AMU ROVC 4.0

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V8

ROVC REPORT

INTRODUCTION

V8 is a single-hull, six-degree-of-freedom (6-DOF) underwater vehicle using a vectored thruster configuration for precise and agile maneuvering. The compact single-hull design improves structural strength, simplifies sealing, and enables efficient component integration.

Vehicle control and stabilization are handled by a Pixhawk flight controller, while high-level processing, communication, and vision tasks are managed by a Raspberry Pi 4. The project integrates mechanical design, electronics, and software to deliver a stable, responsive, and modular underwater platform.



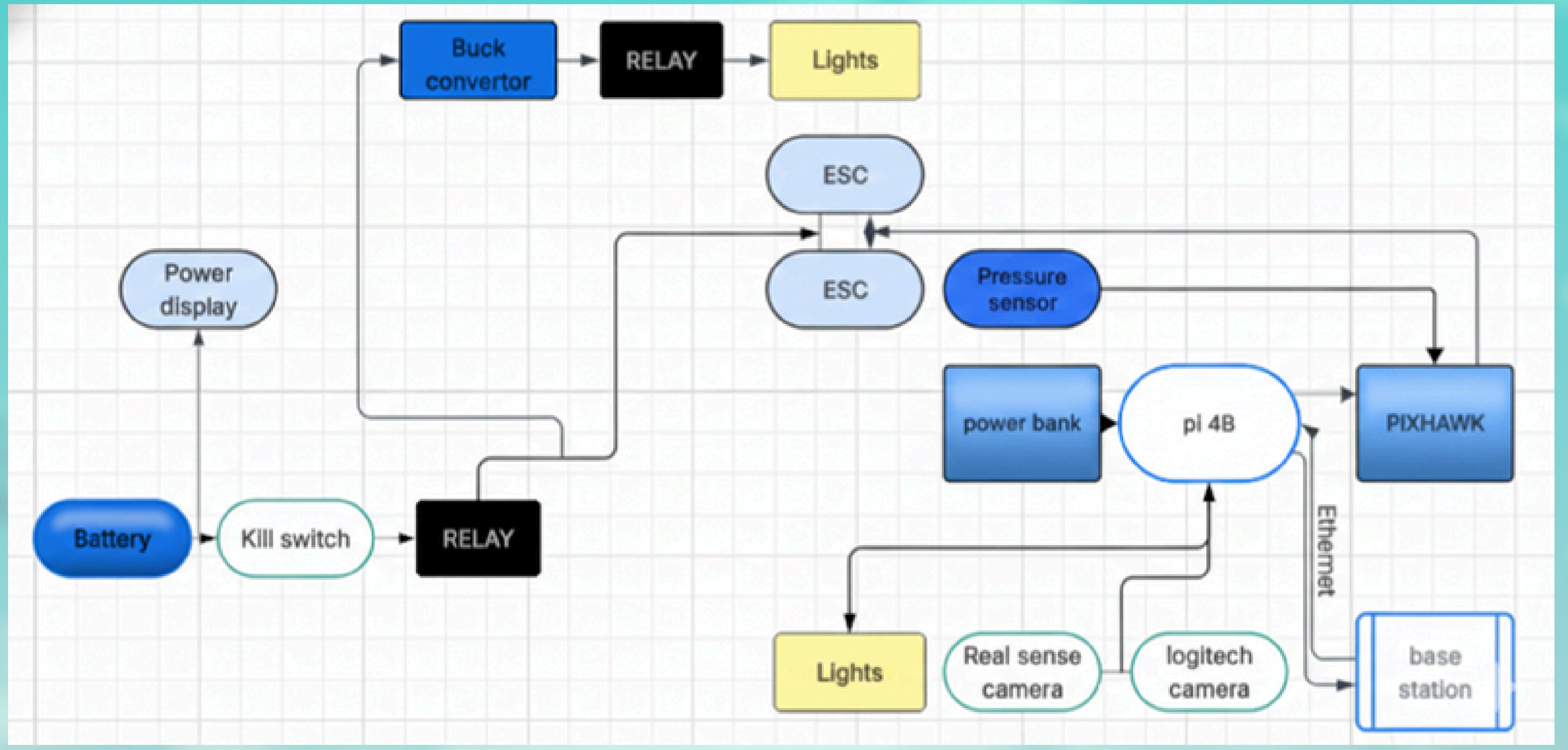
A COMPACT, SINGLE-HULL, VECTORED 6-DOF UNDERWATER ROBOTIC PLATFORM

ELECTRONIC SYSTEM

V8 uses a modular electronics architecture for reliable control and safe underwater operation. A Pixhawk handles low-level control and stabilization, while a Raspberry Pi 4 manages high-level processing, communication, and vision.

