Vertical Profiling Float

The vertical profiling float's buoyancy engine uses a large 550mL syringe with a custom plunger that accepts a central motorized lead screw through a rotationally fixed nut to drive the plunger. The syringe is a cost-effective off-the-shelf method for our engine to achieve a reciprocating seal without requiring the design and iteration of a configured off-the-shelf seal. As the syringe takes in more water, the buoyant force decreases due to a decrease in fluid volume displaced which causes the float to descend. To take advantage of the buoyancy control, 3D printed external clamps secure 1" weathering steel rods as a weight to bring the float closer to neutral buoyancy.

The float is enclosed by a 28.5" long 4-1/2" diameter acrylic tube with resin-cast endcaps, using 3 equidistant 8mm rods to form the internal structure of the float. Recessed shaft collars are used with set screws to retain static platforms to the structure. For the sliding platform that guides the syringe plunger, linear bearings are used for smooth and repeatable motion along the rods.

The endcaps are resin-cast using a silicone molding process with patterns created using FDM 3D printing. This process allows us to utilize 3D printing's ease of manufacturing and low cost while eliminating the issue of porosity by using a watertight material. The endcaps seal the tube with rod O-ring seals. The lower endcap uses epoxy to seal around the syringe barrel, and the top endcap is embedded with BlueRobotics' pressure sensor.

The float is powered using 8 AA batteries connected in series, creating a 12V battery pack. The float utilizes an onboard Arduino UNO unit to control the motor and communicate with the base station using an NRF24L01+ Wireless Transceiver Module. The module utilizes the SPI protocol to transmit data at 2.4 GHz. The Arduino UNO is also utilized as a buck converter to downshift the 12V into 3.3V and 5V for various components of the float.

Numerous safety precautions were taken. A 5 amp fuse was used to comply with safety standards. Additionally, the Arduino UNO unit was used to ensure that the voltage from the batteries is limited to the initial 12 V to 3.3 V and 5 V to satisfy the voltage limit outlined. The float also runs off a 3 amp current which is under the 6 amp guideline. The batteries are also secured with tape. As mentioned, the float is equipped with an endcap secured by O-rings which will pop off in compliance with safety standards. When cutting the tube and fabricating all custom parts, all sharp edges were either sanded down or covered as per guideline rules. The float was also fabricated to ensure that it stands less than 1 meter tall and has a diameter less than 18 cm. All general safety guidelines were followed.