

# Autonomous Swarm Drones

Team:

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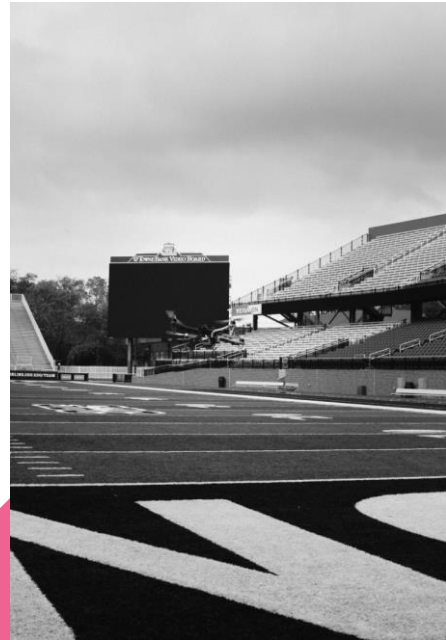
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# Introduction

- Drone swarming requires special sensors, controllers and operating systems
- Built-in swarm function in Ardupilot operating system.
  - Will be utilized alongside Mission Planner to show mission logs
  - Software will be downloaded into the Pixhawk to monitor flight, location and load autonomous missions
- High quality sensors and flight controllers.
  - Includes Sonar rangefinder, Radiolink GPS, and Hereflow
  - Collision & Crash detection sensors will be a goal for the upcoming semester
  - Multiple sensors are needed to track and communicate locations between multiple drones



# Goals

- Accomplishments:
  - Finish construction of our first drone
  - Order remaining parts for construction
- Second Semester Goals:
  - Finish construction of second drone
  - Program the two drones to fly in a swarm

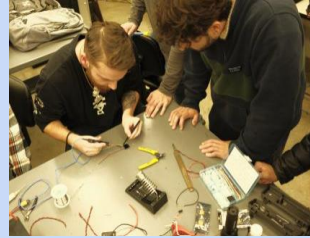
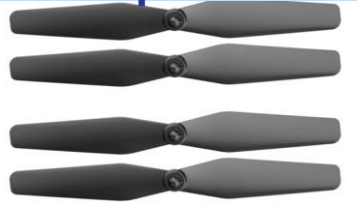


# Design - Sensors

## Drone Frame



## Propellor



## Soldering Components



## Cube Orange



# Design - Sensors

Tattu 5200mAh 14.8V 35C 4S1P Lipo  
Battery Pack With XT60 Plug



Speed Controller



# Design - Sensors

Can fly outdoors on its own



Radiolink GPS



Cube Orange

Will allow for indoor flight and more accurate outdoor flight.



HereFlow



HC-SR04 Sonar Rangefinder

# Engineering Standards



**Federal Aviation  
Administration**

There are several engineering standards that we follow as guidelines for this project. The many principles and ethics are set by the organizations below.

- ASME: The American Society of Mechanical Engineers
- IEEE: The Institute of Electrical and Electronics Engineers
- FAA: Federal Aviation Administration



**IEEE**





# Engineering Standards (cont.)



## Safety Codes & Standards

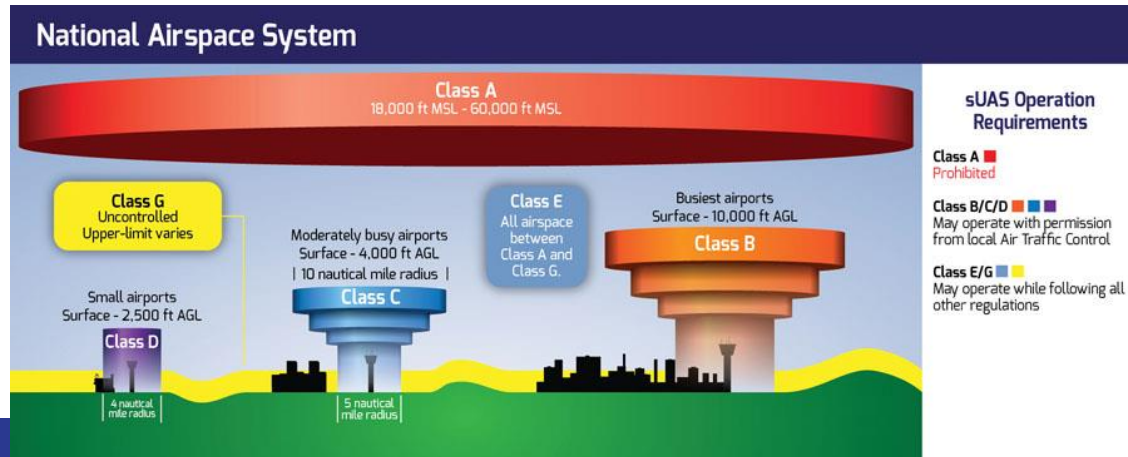
- The Recreation UAS Safety Test (TRUST)
  - Guidelines, rules, and regulations for recreational fliers to understand and take an aeronautical knowledge and safety test to fly
  - Drone must be registered through the FAA if weight is more than 0.55 lbs
- ASME & IEEE
  - ASME: Mobile Unmanned Systems regulations for engineers in inspection, maintenance, & repair of UAV to ensure health & safety of public
  - IEEE: maintenance procedures of any environmentally safe electronic circuit boards or electrical parts utilized in the project



