Mechanical Vehicle Design

Our chosen thruster configuration allows for six degrees of freedom while its symmetry simplifies vehicle control and maneuverability. Designed to be neutrally buoyant and have a low center of mass, the vehicle naturally corrects errors in orientation. All electronics are housed in an acrylic tube with Blue Robotics WetLink penetrators to connect cables to the external environment.

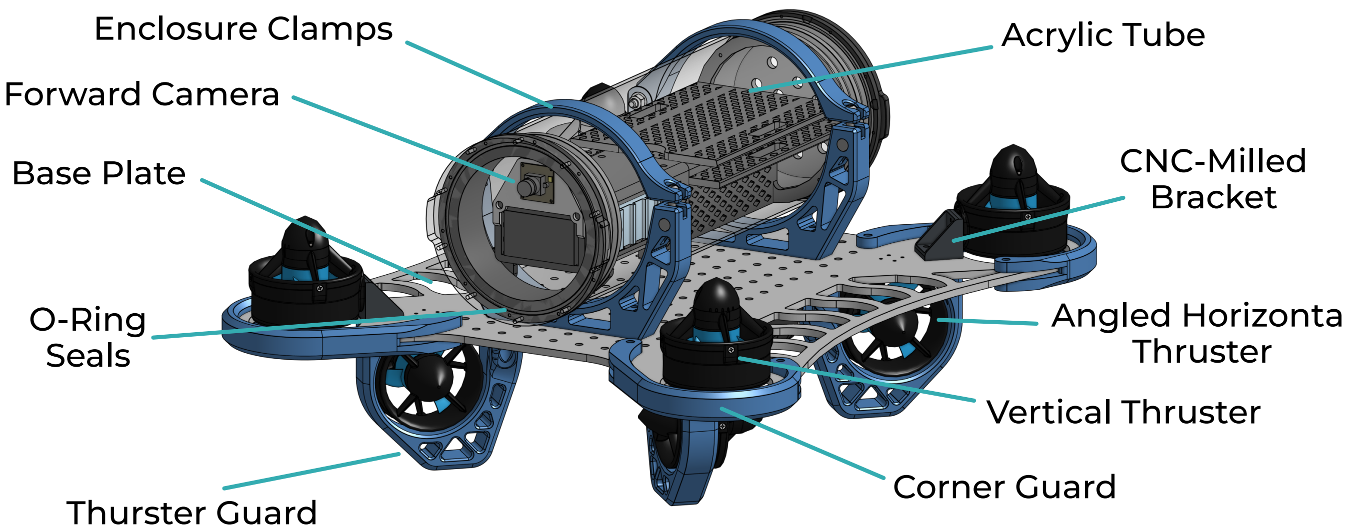

Figure 1: Structural CAD of Robot (Made in Onshape)

Manipulation

We designed servo-actuated mechanisms to release two small droppers into a bin during competition runs. The AUV centers itself over the bin using a downward facing camera and computer vision.

Figure 2: Bin Task

Figure 3: Path Marker

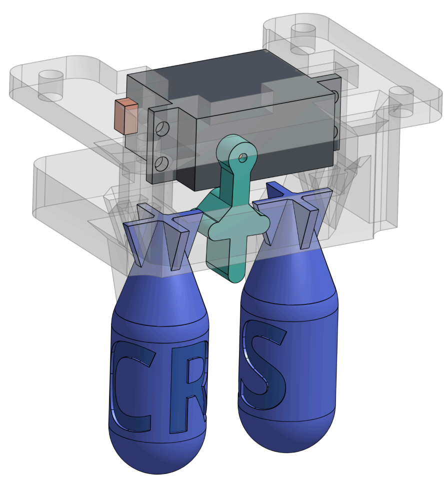

Figure 4: Dropper Assembly

Software Controls

The vehicle relies on a combination of sensors to determine its depth, heading, and position within the pool. All data and commands are sent over a ROS network and mission planning is handled by an executive control algorithm written in C++.

