Hephaestus Robotics

VULCAN III FLOAT

NON-ROV DEVICE DESIGN DOCUMENT

The vertical profiling float, Vulcan III, is designed to perform a minimum of two vertical profiles using a buoyancy engine. The mechanical design of Vulcan III involved creating computer models and conducting virtual testing to optimize buoyancy calculations and displacement. Design constraints included a maximum float height of 1 meter and a maximum diameter of 18 cm. The team chose a buoyancy engine that uses a system of pumps and solenoids to pump water from the outside of the float into and out of a chamber inside of the float.

A 4” Blue Robotics water-tight enclosure was selected as it offered the best volume change ratios and sufficient space for electronics and future equipment.

Vulcan III used custom acrylic end caps that were designed in Fusion 360 and cut out on a laser cutter. The top end cap has a 25 mm hole with a rubber stopper which is a pressure release valve. The float has four rubber feet on the bottom which allows it to stand vertically when topside and protects the bottom of the pool. It also includes a rope on top so that it can be deployed by the Talos IV ROV.

Vulcan III uses a Raspberry Pi Model 4B with custom software, two DYX Mini Pumps, two solenoid valves, a Blue Robotics Bar02 Pressure Sensor and Celsius Fast-Response Temperature Sensor. A screw terminal connector is used to connect the sensors to the Raspberry Pi. A 7 dB WiFi antenna is used to extend the range of the wireless network connection. The Float is powered with 8 C cell batteries which provides 12V of power to the pumps. A custom PCB provides 5V power to the Raspberry PI. A second custom PCB is used to control powering the pumps on/off. The Raspberry Pi communicates with the power switch PCB using i2c.

The software for Vulcan III is implemented in Python. The vertical profiles are initiated by powering the pump to fill the internal water chamber with water from outside the float to increase the mass of the float causing it to descend. Once the float stops descending, the software waits for 30 seconds before starting the ascent which is initiated by pumping water out from the internal water chamber to outside the float which reduces the mass of the float causing it to rise. Once on the surface, a payload containing the pressure, depth and temperature that was collected every 5 seconds is sent over Wi-Fi to the Topside Control Station. The data is stored in an Influx DB and graphed.

Future improvements for Vulcan III included the integration of additional sensing capabilities such as salinity and turbidity sensors.

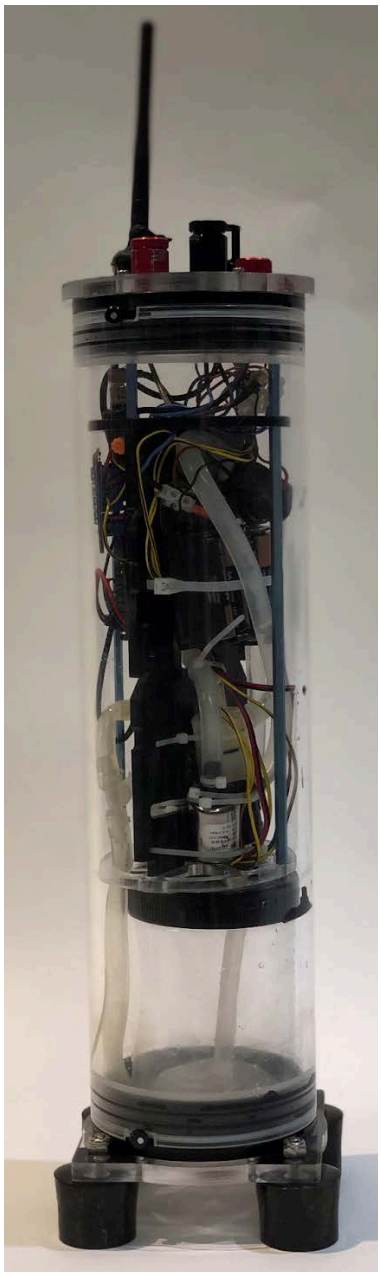

Figure 1: Vulcan III
Photo Credit: Kai Herbst