Positive Operative Buoyancy Submersible (POBS)

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TEXAS A&M UNIVERSITY Engineering

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TEXAS A&M UNIVERSITY
ROBOTICS TEAM & LEADERSHIP EXPERIENCE

Intro & Problem Definition

POBS is an underwater submersible designed to float naturally in any body of water, such as lakes and oceans, due to its positive buoyancy. Using motor propulsion to remain submerged, the vessel can quickly resurface during emergencies without requiring any additional mechanisms by simply cutting the power to the motors.

POBS is also pursuing two additional submersibles': a miniature turtle-shaped submersible for outreach events and a racing focus submersible.

Surfacing

- POBS is unique in its ability to surface without complicated ballast systems. Requiring no power to return to the surface.

Efficiency

- On short term trips, buoyant positive submersibles have been proven to be more efficient than traditional submarines, Due to the lack of the power intensive ballast system.

Impact

- Ideal for protecting life, equipment, and valuable research during emergencies by surfacing without energy consumption thanks to its net positive buoyancy.

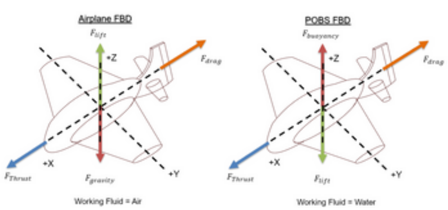

Figure 1: Comparing POBS to an Airplane

Methodology

Using concepts similar to an airplane, POBS is able to develop a buoyant positive submersible that could effectively transverse underwater with the aid of lift provided from the main threads. Curved to direct water underneath and creating downward lift by simply moving.

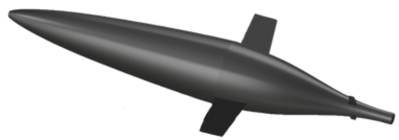

Figure 2: Bulsa's Brainstorm Contribution

Chassis

This semester, the chassis team pursued a sea glider inspired design for a more dynamic design to minimize drag and increase maximum duration in the water. Looking to learn from the pervious iteration's mistakes, the team pursued a threaded connection to make assembly easier and more resistant to the entry of water.

Thruster mounts

- The thrusters are mounted on the bottom sides of the submersible, and attached to IP68 servos, which allow the thrusters to turn 200 degrees. This allows the submersible to control it's depth in the water and submerge itself without any external interactions.

Threads

- The treads were designing to have two screwable halves for the main body as to simplify the process of placing and removing electrical components, while maintaining water-tight properties.
  - Tolerances and Surface Friction: Faced design and prototype difficulties. Internal and External threads disconnected within the assembly requiring resizing. While printings, both PLA halves were difficult to twist into place because of the surface tension. Corrected through a final resize and greasing.

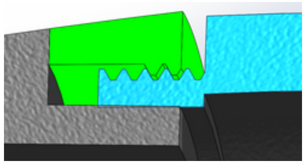

Figure 3: Bri's threads

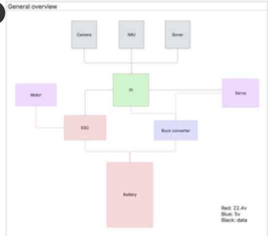

Figure 4: Simplified Electrical Map

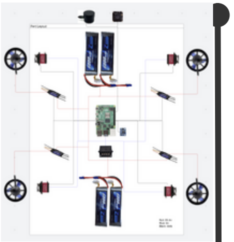

Figure 5: Electrical Map

Electrical and Navigation

The main utilizes the following components:

- 2+ Zeee 6S Lipo Battery 22.2V 100C 6000mAh.
- 4 Blue Robotics T200 Thrusters.
- 6 IP68 20KG Digital Servos.
- 1 Raspberry Pi 4.
- 1 Adafruit 16-Channel PWM.
- 1 Flysky RF Controller and Receiver.
- 1 Blue Robotics sonar sensor.
- 1 Blue Robotics, low light camera sensor.
- 1 Skybro IMU.

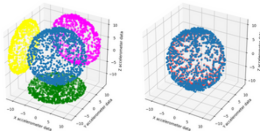

Figure 6: Clustering analysis on accelerometer data

Testing

Sonar Sensor:

- Calibrated and updated the Blue Robotics sonar sensor.
- Tested and coded the sonars' reading distance in the lab water tank.

Low light camera:

- Interpreted live readings on the computer and stored its data.

Motor Testing Experiences.

Thrusters:

- Tested the thrust and velocity of the T200 thrusters to determine effectiveness in water.

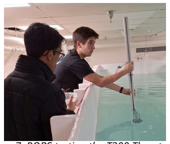

Figure 7: POBS testing the T200 Thrusters.

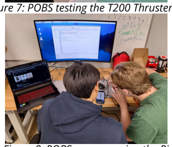

Figure 8: POBS programming the Pi

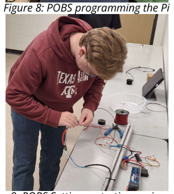

Figure 9: POBS Setting up testing environment

Mini Turtle

The mini turtle is a small, Turtle-shaped submersible, that is meant to be a fun project for POBS members who are looking for a more recreational approach to exploring submersibles. Inspired by our TURTLE logo, this project is also a perfect outreach robot for when POBS showcases to the community.

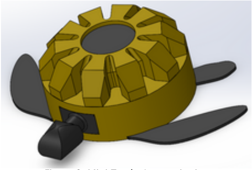

Figure 9: Mini-Turtle; Isometric view

Figure 9: Mini-Turtle; Top view

Simulations:

Starting this semester, POBS has been developing simulations to demonstrate how our robots interact in aquatic environments. Using Ansys to study how water interacts with our submarines, and Blender to render examples, POBS can speed up development of our submersibles By testing the success of each submersible design.

Collaborations:

This semester, POBS has embarked on establishing collaborations with the OCEAN Engineering Department, and other submersible projects, including with an independent AUV team under WIRED and the newly established, Galveston team: TART.

Next Steps

In the coming semester, POBS plans to continue improving our submersibles, as well as starting a new subproject to pursue racing competitions. POBS aim to have a V1 printed and actively collecting data next semester, with a potential deepening of collaborations moving forward.

Texas A&M University Robotics Team and Leadership Experience (TURTLE) Lab