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RoboBoat 2.0 with a UAV

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Project Overview

This project's goal was to design and integrate an Unmanned Aerial Vehicle (UAV) to act as an autonomous, mobile sensor to aid an Autonomous Surface Vessel (ASV) in data collection for navigating the 2021 RoboBoat competition in late May. RoboBoat is a competition where students are tasked to design and build an ASV to autonomously navigate through various tasks in a marine environment. The general course layout is shown in Figure 1. In 2019, a ULL RoboBoat team designed and built the initial version of the ASV.

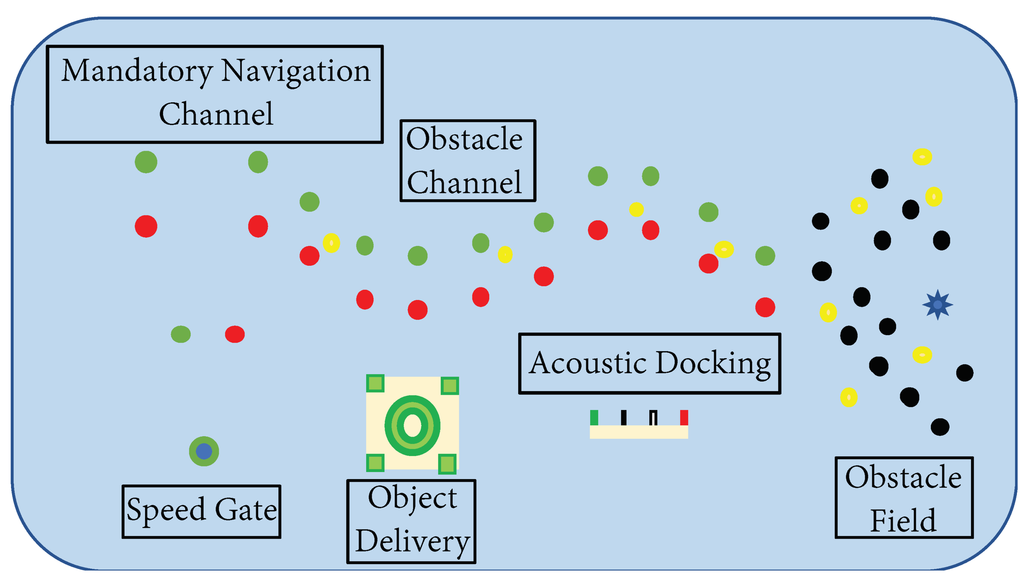


Figure 1: 2021 RoboBoat Competition Course [1]

2019 UL Lafayette ASV

The proposed system is to be integrated with the 2019 ULL ASV that is shown in Figure 2. The ASV displayed below is running the Robot Operating System (ROS) on its on-board computers. ROS is an open source framework that aids in the control, implementation of algorithms, and communication between robots. ROS also aids in the integration of multi-agent robotic systems by allowing collected information to be shared across multiple systems.

