



AQUABOT TECHNICIANS

Foy H. Moody High School
Corpus Christi, TX, United States
Company ID: 0211A
Technical Documentation

Members

Zane Hosey
CEO

Jonathan Loreda
CTO

Julia Perales
COO

Sebastian Miranda
Pilot

Carmandy Ortiz
Project Manager

Robert Garcia
Safety Lead

Andrew Sanchez
Safety Assistant

Jacob Gutierrez
Mechanical Engineer

Yurem Balboa
Mechanical Engineer

Mason Martinez
Intern

Mentors

Madeliene Martinez
Head Coach

Gina Perez
Assistant Coach

TECHNICAL DOCUMENTATION

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Abstract

Aquabot Technicians is an underwater robotics company based in Corpus Christi, Texas. The company comprises of 10 proficient engineers who are passionate about creating technology that addresses challenging global issues. This technical documentation details the design process of Hammerhead itself from the design stage, prototyping, design criteria and rationale, creation, testing, and finally the final product to be used for the Mate ROV 2026 competition. It will also include the company evaluations, company structure, and safety that helped the team become more efficient and communicate better this year.

Hammerhead, Aquabot Technicians' all-new ROV, was designed to support ocean health and sustainability, monitor cold-water habitats, map coral gardens, and survive the icy environments. Hammerhead is equipped with a claw made to help coral species and safely return them to the surface. It is also made to recover and replace old eDNA biodiversity sensors, while also powering an offshore oil platform and getting it back online. Hammerhead is also equipped with a USB camera made to map the seabed of the coral gardens, along with a control system designed to ensure smooth piloting.

During the creation of Hammerhead, Aquabot Technicians factored in its weight, size, strength, speed, buoyancy, and reliability in the water during its prototyping and construction. In the end, Hammerhead utilized multiple components such as its electronics, claw, thrusters, 3d printing, and much more.

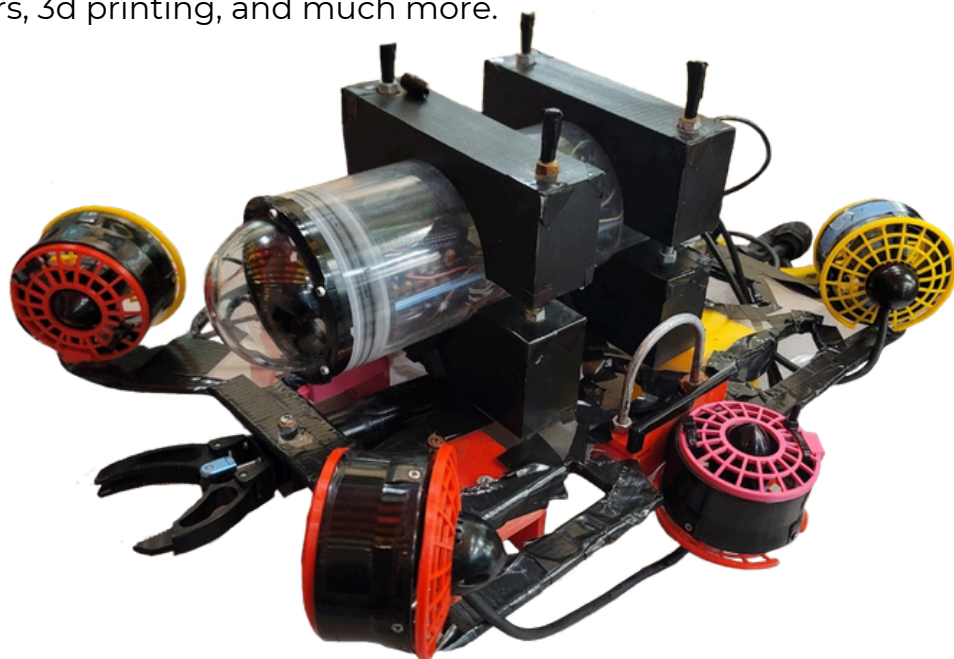
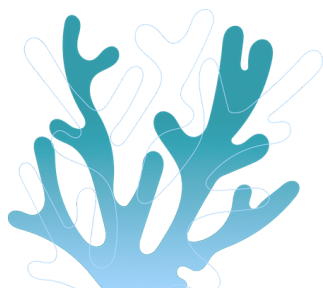


Figure 1: Hammerhead



Project Management

COMPANY OVERVIEW

The Aquabot Technicians is a company based in Corpus Christi, Texas, run by high school students with the goal of transforming the Global Ocean Observing System to protect and restore ecosystems and biodiversity. The company is divided into four departments: the safety, electrical, mechanical, and management departments.

Each department is led by a captain, such as Robert Garcia, our Head Safety Lead; Jonathan Loreda, the Electrical Lead; Julia Perales, the Management Lead; and Jacob Gutierrez, the Mechanical Lead.

The Purpose of the Safety Team is to ensure that safety is first, proactively prevent workplace injuries and fatalities, and ensure regulatory compliance and adherence to the rules. We ensure this by providing goggles, face shields, and gloves, depending on what was needed for the situation and task we were completing.

The Financial and Manager Lead held mandatory team meetings where everyone came together to inform the team of what they were doing every week and the progress or issues they encountered. One of the most important lessons was having more communication and how to operate with fewer employees and still get work done, which we believe became more efficient after we experimented compared to having the 27-member team.

