

Kulia is a vertical profiling float built around a 500 mL syringe buoyancy engine, designed specifically to complete the vertical profiles during the 2026 MATE ROV Competition. The float is constructed inside a Blue Robotics Series locking tube (400 mm length × 100 mm diameter), chosen for its dual O-ring end caps and proven depth rating. A fully custom 3D-printed PLA chassis bolts inside the tube, locating the motor, lead screw, and syringe along the float's central axis and keeping the center of mass near the top for passive vertical stability (See Photo 1).

Kulia's buoyancy engine works by moving water into or out of the syringe chamber using an 8 mm T8 lead screw turned by a NEMA 17 stepper motor with 59 N*cm holding torque. When the motor drives the lead screw inward, the plunger retracts, drawing seawater into the syringe. The resulting increase in system mass makes the float negatively buoyant and it descends. Reversing the motor pushes the plunger forward, expelling water and returning the float to positive buoyancy. A DRV8825 microstepping driver controls the motor direction and step rate, giving fine enough displacement resolution to trim buoyancy incrementally during depth hold.

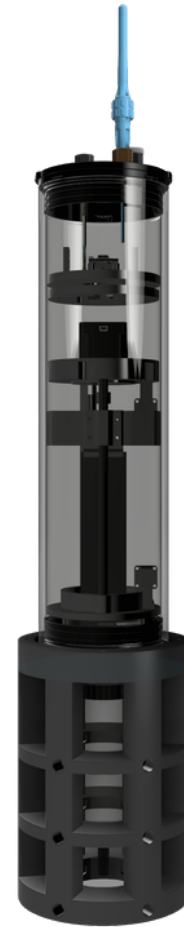


Photo 1: *Kulia* Float
Design by Conor Cavens

Depth is measured continuously by the Blue Robotics Bar30 high-resolution pressure sensor (MS5837-02BA), which communicates over I2C at 3.3 V logic. The Arduino Portenta H7 converts these raw pressure readings to depth using the hydrostatic relation of $P = \rho g d$ where ρ is the fluid density of the EGADS competition solution ($\approx 1.025 \text{ g/cm}^3$), $g = 9.80665 \text{ m/s}^2$, and d is depth in meters. A PID control loop on the Portenta H7 samples depth every 5 seconds and drives the stepper motor to correct any error, holding the float at the target depth without active thruster assistance.

Before deployment, the Portenta H7 wirelessly transmits the first defined data packet to the shore station receiver. Each packet carries the company number, elapsed float time in seconds, pressure in kPa, and computed depth in meters. Once the shore station confirms receipt, the float is released and the buoyancy engine initiates descent. The float descends to 2.5 m, holds for 30 seconds, then ascends to 40 cm and holds for another 30-second interval before repeating the entire sequence a second time. All data packets recorded during both profiles are stored onboard and retransmitted in full after the float is recovered.

Kulia runs on eight NiMH AA cells wired in series, producing a nominal 9.6 V supply rail. The pack is seated in a printed retention tray and secured with mechanical clips so no cell can shift during a profile (See Photo 2). A Blue Robotics Watertight Switch mounted to the end cap controls power without requiring the enclosure to be opened.

All onboard power passes through a single 2-amp ATO blade fuse within 5 cm of the battery positive terminal; the blade color code allows amperage to be confirmed visually without any disassembly, as required by ELEC-NRD-004 (See Photo 3). Should an internal pressure event occur, the Blue Robotics locking end cap acts as a passive pressure relief: the push-fit cap unseats before the tube can build dangerous pressure, satisfying ELEC-NRD-006 Method 2. The sealing diameter of 101.6 mm greatly exceeds the 2.5 cm minimum. No fasteners are used to retain the end caps. Communication is handled by the Portenta H7's integrated 2.4 GHz WiFi radio. The Portenta operates as a WiFi access point; the shore-side MacBook joins the float's network and runs a custom receiver application that logs all incoming data packets and renders the depth-over-time graph in real time. The WiFi antenna exits the enclosure through a cable penetrator epoxy-potted into the upper end cap with marine-grade two-part compound, cured a minimum of 24 hours before any water contact. The Bar30 depth sensor is externally mounted through a Blue Robotics M10 penetrator. All PLA parts are sealed with conformal coating, and all metal edges are deburred and chamfered.

