

The Orcas - Non ROV Device Design:

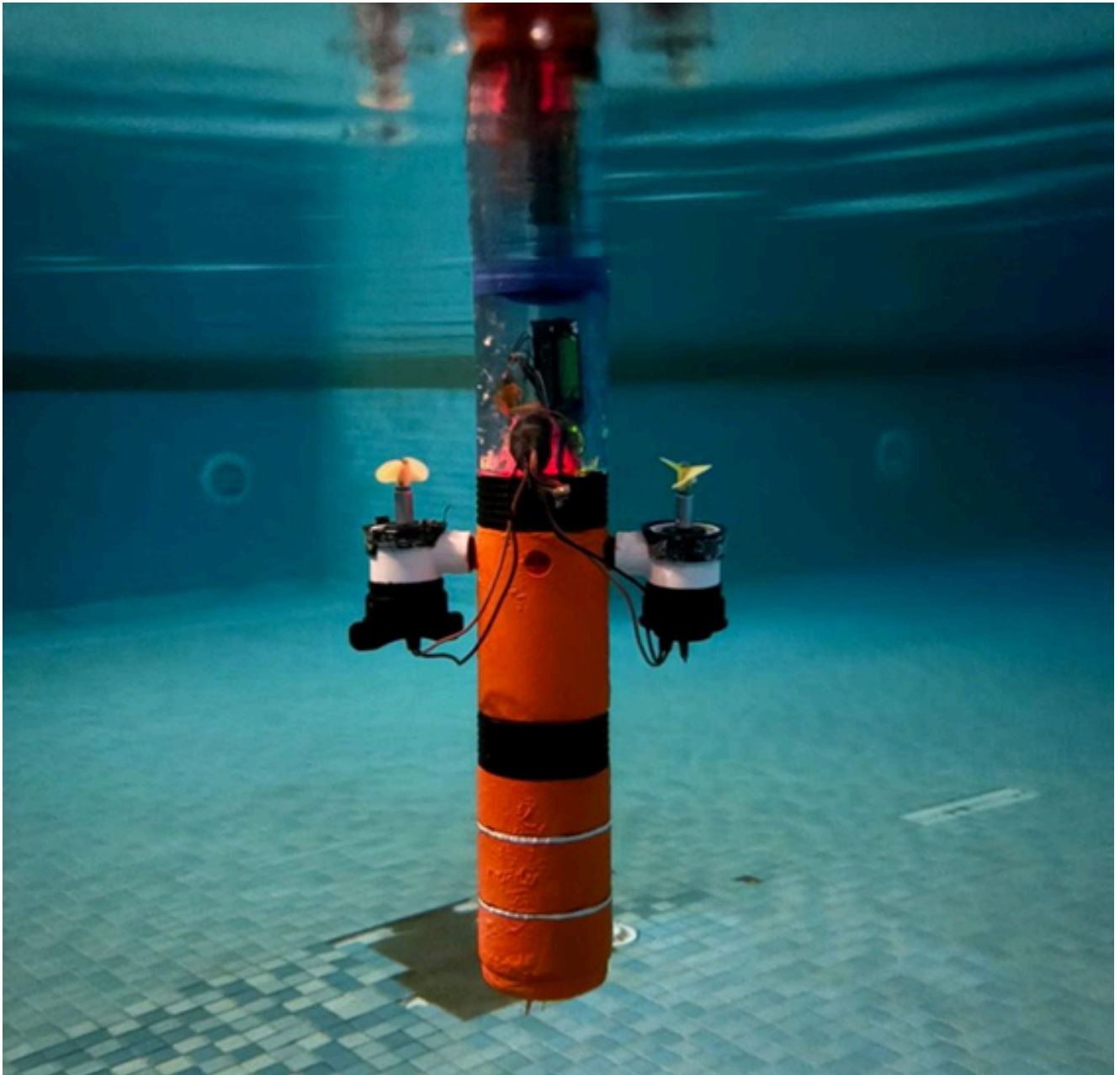


Figure 1: Nemo Vertical Profiling Float

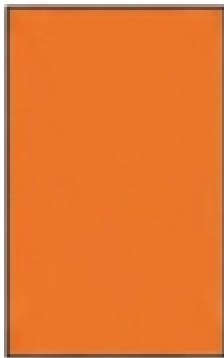
This is the vertical profiling float designed by The Orcas, Nautical Environmental Monitor for Orca, or NEMO for short. It was designed to meet the specifications for Task 4 of the 2026 MATE ROV competition, MATE Floats! Under the Ice.

NEMO features 3 compartments to house the various parts and systems required to operate underwater and carry out the required tasks.

Overall Design:



The topmost compartment houses all the electronics of NEMO, and can be opened and closed for proper maintenance. It gives way for wires to exit to the thrusters and sensor of the float, which are completely waterproofed. This capsule provides positive buoyancy to NEMO.



The middle compartment mounts the thrusters and has holes to act as a ballast system. Water flows in through these holes adding weight to the float.



The bottom compartment fills up with stones and water, ensuring that the center of mass stays directly below the center of buoyancy, providing perfect stability to NEMO.

Power System Details:

- NEMO is powered by NiMH 12V battery pack
- Total Voltage = ~11.6V
- 2 Pumps = $2 \times 1.8\text{A} = 3.6\text{A}$
- Total full load current draw = 4.6A
- To cater to the current requirements, we have chosen a 5A fuse, meeting standard safety requirements.

Component	Quantity	Current Per Component (A)	Total Current (A)
Bilge Pump Thrusters	2	1.8	3.6
ESP32 Controller	1	0.5	0.5
MS5837 Depth Sensor	1	0.2	0.2
MDD3A Motor Driver	1	0.3	0.3

**TOTAL FULL
LOAD CURRENT**

4.6A



Figure 2: 5A Fuse



Figure 3: NiMH 12V Battery Pack

Safety:

- The battery pack is housed inside a waterproof, airtight bag with only wires emerging. There is a 5A fuse within 5cm of the battery pack. The entire circuit is placed inside another airtight bag, providing 2 layers of protection

