Demon Diver

MATE FLOATS! Documentation

The Demon Diver is a low-cost, autonomous vertical profiling float designed to support oceanographic research. The 2025 model incorporates major updates to improve reliability, serviceability, and environmental impact, including a modular housing system, closed-loop control logic, and optimized power distribution.

STRUCTURE & HOUSING

The float body is 3D-printed from polylactic acid (PLA) filament for environmental sustainability and ease of fabrication. The structure is sectioned into two watertight compartments: a lower buoyancy and ballast chamber and an upper electronics chamber. Rubber O-rings and dielectric grease ensure waterproofing at all seals. A pressure relief plug is mounted at the top of the housing to prevent structural damage during rapid pressure changes or deep submersion.

BUOYANCY CONTROL SYSTEM

Vertical movement is controlled via a 300 mL medical-grade syringe actuated by a waterproof servo motor. Water intake increases the float's density to induce descent; water expulsion reduces density to enable ascent. The syringe system is housed in the lower chamber alongside ballast weights to maintain stability. Motion is governed by PID control loops executed on a Xiao ESP32-C3 microcontroller. Full dive and surface cycles are completed autonomously.

DEPTH ESTIMATION & CONTROL

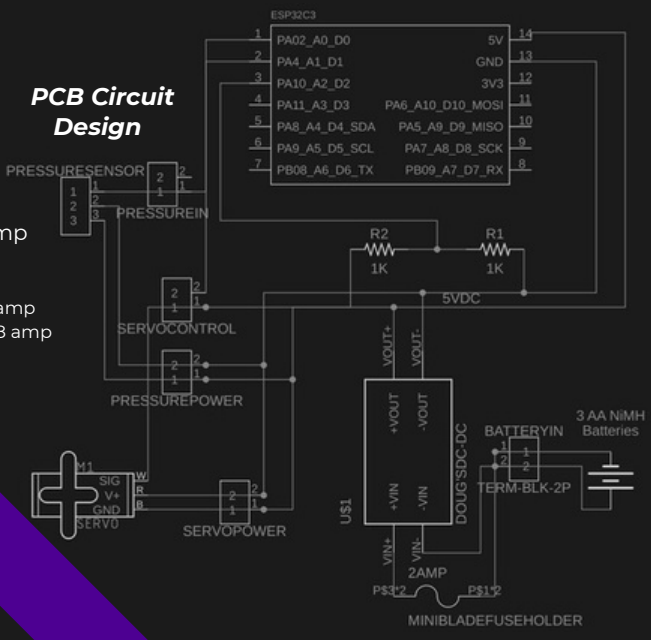
Depth is estimated using the relationship between the density of water, gravity, and the resulting pressure, which is measured by a digital pressure sensor calibrated via a linear regression model. Sensor data is logged alongside timestamps for vertical profiling. The ESP32-C3 executes real-time PID corrections to minimize overshoot during transitions and maintain a consistent depth.

ELECTRICAL SYSTEM & FUSING

The system is powered by four AA NiMH rechargeable batteries (1.2V each, 2500mAh nominal), supplying sufficient current and voltage for the full load requirements. A custom PCB manages power distribution to the microcontroller, servo motor, and pressure sensor. Overcurrent protection is provided by a 2-amp inline blade fuse located between the battery pack and the PCB. Measured idle current draw was about 0.02A; under load, the servo draws 1A, the pressure sensor 0.1A, and the microcontroller up to 0.08A, totaling 1.1A—making a fuse appropriate per NEC 125% continuous load sizing.
2A

COMMUNICATION SYSTEM

Data transfer and command communication are handled via onboard Bluetooth. Upon resurfacing, the float transmits stored data—including depth, pressure, and cycle status—to a shore-side base station. The base station can issue dive or surface commands post-deployment if required.



Under load - 1.2 amp
Idle - 0.02 amp
Power Calculation
Pressure sensor - 0.1 amp
Micro controller - 0.08 amp
Servo - 1 amp
Total - 1.1 amp