# Engineering Standards (cont.)

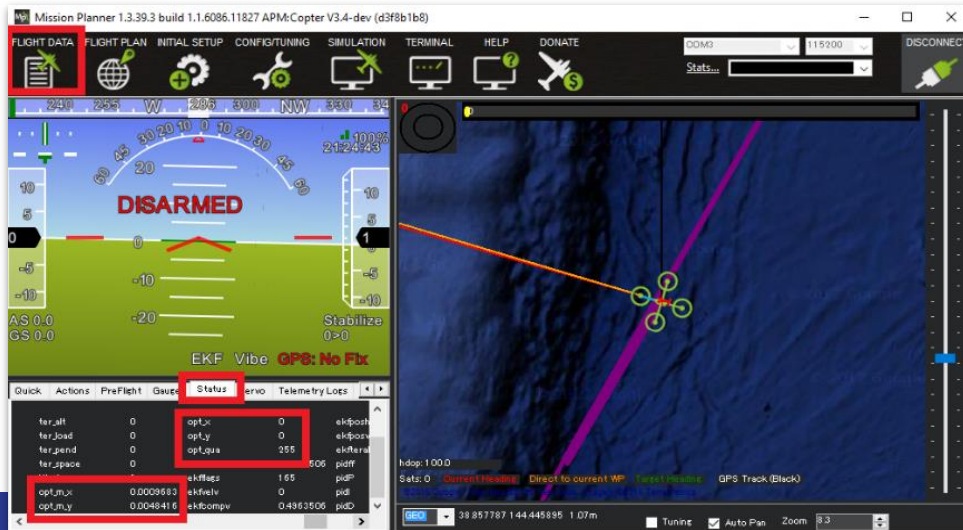
## Restrictions

- Fliers must abide by several rules set by the FAA
  - “No Drone Zones”
  - Airspace restrictions
    - Must keep drone below 400 feet off the ground in an uncontrolled airspace
  - Prohibited areas to fly
    - Airports, military bases, national landmarks, critical infrastructure (i.e power plants), stadiums & sporting events, Washington, D.C, etc.