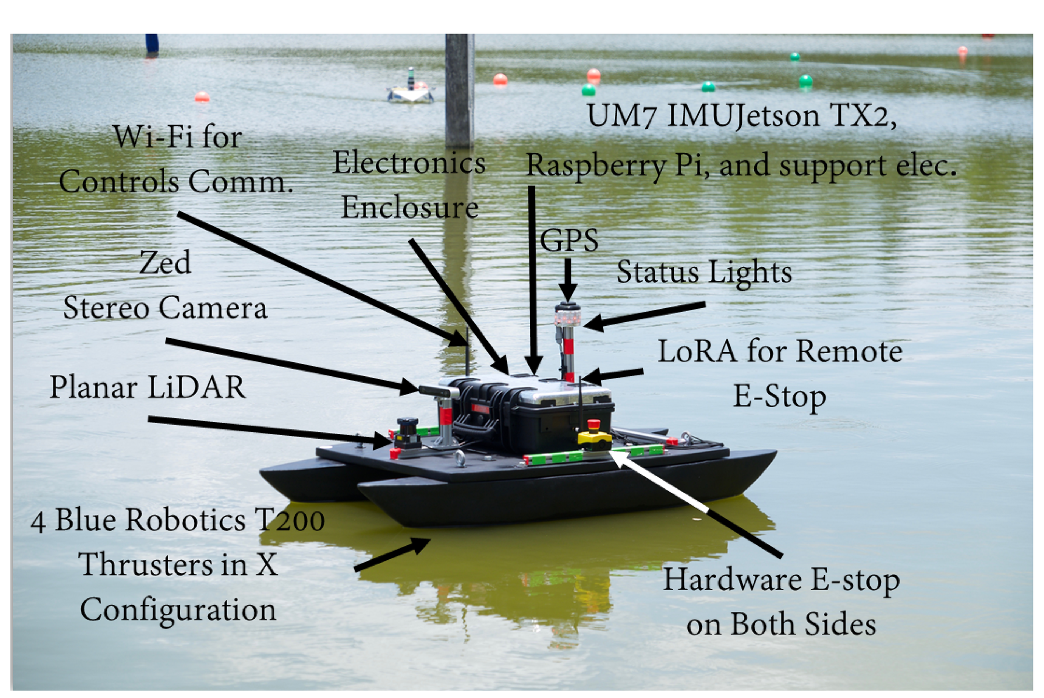


Figure 2: 2019 UL Lafayette ASV

Final Design

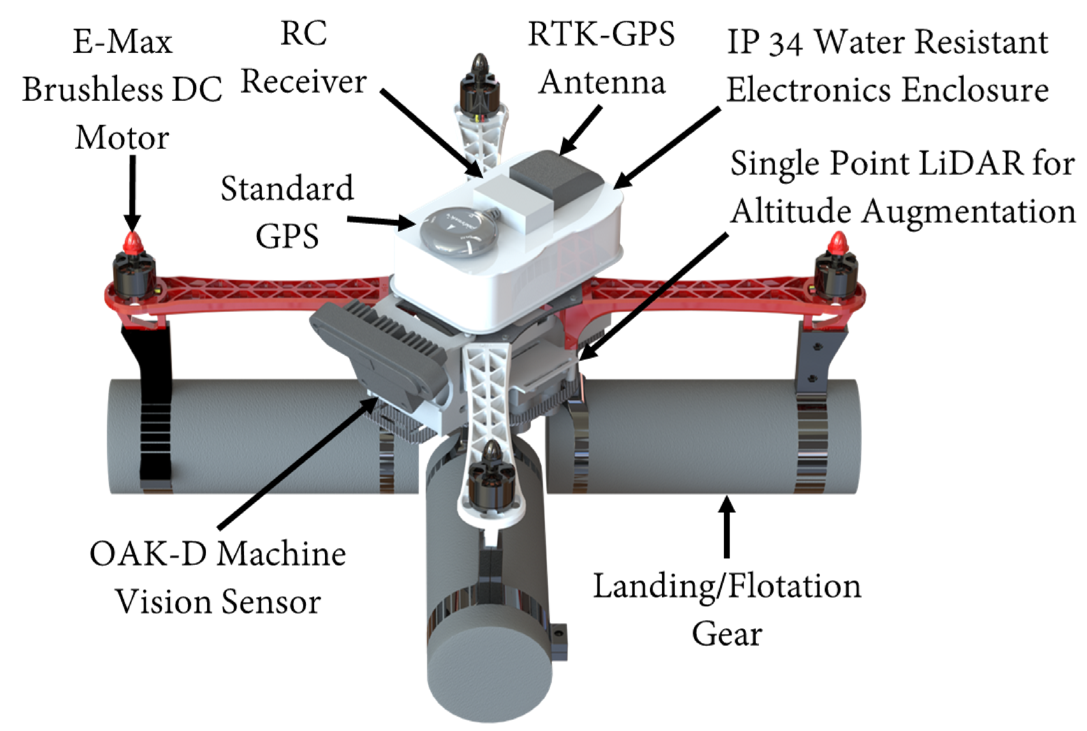


Figure 3: Main ASV System

