Non-ROV Devices

VORTEX
UNCHARTED EXCELLENCE

After three years of competition experience, we proudly present **Floatilla**, an advanced autonomous float designed to surpass previous iterations with enhanced efficiency, reliability, and precision. Through meticulous design and testing, we have significantly improved our mechanical, electrical, and communication systems to ensure optimal performance in the competition environment.

Mechanical System

Floatilla profiles vertically using a pneumatic cylinder actuated by a stepper motor, forming a precise buoyancy engine. The stepper motor drives a power screw that moves the piston inside a sealed enclosure, displacing up to 62.83 mL of fluid to control buoyancy. This enables the float to reach and maintain a **neutral buoyancy point**, where it can remain stable at a specific depth with minimal energy use.

The entire assembly is mounted on an aluminum extrusion rod for structural support and modularity. A flexible coupling connects the motor and screw, ensuring smooth force transmission even with minor alignment offsets.

The enclosure is piston-sealed to protect internal components from water exposure, and a pressure relief mechanism ensures safety in case of overpressure. The float's volume remains fixed, simplifying buoyancy calculations, while the internal lead-acid battery serves as ballast, enhancing stability by lowering the center of gravity. The float's hydrodynamic shape minimizes drag and helps maintain steady movement while profiling.

Figure 1: Floatilla

Electrical System

A 12V AGM lead-acid battery powers all components, chosen for its high current capacity, long life, and maintenance-free sealed design. A 3A fuse is installed within 5 cm of the positive terminal for overcurrent protection.

The voltage is stepped down via a 5V-3A buck converter to supply the ESP32 microcontroller, real-time clock (RTC) module, and a logic level converter. A 3.3V regulator provides power to the IR and pressure sensors. The TMC motor driver is

responsible for actuating the stepper mechanism with high precision and reliability. The RTC module enables accurate timekeeping for float operations, while the IR sensor ensures correct positioning within the desired depth range.

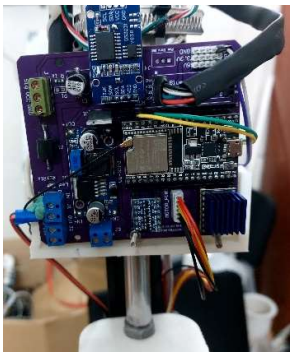

Figure (2.a): PCB On Board

Figure (2.b): Battery & fuse

Figure 2: Electrical System

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Communication System

Floatilla uses two ESP32 modules for communication between the float and the base station, utilizing the low-latency ESP-NOW protocol. This wireless, peer-to-peer method ensures fast and stable data exchange without relying on an internet connection. The on board ESP32 module collects and processes sensor data before transmitting it wirelessly to the base station for real-time monitoring.

Power Calculations

Component	Voltage (V)	Current (A)	Power (W)
Stepper Motor	12	1.5	18
ESP32	5	0.25	1.25
TMC Motor Driver	12	0.1	1.2
Buck Converter	12	0.3	3.6
Total	–	**2.15**	**24.05**

Table 1: Power Calculations

Full Load Amps in water = 2.15A
Therefore, the Chosen fuse rating is **3A** to ensure overcurrent protection.

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