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Summary

Rocker Robotics is participating for the first time this year at Robosub 2026. As this is the team's first year competing in RoboSub, development efforts were focused on a single vehicle named Brian. The team focused heavily on addressing the challenges associated with underwater autonomous operation. This year we deeply focused on ensuring watertight electronics and autonomous movement.

The team prioritized reliable completion of foundational tasks rather than attempting every competition objective during the first year. So we decided to focus on the gate, dropper, obstacle course, and finally returning.

Design

Mechanical

System Overview

The mechanical subsystem was designed to provide an easy platform for the electrical and autonomy subsystems to work from. To accomplish that, the autonomous underwater vehicle (AUV) was designed with two main goals mechanically. For the electrical subsystem, it needs to have plenty of space for the electrical components. A cooling system was also designed to prevent the components from overheating. The autonomy subsystem needed sensors mounted to the frame and for the design of the frame to provide excellent maneuverability. The mechanical components of the AUV include the frame, electrical box, marker dropper, and the cooling system.

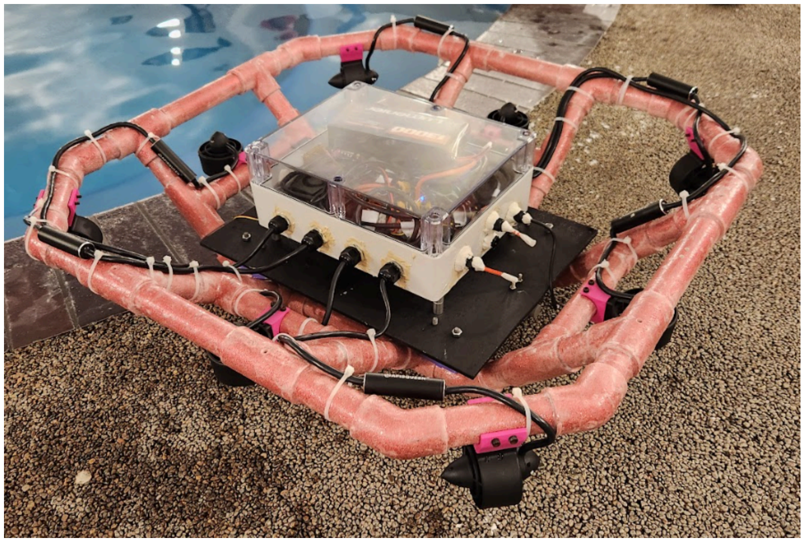

Figure 1: Completed Submarine

Frame

The AUV frame is designed in a hexagonal shape to provide the most convenient mounting positions for the thrusters. Using an eight-thruster configuration enables full 6-DOF maneuverability and improved translational stability. The frame is put together using solvent welded PVC piping. This was done for easy modularity and the low cost. The mounts for the components are all 3d printed with ASA filament. This provides strong components that are UV light resistant. An epoxy was used to protect the AUV and its mounting components. This keeps the parts waterproof and makes them safer to handle as they have softer edges.

Electrical Box and Cooling system

The electrical box is a waterproof container for the internal electrical components. To cool the components down, there are heat sinks connecting the inside and exterior of the box. The exterior heat sink uses the water in the pool to cool the inside heat sink which absorbs heat from the internal air.

