Non ROV Device: Float

Stingray company aims to develop a global network of profiling floats that can monitor the ocean's state. To achieve this goal, its employees have designed and tested Pearl, a fast, accurate, and autonomous float that can perform multiple vertical profiles and communicate with the station from underwater (*Figure 1*).

To change its density, Pearl uses six 60-ml syringes that push or pull water in and out. A DC-motor coupled with a lead screw, moves the plungers of the syringes that slide on two rods that act as linear guides with two limit switches toggling the direction of motion when clicked. A setup adjustment was made after experiencing slippage with the NEMA_17 stepper motor. The motor's torque couldn't overcome a depth exceeding 2m which is not sufficient for MATE's 4m pool. Using the DC-motor and flipping the syringe outlet to be at the top of the float to decrease the water head by nearly 70cm resolved the issue. Pearl can reach its maximum density in just 13 seconds. The syringes and the electrical system are fixed inside a PMMA tube that is 15 cm diameter and 65 cm long. Two threaded rods, and 3D printed and PMMA plates hold the structure. The communication module is placed at the top of the tube to communicate well with the station.

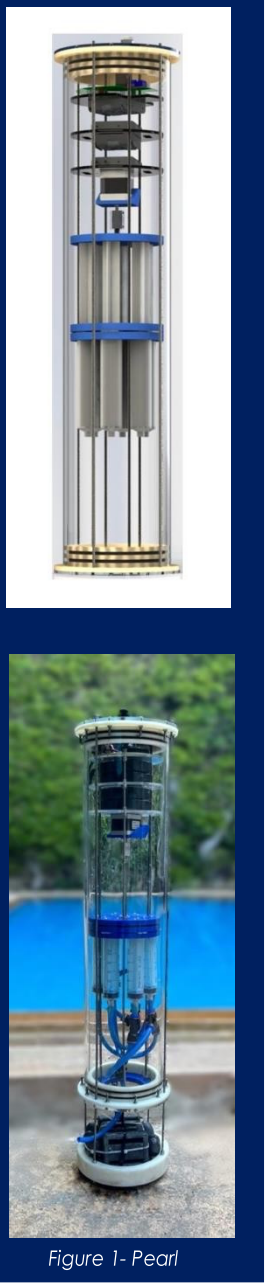

Figure 1- Pearl

The tube has custom-made HDPE end caps on both ends, each with two radial O-rings. These end caps allow the pressure to be released from the housing if it exceeds the external pressure, complying with Mate safety regulations. Moreover, an O-ring face seal connects the faceplate to the end cap. Faceplates make it easier to test, troubleshoot and are more convenient than removing the whole end caps because they can be attached and detached more easily and provide better access to the entire system. The system is activated manually using a Blue Robotics switch placed on top of the faceplate.

Pearl uses several components to send data to the station. These components (Arduino Nano, motor driver, sender module) are integrated on a PCB. The components are powered through the PCB using a set of 8-in series AA alkaline batteries placed in parallel with a similar set, setting the voltage to 12 VDC. A 5 Amp fuse is positioned within 5 cm from the positive terminal of the battery. This allows the entire system to function as required.

Pearl communicates with the station using the HC-12 module, which was selected based on a trade-off analysis between HC-12 and NRF24L01. The HC-12 module has the lowest SNR among the modules that can transmit up to 1 km and does not need any extra libraries to establish the connection. It also has a 10-times longer range than the NRF24L01 module. Two HC-12 modules are installed, one as a sender and the other as a receiver. The sender module delivers the company number and the current UTC to the receiver after deployment. The receiver passes the data to the station via Arduino UNO to be displayed directly on the GUI. To avoid interference from other sender modules on the same frequency, the software team changed the default frequency of the module to ensure reliable data transmission.