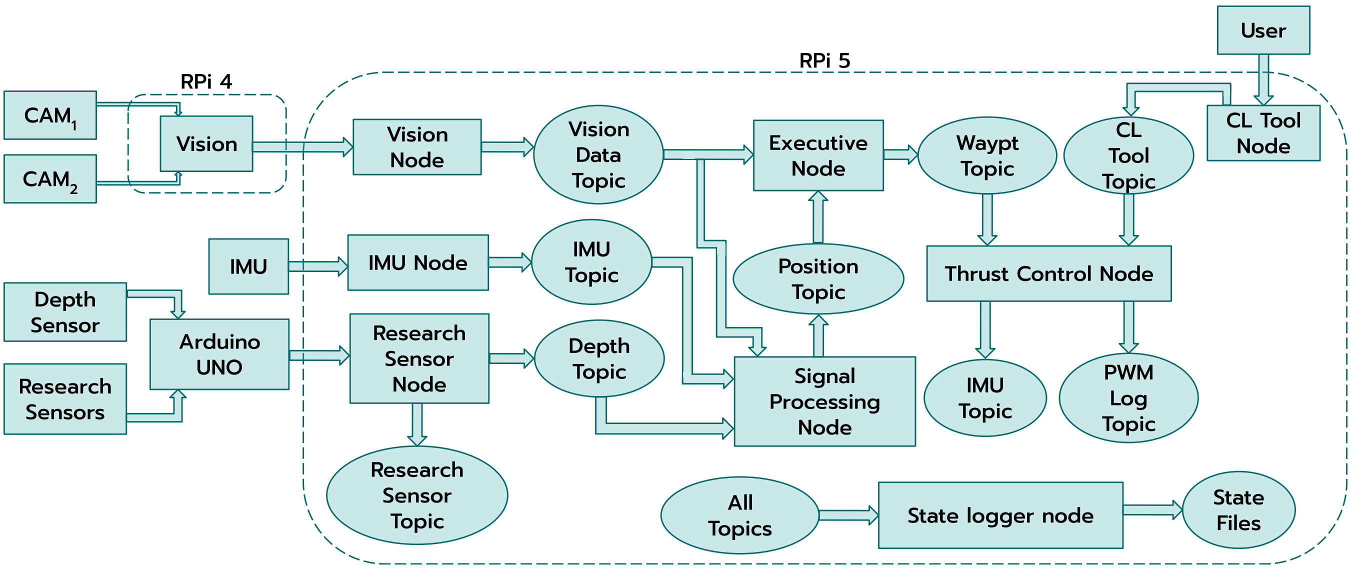

Figure 5: Software Structure Across All Hardware

Dynamics Modeling

The control scheme is built in MATLAB Simulink which generates trajectories and regulates PID feedback based on a vehicle dynamics model and waypoints. The model accounts for the AUV's 6-axes of freedom, buoyancy, drag, and vectored thruster configuration. The parameters are measured and validated based on IMU data collected during underwater testing.

