Autonomous Underwater Vehicle Improvement Project

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INTRODUCTION

Autonomous Underwater Vehicles (AUVs) are designed for a variety of reasons and come in many different forms. The main uses for AUVs are scientific research and defense. The AUV we are improving is a testbed for both additive manufacturing as a method for constructing underwater vehicles, and a potential testbed for underwater drone swarming technologies. When we inherited the AUV it came with some design shortcomings which we aimed to improve.

PURPOSE

Our main goal is to improve the design of the current AUV. The defined improvements are to achieve zero water infiltration, create an appropriately calculated ballast system, and to create a more ergonomic control system. In addition to our identified improvements we also sought to test additive manufacturing made products in an aquatic environment to further its capability, and further the development of low-cost autonomous underwater vehicles.

METHODS

- Waterproofing the o-ring section using natural rubber film, balloon latex film, and oil-based clay
- Developing water immersion test regime by immersing the AUV in water for a fixed amount of time, finding any area water may have infiltrated via moisture detection, then measuring any accumulated water
- Applying a waterproof coating to protect the hull material from wear by exposure to water
- Performing flotation experiments and buoyant force calculations to find the appropriate weight to ballast the AUV
- Programming an onboard computer to parse inputs from a handheld controller to PWM signals to improve AUV control architecture and ergonomics
- Using string method to find the center of gravity to optimally position AUV ballast

