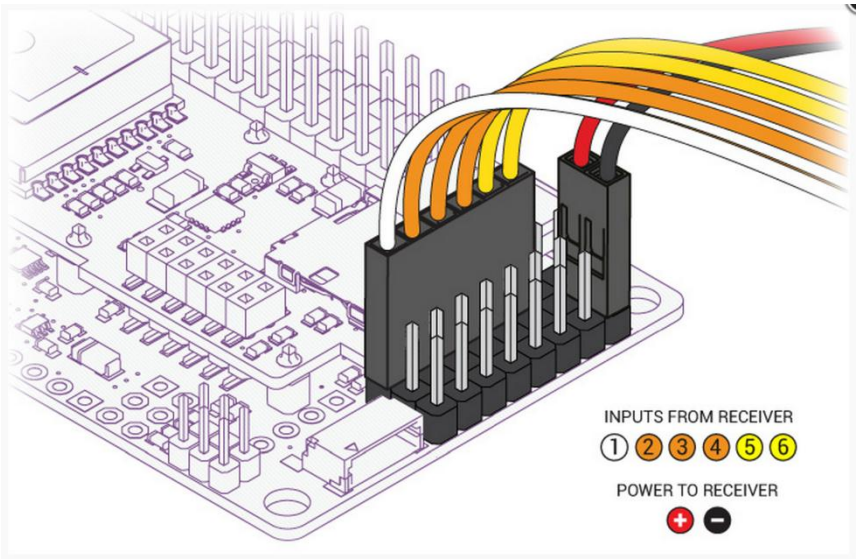
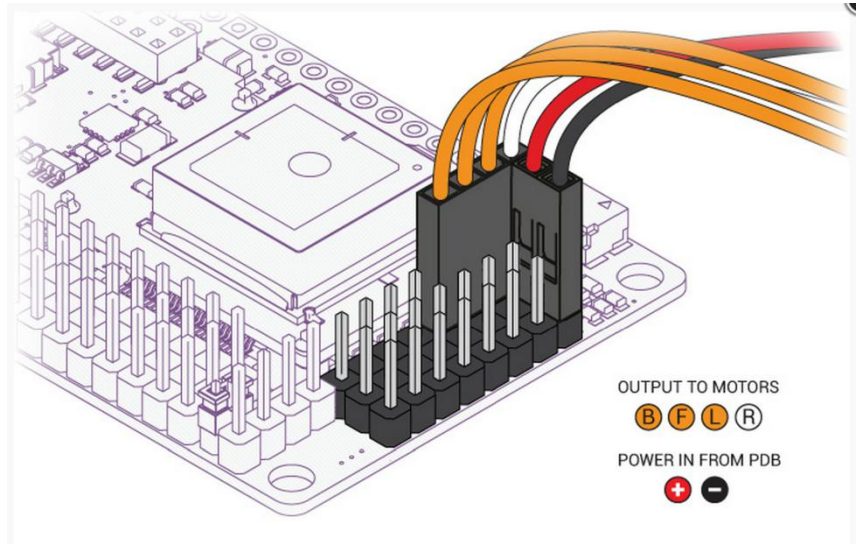
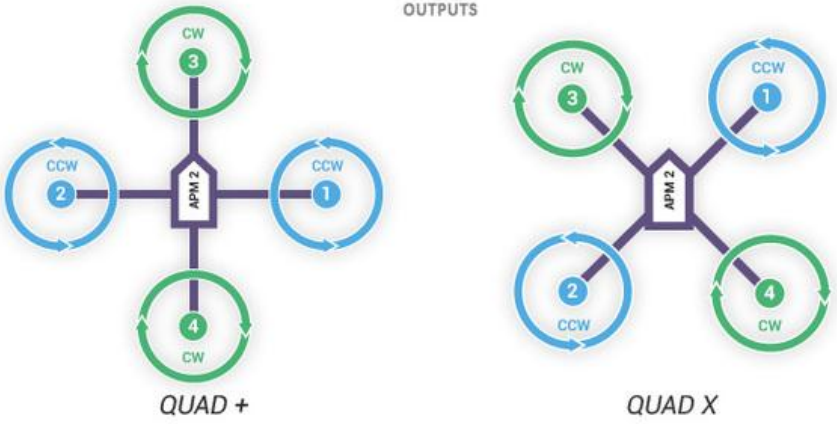

