Washington Latin Sea Lions: Ranger
Technical Report

Washington Latin PCS
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USA

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Abstract:

Originally established in 2018 as a scout team, Washington Latin Sea Lions are returning to the 2025 Ranger Villanova Regional after elevating to Ranger in 2024 from the 2023 Navigator MATE Mid-Atlantic Regional. With the objective of redesigning the 2024 ROV while maintaining a simple but functional underwater ROV; using recycled, donated, and a minimal amount of purchased materials. Including adaptable PVC pipe frame that allows manipulation of the location of our components, donated Lego to create the hydrologic claw, and a single repurposed automobile backup camera encased in resin to make it waterproof. The flexibility of the ROV will allow it to manipulate tools like the thermometer, cable to support initiatives like Coastal Pioneer Array, SMART Cables for Ocean Observing and monitoring ocean temperatures. While still being maneuverable to evaluate habit and species for initiatives like Sturgeon Restoration and Red Sea to Tennessee.

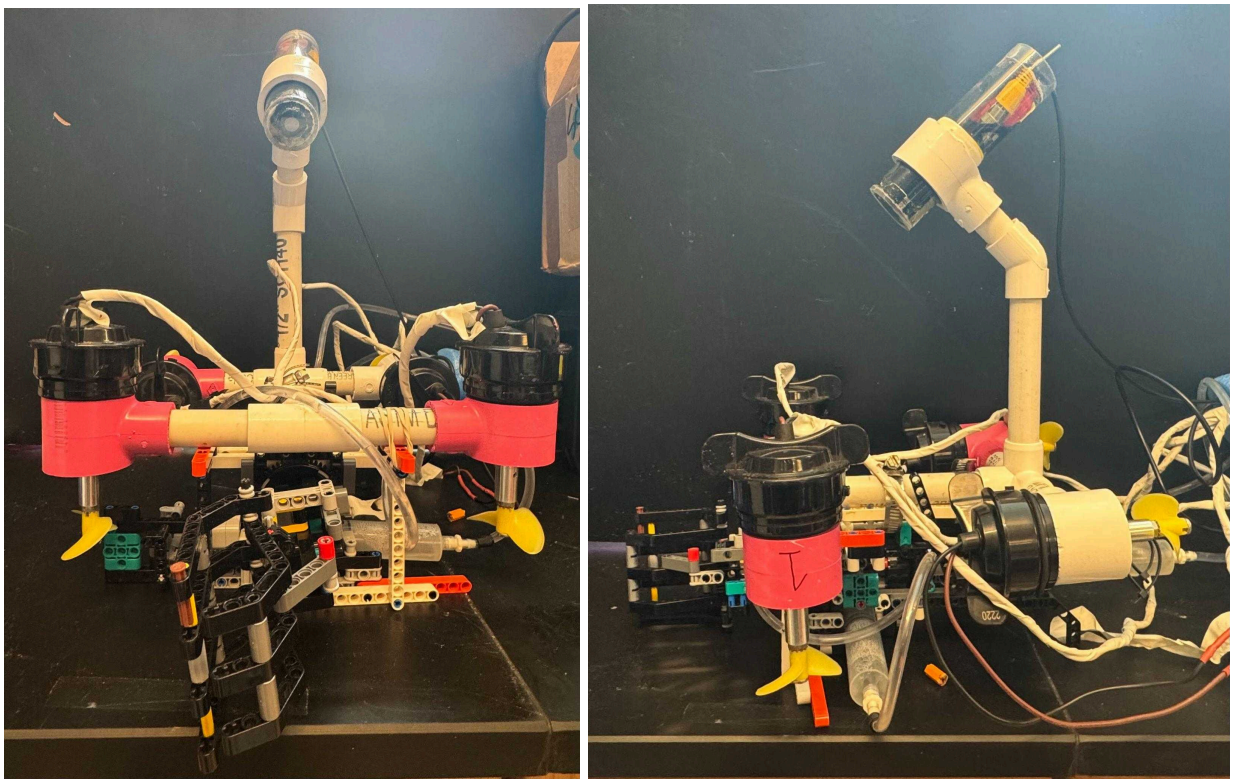


Figure 1a and 1b: Final Robot:
scorpion-like compact shape allows for it to move easily through the water, and to be more efficient with our use of power. With hydrologic powered Lego Claw and 3D printed shrouds
Weight: 2kg Dimensions: 0.41m width x 0.33m length x 0.41m height,