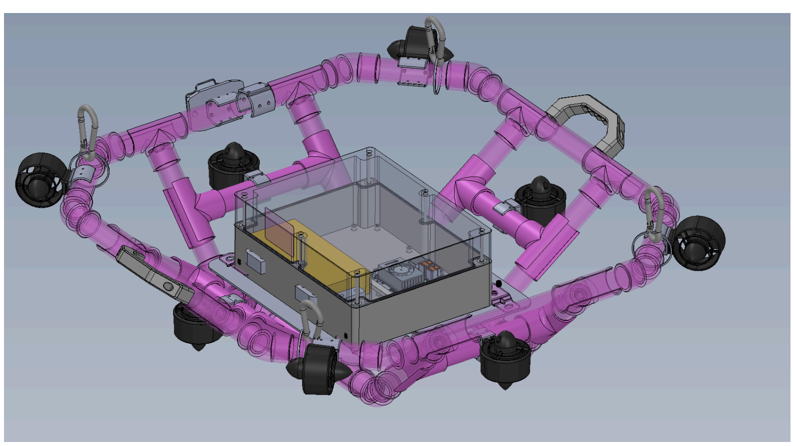

Figure 2: Cad Model

Marker Dropper

The dropper is designed to hold two weights being used as markers and release them on the target. The dropper works by rotating a disk with a hole to release one marker at a time. The disk is rotated using a servo mounted inside the dropper. To reload the dropper it can be removed from the AUV to access the inside. The dropper is mounted on the bottom of the AUV next to the down-facing camera for easier aiming.

Electrical

System Overview

The electrical subsystem was designed to provide reliable power distribution, communication, and control for all onboard systems while operating in a waterproof environment. The primary focus of the design process was developing custom Printed Circuit Boards (PCBs) to simplify integration, improve reliability, and reduce wiring complexity. The final design consists of two PCBs, the Power Distribution Board (PDB) and the Control Board.

Power Distribution Board

The PDB is the central power hub for the submarine. The board connects directly to the battery and distributes the required power across the system to support the thrusters, control board, and sensors. The design provides direct battery voltage for the high current draw of the thrusters, and regulated 5V and 12V outputs for the lower power electronics and sensors.

The PDB was designed to improve electrical organization within the enclosure and simplify subsystem maintenance and replacement. Dedicated output connectors enable each subsystem to be independently disconnected and replaced without compromising the waterproofness of the enclosure. The PDB also integrates an emergency stop (E-Stop) input to allow for immediately disabling thrusters.

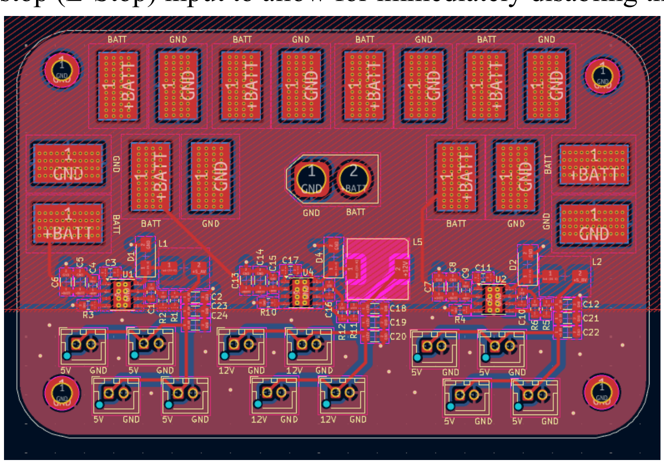

Figure 3: Power Distribution Board

Control Board

The Control Board serves as the central processing hub for vehicle control, bridging the software and the hardware. The board is designed around an STM32 microcontroller running ArduSub firmware, which handles low-level stabilization, sensor input, and thruster control. It is powered directly from the PDB's 5V rail.

The board includes onboard sensors including a barometer, inertial measurement unit (IMU) and magnetometer, providing ArduSub with the orientation and heading data needed for its proportional integral derivative (PID) stabilization loops. Dedicated pulse width modulation (PWM) output channels drive each of the eight thruster electronic speed controllers (ESCs), while additional connectors for the depth sensor, leak sensors, and 1D sonar are included to gather sensor data to pass to the Jetson. Transient voltage suppressor (TVS) diodes are included on sensor inputs to protect against electrostatic discharge in the environment. Communication with the Jetson Orin is handled over a serial UART link. Additional UART headers are included on the board to support future peripheral expansion.