The vehicle is powered by an 8000 mAh Li-Po battery for propulsion and a separate power bank for the Raspberry Pi. Eight thrusters provide vectored 6-DOF motion through ESC control. Safety is ensured using a Blue Robotics kill switch and a 4-channel relay module for power isolation and load control. Visual feedback is obtained from a Logitech camera and an Intel RealSense camera, supported by high-intensity LED lighting.

CIRCUIT DIAGRAM



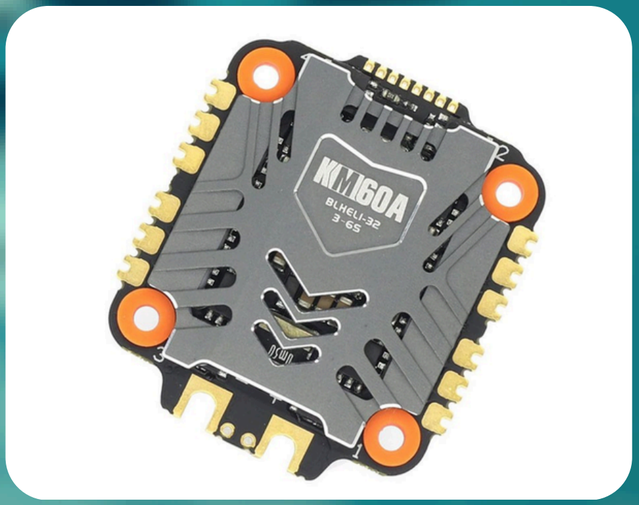


1 THRUSTER

- Blue Robotics T200 thrusters
- 7–20 V operation with thrust output up to 6.7 kgf per unit
- 300 m depth rating for reliable deep-water performance

2 ELECTRONIC SPEED CONTROL

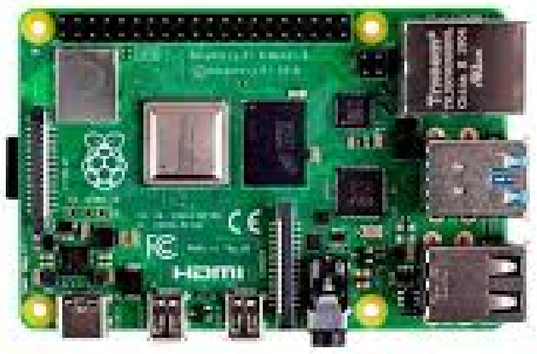
The thrusters are driven using SkyStars BLHeli_32 electronic speed controllers, supporting 3–6S Li-Po input and DShot 600/1200 communication for fast and precise motor control. The ESCs provide high current capability (up to 60A continuous) with telemetry support, ensuring reliable performance and real-time monitoring during operation.



3 FLIGHT CONTROLLER

The Pixhawk is used as the primary flight controller, handling sensor fusion, stabilization, and low-level control for precise 6-DOF underwater maneuvering.





4 MICROCONTROLLER

A Raspberry Pi 4 Model B serves as the onboard microprocessor, responsible for high-level computation, vision processing, data handling, and communication between the vehicle and the operator station.



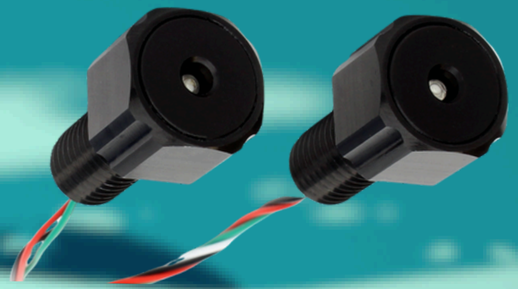
LOGITECH & REALSENSE

An Intel RealSense camera is used for front-facing vision and gate detection, while a Logitech camera provides downward-facing vision for QR code detection on the ground.