Theme:

Latin Sea Lions strive to use minimal resources to create an ROV that can be used to address local and global ocean issues including Climate Change.[1] By creatively working to make it easier to engage the science needed to monitor changes in the ocean making data more accessible to a global community looking to better understand how to protect, restore, and manage our oceans ecosystems.[2]

About us:

The entire body of the company is made up of students from Washington Latin Public Charter School (WLCPS). The Sea Lions first started as a summer class in 2018 and further developed into an official team shortly into 2019, disbanded during COVID and reformed to compete in 2022 in the scout class. Our 2023 team competed in Scout and Navigator classes during the Mid Atlantic Regionals. In 2024 Updated the Navigator robot to compete in Ranger. Our 2025 team has been hard at work updating our ROV Design for the Ranger class. Meeting during lunches, after school, and weekends. The Sea Lions accept members of all levels, even those with no experience, so that they can further grow from participating in this company. A future goal is to expand that team into the Middle School in future years. This team is currently under the supervision of our faculty proctor Adam Keller

Figure2: Latin Sea Lion Ranger Team (photos by Adam Keller)

Project Management:

The Latin Sea Lion Team meets weekly on Wednesdays during the club schedule from 2:10-3:00pm. To allow athletes to be a part of the team. During the second semester the Team divided into smaller action teams to complete tasks more efficiently. When needed we added meeting times during lunch or during the end of day Tutorial.

YEAR PLAN	
Date:	**Activity:**
9/18/24	Plan Bake sale
9/19/24	First Bake sale
9/25/24	First day of club go over ground rules and what we will accomplish in club this year. Teach sautering using spare wire +tool saftey check, ask everyones preferred intrest for groups
10/2/24	What happens at compeition, watch video walk through + Sea Lion Swag!!
10/9/24	go over soldering basics + start planning fundraiser
10/16/24	assign teams based on everyones interest and skill level explain what each team does allow them to start talking about the robot +Plan fall festival setup
10/19/24	Fall festival, potential bake sale
10/23/24	prepare for driving test+Plan bake sale
10/24/24	Bake sale (if we didn't do one at the fall festival)
10/30/24	**TEST DAY! drive previous robots and make to-do list**
11/6/24	Brinstorm fundraising and possible corprate sponsor
11/13/24	material count assess what we need to buy
11/20/24	brainstorm ideas for fundraiser assess how much money we need to make+Plan bake sale
11/21/24	Bake sale - cancelled
11/27/24	**NO SCHOOL**
12/4/24	Team goals and reports
12/11/24	Team goals and reports
12/18/24	Team goals and reports +Plan bake sale
12/19/24	Bake sale - cancelled
12/25/24	**NO SCHOOL**
12/31/24	**NO SCHOOL**
1/8/25	**FUNDRAISER cancleed due to snow**
1/15/25	make sure controle box (triggerfish) is programed, attach motors
1/22/25	hook up camera to a system, watch videos about competion
1/29/25	trouble shoot camera - order new motors
2/5/25	work on robot tasks in teams
2/12/25	Teams report in prepration for testing
2/15/25	**TEST DAY! canclled**
2/19/25	Teams report out on work done on tasks
2/26/25	Teams report out on work done on tasks
3/5/25	**NO SCHOOL**
3/12/25	Decision day, can the robot compete, who can travel, and bedget update
3/19/25	Teams report out on work done on tasks
3/26/25	**NO SCHOOL**
4/2/25	Teams report out on work done on tasks
4/9/25	Teams report out on work done on tasks
4/30/25	Teams report out on work done on tasks
4/30/25	Teams report out on work done on tasks
4/30/25	Prepare for test day finilize poster
4/26/25	**TEST DAY + Last tweaks**
5/7/25	Confim paper work and troubke shoot robot
	Robotics Competition
5/15/24	**Debrief and finial reports**
5/22/24	**last day: clean up day!**
5/29/24	School Exam no club

