NON-ROV DEVICE DESIGN DOCUMENT

KELPIE ROBOTICS '25

University of Ottawa, Ottawa, ON, Canada

PRESENTED TO

MATE ROV COMPETITION 2025 - EXPLORER CLASS

PRESENTED BY

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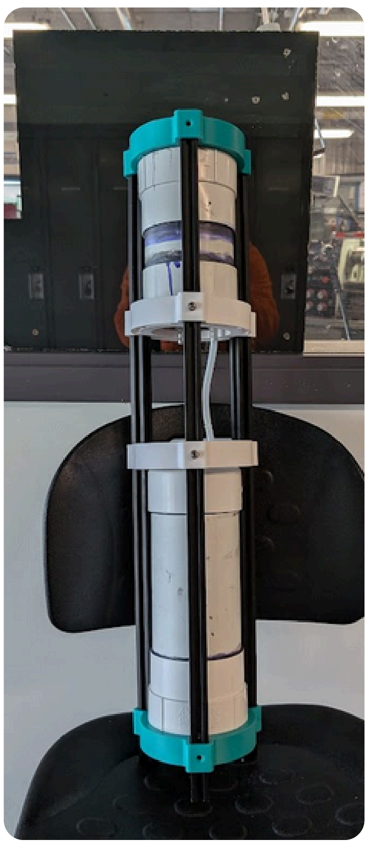
Engineering Design Rationale

In response to Task 3 of the 2025 MATE ROV competition, we designed and constructed a vertical profiling float to conduct ocean-monitoring missions inspired by the GO-BGC initiative. Our float prioritizes cost-effectiveness, simplicity, and robust performance within the constraints of limited pool depth and battery regulations.

Figure 1: non-ROV device



Frame and Construction

The float's body was constructed from a standard 20x20 mm aluminum extrusion frame for structural integrity and lightweight performance. The central buoyant compartment was formed using a cylindrical PVC tube due to its accessibility, low cost, and ease of waterproofing. Given the shallow depth requirements of the regional pool, high-pressure resilience was deprioritized.

To ensure waterproofing, PVC components were sealed with cement and gaskets. The overall frame and cap were built to pop open under excess internal pressure, as per safety regulations, fulfilling the pressure release requirement.

Buoyancy System

The buoyancy engine operates by expelling and drawing in water to control float density. Buoyancy is adjusted through a water displacement chamber actuated by a low-power motor controlled by an ESP32 microcontroller. This microcontroller was selected for its integrated Wi-Fi capabilities and low power consumption, enabling wireless communication without additional modules.

Sensors and Data Logging

A Blue Robotics BAR02 pressure sensor logs depth data during descent and ascent. The ESP32 runs FreeRTOS to manage two concurrent tasks: one for motor control and one for sensor data collection. Depth data is recorded at 5-second intervals and sent to the surface once the float resurfaces.

Once surfaced, the ESP32 connects via Wi-Fi and transmits data wirelessly to a laptop at the mission station. The data is parsed and graphed to verify that the float held the target depth (2.5 m ±50 cm) for at least 45 seconds. Timestamps of each data packet refer to the time since the float was powered on.

Figure 2: Battery packs

Power System

The float is powered by onboard batteries within the 12 VDC and 5A limits. The current draw of the system was measured to peak at 270mA during bouyancy change, and 30mA at idle. The next size standard fuse is 500mA. With this measurement, a single 500mA fuse is placed within 5 cm of the positive battery terminal safeguards the system, in accordance with ELEC-NRD-004 and DOC-004 safety guidelines.

Safety Features

Battery pack includes a visible cartridge fuse.
Housing built to pop open under pressure using friction-fit end caps.
All electronics housed above the buoyancy chamber to ensure communication remains above the waterline.

Figure 3: Fuse used on the non-ROV device

Communication System

Communications with the float are established with TCP packets over Wi-Fi. The network is created with a wireless access point, where the topside computer connects and creates a TCP server. The ESP32 onboard the float connects to this server as a TCP client when it is at the surface of the water, and disconnects before diving. A "GO" command is send to the float from the server to start a dive.

Fuse calculation

The current draw of the float was measured by having the pump move water from one container to another, where the current peaked at 270mA. Idle current consumption of the device is 30mA, but rises to over 100mA during wireless transmissions. Wireless communications and buoyancy change mode are mutually exclusive as communications only occur once the float has ascended to the surface of the water and the motor is turned off. Based on this information, the next standard size fuse available is 500mA.

Compliance and Testing

- Vertical profile successfully demonstrated in controlled conditions: descent to 2.5 m, hold for 45 s, ascent.
- Graph of depth vs. time created from data packets transmitted by the float.
- Communication tested successfully using Wi-Fi broadcasting to a laptop at the surface station.

Figure 4: non-ROV device SID