TURNIGY
2.4 GHz
9X8Cv2
8 CH FULL RANGE
RECEIVER
MADE IN CHINA
CE 0678
BIND
BAT
CH8
CH7
CH6
CH5
CH4
CH3
CH2
CH1


INPUTS FROM RECEIVER
1 2 3 4 5 6
POWER TO RECEIVER


OUTPUT TO MOTORS
B F L R
POWER IN FROM PDB

쿼드콥터



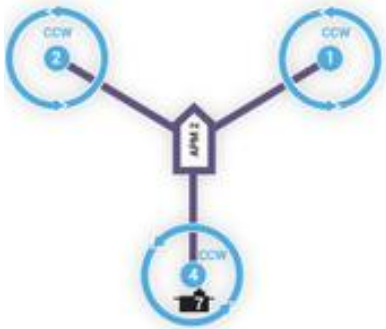
QUAD +

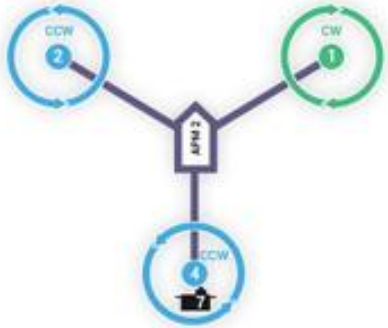
QUAD X

CLOCKWISE ROTATION
USE PUSHER PROPELLER

COUNTER-CLOCKWISE ROTATION
USE NORMAL PROPELLER

트라이 콥터



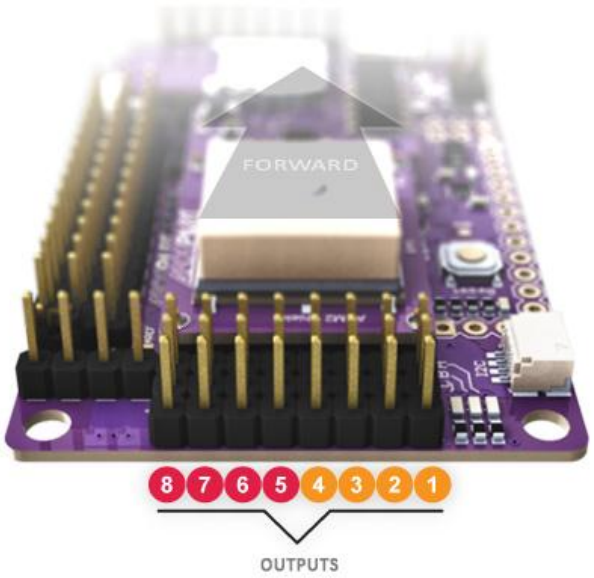


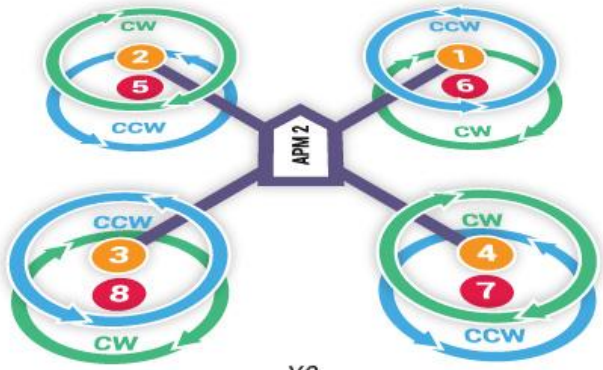
optional tri-copter setup
(no change in the code)

CLOCKWISE ROTATION
USE PUSHER PROPELLER

COUNTER-CLOCKWISE ROTATION
USE NORMAL PROPELLER

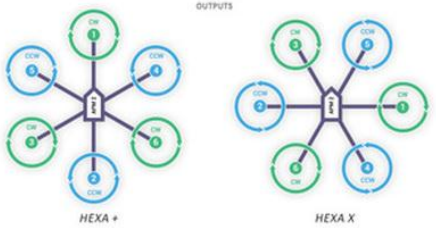
옥타콥터

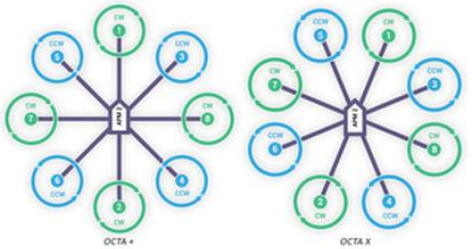


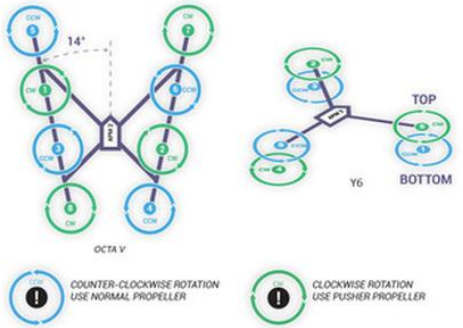


X8
(OCTA QUAD)

