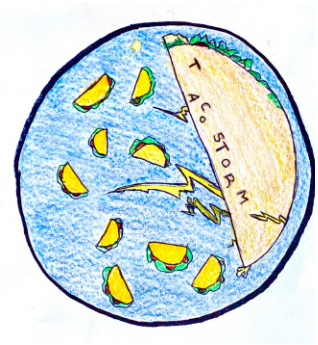
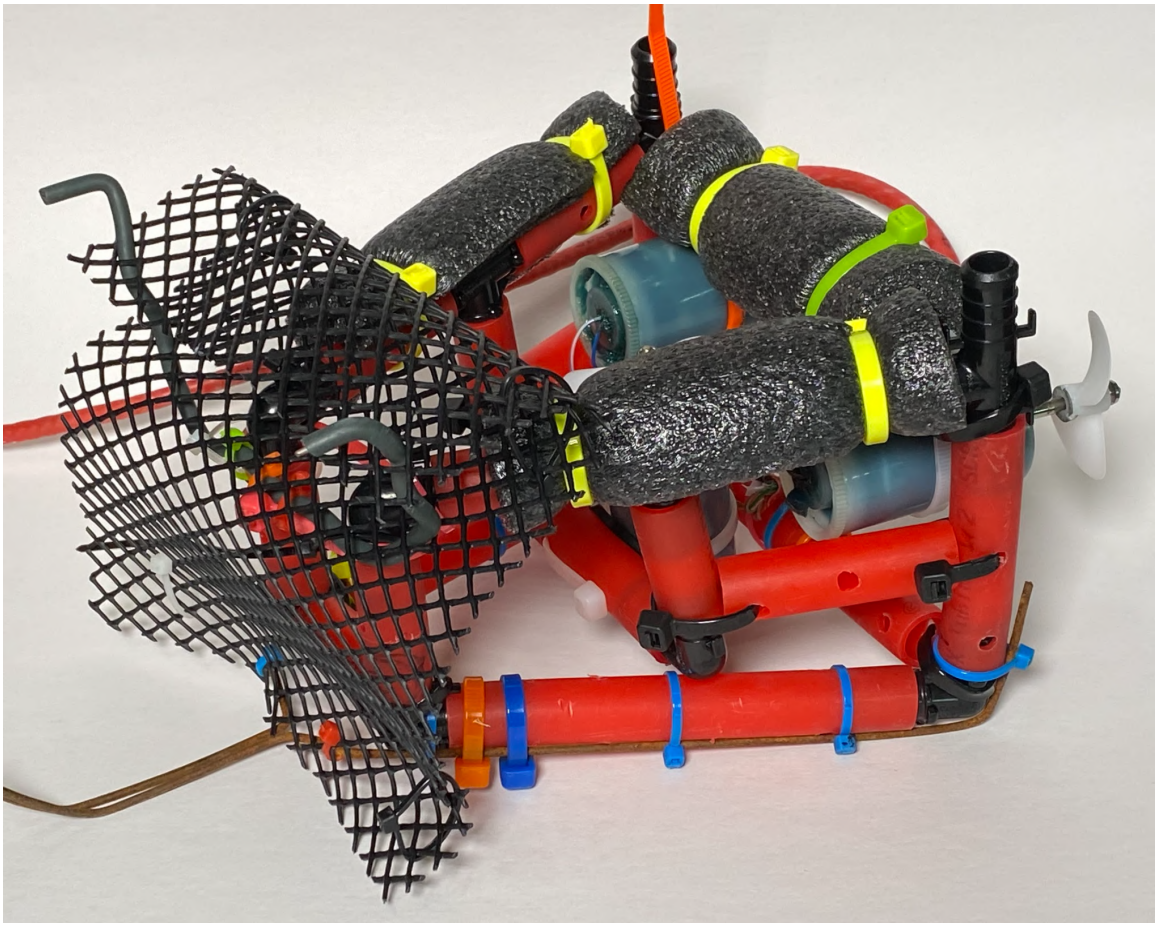


Technical Design Report

TACO STORM 2



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seaperch

ABSTRACT

The legacy of this team is very unique. Most of our members met in 3rd grade and participated in an after-school activity called Lego Robotics. At the end of 2019, we started SeaPerch and got together quickly. We practiced all year, but the coronavirus came and the competition was canceled. When the fall 2020 season started, we got together and continued on SeaPerch again and started practicing. We worked slowly, but we decided on a resolution to speed things up and accomplish more tasks. After we got together, we understood each other and we became a better team than before which is what matters most. For the 2020 season, we decided to compete as 2 separate teams, Taco Storm 2 and Taco Storm 1.