- The battery pack will be securely mounted onto a plate inside the main capsule to prevent movement
- The fuse is present in a clear housing and the wires are properly colour coded and organised
- On the main capsule, there is a pressure relief rubber stopper fit into a hole of 2.5cm diameter which opens up when the pressure inside the capsule exceeds the outer pressure
- All wiring and connections are sealed with epoxy, silicone and marine-grade clay.

Vertical Movement:

- NEMO is +0.15kg positively buoyant. This ensures that it naturally resurfaces when power is cut off.
- Thrusters face upwards, so that they spin clockwise, NEMO is propelled downwards to begin its profile. To resurface, the thrusters are turned off.
- Stones act as a ballast system, allowing us to vary the weight of the float
- The entire float operates by taking inputs from the depth sensor and accordingly varying the maintained depth

Communication:

- NEMO uses an ESP32's bluetooth module to communicate with a shore-side device receiver which is a mobile device using Serial Bluetooth
- Once connected, the profile is started and the initial data packet is sent.
- Once underwater, connection is lost. The ESP32 saves all the data in regular time intervals
- After resurfacing, NEMO reconnects to the mobile device and transmits all the data packets of the entire profile

Waterproofing:

- The main capsule is waterproofed using a double O-ring system for the cap, and silicone to cover any gaps
- The wires entering the capsule go through 3 step waterproofing - Epoxy, Resin, Silicone and Marine-Grade Clay

Electronics:

- The system is powered by a 12V NiMH battery pack
- An ESP32 controls the input and communication
- An MDD3A motor driver regulates the thruster movement
- A MS5837 Underwater Depth Sensor gives input to the ESP32, and gives the necessary data for the task