Real World Innovation

SeaBenders

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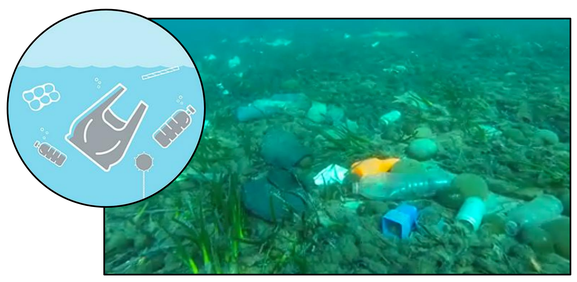
Abstract

To rid the waterways of the immense amount of trash that pollutes it, the SeaBenders have designed a ROV that successfully picks up trash from the bottom of a body of water and retrieves floating garbage along its surface. With the SeaPerch knowledge that we have accumulated from participating in SeaPerch competitions over the past four years, we've designed and built a small, thin, and hydrodynamic 3D-printed ROV that uses fishing bobbers as floatation and contains a detachable hook, which makes our ROV easily maneuverable when performing recovery tasks. At every in-school, Regional, and International competition that we've participated in and won awards at, there was always a recovery aspect in the game course, so our team's strong point became picking up and recovering game pieces. This season, we prioritized and focused on making sure our ROV could easily perform recovery missions in the national game course inspired by waterway cleanup; we compared this importance to picking up and retrieving all the garbage on the waterways' floors, where there is the greatest amount of garbage accumulation. A new challenge we attempted this season was trapping or capturing floating trash with the ROV. We knew it wouldn't be easy to achieve this with a ROV, but in the end, we created a ROV that is able to perform the task in the water and solve the challenge that can save the waterways from pollution.

Background & Motivation

Our priority is to help clean our waterways; with this challenge and the 2021 Mission Course themed as a waterway cleanup, we combined design strategies to build a unique ROV, one we've never attempted before. Inspired by last year's 3D-printed ROVs that won at last year's International competition, we wanted to design a completely 3D-printed ROV that was fast and hydrodynamic so it could complete tasks quickly and efficiently. Since we hadn't won any awards at Internationals, we also wanted to outdo ourselves from the previous years of making PVC pipe ROVs. This season and challenge was our chance to create a ROV that would contribute to the efforts of cleaning our waterways by being able to pick up and retrieve game pieces and trash during the game course, like it would if it were cleaning the garbage above and below the water's surface.

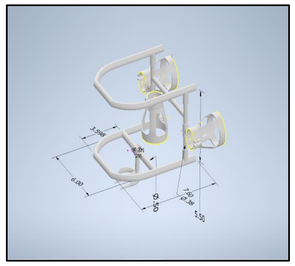
Completing this project was important to us because we'd be contributing to get rid of the trash that pollutes our waterways, allowing us to practice driving our ROVs and putting them to use in the real world. Without clean waterways, we wouldn't be able to do seaperch, so we decided to take on the challenge for our love of seaperch and water.



Methodology

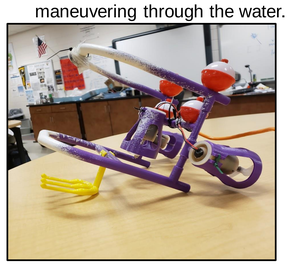
We approached designing, CAD-ing, and building the ROV by understanding the different locations of garbage that are seen in typical bodies of water: floating and sunken trash.

We started off with creating this frame as the base of our ROV:



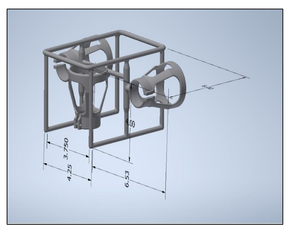
We created this design because we wanted the ROV to porpoise above the water's surface so it could sail higher than the trash and submerge floating trash from the water's surface in one motion. We figured This design would also do well in picking up any sunken pieces of trash because of the detachable hook we had planned to attach on a bar underneath it's center. The thin frame would allow that water to pass through it and increase the ROV's speed and agility when maneuvering through the water.

After we printed the ROV, we decided to add fishing bobbers as flotation because they were more reliable than pool floaties that became waterlogged only after a few uses. The bobbers were also more buoyant.

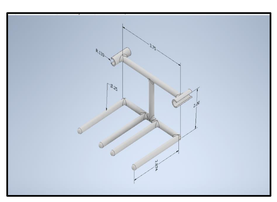


The hook was made with spiked ends so that it could pick up the game piece off the ground and avoid dropping them. As we test-drove it, we realized that the ROV struggled to maintain neutral buoyancy, so we redesigned it to be balanced between the bow and stern.

Our new understanding of what went wrong helped us design our current ROV:



With this rectangular design, the ROV would have greater stability when traveling underwater with the center of mass at the center of the ROV. We also designed the ROV to have a detachable hook that could attach to the vertical bars on the front of the frame.