Our seaperch ROV is unique and different because we started out building many designs. At the end we combined two of the designs, the triangle and the marshmallow into our final ROV. We practiced really hard and we fought against Taco Storm 1 in the pool arena every week. The friendly competition motivated us to work harder and become better.

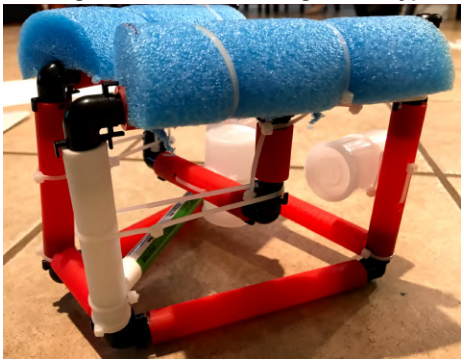
We needed our ROV to be agile while also being hydrodynamic. Before we assembled ROVs, we had to design prototypes. We made several diverse ROV designs. In the beginning, we had many challenges including speed, agility, and the ability to lift heavy objects. But in the end, we did finish all of our challenges. Our engineering notebook will contain information about our goals for the ROV, our strategy, our designs that worked and failed, our steps to present our ROV and the future for our team. We hope we make the top 3 in the international competition.

TASK OVERVIEW

Obstacle Course	**Challenge Course**
● We want our ROV to be very agile while also being fast and hydrodynamic. This will help us in the course and it will make it easy to go through the hoops in under 55 seconds. ● We want to have good drivers. To complete that task we had to practice and practice over and over again until we got good driving skills. ● A good navigator will give enough tether so the tether isn't touching the floor but it has some slack for the ROV to be able to go through the hoops. If the tether isn't on the floor it won't create drag which will let the ROV drive faster and not have to pull on the tether	● We want to be able to pick up heavy objects without breaking and sinking. To prevent this we got a new flotation that has positive buoyancy to counter the weight of the objects to pick up. ● We need a strong hook to push the lever on the vault so we added a metal hanger hook that was sturdy and strong. This was sturdy enough to open the vault ● We need to be able to take the sunken trash out of the vault and move it to a different location so we added a curve to the hook to secure the items when we have to pick it up and move it. ● We need to be able to move floating trash so we added a net to grab onto the floating pieces of debris. We then curved the top of the net to make it stronger which allowed us to push the debris outside of the ring.

DESIGN APPROACH

Ask	Imagine	Plan
• Ask yourself what are the requirements for the ROV and what needs to be in the ROV • Ask where to add motors, floatation, and etc • What improvements do we need to add	• Imagine what the ROV is gonna look like and sketch it out on a piece of paper • Discuss what it will look like • Imagine extra stuff like hooks and etc	• Plan out the ROV • Make measurements • Deicide on what material to use • Determine if the design is possible.
Improve	**Test**	**Create**
• Review the results • Find the flaws • Repeat this process until modifications are no longer needed	• Test the ROV • Double-check and test one more time • Record performance and results	• Create the ROV • Attach motors • Make the frame • Attach flotations • Add hook • Include net • Add weights(if needed)

Design 1 - Marshmallow 	• Easy to mount motors • Cube-shaped • Not very Hydrodynamic, a lot of drag • Flimsy frame • Tends to flip or tip over • Unbalanced frame • Protected motors • Curved Net • Heavier than our present ROV
Design 2 - Sea Dorito/Triangle Prototype 	• Hydrodynamic • Easy to mount motors • Easy to mount floatation • No hook place to mount hook/net • Flotation shrinks over time • The flotation needed to be changed frequently • Not as flimsy as the marshmallow • More hydrodynamic than the marshmallow • Faster than marshmallow

Final Design - Sea Dorito	
	• Easy to mount motors • More hydrodynamic • Strong frame • Easy to mount flotation/hook/net • Won't tip as easily • Fast and easy to control • Flotation stays the same • Less drag and resistance • Slightly positive buoyancy • Can counter the weight of heavy objects • Curve net to bulldoze floating objects.

