Purdue ROV Float

ROV NEMO TECHNICAL DOCUMENTATION

The float is a device utilized to perform a number of vertical profiles, while recording and transmitting data back to its ground station. The float is controlled by a buoyancy engine, which alters the density inside the float container through the use of fluid intake. When the float begins a vertical profile, a peristaltic pump pushes water into a bag, altering the density of the entire device and causing the float to sink. The float consists of cast acrylic tubing, Aluminum 6061-T6 with type II anodization for the flanges, ⅛ in aluminum plating, lead fishing weights, and parts printed in PLA. These parts were selected for their maximum pressure rating, size, cost, and MATE safety standards. The float is waterproofed through the liberal use of zip-ties around the tubing and epoxy around components that breaches the outside of the container through either lid. O-rings were used to create a seal between the flanges holding the base plates and the acrylic tube.

Figure 1: Assembled Vertical Profiling Float

Operation of the float is controlled by a custom microcontroller board based on the Adafruit Industries Feather RP2040 RFM dev board. The mission code is run on the dual-core Arm Cortex M0+ RP2040 microcontroller using FreeRTOS for multithreading in the embedded environment. The base station also uses the same core design to maximize design commonality. The float mission code utilizes a state machine to robustly control the progress of the float through the mission as informed by sensor input, radio commands, and backup timers. The float initially starts into a safe mode while being towed into the deployment position. Upon receiving commands from the base station, the float will enter the profiling state and begin performing the vertical profile autonomously by driving the buoyancy engine to dive, idle at the bottom briefly, and surface again before transmitting telemetry back to the base station for recording. The device is powered off 8xAAs in series providing 12V at a maximum of 6A pursuant to ELEC-NRD-001 and ELEC-NRD-004. Inline with the batteries we have 3.9A fuse per ELEC-NRD-005. Figure 2 depicts the operation guidelines for the float and how it is controlled from the base station.

To ensure protection due to over pressurization from the pump, a ball valve was installed in the base of the float. The float's housing consists of a acrylic tube with two 6" holes sealed up with two 6" end caps containing O-rings that are friction-fit into the housing and are not secured with other fastening methods pursuant to ELEC-NRD-006. A pressure transducer was included between the pump and the bag to measure the fluid pressure inside the bag, ensuring a signal would be sent to the operator to shut off pumping if the bag ever approaches maximum capacity. A two-level design was utilized to separate the batteries and electronic components from the buoyancy engine in an attempt to protect them in the event that the engine fails or leaks.

The float utilizes a 915 MHz packet radio for communicating between the float and the base station. The radio used implements the LoRa packet radio standard operating in the ISM license-free radio band. The LoRa packet radio provides low bitrate transmissions but with extreme ranges and reliability, making it highly suitable for remote sensing applications where high data rates are not required. Both the float and base station include a castellated LoRa module provided by Adafruit Industries and the RadioHead driver library provided by Airspayce. Digital data transmissions over this radio are used for status, telemetry, and control of the float.

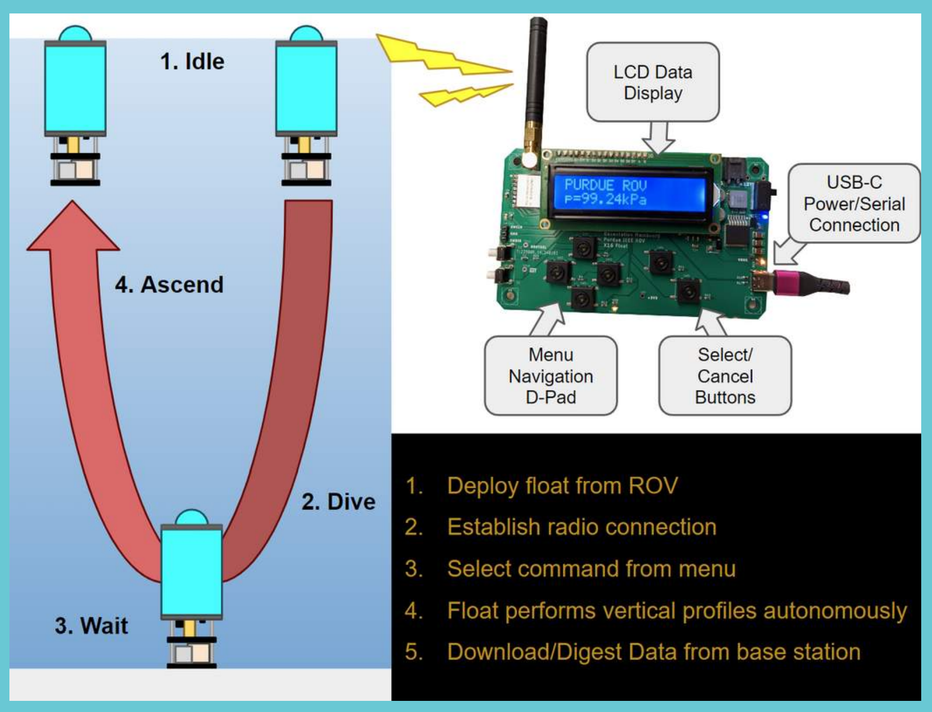

Figure 2: Operation Guidelines

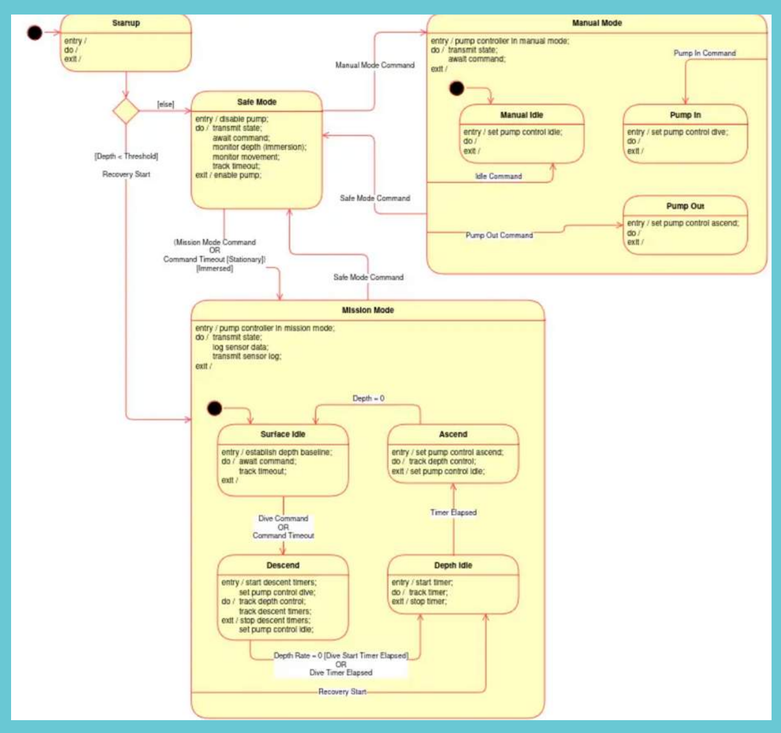

Figure 3: Software Flow Chart