Design Philosophy

NUWave decided to control the buoyancy of the profiling float by intaking and expelling water from an internal bladder using a pump system, manipulating the volume of water displaced and thus the buoyancy of the profiling float and vertical motion. We made sure to prioritize critical design aspects for the application of profiling floats such as energy efficiency, reusability, and modularity.

Electrical System

Overview and Safety

The electrical system was specifically designed for the task of vertical profiling. The components included an ESP32-WROOM, Adafruit RFM96W LoRa Radio Transceiver Breakout, Blue Robotics Bar30 Pressure Sensor, an XY-3606 12 to 5 volt step down buck converter, and a Dual TB6612FNG motor driver, a DC Gear Pump. The power is supplied from two separate 12 volt battery pack systems made up of eight 1.5 volt AA primary batteries in series for a total of sixteen batteries. For the microcontroller system the maximum supply current of the ESP32 is 250mA, the transceiver's peak draw is 150mA, and the depth sensor's peak draw is 1.25mA a fuse of 0.3A was implemented . A fuse of 1A was implemented for the pump battery system, since the peak current draw of the motor used is 0.6A. These choices allow all components to be sufficiently powered while preventing unsafe current draw.

Table 1. Components and Current draw

Micro-controller System	ESP32 microcontroller	Max supply: 250 mA
	Bar02 Depth Sensor	Max draw: 1.25mA
	Adafruit RFM96W LoRa Radio Transceiver	Max draw: 150mA
	Buck converter	Rated for: 3.2A
Pump system	XY-3606 Motor	Max draw: 0.6A
	Dual TB6612FNG Motor Controller	Rated for: 1.2A

Communication and Sensor Systems

As the float descends, a Blue Robotics Bar30 Pressure Sensor records depth data. This depth data is then iteratively saved within a linked list of structs and communicated through I2C protocol. Once the vertical profile has been completed and the float has risen to the surface, the stored data is transferred to the ground station using a transceiver system. An Adafruit RFM96W LoRa Radio Transceiver Breakout was selected for the transceiver system due to its range, reliability, and wireless capabilities.

Motor Control

A Yanmis DC Mini Gear Water Pump was selected to manipulate the fluid flow in and out of the float due to its ability to reverse flow direction in a small and cost-efficient package. To control the pump, the ESP32 is used to send logic signals to a Dual TB6612FNG motor driver. These signals control the polarity of the 12 volt signal to power the pump that determines the direction of the flow of fluid.

Mechanical System

The profiling float utilizes a BlueRobotics 6 inch series watertight enclosure for ROV/AUV application. The enclosure features interchangeable end caps with double O-ring sealed flanges on either end of a 11.75 inch long and 6 inch diameter cast acrylic tube, tested to a depth of 65 meters. Set in one of the end caps is a pressure relief plug 2.5 centimeters in diameter. To equalize pressure, the end caps of the acrylic enclosure sit within the tube such that should the pressure in the tube housing be greater than the outside pressure, the end caps will separate from the housing to release the internal pressure. Within the acrylic enclosure, a Yanmis DC Mini Gear Water Pump moves water into the float housing to change the volume of water displaced, reducing the buoyant force and causing the device to sink. When the pump is reversed, water flows out of the pump and housing, increasing the displaced volume and buoyant force. The mounting of components within the tube was critical for the safety, operability and modularity of the float, so custom mounts were designed and 3D printed to secure and protect the float components.