Developing a Collision Avoidance Quadcopter
By Cameron Robinson

Project Overview

- ❖ Custom building a quadcopter and remote control
  - Drone frame and controller shell (3D printed)
  - Drone and controller software
  - Developing collision avoidance algorithm
- ❖ Quadcopter uses a 2D LiDAR to detect surrounding obstacles and avoids any it senses it will collide with

Part Name	Type
NUCLEO-H755ZI-Q	MCU Dev Board
BMI088	IMU
ICP-10111 Pressure Sensor	Altimeter
F405 V3 50A 4in1 ESC	ESC
NRF24L01+PA+LNA	Radio
ILI9341 2.8" SPI TFT LCD	LCD
FHL-LD19	2D LiDAR
2212 920KV BLDC Motor	BLDC Motor
HRB 4S 4200mAH LiPo	Battery
LIDAR07	Rangefinder
1045 Carbon Fiber Propellers	Propellers
NylonG	Nylon + Glass Fiber Filament
NylonX	Nylon + Carbon Fiber Filament
URGENEX 7.4V LiPo	Battery

Custom Drone Frame

- ❖ Fully 3D-printable
- ❖ Physically testing the flight controller and collision avoidance is almost guaranteed to result in accumulated damages to the drone
- ❖ A 3D-printed frame allows for quick repairs