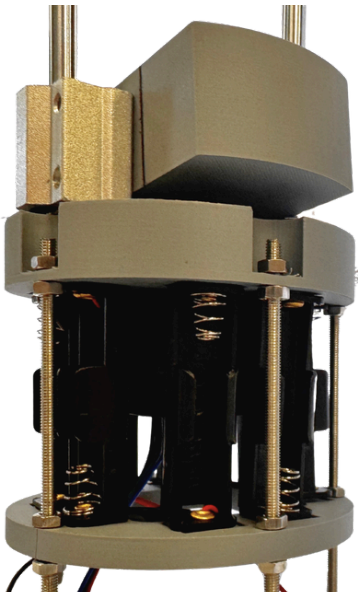


Photo 2: Eight AA battery holders inside a 3D-printed retention tray, secured with mechanical clips
Photo by Matthew Schwarting



Photo 3: The 2-amp fuse
Photo by Conor Cavens

Condition	Current
Idle Load Current	1.30 A
Full Load Current	1.60 A
Fuse selected	2A ATO blade (gray)

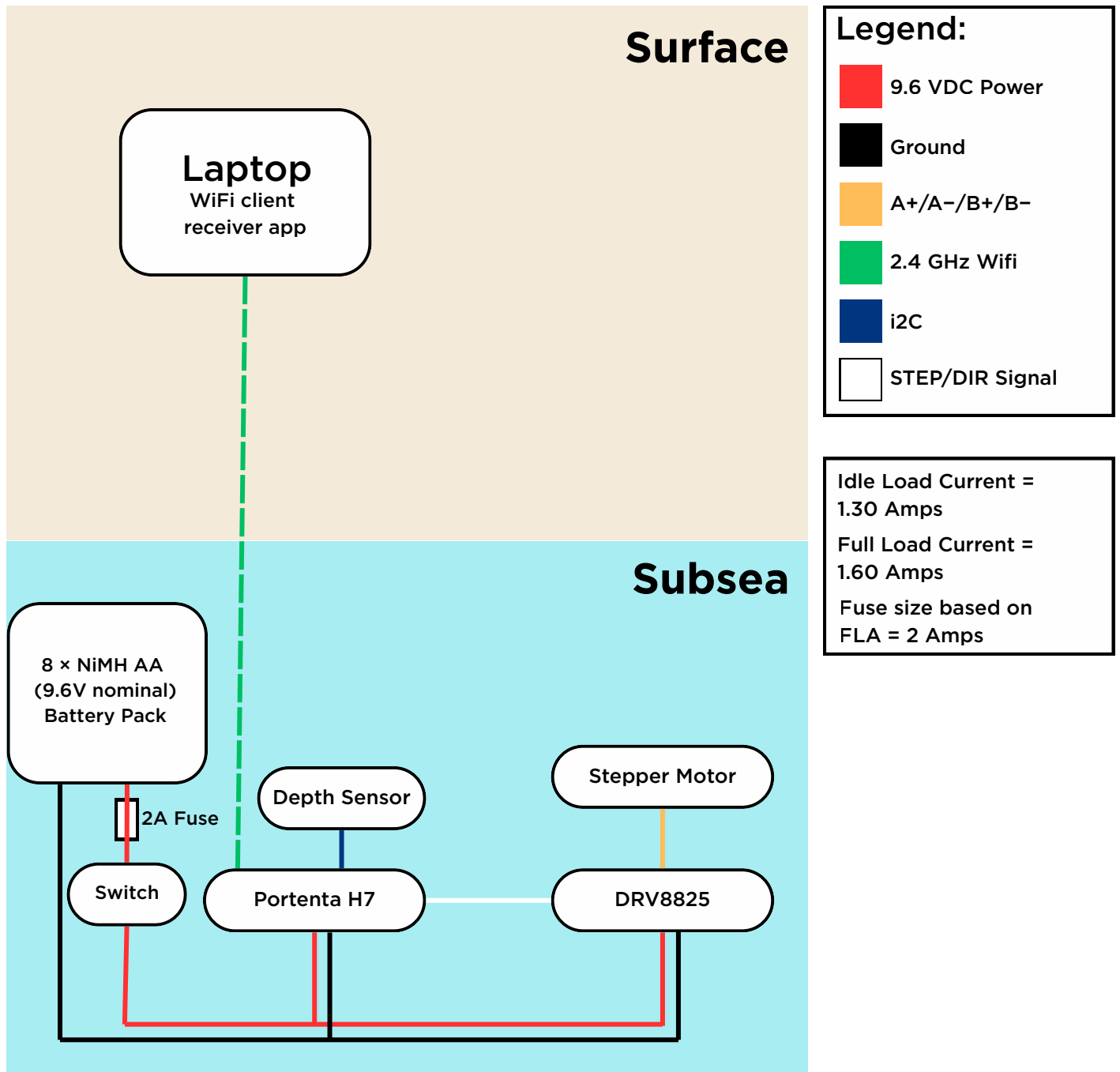


Photo 4: Float SID
Schematic by Matthew Schwarting