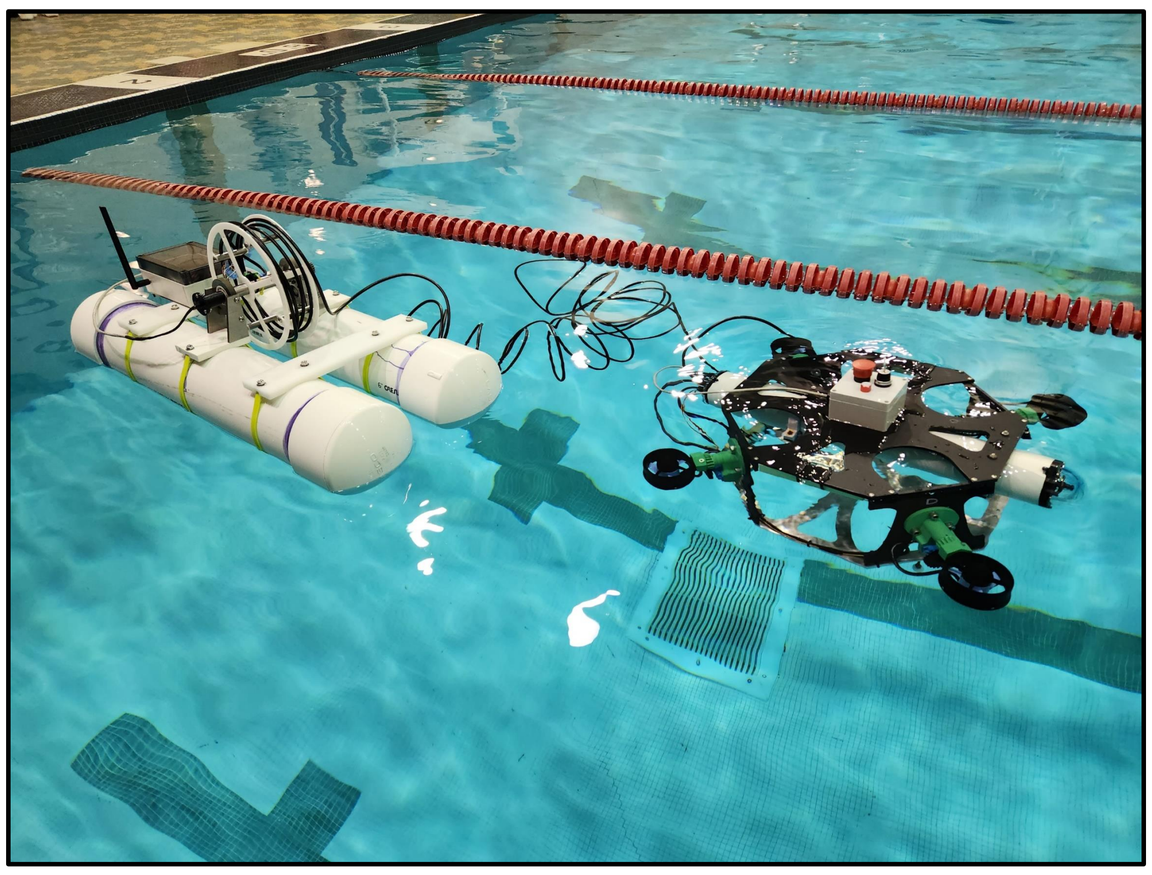
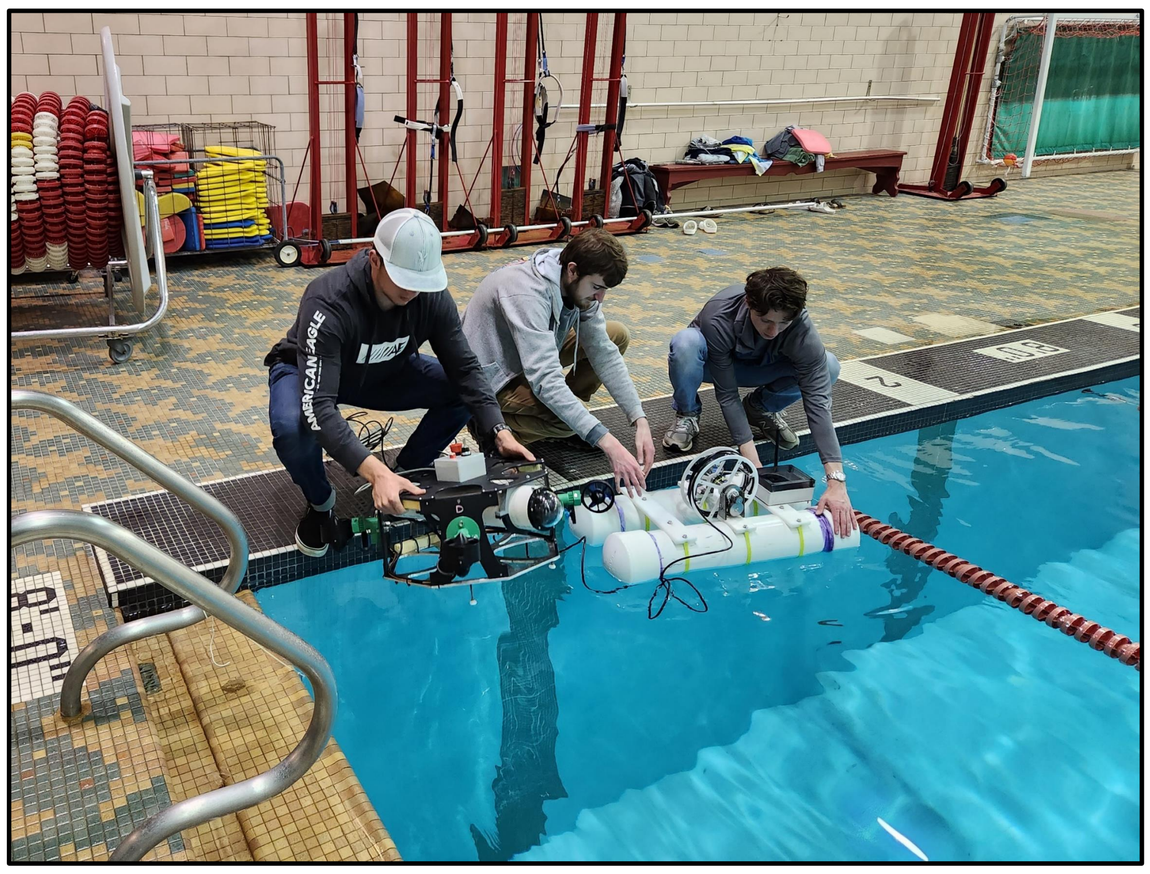
RoboSub 2023: GUAVA