Figure 3: Planned schedule by week, including weekend testing days

Safety Procedures:

All students had to complete a student created soldering clinic including a YouTube tutorial, and pass a soldering test. [3]

Name	Soldering Wires	Soldering practice board	Watch video:	Soldering Wires Description	Practice Board Description
Max Arron	N…	Not ta…	YES	strip the wires	place the metal prongs into the board
Mira Soskis	N…	Not ta…	YES	Add heatshrink	don't use too much solder
Seamus Sacks	P…		YES	Solder wires together	have a hershey kiss shape
Daniel Butler	P…	Pass		use heat gun to add heat shrink to wires	solder 3 of 5 prongs
Sebastian Risso	P…	retake			
Benjamin Baptiste	P…	Not taken			
Jacqueline Trayner	P…				
Joshua Lewis	P…				
Charlie Jacob	P…				
Imanuel Brandon	P…	Not ta…	YES		
David Browne	P…	Not ta…	YES		

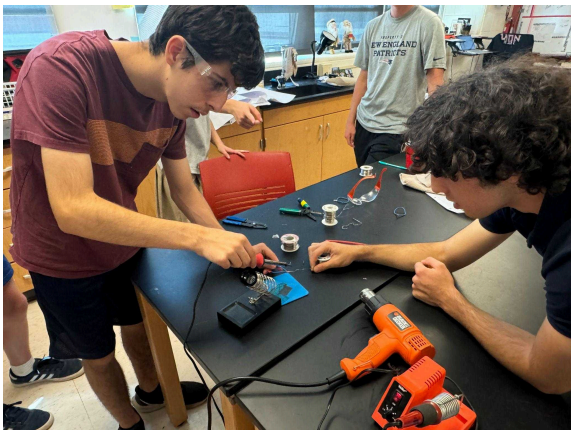


Figure 4a and 4b:
4a: Soldering test tracking sheet 4b: Max administering a soldering test during club meeting

While building we have safety checklists that everyone must follow while building and creating.

SAFETY CHECKLIST:

For using any tools you first have to:

- ◯ Have Advisor supervision.
- ◯ Take a test in order to ensure you can safely use the device.
- ◯ Complete your soldering test.
- ◯ Have a super visor check your work.

SAFETY STEPS FOR SOLDERING:

Make sure you are:

- ◯ Wearing Goggles.
- ◯ Stripping the wire using the correct equipment.
- ◯ Twisting the extra wire together to form a ring.
- ◯ Cutting a piece of solder wire.
- ◯ Having the ring checked by an advisor.
- ◯ Solder then add the heat shrink.
- ◯ And finally getting it checked by an advisor and adjusting if needed.

Figure 5a and 5b: Safety checklists

Design Rational:

In designing the ROV, we had to keep two crucial things in mind: how we can increase power and movement while keeping full axis movement. We aimed to produce the most hydrodynamic design possible while keeping full axis movement to be able to move and maneuver in any direction. Designing and building our own components ensured that we could execute the tasks in the most efficient way possible.

Figure 6: Testing Mobility
Spring testing of previous design and using the camera to navigate and engage in simple tasks, while noting trouble points and flaws in design

Innovation:

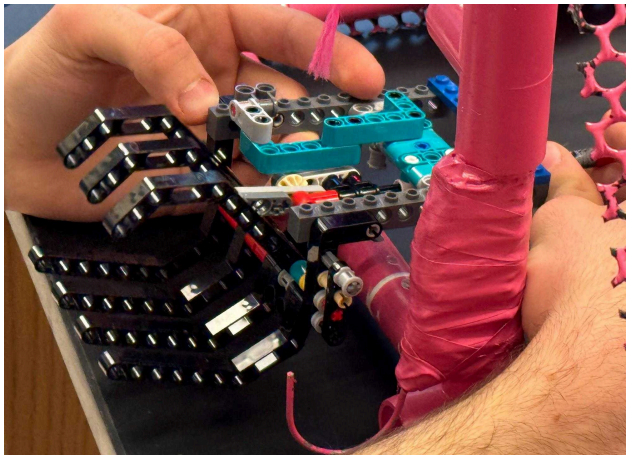
Our team was very thoughtful in this project. We focused on updating the larger shrouds to more compact shrouds that still allowed for undisrupted water flow through the motors without any damage. Using resin to waterproof the backup camera, shifting the camera to improve visibility, and designing the hydraulic claw from donated lego that could approach objects horizontally or vertically and rotate while in the water. While designing a lighter and more compact ROV.

Vehicle System Overview

Our ROV has a scorpion-like compact shape that allows for it to move easily through the water, and to be more efficient with our use of power. It also allows for more balanced tools without taking too much space. This design is beneficial because if a company were to mass produce it, it is easily assembled and the design requires less material. Packing utility into a little amount of space.

Payload and Tools

The Claw: Low profile to scoop off the ocean floor. It uses a separate dual hydraulic system to minimize energy use. The design of the dual hydraulics allows rotation of the claw to turn objects or for the claw to open vertically or horizontally depending on what is being grabbed, while still having the ability to open and close. The choice of using donated Lego allowed for a flexible low cost design.



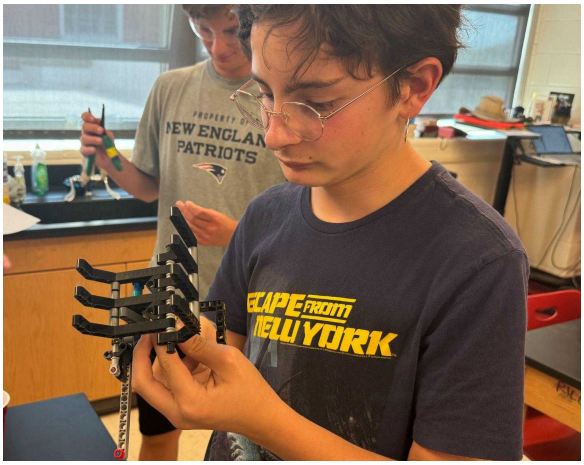
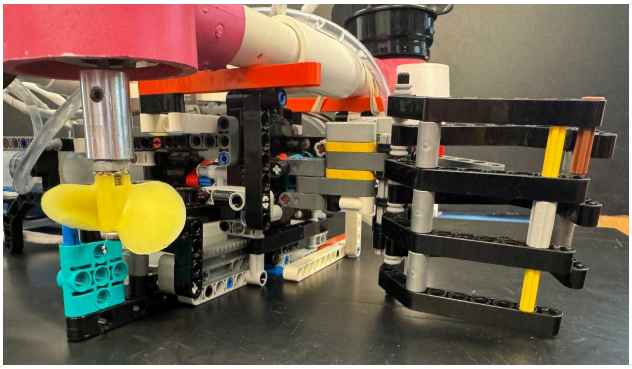
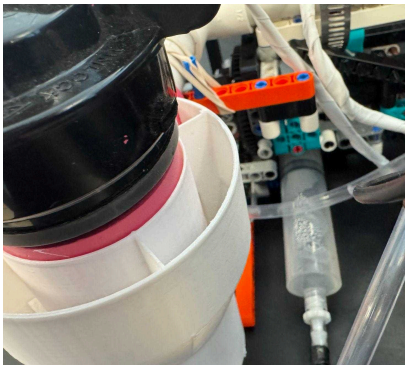


Figure 8a, 8b, 8c, 8d: Hydraulic Claw and Hook

Clockwise from top left 8a: Repurposed lego claw attached to two hydraulic systems to open and close the claw and rotate the claw to horizontal or vertical position 8b: Jacqueline adjusting claw to mount to new frame design. 8c: Claw placement on new scorpion design with vertical orientation and reinforced "fingers". 8d: Hydraulic claw mechanism within the structure of the ROV, water filled syringe and tubing.