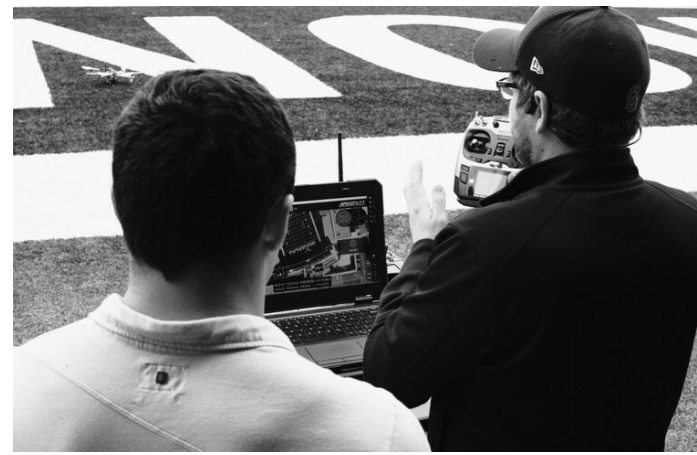
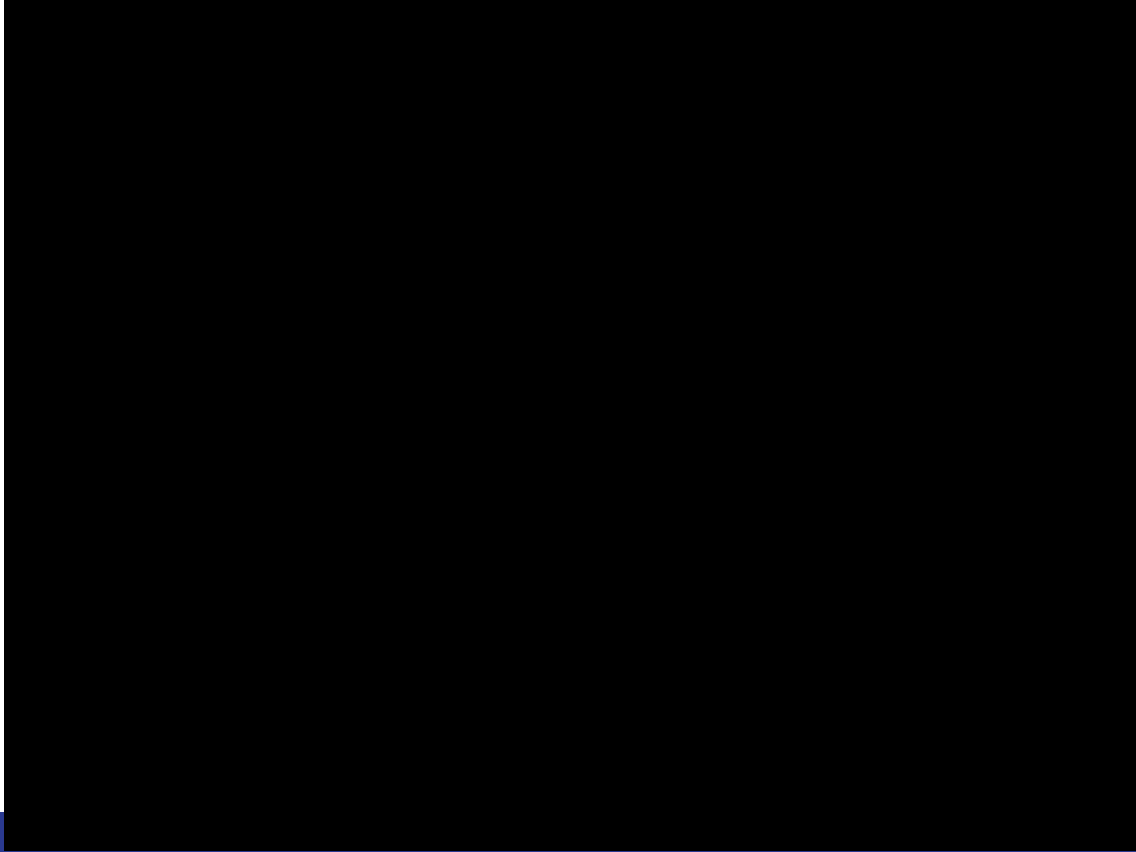
# Programming Methods

- Installing Firmware
- Ardupilot : Pixhawk : Mission Planner : Flight
- EasySwarm
- GPS Module
- Limitations