Grover Underwater Autonomous Vehicular Apparatus

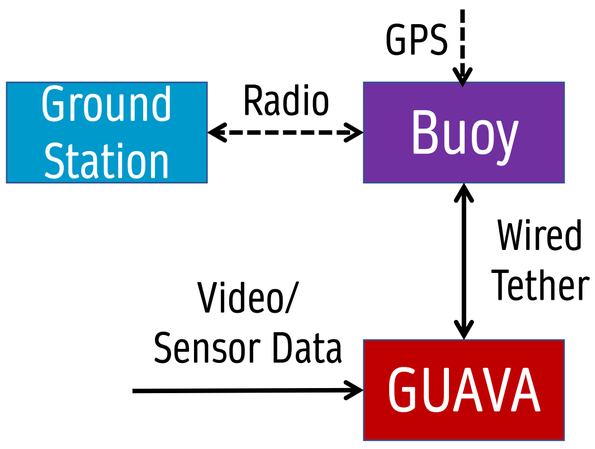
GROVE CITY COLLEGE



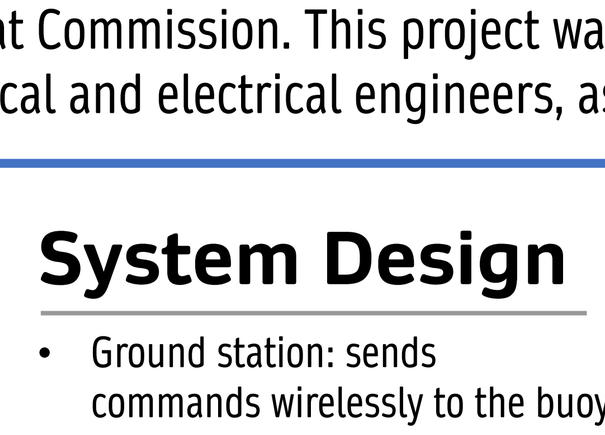


The goal of the RoboSub project (also known as GUAVA) was to create a fully autonomous vehicle for lake exploration and data recording. This data is primarily in the form of video footage of dams and fish habitats that can be used by PA DCNR and the Fish and Boat Commission. This project was a collaborative effort between our senior design team, consisting of both mechanical and electrical engineers, as well as a computer science senior design team.