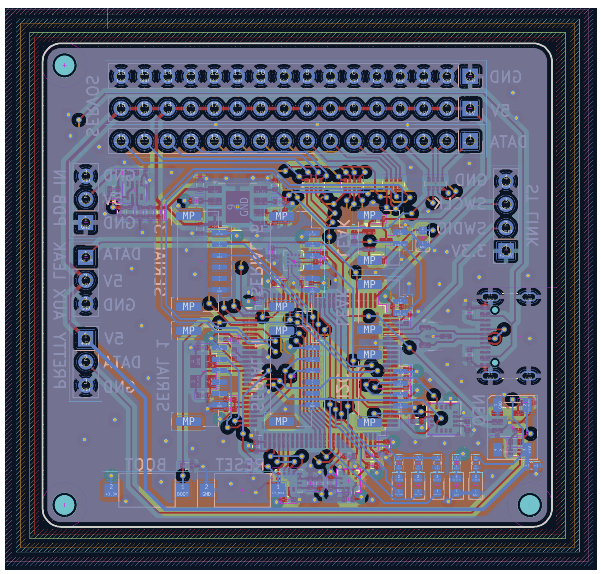

Figure 4: Control Board

Sensor Integration

The vehicle utilizes an IMU, depth sensor, leak sensors, 1D sonar, and cameras to support the autonomous navigation and vehicle stabilization. These sensors communicate with both the Control Board and the Jetson Orin to provide real-time environmental and positional data for the autonomy system.

Autonomy

System Overview

The submarine's autonomous system is built around a layered control architecture in which high-level decision making is separated from low-level vehicle control. Mission planning, object detection, and behavioral logic are managed by a custom autonomy framework, while ArduSub handles real-time stabilization and movement control. This structure allows the vehicle to independently manage navigation objectives while maintaining stable operation underwater.

ArduSub Integration (Low-Level Control)

ArduSub, a specialized branch of the ArduPilot ecosystem for underwater vehicles, functions as the primary real-time controller for the ROV/AUV. It is responsible for combining sensor data from the IMU, pressure sensor, DVL, magnetometer, and acoustic positioning systems in order to estimate the vehicle's state. Using this information, ArduSub maintains stable roll, pitch, yaw, and depth through PID-based control loops while also translating movement commands into direct thruster outputs.

Depending on mission conditions, the autonomy system dynamically switches between different ArduSub operating modes. During search operations, the vehicle may operate in `ALT_HOLD`, maintaining a constant depth while executing a predefined search pattern. Once a target has been identified by the vision system, the controller transitions into `GUIDED` mode, allowing real-time position updates from the perception pipeline to direct the vehicle toward the target. In emergency situations or during manual override, the vehicle can switch into `STABILIZE` mode, disabling autonomous position hold and returning direct control authority to the operator.

Vision-Based Perception with YOLO

Figure 5: YOLO testing

The perception system is built around a custom-trained YOLO model due to its ability to perform object detection at real-time frame rates while maintaining robustness in dynamic underwater environments. This makes it well suited for RoboSub tasks involving image recognition.

A 1080p video is sent to the Jetson where the YOLO model processes these frames and identifies mission-specific targets within the environment. Once an object is detected, the system converts the bounding box coordinates from image space into the vehicle body frame using camera calibration parameters and depth information obtained from the pressure sensor.

Position Tracking

The submarine also uses an IMU for short-term position tracking and navigation. The IMU continuously measures acceleration and angular velocity, allowing the system to estimate orientation, velocity, and relative movement through dead reckoning. This allows the vehicle to maintain stable navigation even when visual tracking or external positioning data becomes unreliable.

Conclusion

In conclusion, attempting a water based challenge was vastly different from what our team has approached before. Overall we accomplished what we originally set out to achieve and have learned significantly on how to construct and design an AUV. Going forward in the future we hope to fully develop our own autonomous system in addition to improving upon the base mechanical design.