SWARM Project Midterm

Department of Mechanical & Aerospace Engineering
Old Dominion University

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OLD DOMINION UNIVERSITY
IDEA FUSION

Introduction

- Drones are becoming a more popular technology, commercially, recreationally, and by government use
- The ability to fly them in a group is needed for commercial and military use
    - Delivery for companies like Amazon
    - Drone usage in the military can reduce deaths
    - Delivering supplies to people who are quarantined or the elderly/disabled

Concept

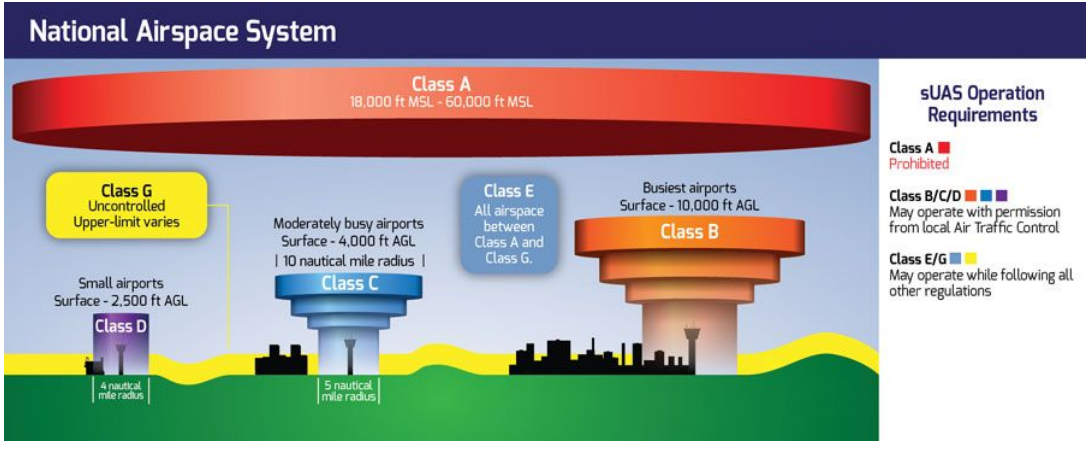
- Deliver a fully autonomous multi-drone swarm
- Capable of flying as a group with parallel routes, in close proximity, without collision and user input
    - Drone can operate in both indoor and outdoor environments

Engineering Standards

LiPo Batteries are quite volatile and require special precautions.

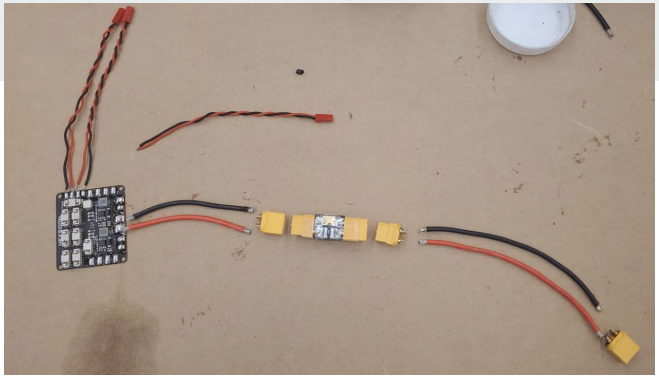
There are several engineering standards that we follow as guidelines for this project. The many principles and ethics are set by the organizations below.

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



Federal Aviation Administration

Accomplishments



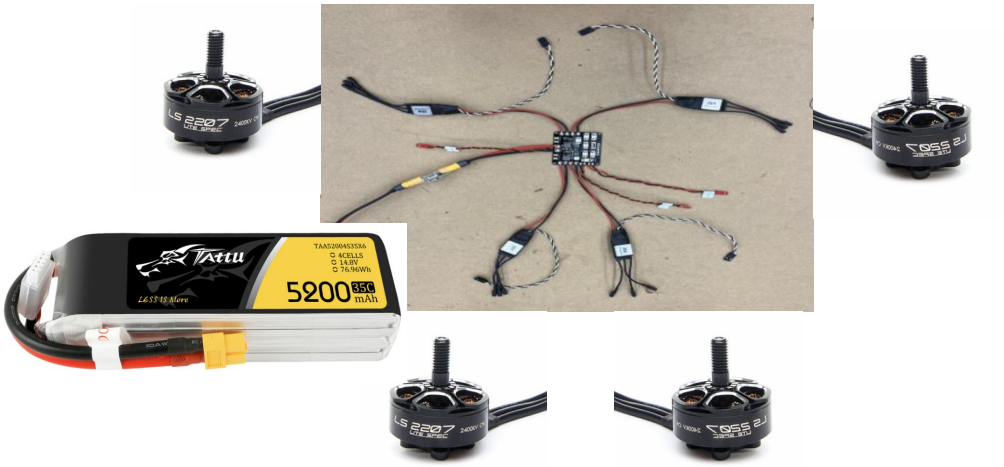
- Budget Proposal of $3709.36 accepted by ODU
- All parts have been ordered & received
- The first drone is in the process of being near completion in construction