LED LIGHTS

High-intensity underwater LED lights are used to illuminate low-visibility environments, improving camera clarity for navigation, gate detection, and QR code recognition.



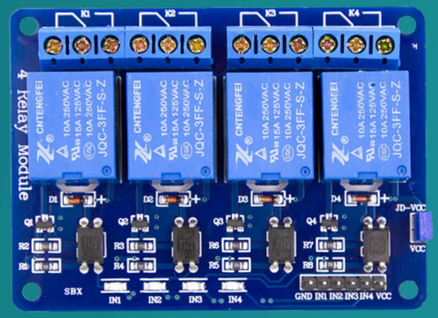
PRESSURE SENSOR

A Blue Robotics Bar30 pressure sensor is used to measure underwater pressure and depth up to 300 m, enabling accurate depth estimation and stable vertical control of the vehicle.



XBOX CONTROLLER

A Bluetooth Xbox controller is used as the primary input device for manual operation, providing smooth and intuitive real-time control of the ROV.



4 CHANNEL RELAY

A 4-channel relay module is used to switch and control the LED lighting system, providing safe isolation between the control electronics and high-power loads while allowing independent control of multiple channels.



130 AMP SCREW TERMINAL AUTOMOTIVE RELAY

A 130 A high-current relay is used to control and isolate power to the thrusters, ensuring safe operation and emergency shutdown capability.



POWER BANK

A power bank is used to provide a stable and independent power supply to the Raspberry Pi 4B, ensuring uninterrupted high-level processing and communication during operation.



BATTERY

An 8000 mAh, 7.6 V Li-Po battery is used as the primary power source for the propulsion system, providing high current capability and sufficient energy for sustained underwater operation.

CHALLENGES & SOLUTIONS

Pressure Sensor Integration

Problem: Unstable communication and inaccurate depth feedback

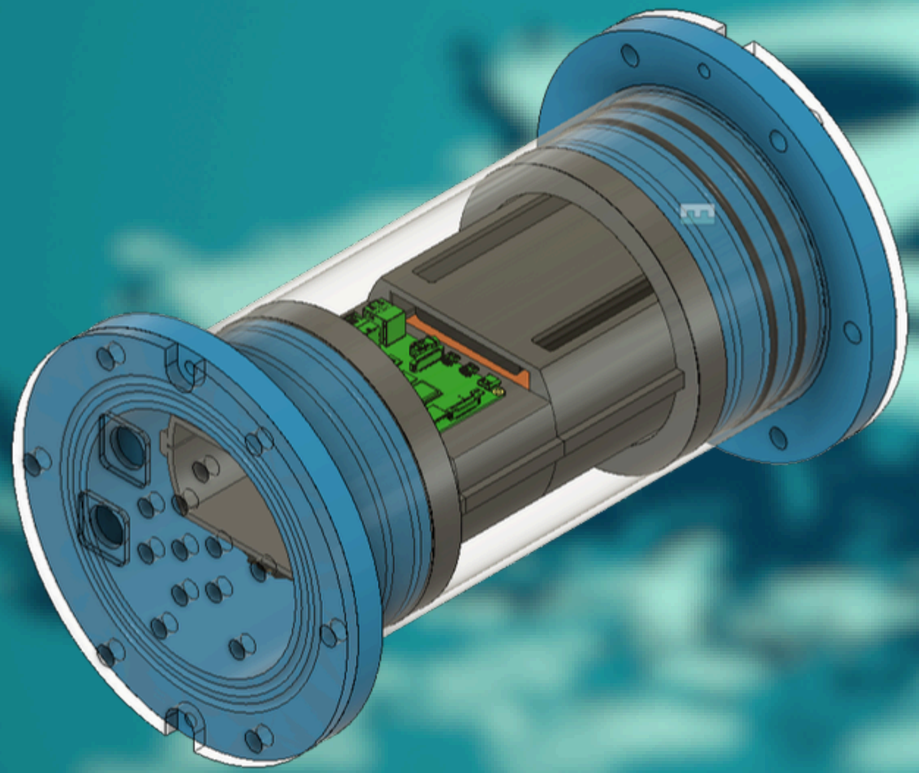
Solution: Proper firmware configuration and sensor calibration with Pixhawk