# Flight Data

UAV Log Viewer

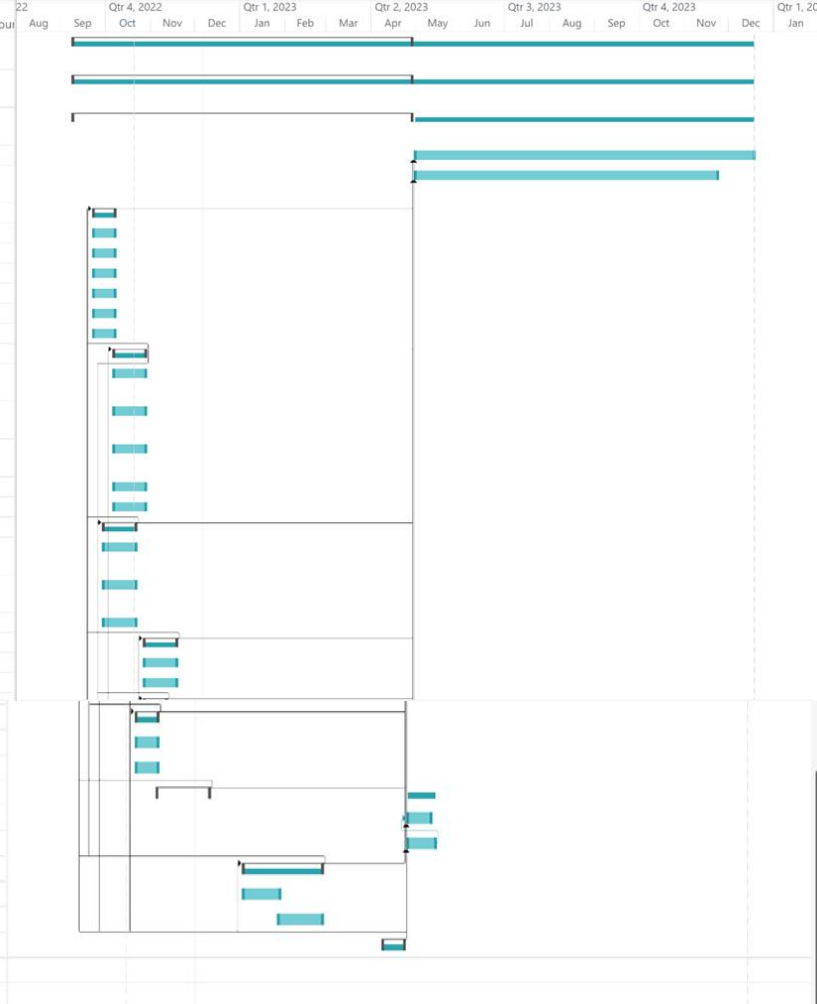


# Gantt Chart

Task Mode	Task Name	Duration	Start	Finish	Predecessors	Resources
1	Autonomous Swarm Drone	166 days?	Fri 9/9/22	Fri 4/28/23		
2	I. Research Aurdo-Pilot/Copter	166 days?	Fri 9/9/22	Fri 4/28/23		
3	II. Collaborate with instructors weekly	166 days?	Fri 9/9/22	Fri 4/28/23		
4	A. Meet with advisor	166 days	Mon 5/1/23	Mon 12/18/2 6,13,19,23,26,29,31		
5	B. Meet with ODU Drone Club	149 days	Mon 5/1/23	Thu 11/23/23 6,32,29,35		
6	III. Materials	11 days?	Fri 9/23/22	Fri 10/7/22	23,29,32,13,19,35	
7	A. Frame	11 days	Fri 9/23/22	Fri 10/7/22		
8	B. Motors	11 days	Fri 9/23/22	Fri 10/7/22		
9	C. Propellers	11 days	Fri 9/23/22	Fri 10/7/22		
10	D. Speed Controllers	11 days	Fri 9/23/22	Fri 10/7/22		
11	E. GPS	11 days	Fri 9/23/22	Fri 10/7/22		
12	F. Blade Guards	11 days	Fri 9/23/22	Fri 10/7/22		
13	IV. Budget	16 days?	Fri 10/7/22	Fri 10/28/22	23,26,29,32,35	
14	A. Smart Transmitter/Receiver	16 days	Fri 10/7/22	Fri 10/28/22		
15	B. Cube Orange Pixhawk	16 days	Fri 10/7/22	Fri 10/28/22		
16	C. Battery/ Battery Charger	16 days	Fri 10/7/22	Fri 10/28/22		
17	D. Sensors	16 days	Fri 10/7/22	Fri 10/28/22		
18	E. Replacement Parts	16 days	Fri 10/7/22	Fri 10/28/22		
19	V. Sensors	16 days?	Fri 9/30/22	Fri 10/21/22	13,23,26,29,32	
20	A. Optical Flow/ Hear Flow	16 days	Fri 9/30/22	Fri 10/21/22		
21	B. Non-GPS Navigation	16 days	Fri 9/30/22	Fri 10/21/22		
22	C. Object Avoidance	16 days	Fri 9/30/22	Fri 10/21/22		
23	VI. Software	16 days?	Fri 10/28/22	Fri 11/18/22	26,29,32,35	
24	A. Mission Planner	16 days	Fri 10/28/22	Fri 11/18/22		
25	B. Q-Ground Control	16 days	Fri 10/28/22	Fri 11/18/22		
26	VII. Drone Schematics	11 days?	Fri 10/28/22	Fri 11/11/22	29,32,35	
27	A. Brush Motors	11 days	Fri 10/28/22	Fri 11/11/22		
28	B. Brushless Motors	11 days	Fri 10/28/22	Fri 11/11/22		
29	VIII. Prototype	26 days?	Fri 11/11/22	Fri 12/16/22		
30	A. Assmebly	12 days	Mon 5/1/23	Tue 5/16/23	31,32,35	
31	B. Pre-Test	15 days	Mon 5/1/23	Fri 5/19/23	32,35	
32	IX. Flight Testing	40 days?	Mon 1/9/23	Fri 3/3/23	35	
33	A. Indoor	19 days	Mon 1/9/23	Thu 2/2/23		
34	B. Outdoor	22 days	Thu 2/2/23	Fri 3/3/23		
35	X. Final	11 days	Fri 4/14/23	Fri 4/28/23		
36	A. Demonstation					
37	B. Presentation					

GANTT CHART

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# Acknowledgements

## Contributors:

Drs. Krishna Kaipa, Thomas Alberts, and Drew Landman

## Old Dominion Drone Club:

Rob Stuart, Ana Eggleston (Secretary),  
Jack Hawkins (President)



# References

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