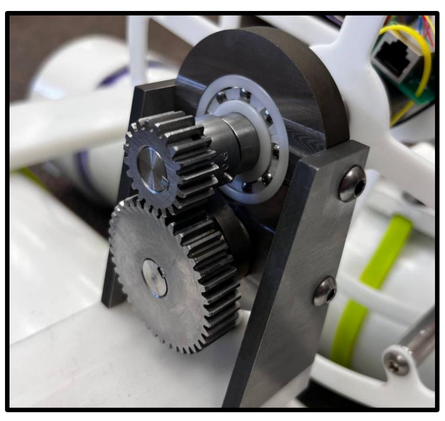
System Design



- Ground station: sends commands wirelessly to the buoy
- Surface buoy: receives GPS, transmits location and commands to GUAVA
- GUAVA: navigates autonomously from commands, records video and sensor data



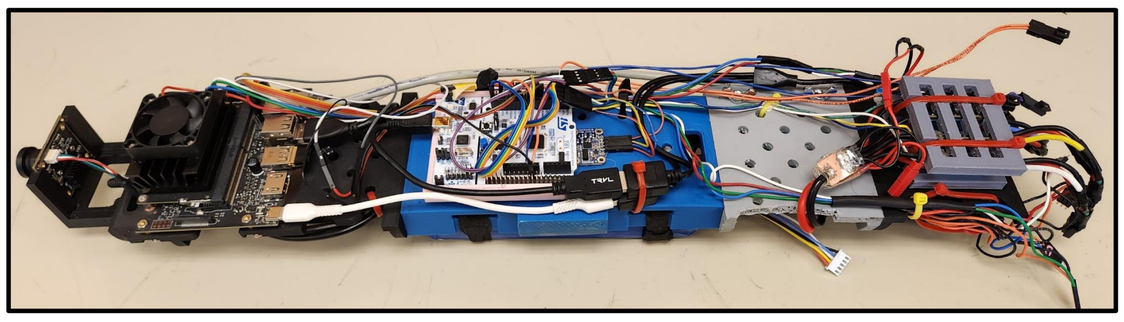
The vehicle is equipped with four BlueROV thrusters, each of which can pivot 180 degrees. The tube was made waterproof and has 12 penetrations for cables. The box on top has a status indicator, power switch, and an emergency stop button.



The buoy floats on two PVC pontoons and carries the radio, GPS, and tether reel. The tether retraction mechanism consists of a constant-force spring, gears, and a spool. The 2:1 gear ratio halves the amount of spring travel required to fully extend the cable.

User Interface

Designed by the computer science team, the user interface allows for control over the sub while showing position and telemetry data. Users can plan routes on the map for the sub to autonomously traverse. At each waypoint, actions can be completed such as start/stop video recording, surface, or orbit.



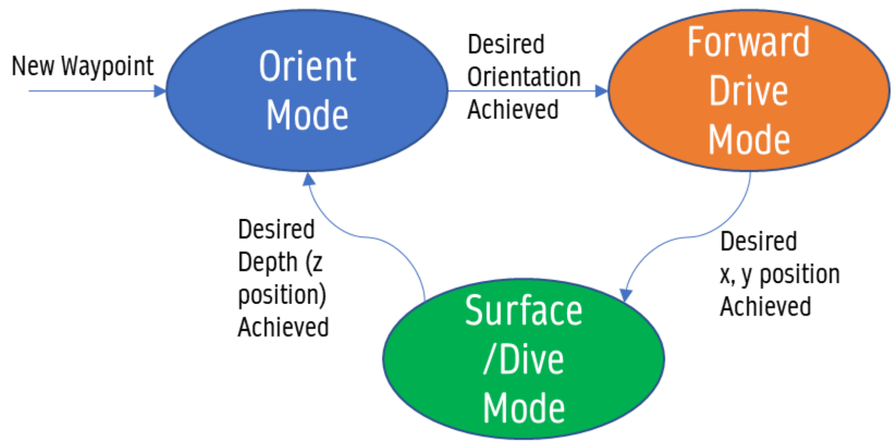
Electronics

From left to right:

- Camera
- Nvidia Jetson Nano: runs control system, connects to other electronics
- STM32 microcontroller: commands thrusters and servos
- Inertial measurement unit: measures orientation
- Battery board: monitors battery level, has power cutoff functionality
- Electronic speed controllers (ESCs): send power to the thrusters
- Depth sensor (not shown; attached to the tube enclosure)

Control System

- Implements a Finite State Machine (below) with three states
- PID and/or proportional feedback control loops within each state
- Implemented in a node network managed by Robot Operating System (ROS)



The Team

Back row (left to right): Evelyn DeMember, Michael Lindstedt, Dr. Luke Rumbaugh (Faculty Advisor)

Front row (left to right): Kyle Ebiri, Caleb West, Kirk Alderson