ESC Calibration

Problem: Uneven thruster response and inconsistent motor output

Solution: Manual ESC calibration and synchronization with Pixhawk for uniform thrust control

HULL CONSTRUCTION



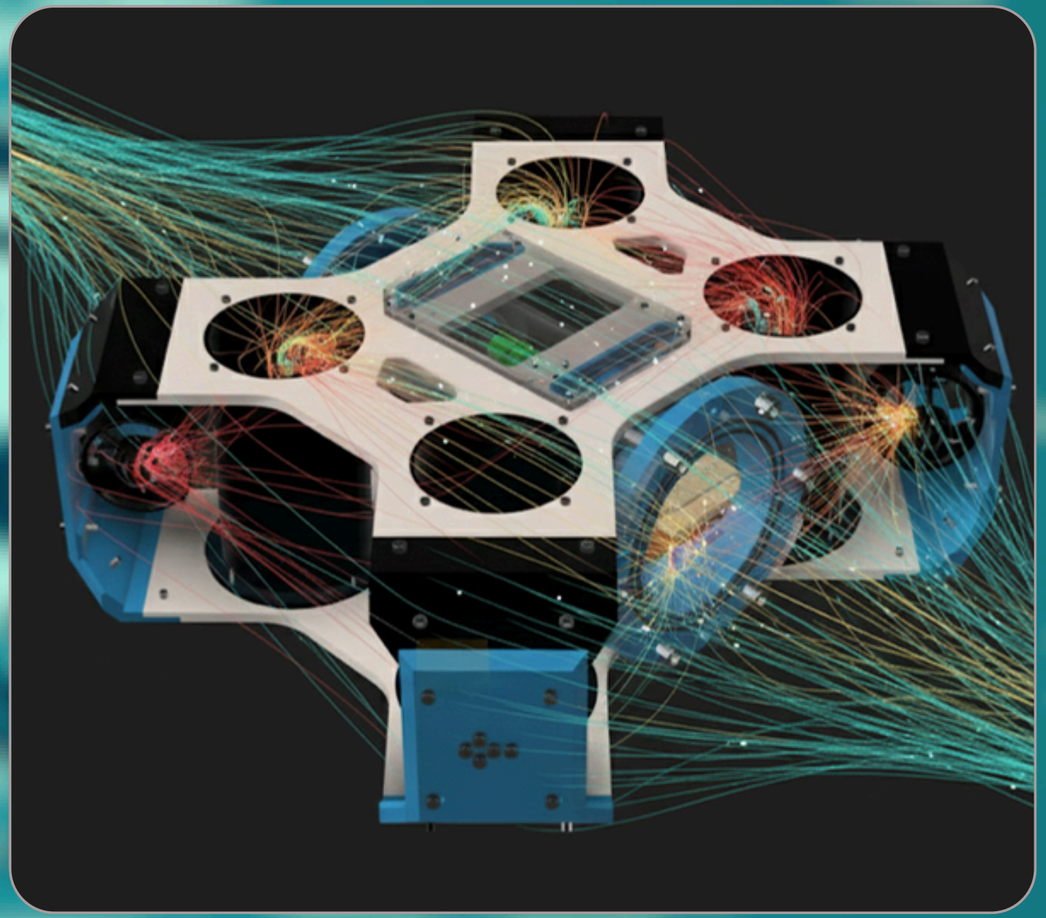
- A cylindrical hull was used to provide uniform pressure resistance and efficient use of internal space
- Flanges were 3D printed using PETG, chosen for its strength, durability, and water resistance
- Two acrylic end plates were mounted on both ends of the hull to enclose the electronics
- The flanges and end plates were bolted and properly sealed to ensure a watertight enclosure