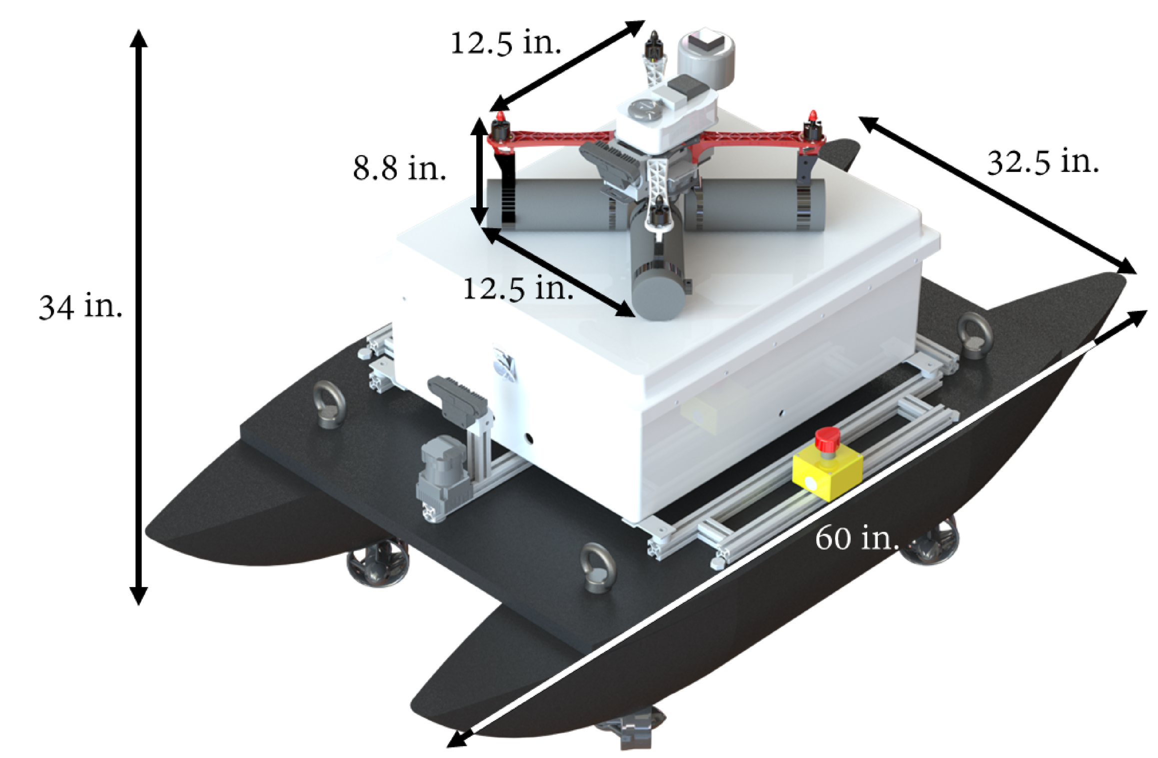
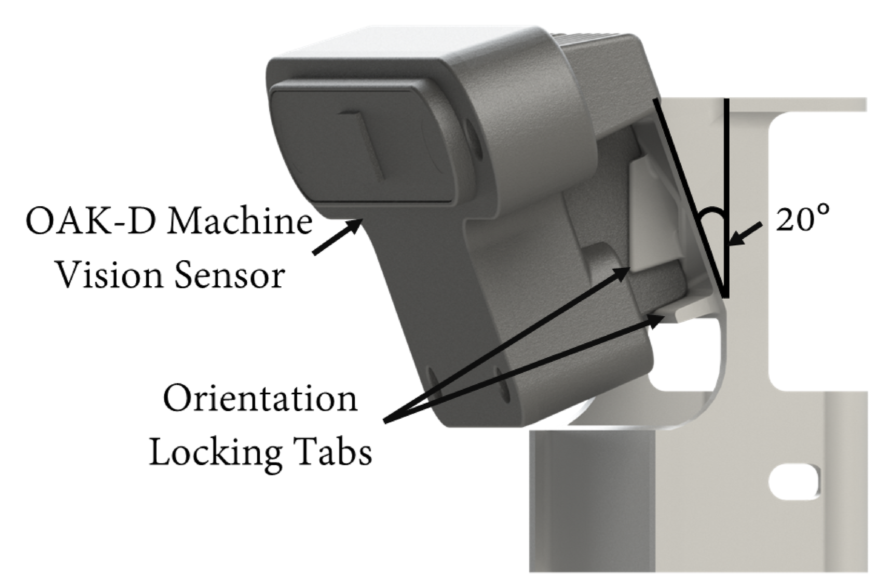
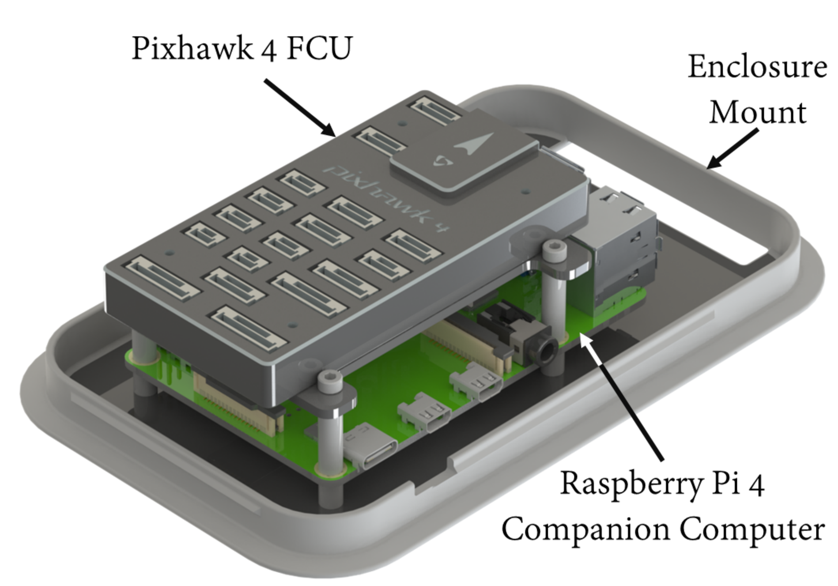
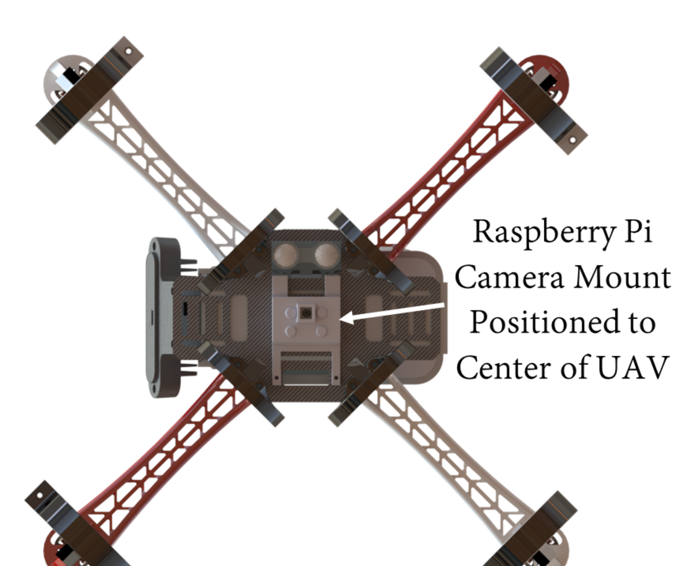


