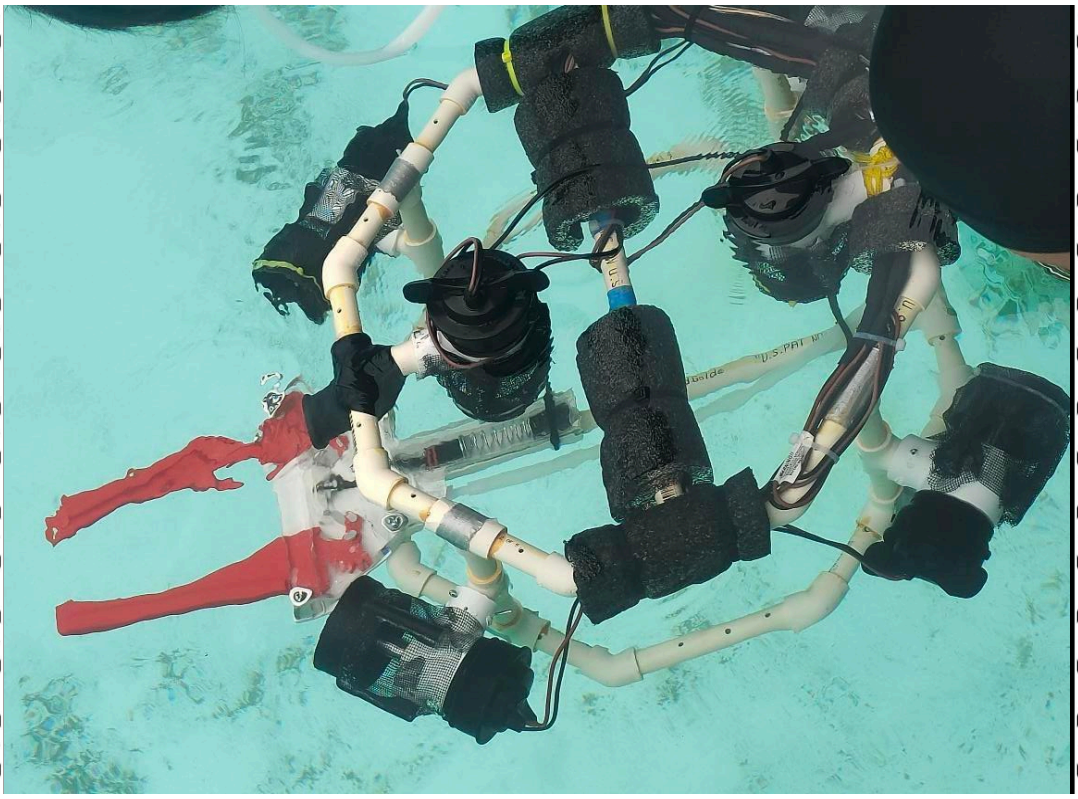
Pacific Horizons Submersibles
American Samoa 96799
Technical Documentation 2024

Tautai Malosi



MATE ROV RANGER DIVISION

Pacific Horizons School, AS

Chief Executive Officer:
Jiawei Zou
Chief Financial Officer:
Gavin Homsany
Mechanical Systems Co-design:
Thomas Jones
Jiawei Zou
Daniel Lee
Electrical Systems Design:
Amelie Chen
Human Interface Design:
Amelie Chen
Software Design:
Amelie Chen

Dive Operations:
Yuchen Bai
Chief Technical Translator:
Amelie Chen
Marketing Lead:
Kelly Liang
Marketing Specialist:
Gavin Homsany
Photographic Lead:
Jackie Zhang
Presentation Board Design:
Kelly Liang
Creative Consultant:
Evan Zou

Mentors:
- Michael Homsany
- Kendra Pinsker

Sponsors:
- Tool Shop
- Manu'a Store
- NOAA
- TMO Hardware
- All-Star Signs
- Industrial Gasses
- Graham Dunstan
- Claire Dunstan
- Teresa Dunstan

Note from the CEO:

As the new CEO, taking over from a long line of excellent leaders who continuously promoted innovation and advancement in the field of remote maritime vehicles, it would be a lie to say that there has been no pressure to excel. However, I can assure you that our great team has gone above and beyond with this new iteration of our well-tested product, and we can guarantee it will exceed all expectations.

While our predecessors have focused on innovative buoyancy, structural design, and an easy-to-use interface, we plan to improve in previously neglected areas. In the new ROV MK4, the Tautai Malosi, we have created an entirely new three-dimensional motor system, allowing for a full range of motion on all axes. In addition, we have pioneered our latest invention; “The Claw” (™ Pending.)