BUOYANCY CONTROL OF ROV

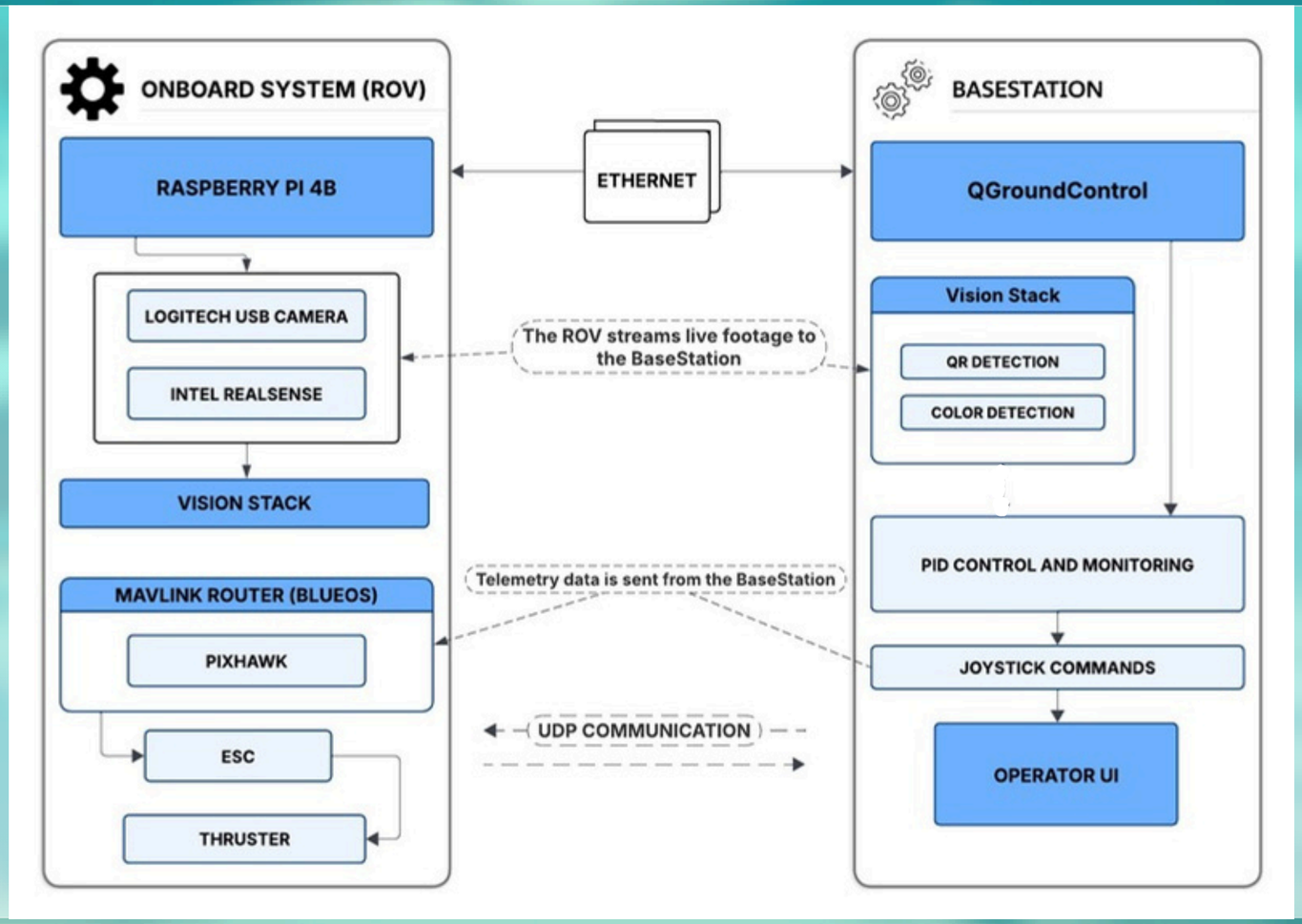
Neutral buoyancy was achieved by balancing the vehicle's total mass with the displaced water volume through careful buoyancy estimation and ballast tuning. Incremental adjustments to the dead weight were carried out during testing to ensure the ROV maintains depth with minimal vertical thrust input.

