

7/8-5-25

## Drone workshop

### Software

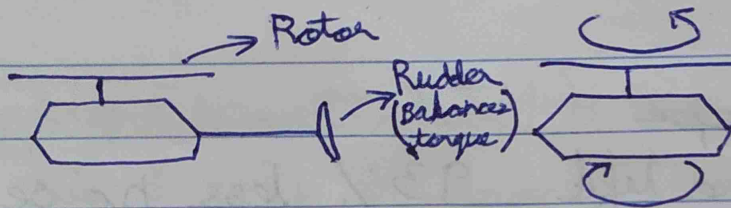
OpenCV - Python library to process image

- i) Dividing frames of video from camera into images
- ii) Processing images (RGB, Greyscale, Binary, <sup>border</sup>)
- iii) Stitching processed images (Panorama)
- iv) Optimal path finding (Obstacle tracking)  
(Source & Destination finding)

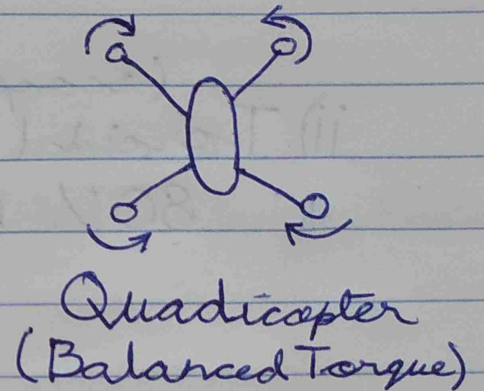
Websockets → two-way, continuous, low-latency communication ~~protocol~~ channel over TCP.

What is a drone? (aka UAV)

aircraft which operates without human pilot on board. (auto/semi-auto/manual)  
Remote controlled (or) autonomous



Helicopter



Types of drones

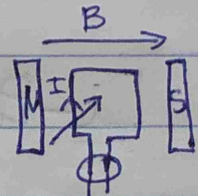
- Fixed-wing
- single rotor
- multi rotor

Parts of motor

Stator - permanent magnet

Rotor - coil

Commutator - delivers current to rotor

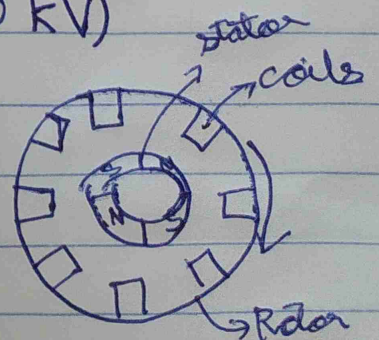


BLDC motor (A2212 1800 KV)

diameter height

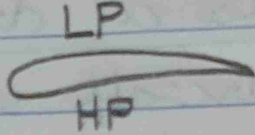
rpm per 1V

Controlled by MOSFET switching rate





## Propellers

- i) Airfoil shape (cuts air)
- 
- Bernoulli's & Newton's 3rd law

- (scoops)
- ii) Toroidal shape (MIT toroidal propeller)
- 80% more lift, 93% less noise

## Battery

- Li-Ion → High charge density, Compact  
→ Li-ions will break at high load
- Li-Po → Can withstand high loads

## Electronic speed controller (ESC)

Varies power delivered to motor by emitting PWM signals of different Duty cycle

## Flight controller (KK2.1)

Brain of drone - Connected to sensors & motor

### Sensors

Angular velocity

MPU6050 { Gyroscope (orientation) - Roll, pitch, yaw  
MEMS { Accelerometer (acceleration) - linear acceleration  
(uses PID to stabilize drone) { Barometer (Ultrasonic + pressure) - calculates altitude  
Lidar  
Magnetometer - Compass

### Communication protocols

G2D, D2G, D2C, D2C

Physical layer - LORA (Long Range)

Network layer - Wi-Fi, BLE, LTE, ZIGBEE

Application layer - MAVLINK, ROS  
(Micro Air Vehicle Link)

Ardupilot, PX4 - Open source drone protocol

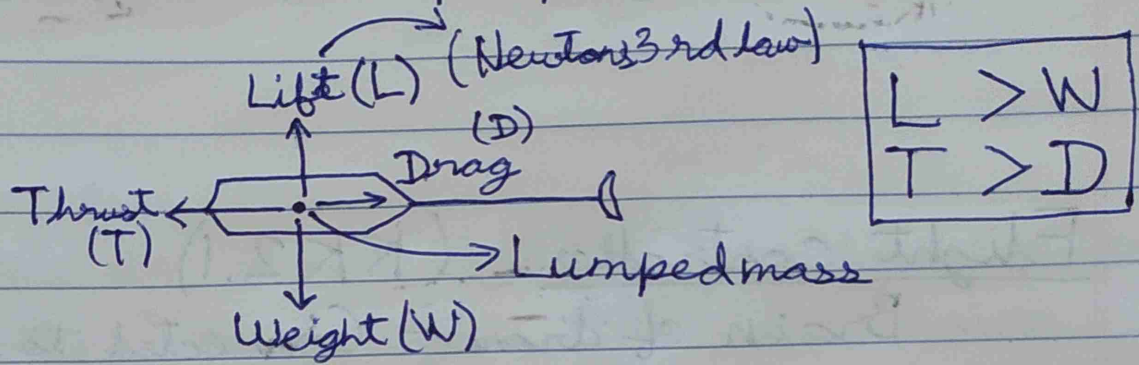
RTSP/RTP - Video streaming protocol in FPV drones



## 3D printing

PLA - Poly Lactic Acid

To construct propeller and drone chassis



$$W + D < T + L$$

$mg + R_a < \text{Action of motor}$

Air resistance

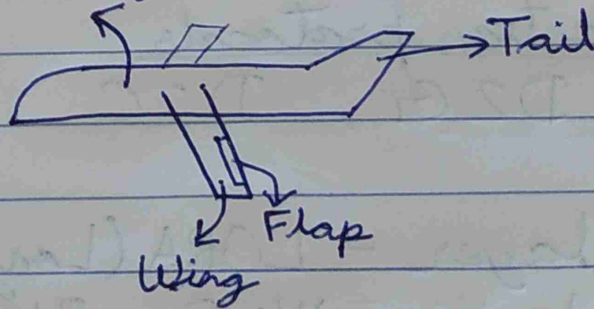
$$R_a = \frac{1}{2} \rho C_D A V^2$$

$\rho$ : Density  
 $C_D$ : Drag coefficient  
 $A$ : Frontal area  
 $V$ : Velocity

Barometer  $\rightarrow P_2 = P_1 + \frac{1}{2} \rho V^2$

(static) (Dynamic)

Fuselage



## Nomenclature of Air foil

car



High downforce  
(reverse airfoil)

vs

drone



Low downforce  
(airfoil)