Drone Design

- Frame/Motor/Propeller: Hexsoon Edu-450 V2
- Cube Orange Autopilot Flight Controller: Cube Orange+ Standard Set ADS-B (IMU V8)
- Distance Sensor: Ultrasonic Distance Sensor - Hc-Sr04
- Object Avoiding Sensors: Lidar-Lite, Slamtec Rplidar A1-360 Laser Range Scanner
- Optical Flow Sensor: Hereflow – Ir-Lock
- Camera: Siyi Ip Camera For Siyi Ak28 Vd32 Mk15
- Battery Charger: Gens Ace Imars Dual Channel AC200W/DC300W Balance Charger Black
- Battery: Tattu 5200mAh 14.8V 35C 4S1P Lipo Battery Pack
- Transmitter/Receiver: SIYI MK32 Long Range Remote Controller with 7 Inch HD High Brightness LCD Touchscreen
- Prop Guards: Blue & Grey Filament (Plastic, Fiberglass, Carbon Fiber)

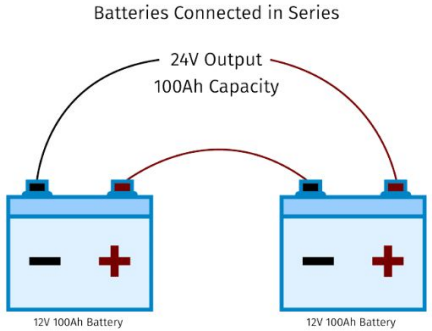
First Drone Construction

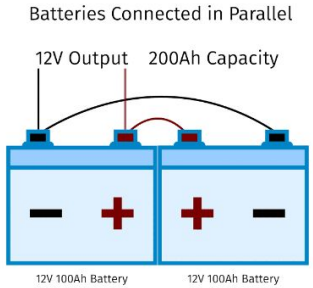
- Meeting twice a week with Rob to build drone
- Currently we have the power distribution wiring finished (soldering)
- Next we are going to build out the frame so that we know where to attach all the sensors, motors and wiring.
- Within the next two meetings the drone will be fully constructed and we can start focusing on programing.



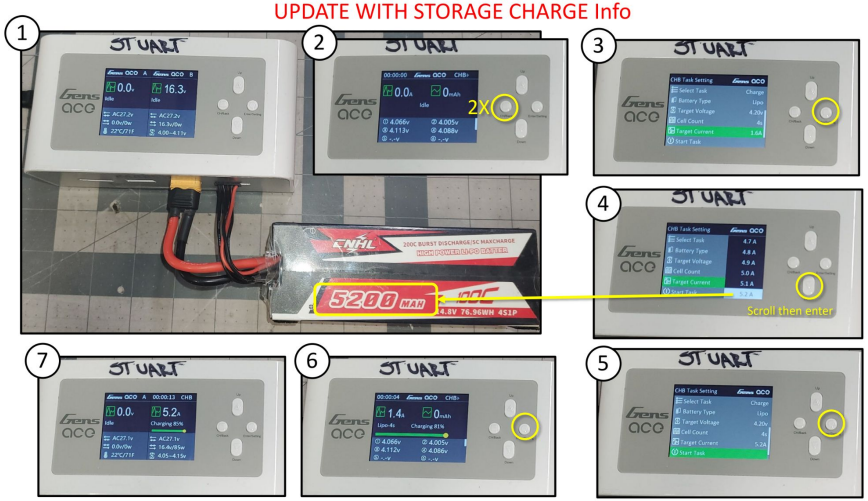
Battery Do's & Don'ts

- Always supervise lipo batteries when charging
  - NEVER overcharge or over discharge the battery
- Always store and charge batteries in a safe environment
  - Room temperature and dry
  - Away from flammable things
  - Some people use a fireproof container such as LipoSack, Ammo Box, or a fireproof cash box
- Always keep a fire extinguisher nearby





UPDATE WITH STORAGE CHARGE Info



Flight Time at Full Power:

5200mAh/(35x1000 mA/A)x0.8x60 min/h = 7.2 minutes

Rule of thumb: 80/20 rule: Discharge no more than 80% of the battery.

