Technical Design Report Team

Name: Titan Underwater Robotics

Institution: California State University, Fullerton

Competition: RoboSub 2025

Introduction

The Titan Underwater Robotics team designed and developed an autonomous underwater vehicle (AUV) for the RoboSub 2025 competition with an emphasis on modularity, ease of maintenance, and mission capability. This report outlines the system architecture, hardware selection, and rationale behind design decisions made throughout the development process.

Layout

Hardware

1. Jetson Nano(Main Board)
2. Ping 360 sensor
3. Underwater sonar(s)
4. Underwater GPS Navigation
5. Adding one more camera on the Bottom
6. Dvl (opt)
7. Control Board custom PCB

- Voltage regulator
- Relay module
- Has internal Humidity & Pressure Sensor
- Temp sensor
- Deck sensor
- IMU sensor
- Light controller
- Battery

Mechanical

1. Adding 2 extra Thrusters
2. Changing Ford and Thrusters pan (45 degree)
3. Fluid dynamic system
4. Design and 3d print Thrusters 4s braces support
5. Top cover design (optional)
6. Gripper design
7. Torpedo design
8. Camera gamble design

Software

1. ML (Object Decl)
2. Tether Controller
3. Navigation using sensor decte
4. Watchdog

5. Blue OS (custom OS)
6. GUI with custom controller
    - Video feed
    - Telamator
    - Path finding

Vehicle Frame and Enclosure

At the core of our AUV is the Watertight Enclosure for ROV/AUV (8\u2033 Series), which houses the main electronics and computing hardware. This enclosure provides reliable waterproof protection to depths exceeding competition requirements and includes a transparent dome for visual sensors. We mounted this onto a BlueROV2 Payload Skid, offering a lightweight and durable base with sufficient space for modular payloads.

Power System

The vehicle is powered by a Lithium-ion Battery (14.8V, 18Ah), chosen for its high energy density and compact form factor. This battery is secured inside the skid with proper insulation and connectors. The Basic ESC (Electronic Speed Controllers) regulate power delivery to the thrusters and prevent voltage spikes that may harm the Jetson Nano or other subsystems.

Propulsion

The AUV is equipped with four T200 Thrusters, offering strong and reliable thrust in all directions. Their configuration allows for full six-degree-of-freedom (6-DOF) motion, enabling the AUV to maneuver precisely during tasks such as object retrieval and gate navigation.

Computing and Control

At the heart of the control system is the Jetson Nano, a compact AI-enabled computer that processes camera input, sonar data, and sensor fusion. Its low power requirements and robust GPU performance make it ideal for onboard deep learning models and real-time decision-making. Input/output interfaces are protected and sealed using WetLink Penetrators.

Perception and Navigation

We utilize the Ping360 Scanning Imaging Sonar for object detection and mapping in murky water conditions. It offers 360-degree scanning, which is critical for detecting gates, markers, and navigating obstacle fields. A Bar30 High-Resolution 290m Depth/Pressure Sensor provides accurate depth data to maintain and adjust buoyancy and depth levels dynamically.

Manipulation System

For interaction with physical objects, our AUV includes the Newton Subsea Gripper, a compact and robust manipulator capable of gripping, releasing, and retrieving items. It is integrated with our perception and control systems to respond to target detection and proximity cues.

Auxiliary Systems

The Adafruit Industries LLC 4754 breakout board assists with sensor interfacing and level-shifting, particularly for communication protocols like I2C and UART. This modular approach ensures hardware scalability and simplified debugging.

Conclusion

Our design prioritizes modularity, reliability, and effective mission task completion. Each component was selected based on performance, ease of integration, and proven field reliability. The integration of sonar, pressure sensors, AI processing, and a robust propulsion/manipulation system equips our AUV for success in RoboSub 2025.