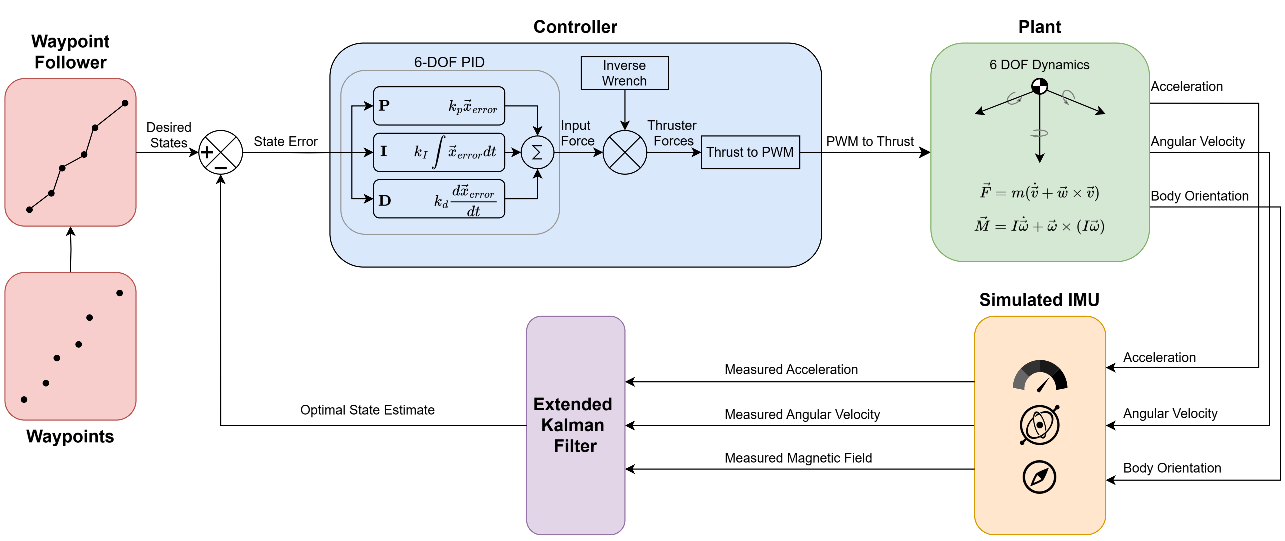

Figure 6: Vehicle Dynamics Model and Control Loop

Vision

Two cameras provide video feeds, which are processed by a YOLO vision model to identify objects of significance. The model is on team-gathered image-data of game elements such as the path found in Figure 3 in pools.Identifying objects along the course help the robot track its position within the pool.

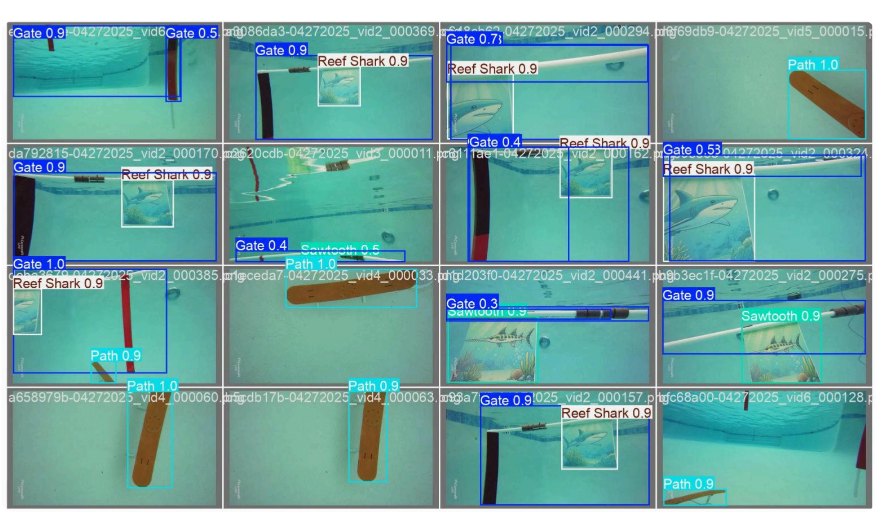

Figure 7: Object Recognition

Electrical Systems

The vehicle is powered by a single 16V Lithium Polymer (LiPo) battery which supplies power to the AUV's computers, sensors, and thrusters. Electrical components are mounted to a 3D-printed internal structure to maximize volume within the tube and efficiently route wires between components. A custom PCB distributes 5V of power from the buck converter to low-voltage components.