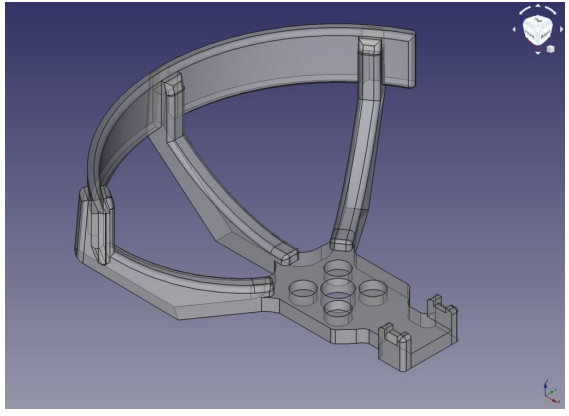
Voltage Current Relationships for DC Motors

$$Speed \propto V$$

$$Torque \propto I$$

Prop Guard Design

- Using Inventor software, we are modelling concept prop guards that would be suitable for our two Hexsoon drones in both indoor and outdoor environments
- Baseplate dimensions: 1.193 “ x 1.193 “
  - 4 * 10” Propellers Made of PLA Filament (blue & grey)
  - 7.498” diagonally apart with screw M3 * 5 screw types
- Prop guards to almost fully encompass the drone perimeter
  - Protects against collision and injury to nearby pedestrians