다양한 콥터







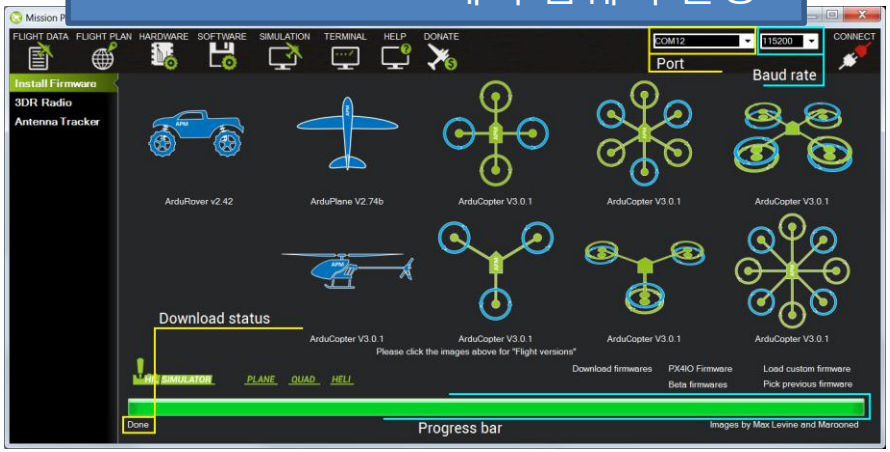
쿼드콥터 펌웨어 업로드

6

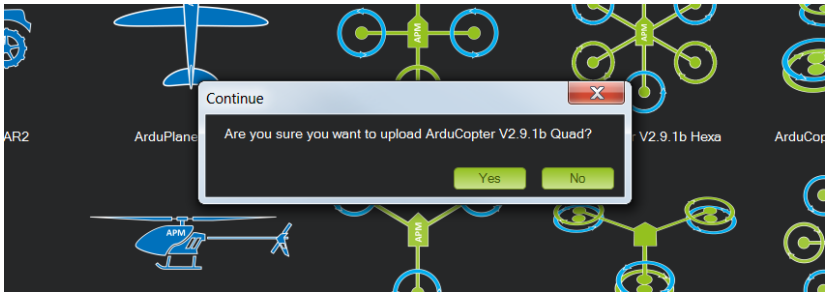
1.APM 을 컴퓨터에 연결

2.APM을 Mission Planner 에 연결

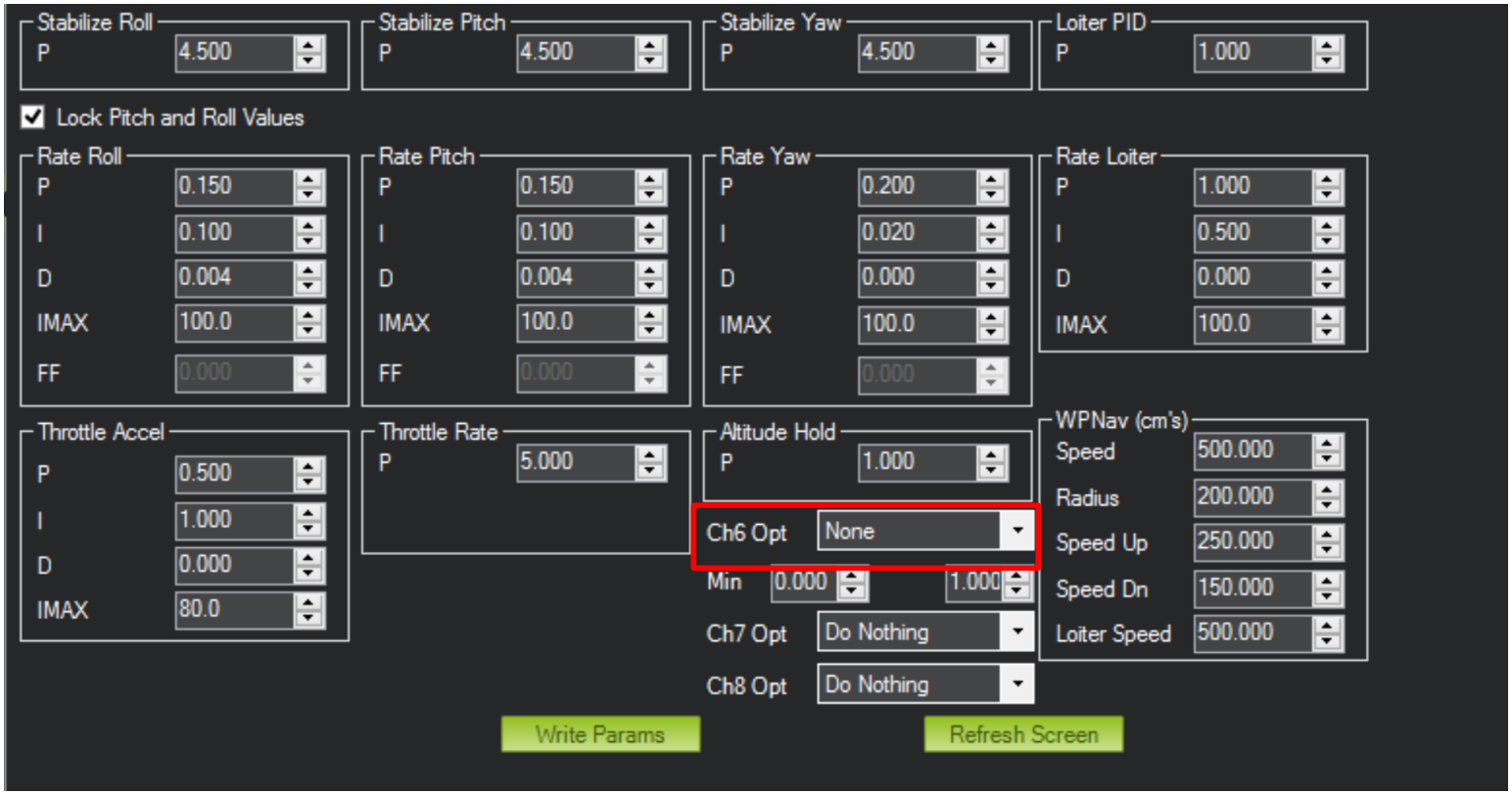
3. Mission Planner 에서 펌웨어 설정



4.펌웨어 업로드

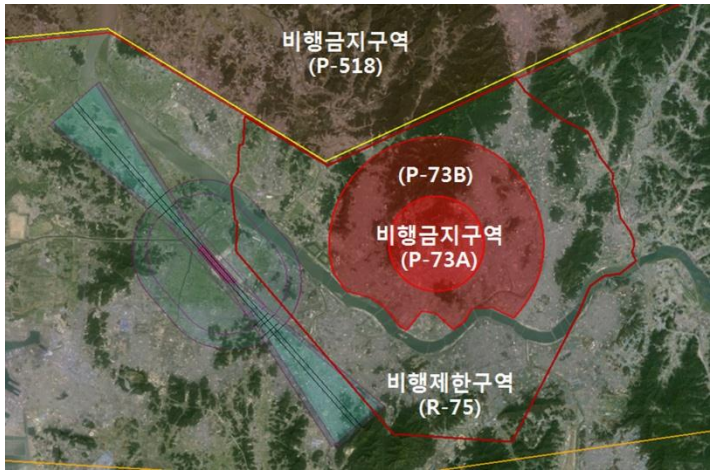


쿼드콥터 칼리브레이션

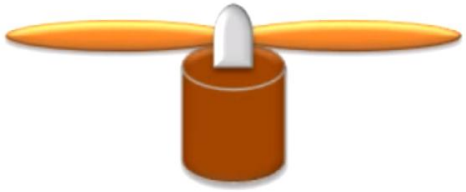

Stabilize Roll
P 4.500
Stabilize Pitch
P 4.500
Stabilize Yaw
P 4.500
Loiter PID
P 1.000
Lock Pitch and Roll Values
Rate Roll
P 0.150
I 0.100
D 0.004
IMAX 100.0
FF 0.000
Rate Pitch
P 0.150
I 0.100
D 0.004
IMAX 100.0
FF 0.000
Rate Yaw
P 0.200
I 0.020
D 0.000
IMAX 100.0
FF 0.000
Rate Loiter
P 1.000
I 0.500
D 0.000
IMAX 100.0
Throttle Accel
P 0.500
I 1.000
D 0.000
IMAX 80.0
Throttle Rate
P 5.000
Altitude Hold
P 1.000
Ch6 Opt None
Min 0.000 1.000
Ch7 Opt Do Nothing
Ch8 Opt Do Nothing
WPNav (cm's)
Speed 500.000
Radius 200.000
Speed Up 250.000
Speed Dn 150.000
Loiter Speed 500.000
Write Params
Refresh Screen

쿼드콥터 비행테스트

- 1.비행공역 확인
- 2. 넓고 사람이 없는 장소
- 3. 바람이 불지 않는날



효율적인 프로펠러, 모터 선택



Specification	Value
Motor	2822/12 1800KV
Prop	7 x 4.5
KV	1800kv
Prop Diameter	7”
Prop pitch	4.5”
Model weight	1175g
Average Amps	25.4A

VS

Specification	Value
Motor	2213 935KV
Prop	10 x 4.5
KV	935KV
Prop Diameter	10”
Prop pitch	4.5”
Model weight	1244g
Average Amps	16.37A