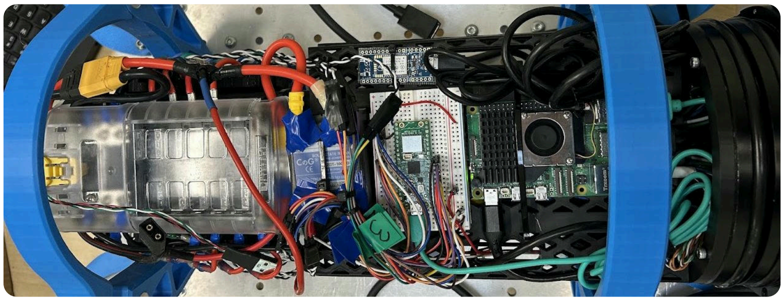

Figure 8: Primary robot wiring

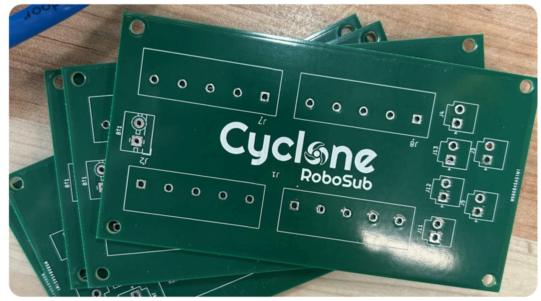

Figure 9: Custom designed PBCs

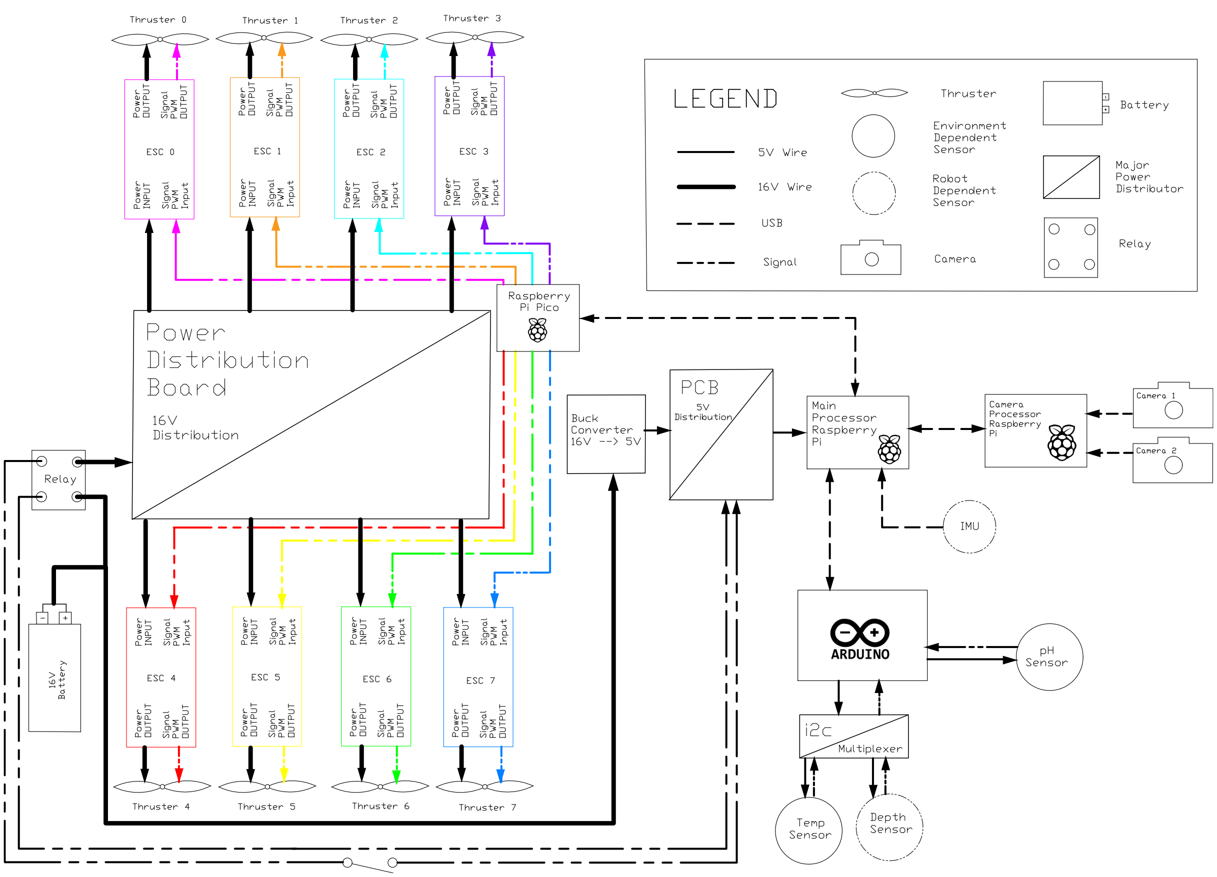

Figure 10: Robot Electrical Diagram

Research

Beyond the competition, Cyclone RoboSub is contributing to environmental research efforts through field deployments and interdepartmental collaborations. Equipped