Figure 1: Submersion Testing Apparatus

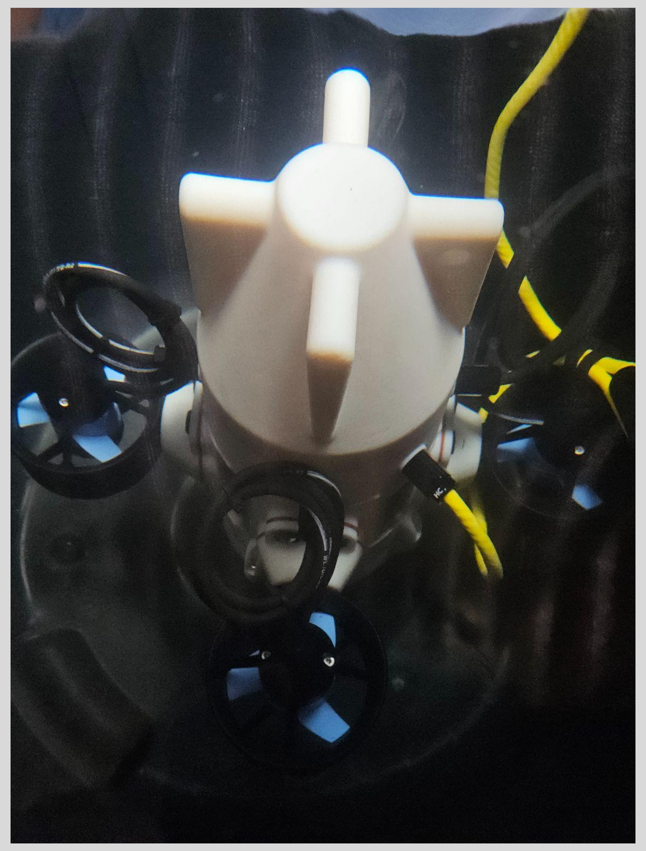

Figure 2: AUV During Submersion in Testing Apparatus

Figure 3: Balloons Seal to be tested for waterproofing

Figure 4: Clay-sealed top cap

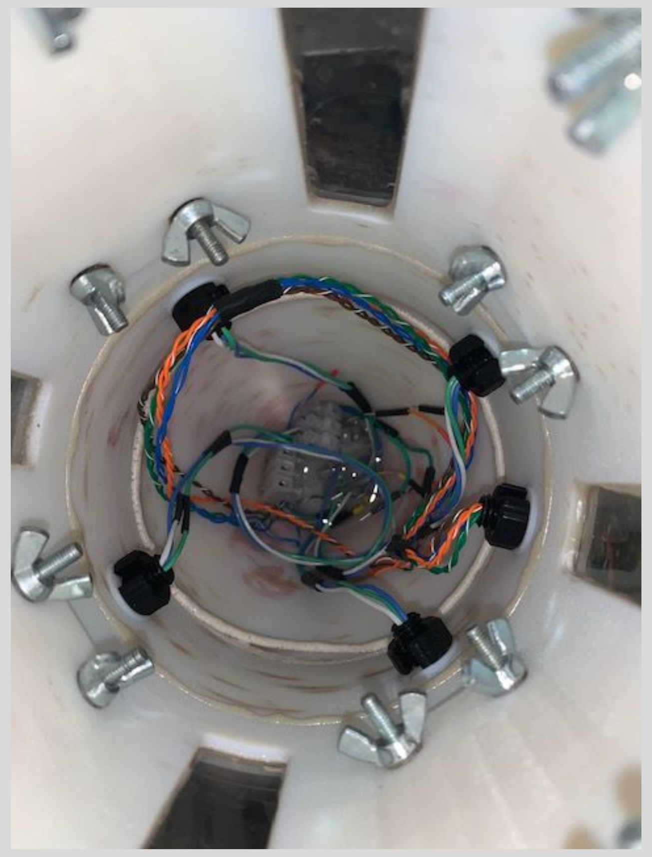

Figure 5: Test Result with minor water infiltration

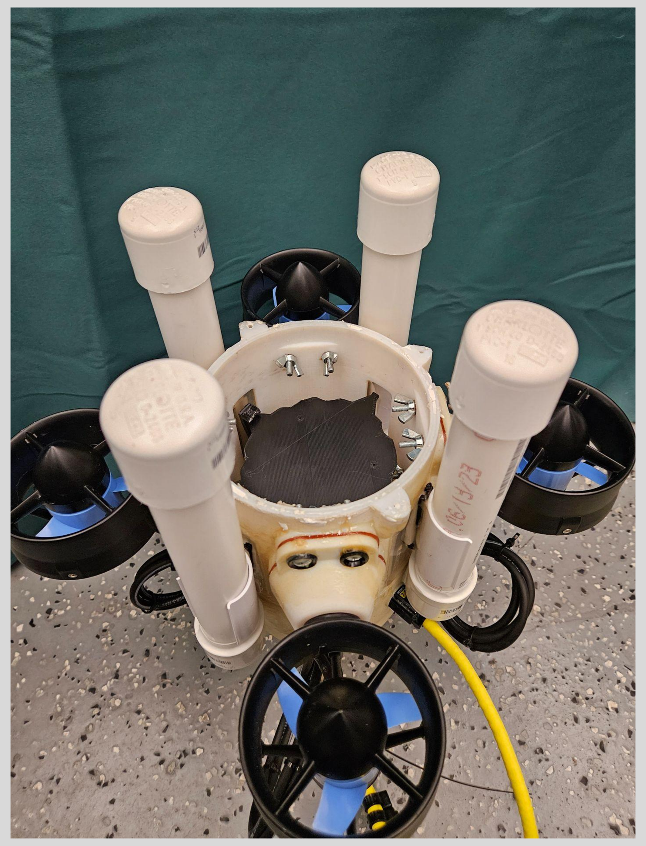

Figure 6: Raspberry Pi 3 Model A+ Mounting System

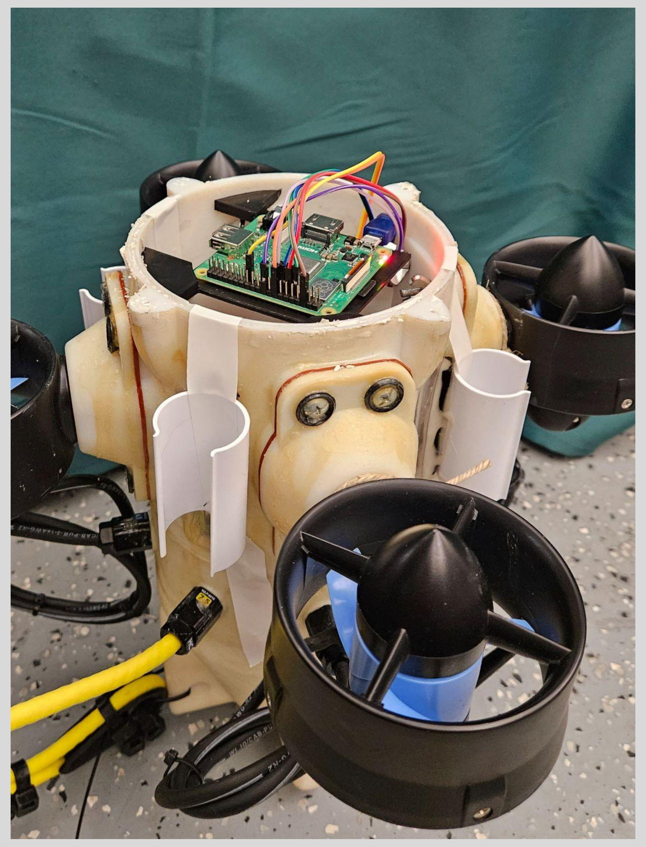

Figure 7: Raspberry Pi 3 Model A+

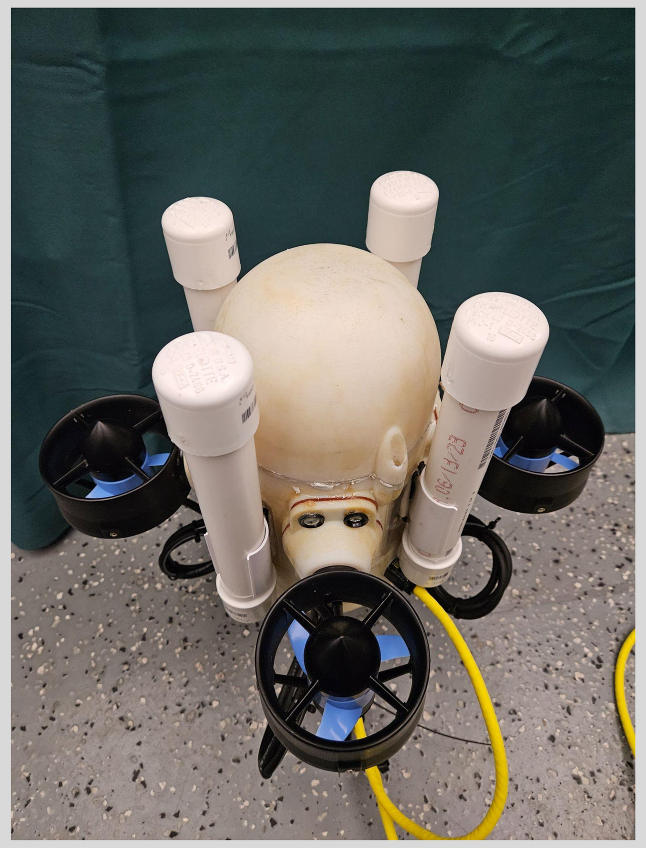

Figure 8: AUV Exterior view with Modifications

RESULTS AND CONCLUSION

- After extensive testing with various waterproofing methods we found that no water infiltrated the AUV.
- Center of gravity found and ballast placed in the most optimal configuration.
- Control system fully intact; went from four potentiometers to one handheld controller.
- Buoyant force calculation based on AUV total volume and density of water yielded a neutral buoyancy ballasting requirement of 3.07lbs (1.39kg); however for submersion testing negative buoyancy was required so a total ballast of 6.70lbs (3.04kg) was added.