Why our SeaPerch is special	
Stock SeaPerch has: • Normal stock ROV • Flotation is neutral • ROV is unstable • Frame isn't hydrodynamic • Material for frame is too heavy • Uses toilet bowl wax	Our SeaPerch has: • Small, fast and agile ROV • Floatation slightly positive • ROV is stable • Frame is sturdy and holds down • Pex pipe is hydrodynamic • Lighter material for frames. • Our motors use marine grease

Frame: For the ROV design, we combined the marshmallow and the triangle. We add the base of the triangle and attributes from the marshmallow to make the Dorito which has a frame like a triangle. The triangle has a triangle-shaped frame which is good for **hydrodynamics** which reduces **resistance** and **drag**. For our frame, we used PEX pipe instead of PVC pipe, because it was smaller and lightweight. This made our ROV faster and lighter.

Ballast: The pool noodle flotation was bad because it was squished and shrunk over time. We had to measure the frame to see how long the floatation would have to be. After we measured the frame we had to see which material we had to use. We decided to use pipe insulation because it was more compact than a pool noodle. After all, pool noodle has tiny holes in it which absorb water inside and becomes full of water and will become **negative buoyant**. But pipe insulation was more compact and didn't have little holes like the pool noodle. Once we replaced it the flotation was too positive. We had to cut it, and test it over and over and over again until it was fit for our ROV and became neutral.

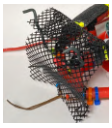
Waterproofing: Also, a choice was that we use marine grease instead of toilet bowl wax because the toilet bowl was too thick and our motors would go as fast. Instead, we used marine grease which wasn't as thick and was smoother and easier to add. Marine grease was specially made for any underwater vehicle instead of toilet bowl wax.

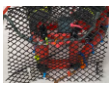
Motors: Next was the motors, the motors were unbalanced. We realized that the motors were placed not equally so that they were unbalanced. One motor was too loose and angled. So then we put each motor in the same place and angle and fixed our motor problem. After all that, our stability problem was fixed.

EXPERIMENTAL RESULTS

We built our very first stock SeaPerch ROV, our stock ROV had very thick PVC pipes which also caused the ROV to be very heavy and slow. We realized we need to change the PVC to a thinner, lighter material such as PEX pipe in order to make a smaller, lighter and fasterROV to be able to fit through the obstacle course hoops.

Another development we made was how we renewed the waterproofing of the motors. The first wax we used was Toilet Wax which only lasted for a little while, but then the motor began to rust. This year, we wanted to experiment with Marine Grease. We think that Marine Grease is better because Toilet Wax is too solid against the motor, which means that water can slide in easily when the wax is solid. Right now, the Marine Grease is doing much better than Toilet Wax because it coats the motor better due to it's paste consistency..





The next part was our nets and hooks. We had a hard time designing them and it was kind of difficult to move it and edit it. We didn't know how to design our net or place it so we all came up with our design for our net and hook and we came up with a net that had a curve on the top kinda like a bulldozer. Our hook was made with a curved end and was made out of a metal clothing hanger which is also a bendable wire. We made the net by adding a piece of net on the front of our ROV and trimmed it many times. We then added the bendable wire to form a curve at the top to catch floating objectives and hold onto it. We keep testing it by cutting, bending until it works. For the arm, we used the metal hanger and split it into a long stick and then bend it into a hook shape so the sunken object doesn't fall off when we move it around but still strong enough to open the vault lever

The last major augmentation was our flotation. The flotation was always a difficulty, we could never get the flotation in the exact neutral buoyancy, so our ROV would either sink or float. The floating a bit was good because we needed it to be slightly positive to lift heavy objects. The first item we used was pool floatation, but the problem with using that was that we had to change the pool flotation several times. In doing that, it took too much time. Instead of taking up our time, we started to use a pipe insulator. The pipe insulator was perfect, it didn't deform, and it wasn't bulky and hard to mount.

We can make our ROV more stable by tweaking our motors to a better position to make it a little more stable. We also need our ROV to be faster, and smoother, to make our ROV faster we might make it smaller and more hydrodynamic. The more hydrodynamic the ROV the faster. A sharp Item is hydrodynamic, and there is less water resistance, while a blunt object has more water resistance. Our motors are put on the outside because it gives us increased maneuverability. One of the ROVs we made has the up and down motor with the propeller facing down. The propeller facing down has an advantage. If the propeller is facing up, the propeller is vulnerable to be broken if you accidentally ram into the hoop.