작은 프로펠러 ,높은 KV	큰 프로펠러, 낮은 KV

오늘날의 드론

“Attack of the drones”, USA Today Tech CES 2015

Airdog

DJI Inspire 1

DJI Ghost

Harwar Military Drone

Hubsan ProtoX

MaxAero X-Star

Zano Nano Selfie Drone

Parrot Bebop

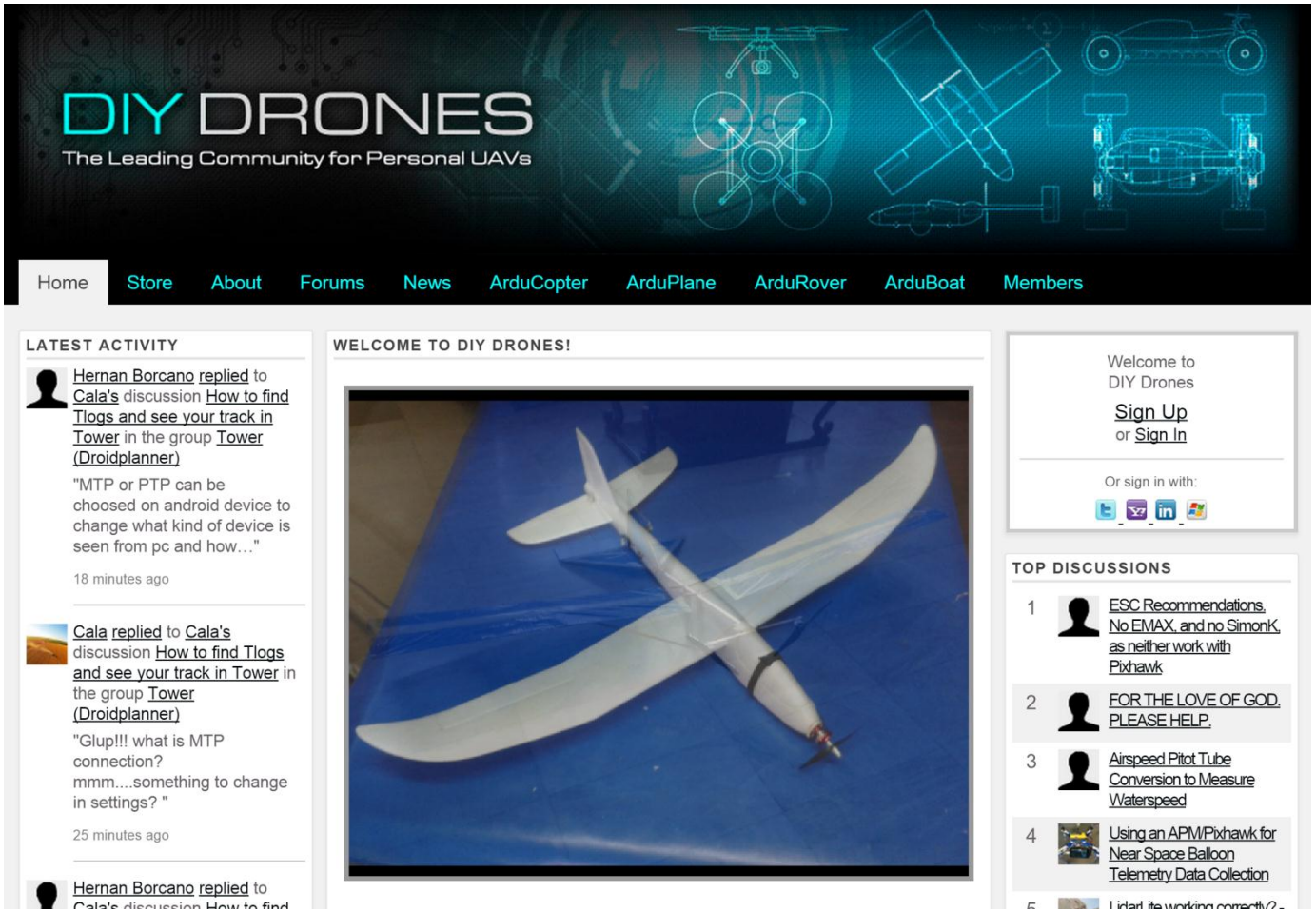
* http://www.pcmag.com

드론의 다양한 활용분야

분야	주요 내용
물류	Amazon Prime Air, UPS, DHL
통신	인터넷 연결 사업 (Google, Facebook)
시설 감시	송유관 점검 (British Petroleum)
응급환자 수송	구급차 드론 AirMule (Urban Aeronautics)
구호물품 배송	신흥국 오지에 의약품, 구호 물자 전달 (Matternet)
기상 관측	기상 정보 취득, 허리케인 중심부의 데이터 수집 (Aerosonde)
청소	다수 드론 협력으로 청소 (Electrolux)
동물 감시	멸종 위기 동물을 드론으로 파악, 보호, 구호 (WWF) 알래스카에서 빙하와 고래의 이동 연구 (Insitu)
농업 기계화	드론을 이용해 씨를 뿌리고, 농약 살포 방재

* LG경제연구소, 언론자료, KB투자증권

Community has answers to your questions



http://diydrones.com/

ArduPilot

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Open source autopilot

APM MULTIPLATFORM AUTOPILOT
Dronecode