Using The Claw, we will create an entirely new medium upon which ROV platforms can be constructed, with an emphasis on manipulation capabilities, ease of construction, and simplicity of design. The Claw will change the way American Samoa views ROVs and will provide our platform with flexibility that our competitors simply cannot match.

Project Horizons Submersibles wishes you all the best of luck with life and the best experience with your purchase.

Simple, Effective, Affordable - Project Horizons Submersibles

Chief Executive Officer
jiaweizou@pacific-horizons-school.com

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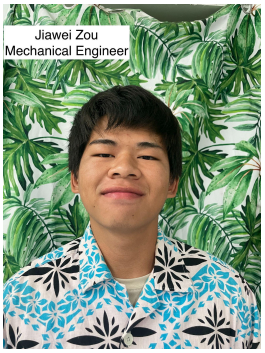
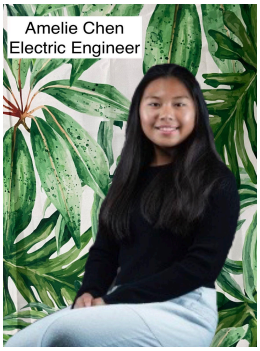
1.1 Abstract

Talofa, and welcome to Pacific Horizons Submersibles. We aim to serve the untapped Polynesian market with high-quality goods and ongoing innovation in remotely operated vehicles. Our company's core values include collaboration, ongoing innovation, environmental sensitivity, and a strong commitment to quality that permeates everything we produce. In the 2024 MK4 “Tautai Malosi" ROV, we created an enduring product with a promise of venerability. The propeller guard helps to protect the propeller at the same time it prevents sea creatures from getting stuck inside of the propeller. The thruster motor is upgraded to the Johnson 500 GPH Cartridge Bilge Pump Specs. The claw is once again upgraded to be more environmentally friendly using Polylactic Acid (PLA). Improvements on the claw such as using its modular design, we were able to attach a container piece to the claw, which opens along with it, to allow for the safe capture and release of fish for taxonomic purposes. This can also be used for hooking up power cables, attaching solar panels to offshore power generators, and even documentation of underwater wrecks using the built-in camera system.

1.2 Company Information





Jiawei Zou-

CEO, Electrical Systems Co-design, Mechanical Systems Co-design

Credentials: 11th Grade. Previous experience with mechanical design and electrical systems. Current President of the Pacific Horizons Technological Institution. Fluent in Java, C++, PBASIC

Thomas Jones-

Co-pilot, Mechanical Systems Co-design, mechanical engineer, electrical engineer, dive operator

Credentials: 11th Grade. Previous experience with electronics and repeated successful entries into local scientific competitions. Fluent in Python, Java, and C++, PBASIC

Amelie Chen-

Electrical Systems Co-design, Human Interface Design, Software Designer, Creative Consultant

Credentials: 11th Grade. Previous experience with electronics and repeated successful entries into local scientific competitions. Fluent in Python, Java, C++, PBASIC

Yuchen Bai-

Pilot, Electrical Systems Co-design, Mechanical Systems, Co-design.

Credentials: 9th grade, previous experience with mechanical design, JSS Solar Car Regional winner.

Kelly Liang-

Presentation Board Design, marketing leader, manual laborer

Credentials: 11th Grade. Previous experience with electronics and repeated successful entries into local scientific competitions.

Evan Zou-

Photographer, Manual laborer, mechanical engineer

Credentials: 9th Grade. Experienced with Python programming and electronics, JSS Solar Car Regional winner.

Gavin Homsany-

Marketing Specialist, documentation archivist, camera operator

Credentials: 12th Grade. Previous experience with marketing, published writer and editor.

Jackie Zhang-

Lead Photographer, manual laborer

Credentials: 12th Grade. Published photography. Service in the US National Guard.

Daniel Lee-

Chief Technical Translator, software designer, electrical engineer

Credentials: 11th Grade. Previous experience with electronics and repeated successful entries into local scientific and math competitions.

1.3 Design Rationale

Our team has extensive deliberations and considerations when creating a new product each year. We are frequently asked if the ROV's design matters or if the technology that runs it matters more. Everything regarding the ROV's construction and design will be detailed in this section.