The 3 Hoop Test

Name	Time
Talan & Jason	1:39
Kaleb & Talan	1:32
Tristan & Talan	6:30
Tristan & Mateo	4:03
Jason & Talan	34(secs)

Trash Pickup Test

Driver Tether	Run1 (secs)	Run 2 (secs)	Run 3 (secs)
Jason Kaleb	20	29	27
Kaleb Jason	41	53	31
Kaleb Tristan	33	32	47
Jason Tristan	24	28	19
Mateo Talan	32	25	33
Talan Kaleb	18	20	26

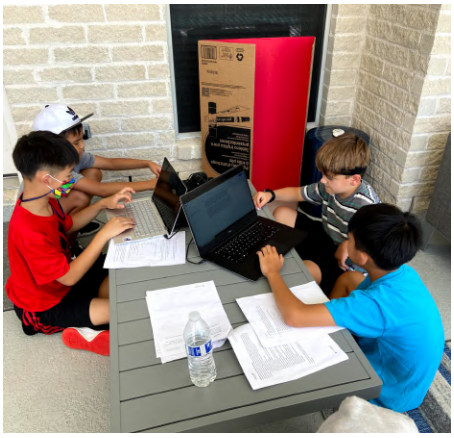
REFLECTIONS

This season was great. We learned a lot of things about how to solder and work together as one. We had some challenges along the way like having trouble with our motors because our right motor was slow so we had to make new motors to replace them. Another challenge we faced was, the water reflected light which made it hard to see and the water jet made it hard for us to learn to navigate the ROV. We learn a lot of life skills in seaperch. We could do a lot of things because we learned how to use many tools. So if we had any job that included teamwork we could communicate because we could work with other people.

During this season we went through some challenges. Compatibility was an issue because not everyone will understand each other. Sometimes the Navigator will say something that the Driver might not understand. Here Is why compatibility is an issue because if someone doesn't listen to someone's suggestions they might get into a massive issue.

Another challenge we had was ROV stability. We thought our flotation and motors were fine but sometimes they weren't. Flotations over time get squished and become unbalanced. Also, sometimes the motors are positioned oddly due to how we store our ROV. But now, we learned that we need to check the positions of the motors and check the floatation condition before we put our ROV in the water during practice. After all that we experienced, we now have a much better understanding. This knowledge can help in future careers, and make us more comfortable with more things that we usually don't get to experience. For example, cooperation with other people in projects, using power tools, and being familiar with the engineering design process.





NEXT STEPS

The future we want for our team is to have the best ROV that we could make. Also winning and getting a top place in nationals again. Right now our ROV still has room for improvements, and we want to do those improvements. The future we want is to be the best team we can be and do our best.

- Make our frame smaller so we can be faster
- Modify our flotation to make our ROV more stable
- Experiment with different motor placement
- Making our ROV more hydrodynamic
- Experiment with different propellers
- Experiment with different kinds of waterproofing materials
- Experiment with different flotation
- Practice getting better at driving and navigating
- Experiment with a different design/frame
- Win the SeaPerch internationals competition

ACKNOWLEDGEMENTS

- We would like to thank Mr. and Ms. Milam for letting us use their pool. Without the Milams, we wouldn't be able to practice and therefore be really bad at driving our ROV.

- We would also like to thank Mr. and Ms. Cao for teaching us about SeaPerch, like soldering, waterproofing, and much more! Without the Cao's we wouldn't be able to have an ROV in the first place and we wouldn't know how to solder or drive.

- Although the person we would like to give the biggest thanks to is Senior Chief Johnson, he is an awesome person, and he sponsored the regional competition. Because of him, we are able to experience SeaPerch this year.

- We would like to thank the parents for supporting us and always taking the time to take us to practice.

- We would like to thank Mr. and Ms. Bui for letting us meet over at their house for the first year of our SeaPerch journey.

- We would like to thank Shadow Creek Ranch HOA for letting us use the community pool for our first year.