The Motors: The four motor design is meant to allow for improved mobility including pitch controls. The new T200 Thruster would have increased power while being more streamline, but due to their late arrival we were unable to adapt them to the triggerfish control box. Instead we recycled older motors from the previous robot. With the recycled motors, the Triggerfish control box allowed us to have motors fire backwards and forward on opposite sides to improve rotation. Have two central motor improves surfacing capability, but buy switching the direction of motion, allowed for more control to the pitch of the ROV

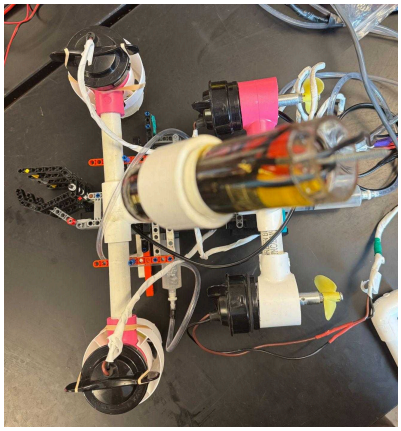


Figure 10a Triggerfish box and 10b motor placement:
The Triggerfish left stick controlled depth and pitch while the right stick propulsion and turning. The placement of the motors in 10b allowed for more efficient turning while having vertical motors controlling the pitch.

Camera: Resin encased automobile backup camera, is waterproof and wide angled with back up indicators to help with navigation and claw use.

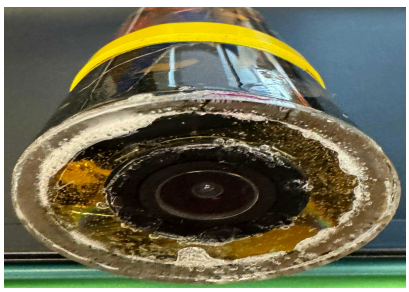



Figure 11a and 11b: Camera:
Resin encased Automobile backup camera

Buoyancy and Ballast: With a lighter design, we will use the weight of the ROV as Ballast, using the increased power to the upward motors as buoyancy. With a plan to use pool noodles and inflatable jack to adjust if needed. After the Regional Competitions we will be looking to design a more permanent placement for the Inflatable jack.

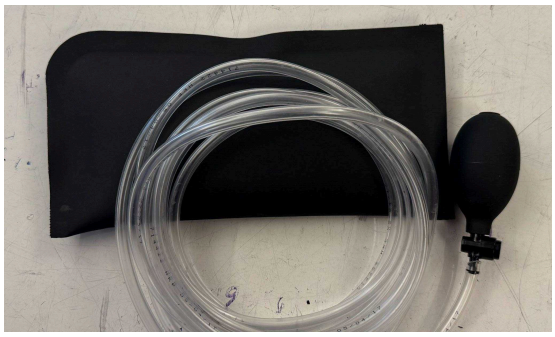


Figure 12: Inflatable jack:
A repurposed inflatable jack has high durability and amount of air can be adjusted.

The Thermometer: Uses an arduino system to be able to send data to the surface team. Troubleshooting the powersource and monitor has been an ongoing issue in the design.

Figure 13: Thermometer:
Doing a functionality test on the thermometer arduino set-up

Safety Features:

Our ROV has large PVC pipe arms, covered motors and covered wires that include fuses. The covered motors and wires ensure that no electronics are ruined by water, this also serves to make sure that they aren't able to be cut easily by anything it may come across on its ocean adventures. With the removal of our original box design, we need to redesign the shrouds. We chose to redesign a small 3D printed shrouds design that still allows for water flow.