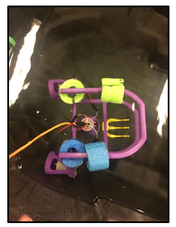


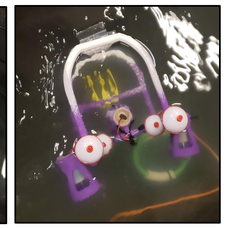
After adding bobbers and adding the new hook, our new ROV was complete. The ROV could pick up and bring down sunken and floating trash in the water. When carrying trash, the hook would be out in position, but when the ROV would bring down floating trash, the hook would be put into a stored position upside down to allow more room for transportation. Depending on the task, picking up from the floor or bringing down from the surface, the ROV could clean waterways and clear the game course.

Results & Discussion

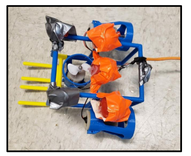
Flotation Testing

Purple ROV: We decided we wanted to use a different material other than the standard pool floaties because we've realized that they slowly absorb water and lose flotation. First, we experimented with using empty test tubes, but the ones we had were too buoyant. Eventually, we switched to fishing bobbers and they proved to work much better because we had many different sizes and had more options as to where to put them on the frame. We found that the center of mass was around the motors, so that was where we needed the most flotation, but then we needed to add fishing weights as ballast to balance the frame since the bow tended to angle upward.





Blue ROV: When we redesigned our ROV, we had to figure out flotation again, but since we knew that flotation needed to be around the motors, figuring out the configuration of the fishing bobbers was very quick.



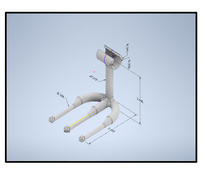
Hook Testing

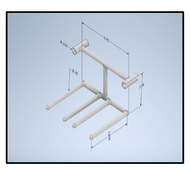
In the past, we've had stationary hooks for our ROVs, and we found that they sometimes got in the way for Obstacle Course and Speed, so we wanted to make an adjustable hook. We also wanted to design our hook to have multiple prongs to try scooping up the sunken trash.

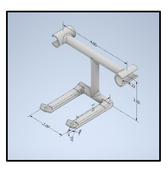
1st hook: The first hook we made was designed to hang underneath the ROV and rotate upward out of the way when it's not needed. After testing it in competition, we found that the rotating aspect worked well and the additional prongs increased the ease of picking up rings, but the prongs were a bit short and could not scoop sunken trash.

2nd hook: We made the prongs much longer on the second hook and made it detachable so that it could be placed underneath for picking up objects or placed in the back out of the way. The longer prongs worked very well, but they weren't flat enough to pick up sunken objects. They also tangled a bit with the ropes for the balls.

3rd hook: On this hook, we made the prongs flatter in hopes of scooping up objects, as well go down to two prongs to ensure the objects were picked up and let go smoothly. At the competition, this hook was very successful in moving objects and was the best of all three designs

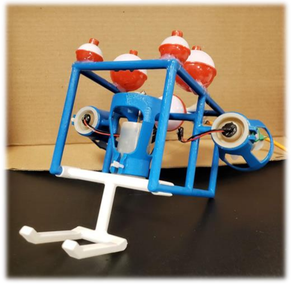






Conclusion

Our main objective was to create something that could successfully aid water way cleanups in our community. Through research, brainstorming, and testing, we created a method to simply clean up the trash underwater.

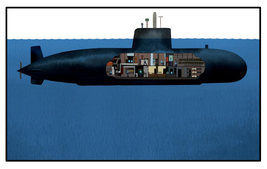


Creating a bio-friendly project helped more with clearing the bodies of water, near the bottom and near the surface. Cleaner water created a safer environment for the water creatures and the rest of the community by having cleaner water to do different activities.

Next Steps

Considering any next steps for our project, we would like to see if we could create different designs that could help the clean up quickly and more efficient. Of course, the design we have now helps a lot, but we would like to explore different types of designs, maybe a structure that is more hydrodynamic or unique to the typical rectangular structure.

We had also thought of the question of whether we could add any form of storage on an updated version of this project. That component would help pick up more trash in one go instead of picking up one by one.



Acknowledgements

We would like to express our deepest gratitude to our club sponsor/coach, Mr. Greg Quast, who has never stopped supporting us in our four years of Seaperch. He was the one to introduce us to Seaperch and continually encouraged us to pursue our ideas.

We are also extremely grateful for our fellow club members who have always extended a hand when needed. This year's club is significantly smaller than past years, but they have still made the effort to take this season seriously despite the unprecedented circumstances.

The 2021 Regionals Competition would not have been possible without the efforts of our regional robotics coordinator, Mrs. Denyse Carroll, who has worked tirelessly to create safe conditions for robotics competitions to continue.

Our CTE teachers also need to be thanked for their valuable guidance throughout the years, whether it be for CAD advice or a quick lesson on abrasive paper.

Finally, we must always thank our family members for their unwavering support in pursuing robotics and for constantly driving us to and from meetings.