- Most of all, we would like to thank RoboNation for sponsoring the SeaPerch program

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    *This video is another demonstration on how to do obstacles 3 and 4

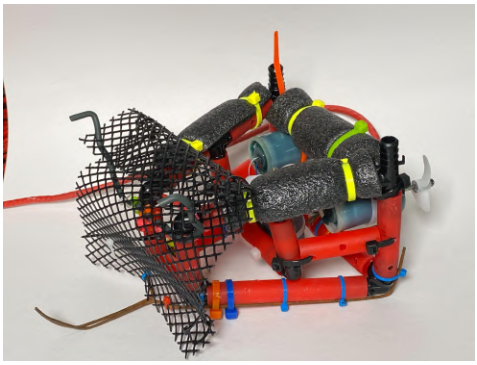
APPENDIX A: BUDGET

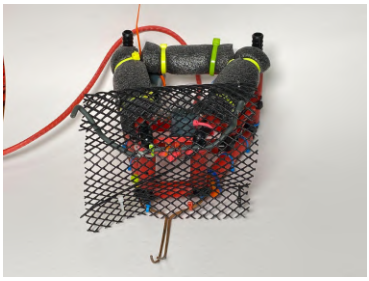
Component	Vendor	How was component used	Cost (USD)
Pex pipe tee (2)	Home Depot	Frame connector	2.51
Pex pipe 5ft	Home Depot	Frame material	1.86
Pex elbow (8)	Home Depot	Frame connecter	6.83
Wire connector	Amazon	Connecting wires	1.00
Flexible wire		Shape the net	1.00
Hanger		Hook	0.20
Marine grease		Motor waterproofing	1.00
Pipe insulation	Home Depot	Buoyancy	0.25
Wire winder	walmart	It helped us tether	1.00
		Total Cost $:	**15.65**

APPENDIX B: FACT SHEET

Taco Storm 2

Shadow Creek Robotics Club, Pearland, TX, USA





Middle School Class Competition

#Years participating in SeaPerch: 2 years

#Times at the International SeaPerch Challenge: NONE

Our SeaPerch is unique because:

Our ROV was small and agile unlike other bulky big ROVs. Our other goal was to make it easily controlled. We also wanted it to be able to go through hoops and pick up items while still being very fast and easy to control. We also tried making it so no one did 1 thing alone. Everybody was involved in multiple tasks.

Some of the reasons that our ROV is special are because the net has a curve at the top, and to support it we used flexible wire. The curve at the top of the net is used to catch floating objects, and not let it go. The hook is special because we used metal hangers, and metal hangers are sturdy. As well as using the net to make our hook more stable. We put zip ties through the holes of the net to hold up our hook and make it stable.

And for the flotation, we used pipe insulation because it slowly absorbed water. But pool noodles absorb water too fast and need to be changed often. And for the motors, we used marine grease instead of toilet bowl wax because marine grease is less thick and is made especially for underwater vehicles.

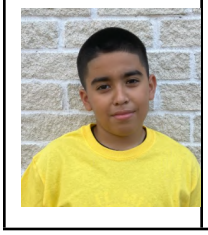
SeaPerch Design Overview:

We built the stock ROV and decided it was too big and bulky. We then wanted to make our ROV small and easy to control. We found the smallest light weight material to make the smallest ROV we can make. Then we needed to modify our ROV to pick up heavy items and rings. We removed all of the non necessary items and tried reducing the zipties and other items.

Our biggest takeaway this season is:

Our biggest take away is soldering because we have never seen it done before. It was amazing that our coach taught us how to solder the wires onto the motors. Another big takeaway was teamwork. It was difficult to work with 5 members and it was hard to get all 5 members input. But as the SeaPerch season progressed, we became better at working together.

TEAM MEMBERS PROFILE

	Hello, I'm JASON. I am 11 years old. I enjoy building. My favorite part of SeaPerch was when we got to build the ROVs. I want to become an engineer when I get older so this skill is perfect for me to learn.
	Hi, I'm TRISTAN. I am 10 years old. I enjoyed designing and building our ROV's and I think maybe I could become an engineer or an inventor to design something amazing then I could build whatever I invent.
	Hi, I'm TALAN. I am 11 years old. I enjoyed designing the ROV on paper and building it which inspired me to design car parts so it will be more aerodynamic and make it faster.
	Hi, I'm KALEB. I am 11 years old. I really enjoyed seaperch, and it inspired me to do many things.First Off seaperch is similar to one of my favorite things building and designing things.Building the ROV was really enjoyable and helped me understand a lot of things about engineering.For My career in the future i would love to have a job that involves building things.
	Hi, I'm MATEO. I am 10 years old. The best part about seaperch is driving. It's similar to driving a submarine. Seaperch inspired me to become a marine biologist for my career in the future, because driving a ROV is similar to driving underwater vehicles.