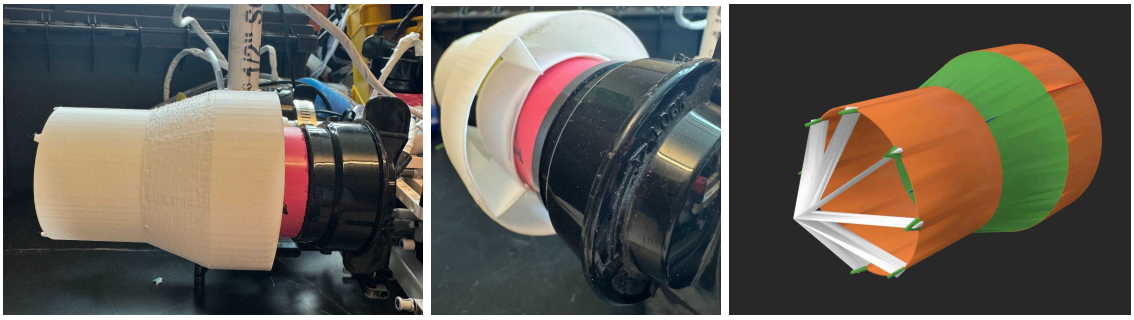


Figure 14a and 14b 14c: Shrouds:
Prototype 3D printed shroud with venting,
seen in 14b, to allow water flow. 14c shows the tinker.obj model design

Built vs. Buy Decisions:

We chose to build or scavenge most items in order to save money and bought other essential or consumable items so that the robot was able to run at its maximum capacity. With the addition of a corporate sponsorship this year we decided to invest in new more powerful motors, but with a delayed timeline the motors were not functional at the time of the competition.

Bought:

New: Attempted to upgrade the motor to more powerful streamline ones, but due to the late nature of their arrival, we were unable to adapt them to our electrical system. We bought new electrical tape and zip ties to ensure a stable final product with reliable materials.

Used: Lego, pvc pipe, the camera, motors, wood, chicken wire, hot glue, pool noodles, and hydraulic system were all used materials that were recycled from either past projects of our team or donated to the team. This reduced the cost of this project, and also was enacted in order to help reduce waste on the planet by recycling.

Company Evaluation:

Entrepreneurship: Because our team falls under the Club structure, we were expected to independently fundraise for all materials and travel. After failing to begin raising money until April, the team has reached out to companies and received 4 figure donations to ensure that the club is financially stable.

Content Knowledge: Five new members and three inexperienced members, the team was in charge of teaching themselves via youtube and other websites the fundamentals of robotics

Obstacles: Initial lack of funding for part, using minimal resources to fix components including a functionless Camera, obstruction to the camera, missing components from previous years builds, general knowledge gaps of robotics fundamentals.

Critical Analysis:

Knowing that we would have limited meeting time due to the nature of the club structure, we divided our engineers into three teams: design, engineering, and budgeting/marketing. This allowed for our team to work on multiple aspects of the robot simultaneously. With limited access to a pool we had to rely on dry testing of components prior to a single water test each semester.

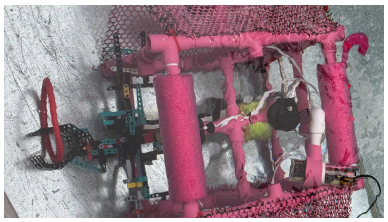


Figure 15: Testing Claw Functionality:
Wet test of claw functionality prior to scorpion redesign.

Robot Strengths:

- Our frame allows for easy customization by having plenty of space for adding new tools
- Our commonly used materials allow for easy replacement of most parts
- Full axis movement

Robot Weaknesses:

- Camara has limited view and can not see behind the robot
- Flexibility of the scorpion design also makes it more fragile
- Old motors are unreliable - new motors were incompatible with the current electrical system.

Problem Solving:

For the testing phase of our robot, we had to identify potential problems pretty quickly. Like with the wire disrupting the balance of our ROV, so we had to add flotation to recover the stability. We are dealing with an older cord to the camera and needed to work to stabilize it to make sure we maintained the picture. The previous camera placement helped balance the ROV's bouncy but also led to an obscured field of view.

