IRON RANGE ENGINEERING

OpenROV Final Project Design Document

Client:

SAS (Society of Air and Space)

I. Introduction

For this project we were tasked with revising an open source ROV from previous projects. An ROV or remotely operated vehicle is a remote controlled submarine which can be outfitted for a variety of tasks. Our ROV was fitted with live camera feed, motors for going forwards and backwards as well as up and down, and a solid state ballast system. We were tasked with continuing on the design and finding ways to improve upon it. While the ROV was in an operational state and all of the components worked, there were still things that could be improved upon and/or added to. This project was done for SAS (the society of air and space) as the ROV is designed to operate in a harsh environment, underwater, and SAS deals with harsh environment exploration. We were given 8 weeks to complete the project and decided to take the direction of improving the ballast system.

II. Problem statement

The problem at hand for this project was that the ROV design limited its capabilities in being able to maneuver and gather information in the water. Our plan was to fix these problems by improving the ballast system, allowing the ROV to adjust its buoyancy and properly navigate underwater.

III. Objective

The main objective of this project was to improve the pre-existing control systems for the OpenROV program and roughly tune the system for future teams to improve upon. We also intended to improve the volume and scope of data collected rather than its current camera only setup. Ultimately our goal was to improve OpenROV for future teams.

IV. Deliverables

Given this mission statement, our deliverables fell into two categories: physical and documentation. The primary deliverable was the OpenROV itself which included the prototype of the new ballast system and should maintain its waterproof shell. The second deliverable was documentation. In a normal project the only documentation would be a user's guide to allow the user to understand how to operate and maintain the system . However this project spans multiple years and teams so additionally the documentation should contain any schematics necessary to adjust and improve the project.

V. Constraints

Some of the constraints that were incorporated in the project are time, materials, budget, and previous designs. For the time constraint we were only given 8 weeks to complete the project, and were not able to have the ROV in our possession for the first week. We do not have a set budget but it is still a constraint as we can't go and spend as much money as we choose without approval. Our largest constraint is all of the previous work done to the ROV. The outside of the ROV is a rigid 3-D printed case with little room for improvement. The controlling and camera feeds take up all of the space provided so no additional cables can be added in its current state. After receiving the ROV, we also found out that the amount of usable space inside of the hull was little. This posed to be one of the largest problems.

VI. Final Design

As stated previously we decided to improve the ballast system on the ROV, and change it from a hard ballast to a controllable remote ballast. While in the design faze we underwent multiple different iterations of remote bassast systems, we settled on one dependent on CO2. For this ballast system a CO2 canister would be used to create pressure in hoses, which would be sectioned off with nominally closed solenoid valves. This high pressure gas when released would push a plunger on the outside of the ROV and displace water to increase buoyancy. From the other perspective, a different solenoid would be opened allowing water pressure to push the gas out of the hoses and into the surrounding water, and decreasing buoyancy. Having adjustable buoyancy on the ROV would in turn allow for better handling and maneuvering underwater, as well as minimize the use of the top propeller which after stirring up sediment on the bottom of water bodies. The finished prototype of the ballast system can be seen below the conclusion.

VII. Important Information

Any and all information needed for further development on this project can be found in the OpenROV shared drive. To get access to the drive please contact one of the following persons, Alex Bissonnette, Jonah Hedblom, or Devin Reimer. The drive contains information regarding operating the ROV, pictures from previous projects, parts list, schematics, citations, previous research, and other various information.

VIII. Conclusion

For this project, we were tasked with improving the current ROV system created by previous IRE student engineers. After deciding on our objective and strategies to accomplish it, we were able to create a proof of concept that can be later refined and applied to the ROV by future teams. Though we weren't able to test or assemble a final product, we were able to add insight to the ROV community and a good foundation for future groups.