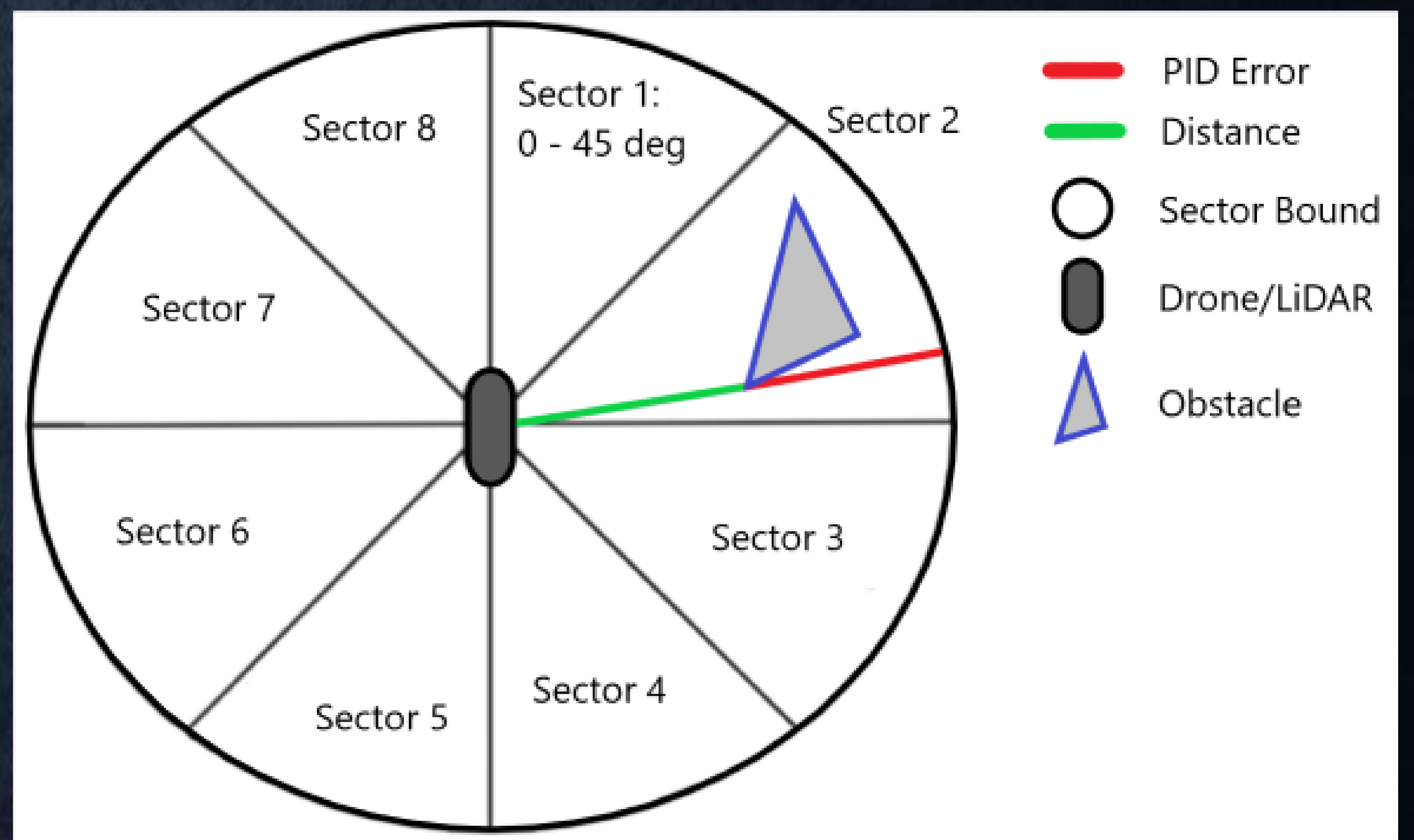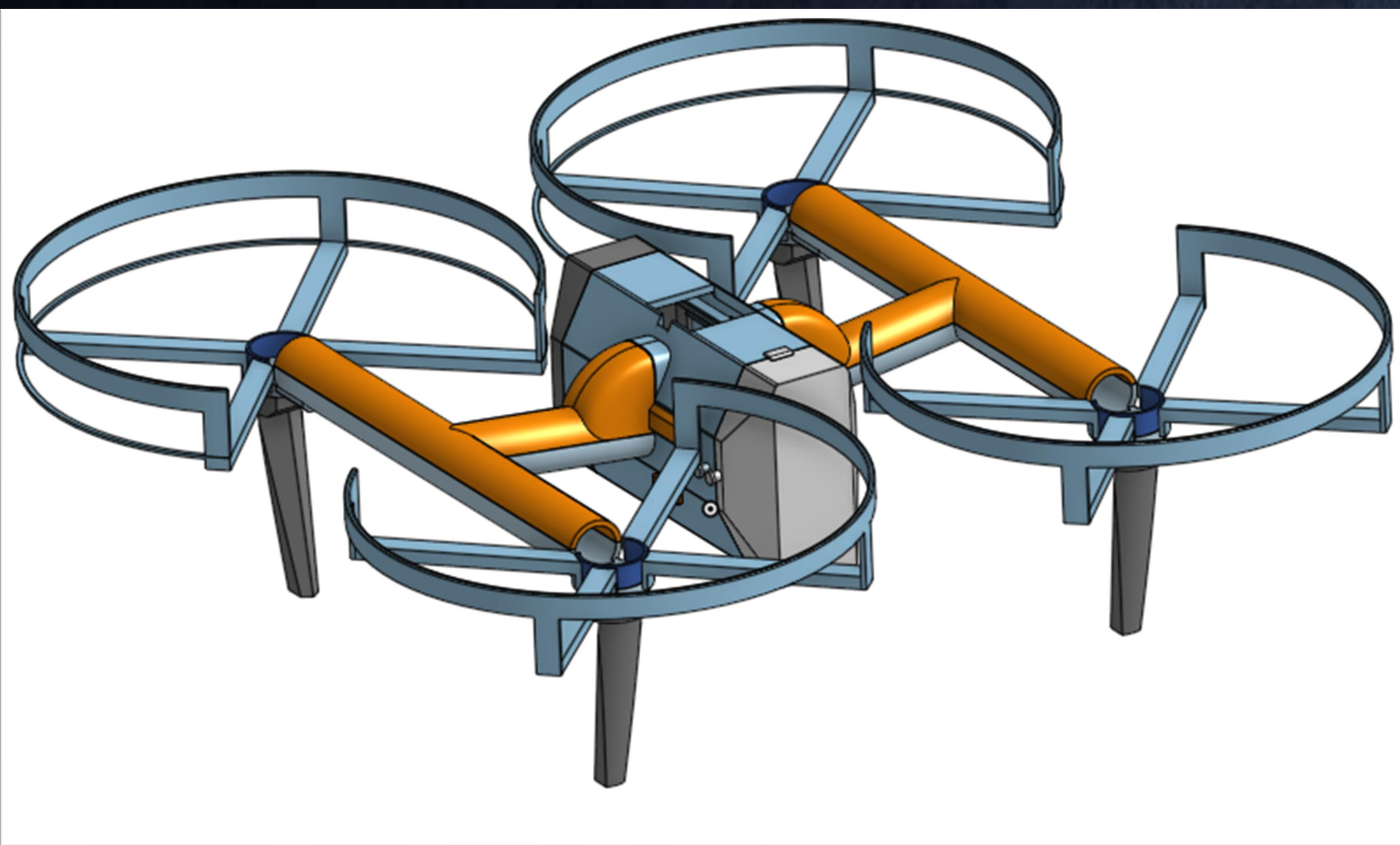- ❖ New parts can be recreated in a matter of hours

Collision Avoidance Algorithm

- ❖ Three Parts:
  - Obstacle detection, hazard assessment, obstacle avoidance
- ❖ Area around drone is divided into sectors bounded a minimum distance objects can be to the drone
- ❖ Each sector is assigned a PID controller that controls the distance between the drone and closest object in each sector
- ❖ PID controllers only have a non-zero output if the objects are closer than the minimum allowable distance
- ❖ Current implementation is extremely simplified. More complexity will be added as the algorithm is developed:
  - Velocity and angle adjustments
  - Path planning

Engineering Challenges

- ❖ Most significant issue has been tuning and stabilizing the flight controller
  - Drone pitch angle controller oscillates out of control instead of stabilizing its angle adjustments
- ❖ Redesigned the drone's frame
  - Made assembly easier
  - Moved props closer to drone's center of mass
- ❖ Low-Pass Filtering
  - Motors create a lot of noise, especially in IMU