Method

Non-Autonomous Sensors

SIYI MK32 remote controller

Cube Orange+

Speed sensor

Autonomous Sensors

Here Flow

Sonar Range

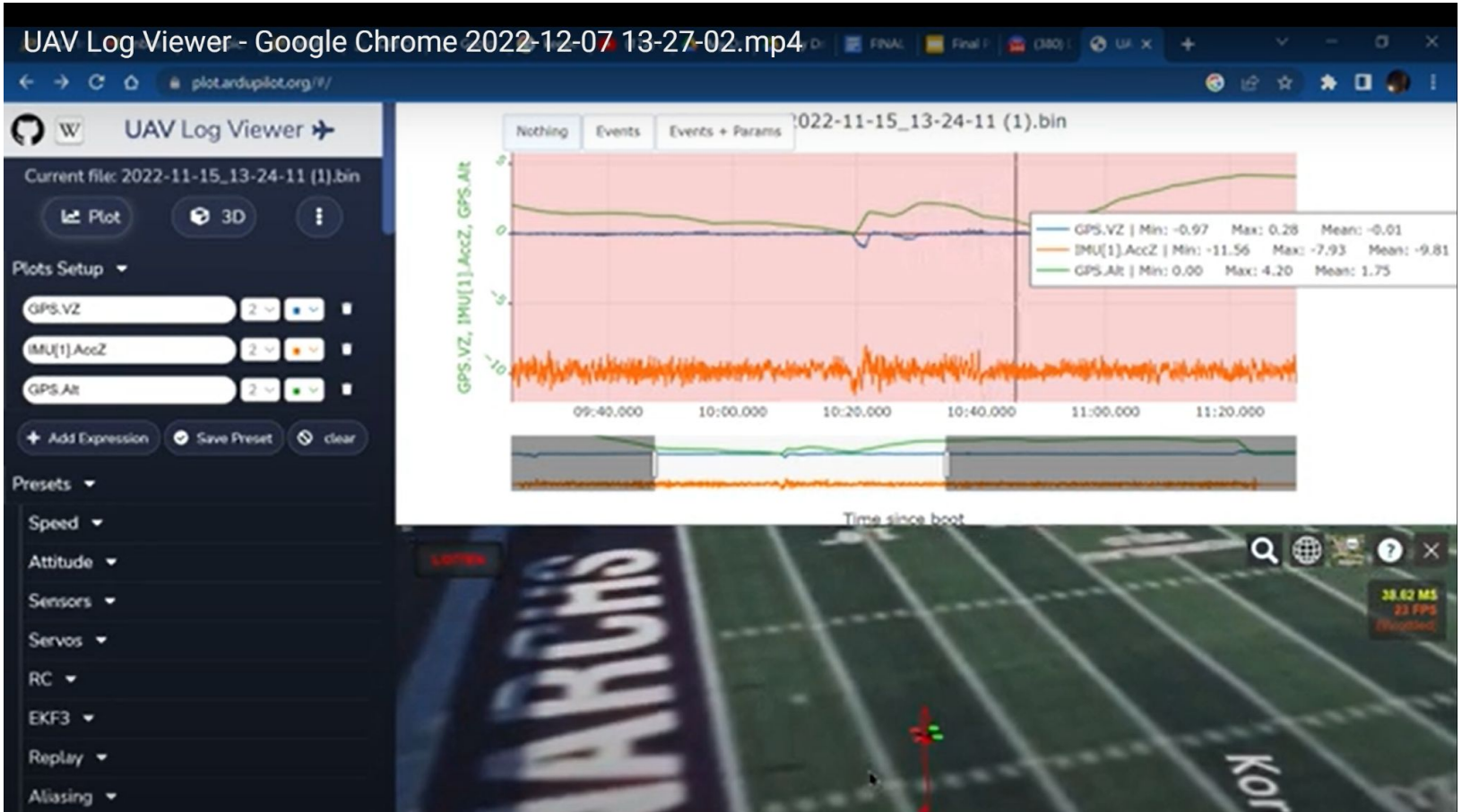
GPS Module

Slamtec Rplidar (Object avoidance sensor)

Software - Programming Methods

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

UAV LOG VIEWER



Website

- Website has a furnished interface with new font and complete tabs with several documents from previous semester
- Future updates will include a new tab that displays a general procedure of the Hexsoon drone build
- Website Link: http://dasp.mem.odu.edu/~swarm_sp23/index.html

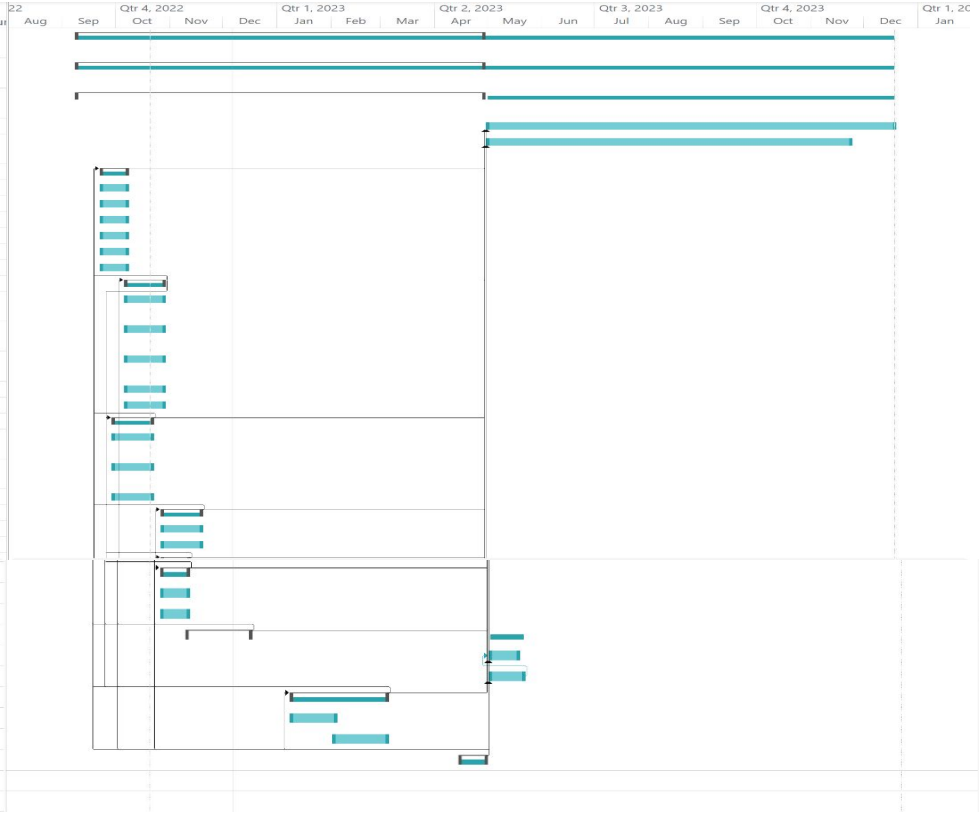
Gantt Chart

GANTT CHART

	Task Mode	Task Name	Duration	Start	Finish	Predecessors	Resour
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	6,13,19,23,26,29,3	
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		

GANTT CHART

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					



Acknowledgements

Contributors:
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Old Dominion Drone Club:
Rob Stuart, Ana Eggleston (Secretary), Jack Hawkins (President)

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