Figure 4: Multi-agent System

Component Design







Buoyancy

Figure 5: It Floats!

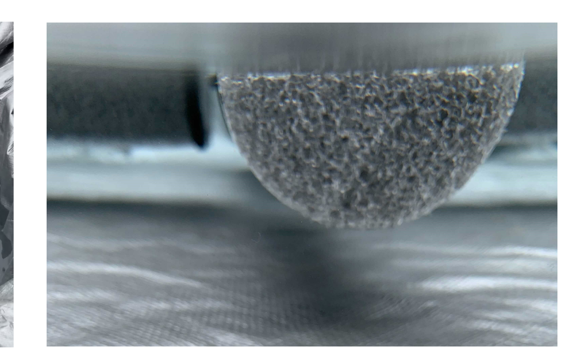


Figure 6: Underwater View

Buoyancy Calculations

Parameter	Value
Total Weight (lbs)	4.23
Submerged Volume of Landing Gear (in^3)	240
Buoyancy Force (lbs)	5.43

Thrust

Thrust to Weight Ratio

Parameter	Value
Desired Thrust to Weight Ratio	2:1
Actual Thrust to Weight Ratio	1.8:1

Thrust to Weight Ratio Improvements

Parameter	PCB	Carbon Fiber
Top Plate (lbs)	0.06	0.05
Bottom Plate (lbs)	0.09	0.06