Figure 16a and 16b: Camera Test
16a:Testing the functionality of the partially obscured camera 16b: changing to the scorpion design lead to higher angle and better range of visibility

After a promising start to courting a corporate sponsor, the payment was delayed and reviewed late in the year, limiting the window for which we could use the money. The team purchased a new more powerful T200 thruster from Blue Wave but they arrived very late into the process and we were not able to be integrated into our electronic system in time. Leading to the use of older, less powerful, motors. Scheduling is always a challenge with only the club meeting schedule to work with.

Troubleshooting: when issues were identified, during wet or dry testing, a team would be assigned to take a strategic approach to identify the area of issue and then work to fix the issue. The two biggest issues were a nonfunctional motor and a poor camera connection, both the results of poor soldering, and able to be fixed by identifying the problematic connection quickly. There were also multiple attempts to design a system to better manage the tether but made it difficult to troubleshoot issues and were eventually scrapped.

Post Regional: Reinforcing the claw, updating the electrical systems, and making a more permanent solution for buoyancy are the priorities as we prepare for Worlds

Integrated System Design:

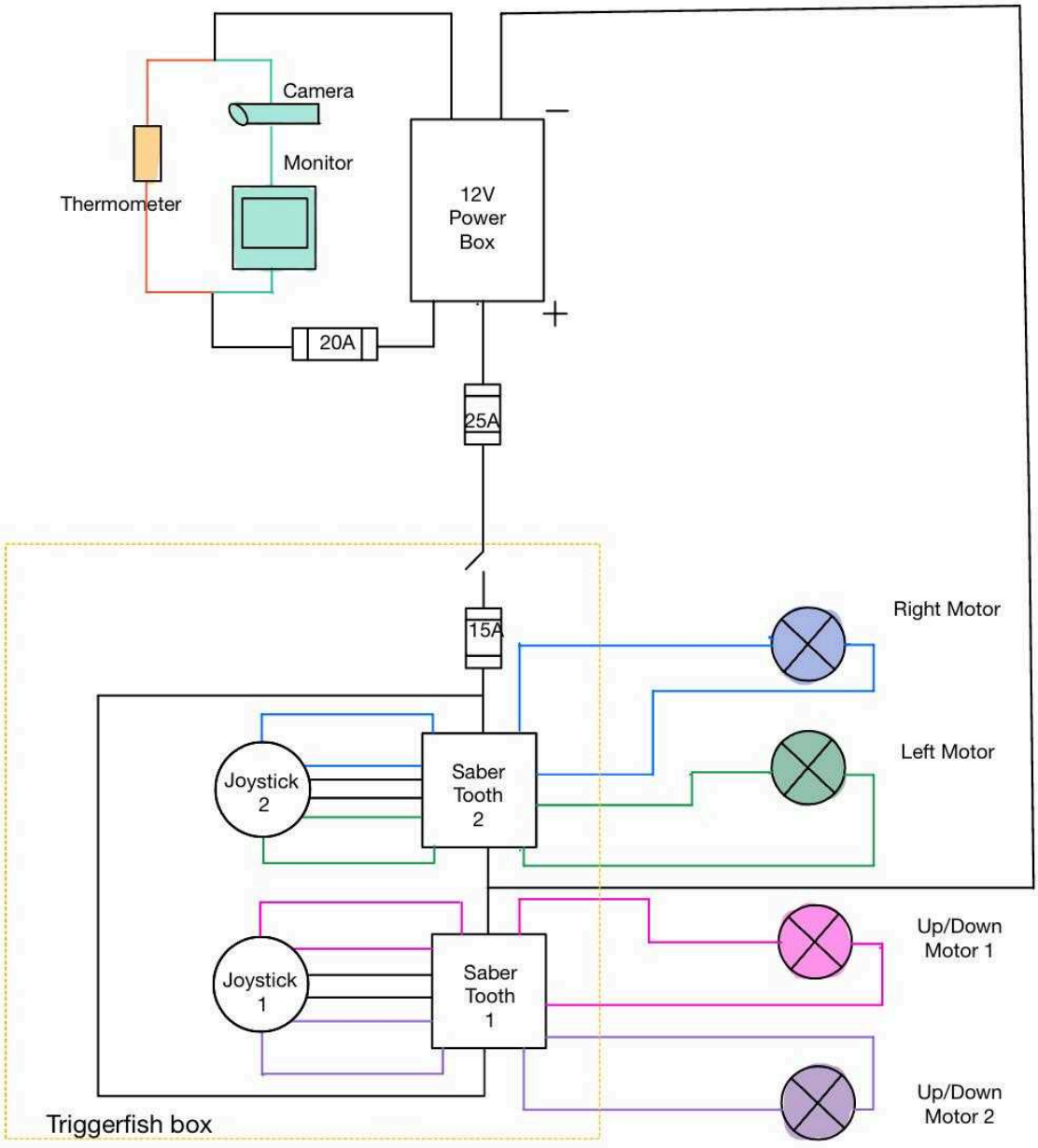


Figure 17:
SID including fuse within the triggerfish control box and fuses on the power cable.

Accounting:

2025 Washington Lating Sea Lions Ranger Team Suplies Budget			
Item	**Unit**	**Unit Cost ($)**	**Total ($)**
~~T200 Thruster~~	~~4~~	~~$258~~	~~$1,032~~
~~ESC~~	~~4~~	~~$38~~	~~$152~~
~~mounting Brackets~~	~~4~~	~~$32~~	~~$128~~
Electrial tape		$6	$6
zip ties		$3	$3
Poster	1	$110	$110
Total			$1,431
*all other materials have been repurposed at no cost to the team.			