Tautai Malosi uses ½ inch Copper Tube Size Chlorinated Polyvinyl Chloride (CTS CPVC) for the underwater ROV frame. The underwater ROV frame of Tautai Malosi is connected by 90° and 135° pipe tees and elbows, forming the shape of an octagonal prism with a shortened, hydrodynamic bow. The CTS-CPVC pipe that runs throughout the ROV's structure has small holes cut into it to let air escape while submerged in water. Venturing air out of the ROV's pipes reduces buoyancy and interferes less with its underwater performance. CPVC cement was used to bind the frame together once it was completed.

Every year, our product evolves into a more effective iteration of our tried and true design practices. Our previous product's controller was already superb, but we upgraded it to provide more access options. The controller box had to be enlarged in order to accommodate the screen that allows us to see the surroundings when the ROV is submerged. This year, the ROV has more features on the remote and can rotate 360 degrees!

The claw became better once again! In order to support ecological causes, we continue our use of PLA(Polylactic Acid) plastic to construct the claw foundation. The top of the claw was made of plexiglass to increase efficiency and reduce error potential. A proof of concept was milled from 1/2 acrylic to verify the mechanism. The ideal material is plexiglass because the claw's components aren't too complicated, but we still needed to make sure that the pressure being delivered was sufficient. Sustainable resources are also used to make the plexiglass.

2.1 ROV Modification

"The Claw and The Controller," the newest invention from Pacific Horizons Technological Institutions, is without a doubt the biggest improvement to the Ranger. We utilized C++ for the Controller to increase the system's flexibility and accessibility. Three further features were added to the controller board to enable 360-degree movement of the ROV. It can move down or up depending on the direction it is going. 360-degree rotation is the third function. Even under pressure from below, the claw is designed to be stronger to grasp objects quickly and with a firmer grip.

2.2 Financials

Source	Item	Quantity	Unit Measure	Price (full retail)	Extended Price	Additional Notes
Investors	CPVC ELBOW 1/2 x 90	4	each	$0.42	$1.68	
Investors	CPVC ELBOW 1/2x45	16	each	$0.53	$8.48	
Investors	CPVC TEE 1/2	16	each	$0.56	$8.96	
Investors	PIPE CPVC 1/2 x 10	1	each	$7.11	$7.11	
Investors	TUBE POLY .170x1/4	35	each	$0.26	$9.10	
Investors	EPOXY ADHESIVE 2PK	1	each	$7.62	$7.62	
Investors	ADHESIVE UNDERWATER EPOXY	1	each	$8.22	$8.22	

Source	Item	Quantity	Unit Measure	Price (full retail)	Extended Price	Additional Notes
Investors	TUBE HEAT SHRINK 1/4	3	each	$2.70	$8.10	
Investors	TUBE HEAT SHRINK 3/4	1	each	$2.42	$2.42	
Investors	CPVC BUSHING REDUCER 3/4x1/2	1	each	$0.56	$0.56	
Investors	CPVC COUPLING 3/4	1	each	$0.62	$0.62	
Investors	BOLT 10 x 2.5	2	each	$0.58	$1.16	
Investors	NYLOCK SS 1/4	10	each	$0.16	$1.60	
Investors	WASHER SS FLAT 1/4	2	each	$0.07	$0.14	
Investors	PLA (for gripper)	0.5	kg	$0.06	$0.03	
Investors	Arduino Mega	1	each	$24.84	$24.84	
Investors	7A motor driver	2	each	$22.00	$44.00	
Investors	Perf board	1	each	$22.00	$22.00	
Investors	Joystick	1	each	$19.95	$19.95	
Investors	Sliding pots	3	each	$1.91	$5.73	
Investors	Case	1	each		$0.00	Recycled
Investors	Tether Wire	4876.8	cm	$0.29	$0.01	
NOAA	Motor Kit (4 pk)	2	each	$180.00	$360.00	4 Reused, 2 new, 2 unused
NOAA	Video Camera Kit	1	each	$155.00	$155.00	Reused
	Total Materials Cost				$697.33	
Investors	Labor Cost	362.25	man-hours	$5.83	$2,111.92	
	Total Cost				$2,809.25	

2.3 Special Safety Features

2.3.1 Waterproofness

To ensure the waterproofness of our wiring and to prevent short, heat shrinks were used around all connected wires. After stripping and joining the wires of our motors to the speaker wires of our control box, solder, liquid electrical tape, and heat shrink tubing were used to seal all exposures of wiring.

2.3.2 Propeller Shield

The engine that keeps the ROV moving is called a propeller. If it strikes an object, it poses a threat to both the propellers and marine life. If one of the propellers fails, the ROV may lose equilibrium. If it strikes the propeller, it can even harm marine life. We 3D printed a shield that would prevent items from striking the propeller using PLA. It safeguards the propeller and averts unintentional mishaps. It also increases thrust by concentrating the force and eliminating turbulence along the propeller tips.