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- Rover
- Mission Planner
- APM Planner 2.0
- Antenna Tracker
- Developer

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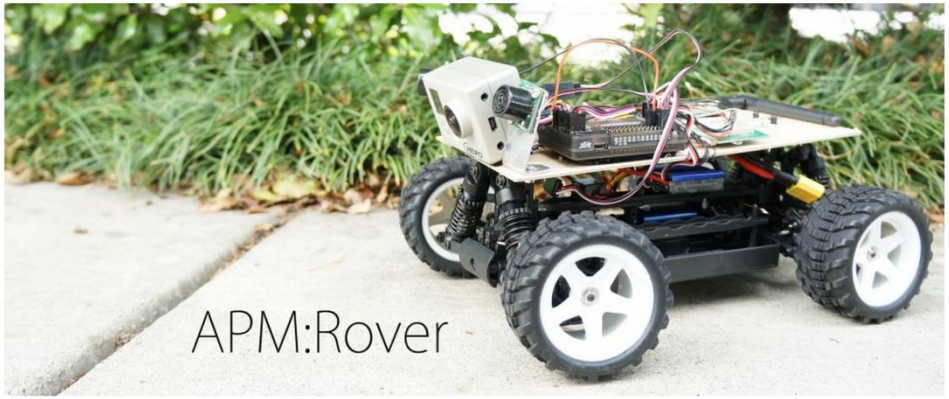

ArduPilot Autopilot Suite

Hardware — Firmware — Software — Community

Hardware – The embedded systems and peripheral sensors that 3DRobotics designs, manufactures, and sells.

Think of hardware as the brain, eyes, ears, etc.

Firmware– The "skill set" code running on the hardware, which configures it for the kind of vehicle you've put it in. You choose the firmware and vehicle that match your mission: Plane, Copter, Rover…

Software– Your interface to the hardware.

Initial set-up, configuration, and testing. Mission-planning/operation, and post-mission analysis.

http://ardupilot.com/

감사합니다.

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Email : pparkblue@gmail.com