Travel Costs			
Hotels			$1,200
Food			$300
Gas			$100
Total			$1,600
*Travel costs are coverd by fundraising, corprate donation, and family donation.			
Fundraising			
Bake sale fundraiser	$228.00		
Parent website donation	$200		
Corprate Donation	$1,000		
Parent cost	$275		
Corporate Donation	$2,000		
Total	$3,703.00		
*Fundraising goes to the cost of the trip as well as the cost of sublies for all Sea Lion Teams			

Figure 18:
Budget and Fundraising spreadsheet

2025 Washington Lating Sea Lions Ranger Team Estimated Overall ROV Cost				
Item	**Units**	**Unit Cost ($)**	**Donation**	**Estimated Cost ($)**
Tubing (50ft)	2	0	Yes (…	44
Hose Clamp	2	0	Yes (…	4
Irrigration srinige (10pk)	1	0	Yes (…	13
73mmx100mm Curit Board (10pk)	1	0	Yes (…	8
PVC pipe		0	Yes (…	20
Chicken mesh		0	Yes (…	$60
Motors	1	0	Yes (…	180
Wires		0	Yes (…	20
Triggerfish Control Box kit	1	0	Yes (…	850
Back-up camera		0	Yes (…	16
Resin kit		0	Yes (…	17
Plexiglass Cylindar (for Camera)		0	Yes (…	15
Solder spool		0	Yes (…	10
Triggerfish Motors (4)	1	180	Yes (…	180
35ml Syringe	1 10pk	0	Yes (…	13
Electrial tape roll	3	0	Yes (…	6
Zipties (200pk)	1	0	Yes (…	3
T200 Thruster	4	258	No (…	1032
Mounting Brackers	4	32	No (…	128
ESC	4	38	No (…	152
total		438		2491
*Donation desiginiation included newlt donated components and repuropsed components from previous years. .				

Figure 19:
Estimated overall cost of ROV (including unused motors)

References:

1. (n.d.). Ocean Decade – The Science We Need For The Ocean We Want. Retrieved April 25, 2025, from https://oceandecade.org/

2. *Vision & Mission*. (n.d.). Ocean Decade. Retrieved April 25, 2025, from https://oceandecade.org/vision-mission/

3. *Soldering Crash Course: Basic Techniques, Tips and Advice!* (2020, July 19). YouTube. Retrieved May 8, 2025, from https://www.youtube.com/watch?v=6rmErwU5E-k

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