3.1 Theme: Global Ocean Observing System

In the age of climate change, keeping our marine environment safe is crucial. The ROV will be a product used in primarily shallow waters, be it for use on the reef side, lake beds, or shoals. The Pacific Horizons Submersibles will be awarded, and the materials used in the *Tautai Malosi should* be environmentally friendly. The claw, the propeller guard, etc. are made of polylactic acid (PLA). PLA is made from renewable resources such as corn starch or sugar cane; it's a natural polymer designed to substitute widely used petroleum-based plastics like PET (polyethylene terephthalate). It won't pollute the ocean, or even if the sea creatures curiously consume it, it won't kill them, except that it could also be food for them. Additionally, we restricted the amount of plastic used in the 2024 ROV since we want the materials to be more environmentally friendly and less literate. In addition to being constructed of eco-friendly materials, the *Tautai Malosi* also contributes to environmental well-being by picking up litter produced by individuals as well as planting more coral, which could improve the marine ecosystem.

3.2 Progress Images

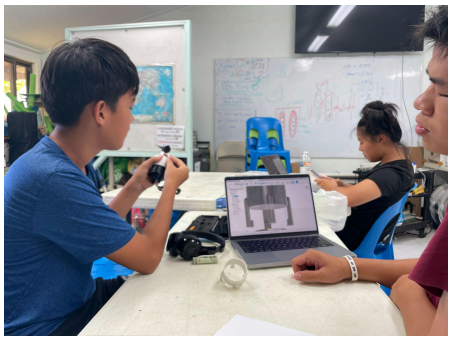


Figure 6: Team discussion

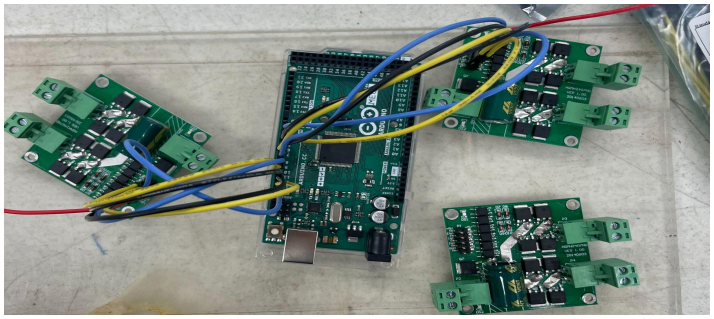


Figure 7: Circuit board for the remote controllers

Figure 8: Members working with Mr. Michael (mentor).

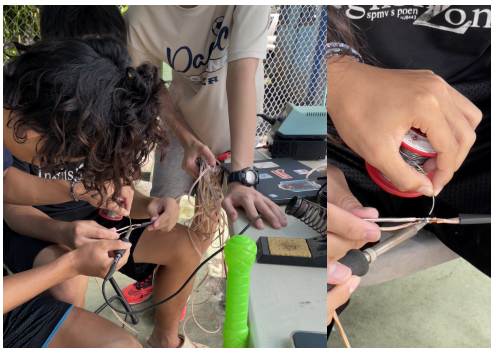


Figure 9: Teamwork.

Figure 10: Mentor and student discussion.

Figure 11: Entire team working.

3.3 Work Timesheet

*Date	Amelie	Kelly	Yuchen	Ty	Jiawei	Daniel
12/20/23	120 min	90 min	120 min	60 min	120 min	
12/22/23	75 min	120 min	120 min		90 min	
12/27/23	120 min	120 min	120 min	60 min	75 min	
12/29/23			90 min	120 min	90 min	
1/3/24	120 min				120 min	
1/13/24	135 min	120 min	120 min		120 min	120 min
1/20/24		150 min	120 min			
1/27/24		180 min	120 min		180 min	60 min
2/3/24	270 min				240 min	210 min
2/10/24	120 min		120 min		90 min	
2/17/24					60 min	
3/2/24		150 min	150 min		120 min	
3/9/24	90 min		120 min		90 min	
3/17/24	150 min	120 min	150 min	120 min	150 min	90 min
3/18/24	120 min	150 min	150 min		120 min	

