Vertical Profiling Float

The Vertical Profiler (Figure 1) prototype is designed for a larger production run aimed at deploying a 50-capsule swarm to collect data in the Red Sea during a solar eclipse. We prioritized easily sourced and economical components, with aesthetic elements like the clear PVC housing being easily modified post-prototype.

The device includes a 25 cm clear PVC tube, a flexible silicone diaphragm secured with a hose clamp, and a modified test plug. Key electrical components are a BlueRobotics Bar02 pressure sensor, a 2-channel relay, a linear actuator, a buck converter, and an Adafruit BlueFruit BTLE chip.

The Bar02 sensor was selected for its I2C connection and dual temperature and pressure data collection, though its delicacy suggests future replacement. The 2-channel relay allows the linear actuator to be powered by a higher current than the Adafruit board can provide, necessitating a buck converter to step down the 9V battery voltage to 3.3V for the Arduino board.

The Adafruit BlueFruit BTLE board, chosen for its built-in Bluetooth and cell phone app, simplifies control during proof of concept but has several shortcomings. It will likely be replaced by swarm control technology similar to aerial drones. As BTLE loses connection when submerged, the dive cycle must be fully automated. While simple, our code needs refinement. Future iterations may rely on SD cards for data logging or other transmission methods.

Specialty components include rare earth magnets to manage the silicone diaphragm's expansion and contraction, initially designed to maintain positive pressure. However, the magnets couldn't withstand this pressure, leading to design adjustments. The VP is tuned for neutral buoyancy at the actuator's mid-stroke, enabling it to ascend and descend to collect data.

Integration with the PVC housing was efficient using test plugs. Modifications included a bracket for the actuator mount and adjustments to maintain a seal after adding the Bar02 sensor. After iterations, a flange-headed bolt and leather washer were used to create an adequate seal.

Future iterations will likely feature printed circuit boards, SD card data logging, improved wireless communication, and added functionality like temperature logging or video capture.

Figure 1. Vertical Profiler