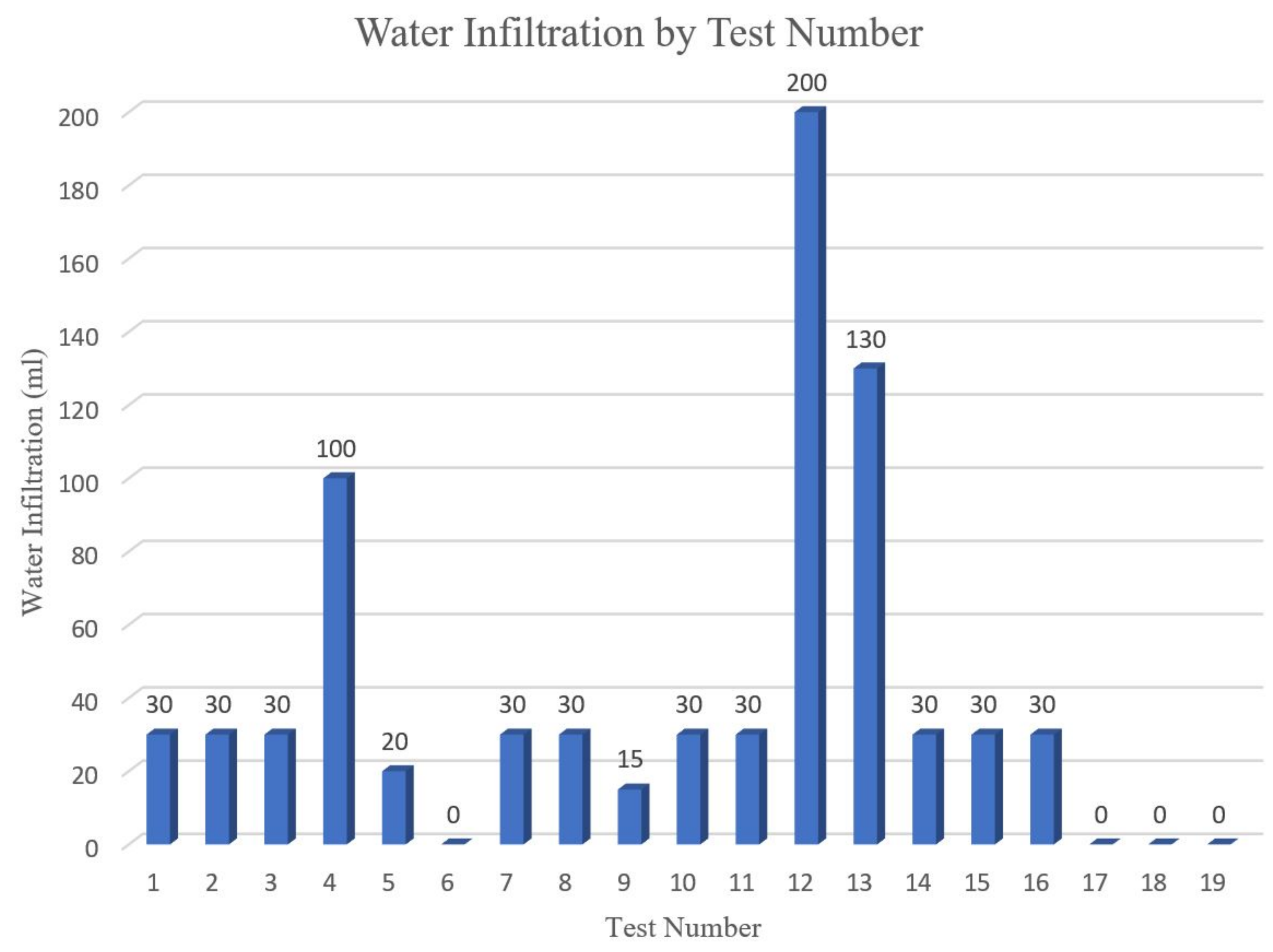

Figure 9. Water Infiltration Measured within AUV after 10-Minute Submersion Testing

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