3/20/24	150 min		150 min		150 min	
3/24/24	120 min		120 min	120 min	120 min	
3/29/24	150 min	120 min	150 min	150 min	150 min	
3/31/24	90 min	120 min	150 min	90 min	150 min	120 min
4/7/24			150 min		150 min	
4/14/24	120 min	120 min		30 min	120 min	
4/16/24	180 min	180 min	180 min	180 min	180 min	
4/21/24	180 min	180 min	180 min	180 min	180 min	
4/28/24	240 min	180 min	240 min	90 min	240 min	240 min
5/5/24	240 min	180 min	240 min	240 min	240 min	240 min
5/11/24	excused	300 min	300 min	300 min	300 min	
5/12/24	excused	240 min	240 min	240 min	240 min	240 min
5/13/24	excused	255 min	255 min	255 min	255 min	150 min
5/18/24	excused	390 min	390 min	390 min	390 min	360 min
5/19/24	excused	360 min	420 min	420 min	420 min	420 min
Total	3000 min	3825 min	4665 min	3045 min	4950 min	2250 min

3.4 Company Evaluation/ Marketing Assessment

Teamwork/Collaboration

In Project Horizons Submersibles, teamwork is highly valued. This project was unable to be completed by simply one individual, but it can be completed when we all work together. We take advantage of these chances to put together "the perfect" team, which is made up of a variety of talented individuals with specialized knowledge. We acknowledge that each of us has various productive hours, but to accommodate the team fairly, we provide varying timetables so that every one of us can complete the same amount of work. In the end, this tactic enabled us to produce an effective result.

Entrepreneurship

In promoting our product, we made sure to take calculated risks that we believed would benefit its overall performance, even if they were unconventional. One of these risks was using

Arduino, an advanced computing system, to increase ease of use for our customers. This decision allowed us to create a user-friendly interface that was easy to navigate, ultimately enhancing the customer experience. Another risk we took was utilizing CTS-CPVC to reduce costs without sacrificing durability. Finally, instead of using a binary system for controlling, we utilized a 6-channel PWM/H-Bridge, which allowed for precise control and a greater range of applications. By implementing this unique approach, we were able to differentiate our product from competitors and position ourselves as innovators in the industry.

Intellectual Development

At our company, we prioritize intellectual development to foster a culture of growth and innovation. We believe in continual trial and error, never giving up despite challenges, and developing a steadfast determination. Our corporate mentor has guided us through intense hours of lecturing, providing us with valuable insights and knowledge to expand our cognitive processing capabilities. Through critical thinking and effective communication, we were able to cultivate an environment of creativity, leading to the development of a highly improved skill set. By continuously challenging ourselves and seeking out opportunities for growth and development, we can continue to push the boundaries and innovate in our industry. Our commitment to intellectual development allows us to remain at the forefront of our field, providing exceptional value to our clients and stakeholders.

In the end, we took risks that ultimately benefited our product. By using advanced technologies, prioritizing cost-effectiveness and precision control in our motors allowed us to promote our product effectively. This allowed us to offer a high-quality product at a more affordable price point. Thus, consumers are able to use our product in industrial, ecological, and other high-precision underwater activities. By prioritizing cost-effectiveness without sacrificing quality, you can see for yourself why our product is going to become a favorite among customers looking for a reliable ROV at a reasonable price. With our latest, highly advanced remote underwater robotics technology, you can dive deeper, stay longer, and explore further than ever before.

Place your order now, and discover the possibilities!

3.5 Acknowledgements

We want to express our gratitude to everyone who has supported us during this project. Above all, we would like to thank The Tool Shop for supplying all the materials we needed for this prototype; either donated or at a greatly reduced price. We are grateful to Mr. Michael Homsany, our incredibly knowledgeable mentor, who did not give up on us, and Ms. Kendra Pinsker for her unwavering support and direction over the whole endeavor. We sincerely appreciate our sponsors, Industrial Gases, Manua's Store, NOAA, TMO Hardware, Tool Shop, and All-Star Signs, for supplying the materials used to construct the *Tautai Malosi*. Finally, we would like to

express our gratitude to our family, friends, and supporters—without your priceless help and never-ending support, we could not have progressed this far.

3.6 Resources

Author Not Provided. “2024 Competition Manual - Ranger Class.” 2024 MATE Competition Manual Page Covers, Marine Technology Society, 2024, 20693798.fs1.hubspotusercontent-na1.net/hubfs/20693798/2024%20RANGER%20Manual%20FINAL_1_16_2024_with_Cover.pdf.

Ashford, Ella. “Remotely Operated Vehicles (ROVs) - A Story about Competition, Field Adventures, and Unexpected Discoveries.” NOAA Hollings Scholars Presentation. PHS MATE ROV Presentation, 10 Apr. 2024, Pago Pago, Pacific Horizons School.