Advantages of Buoyancy Optimization

- Improves depth stability and smooth underwater motion
- Lowers energy usage by reducing continuous thrust demand
- Enhances image and sensor data quality by limiting unwanted movement



SYSTEM ARCHITECTURE



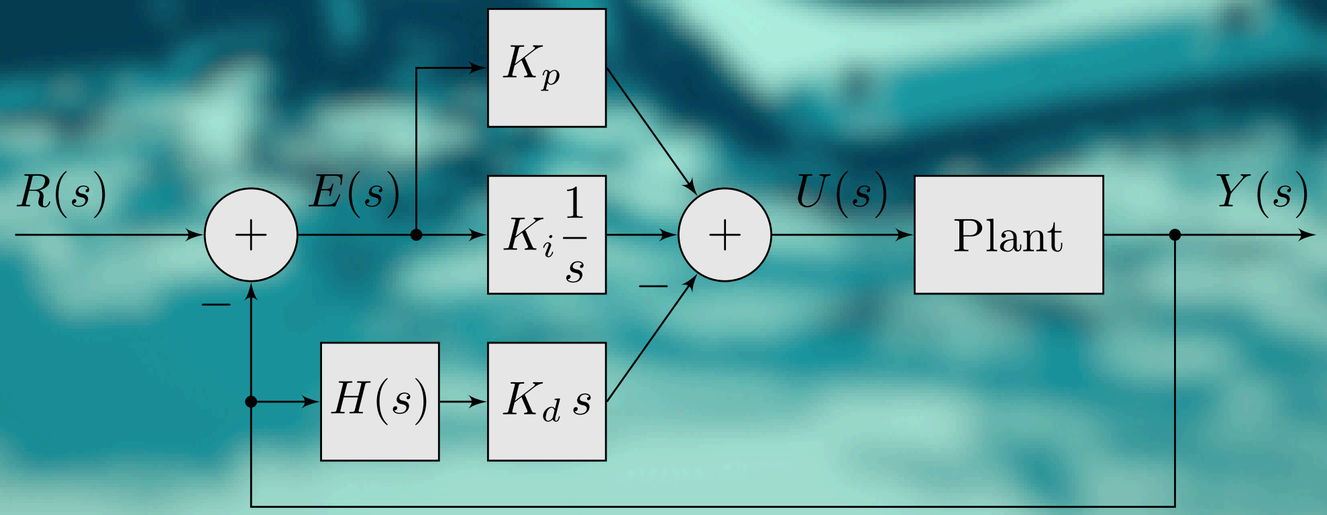
STABILISATION OF ROV

• Yaw and Depth of the ROV are controlled using **PID** loops to maintain heading and depth.

• The **Proportional (P)** term corrects immediate errors, **Integral (I)** compensates for accumulated drift, and **Derivative (D)** smooths rapid changes.

•PID tuning performed using **QGroundControl 4.2.8**, chosen for its slider-based interface, which allows precise, real-time adjustments of P, I, D value.

•Combined with ESC firmware tuning and trim corrections, results in a robust and predictable control system.



ROV CONTROL



ROV Control Using QGroundControl

- QGroundControl (QGC) is a ground control software for operating The ROV.
- It provides graphical interface for real-time monitoring, control, and configuration.

Key ROV Control Features

- **Stabilize Mode:** Automatically stabilizes roll and pitch, preventing excessive tilting.
- **Depth Hold:** Maintains constant depth automatically while allowing horizontal movement.
- **Level Horizon:** Keeps the ROV oriented level with the horizon, working alongside Stabilize and Depth Hold.
- **Joystick Control:** Provides real-time operator input for maneuvering, usable in all active modes.

NETWORK & COMMUNIATION

Overview

The ROV communicates with the Ground Station and onboard systems to transmit telemetry and camera feeds. Both telemetry and video feeds require consistent network connection.

Communication Components

- **MAVLink Protocol:** Used for telemetry (roll, pitch, yaw, depth, battery, etc.). It Communicates between Pixhawk 4 and QGroundControl.
- **Image Transmission:** Dual camera feeds is streamed via ImageZMQ library over UDP. While OpenCV is used for image capture and processing.

2026 OCTOBER 25

SEE You NEXT TIME





STEP INTO THE WEEK AHEAD

As you go into the week, carry this with you: Growth isn't a destination — it's a direction. Choose that direction, even in small ways. And remember, you're not walking it alone.


THE
END
HAPPY SUNDAY