Center of Mass

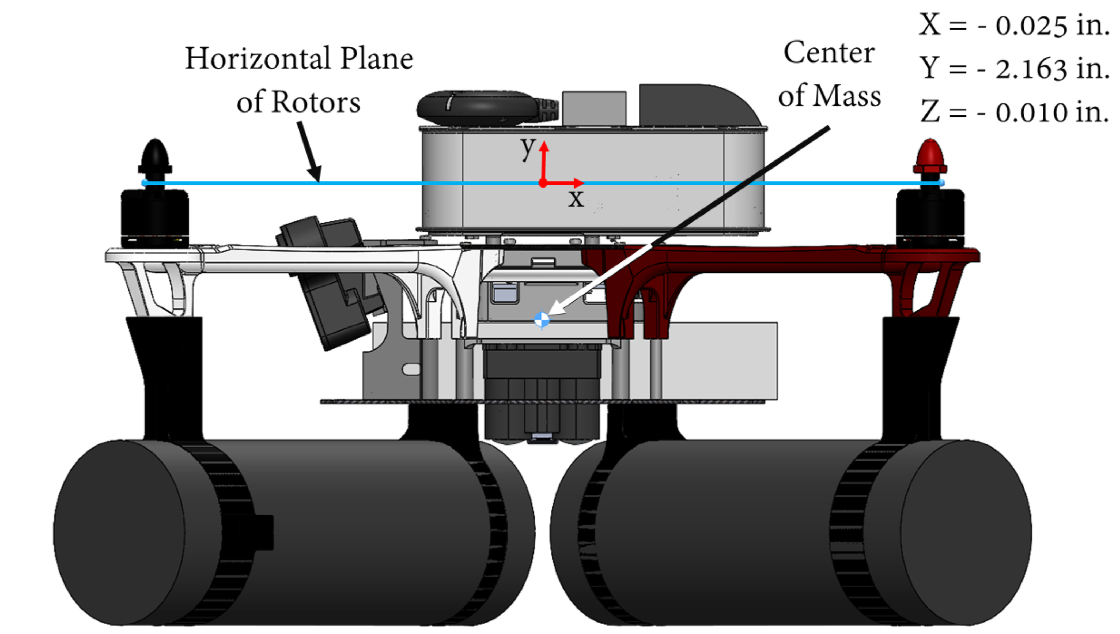


Figure 7: UAV Center of Mass

The location of the center of mass, in reference to the plane in which the rotors lie, determines the UAV's stability during forward flight and its ability to combat wind disturbances.

Global Positioning Requirements

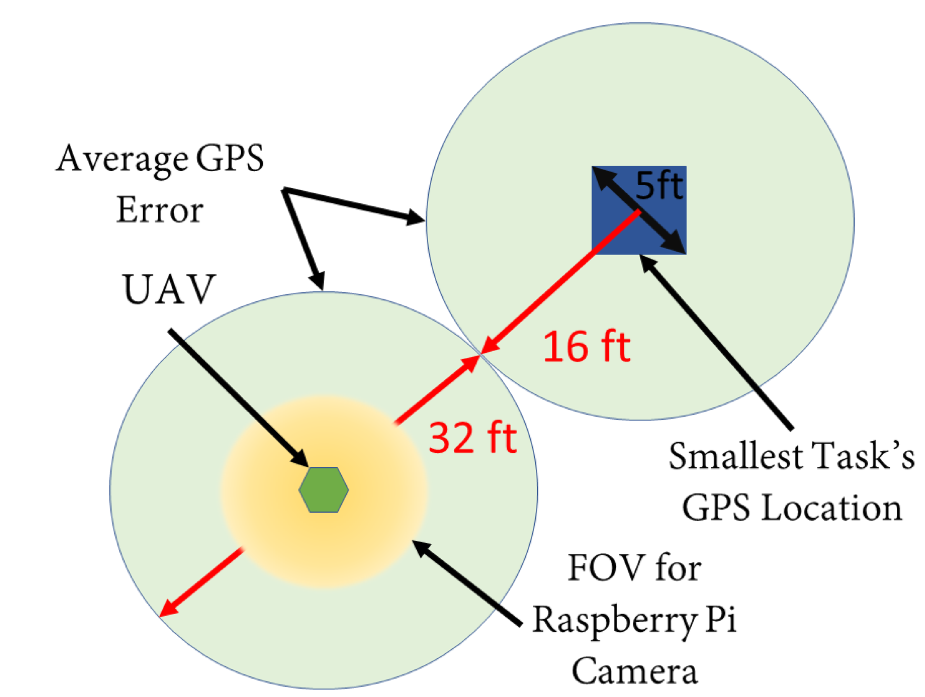


Figure 8: GPS Error Analysis

This GPS error drove the need for a Real-Time Kinematic (RTK) global positioning system.

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References

[1] RoboNation RoboBoat. Roboboat-2021-rules-and-task-description_v2, 2021.