with sensors to measure temperature, depth, pH, and dissolved oxygen, the vehicle can collect environmental data and is scheduled to take two transects along the UC Davis Arboretum. The team is also exploring opportunities to contribute to marine science research at the Bodega Marine Lab.

Figure 11: Research Instrumentation

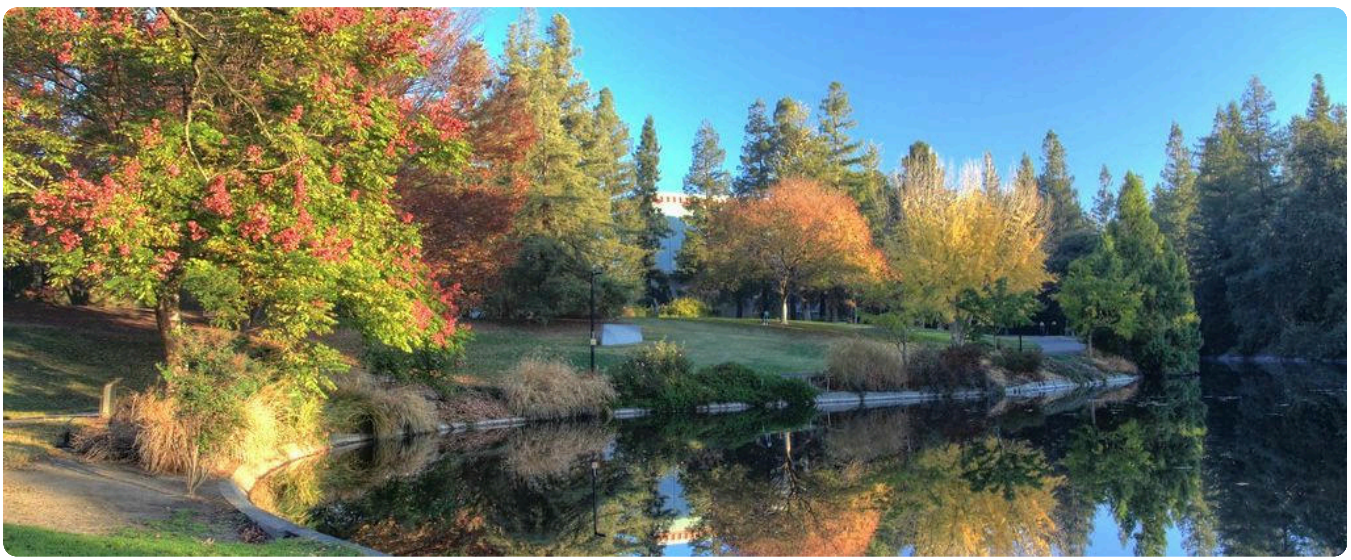
Figure 12: UC Davis Arboretum