Drone Swarming Project

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Department of Mechanical and Aerospace Engineering

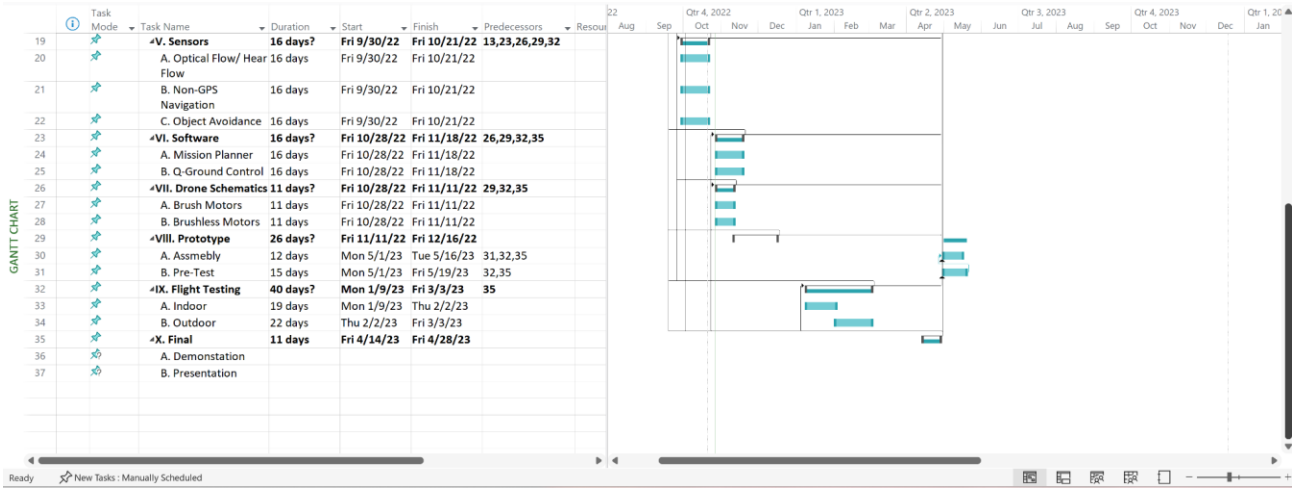
A Capstone Project

Project Objectives and Relevance

In MAE 434W, mechanical engineering students are required to complete a capstone project their last year at Old Dominion University. For our team of nine students, we are tasked to deliver a fully autonomous multi-drone swarm. Drones are becoming more and more widespread in today's world. The demand for drones with the ability to fly in a swarm is used intensively for commercial purposes including outdoor inspections, aerial videography, public safety, agriculture and more. To accomplish this, our team must design, build, program, and lastly fly two or more drones in a group with parallel routes, in close proximity without collision and user input. This is an immensely hard task that will require the coordination of multiple sensors and trackers to communicate location. With weeks of research and assistance from advisors, our team has an understanding of which high quality sensors and flight controllers we will need to get our drones up and running in a swarm. The use of sensors forces students to comprehend what swarm programming software function to utilize in the Ardupilot operating system. However, before programming our team needs a few parts for our two or more drones in order to complete our capstone project task. These parts consist of two cube oranges, one smart transmitter/ receiver, two telemetry, six batteries, one battery charger, two hereflow sensors, two lidars, two object avoidance, and some wires that will connect the sensors to the receiver of the drones.

Project Timeline

Below is a gantt chart designed by our team. The main dates are the prototype and flight testing which we plan on having the prototype done by the end of the first semester so that we can make sure the sensors and software are working properly to begin the flight testing in the next semester.



	Task Mode	Task Name	Duration	Start	Finish	Predecessors	Resou
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					

Necessary Materials	Price	Total			Links
SIYI MK15 enterprise fpv combo	600	600			SIYI MK15 Mini HD Handheld Agriculture Smart Controller with 5.5 Inch LCD Touchscreen 1080p 60fps FPV 180ms Latency 3.5KM CE FCC KC
Cube Orange/Black Pixhawk	350	700			Cube Orange+ Standard Set ADS-B (IMU V8) | CubePilot – IR-LOCK (irlock.com)
Battery 4s x3	900	5400			Gens ace 14.8V 45C 4S 5000mAh Lipo Battery Pack with Deans Plug (genstattu.com)
Battery Charger	150	150			Amazon.com: HOBBYMATE D6 Duo Pro Balance Charger Dual Ports - for Lipo Battery, Li-ion Battery, LiFe Battery, Nimh / Nicd Batttery Pack Charger, Support AC/DC Input （Gray）: Toys & Games
SIYI HM30	360	720			https://www.rc-wing.com/siyi-hm30-30km-long-range-1080p-full-hd-digital-wireless-transmission-system.html
Hex Hereflow Optical Flow Sensor	125	250			HereFlow – IR-LOCK (irlock.com)
HC-SR04 Sonar Range Finder	10.99 (pack of 5)	10.99			Sonar Range Finder
Lidar Lite Range Finder	150	300			LIDAR-Lite v3 - SEN-14032 - SparkFun Electronics
360 Lidar Sensor 12 m	100	200			https://www.amazon.com/Slamtec-RPLIDAR-Scanning-Avoidance-Navigation/dp/B07TJW5SXF
Prop Guards	20	40			Propeller Guards
24ga Silicone Jacketed Pre-Tinned S	14.99	14.99			24ga Wire
14ga Silicone Jacketed Pre-Tinned S	23.38	23.38			14ga Wire
			Needed Funds	7819.36	

Budget

The excel sheet shows the budget proposed to the committee for our swarming project. This budget does not completely cover all resources needed, as, thanks to help from our advisors, the ODU Drone Club, and graduate student Rob Stuart, we have many resources available in the form of drone materials. For example, the actual body of the drones is not included in this budget, as the materials for this were given to us by Dr. Landman.

Budget Justification

The team is aware that this is a great amount of funding to ask from the school. However, due to the nature of the project, this amount of funding is needed. There are multiple sensors needed for each drone in order to properly perform swarming mechanics, and we need to buy multiples of many of the materials due to needing to build multiple drones to test the swarming properly. We also need to buy multiple different types of wires for the different components. 24 gauge wires are needed for sensor and 5V applications, and 14 gauge wires are needed for the battery of the drone.