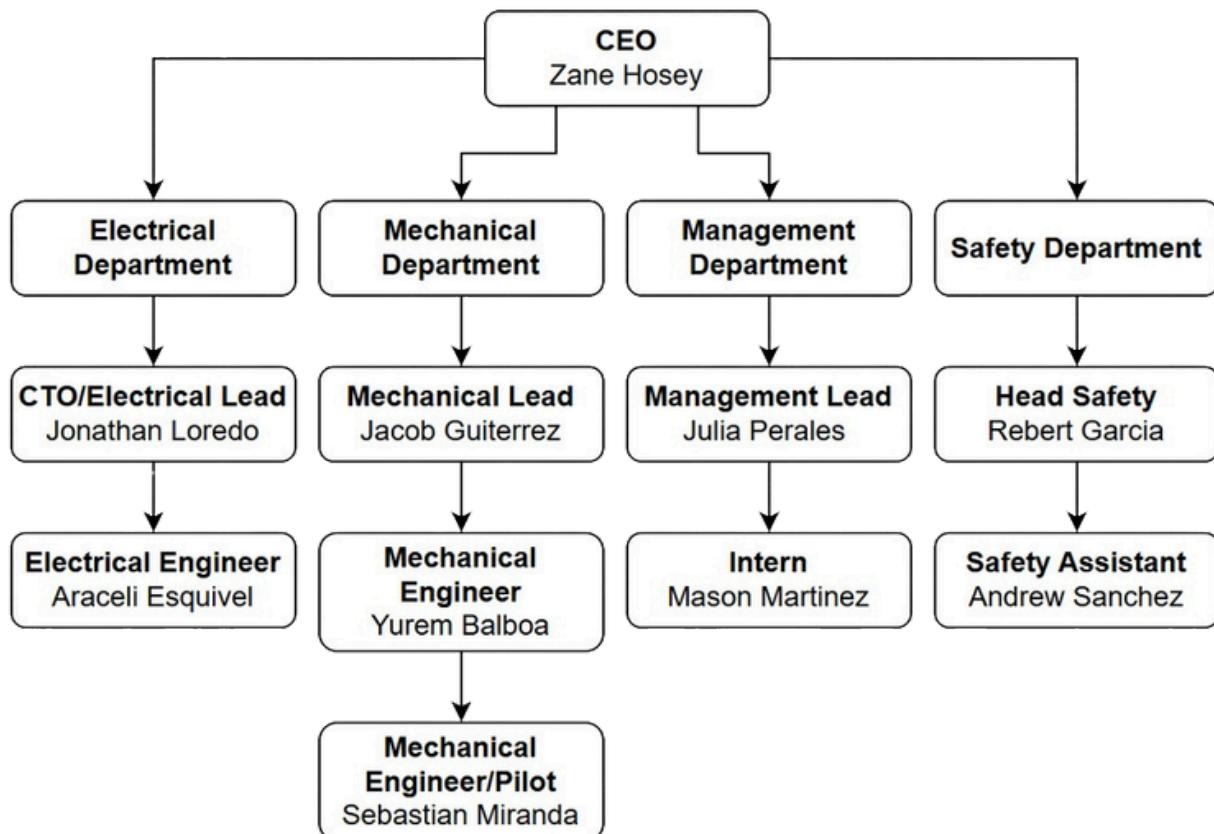


Figure 2: Company Structure

Project Management Continued...

MONTHLY TEAM MEETINGS

The team was managed and communicated through many different ways, but the most efficient was through Google Drive and a group chat. Google drive was the most effective app that we used this year, as we were able to organize everything we needed to do this year into one nice package. From our Google Docs, we were able to plan out rough drafts for our SIDs, company spec sheet, tech doc, marketing display, and more, which we all placed into one single folder. We developed a page with all that we needed to complete the 2026 mission tasks and subpages for the designing and brainstorming of each tool. Google Sheets also allowed us to easily store our financial records and the scheduling we had for our outreach. We also stored videos, photos, and any other documentation we needed for this year's competition.

Process	August	September	October	November
Mechanical				
Frame	Research	Drawing and Planning	Wooden Prototype	Cutting out the Frame
Buoyancy			Research	Research
Tooling			Research	Research
Electrical				
Capsule Electronic	Troubleshooting	Troubleshooting	Troubleshooting	Troubleshooting
Control System	Research	Planning	Prototyping	Manufacturing
Float	Research	Research	Research	Drawing and Planning
Software				
Control Software	Research	Research	Planning	
Business				
Outreach	Communication and Planning		Events	Events

Figure 3:
Schedule
Meetings

Our main way of communication was through our group chat with all of the members so that we could communicate more effectively and get information out better. We created a separate group chat for separate departments that we held, and by doing this we were able to split our work into different sections. We were also able to communicate a game plan for the task missions much better and got everyone on the same page. After all was said and done, we were able to successfully manage and coordinate between the different departments at the start of the season and communicated what we wanted to do as a team. Creating a more specific schedule helped the team become more organized, although it has had unexpected challenges that the team dealt with.

December	January	February	March	April	May
Attaching Components to frame		Manufacturing	Testing	Testing	Complete
Planning	Planning	Manufacturing	Testing	Testing	Complete
Planning	Planning	Manufacturing	Testing	Testing	Complete
Troubleshooting	Troubleshooting	Testing	Complete		
Testing	Testing	Complete			
Prototyping	Manufacturing	Testing	Testing	Troubleshooting	Testing
		Testing	Testing	Complete	
Events	Events	Events			

Figure 3:
Schedule
Meetings

Design Rationale

When our team first began production of our ROV in the fall of 2025, the 2026 MATE ROV Ranger Competition Manual had not been released. However, we knew we needed a huge improvement in design based on the results in the previous 2025 competition. Looking back at last year's competition, we realized we had to be more precise and careful with our design process. We looked to our predecessors' designs for inspiration, as well as looking for inspiration from past teams. We started brainstorming every day and planned to adjust once we knew the constraints set by the manual. We set out to create a frame design that improved upon the design of TR5-Stingray2.0. We created several cardboard prototype designs. The ROV would be designed to operate efficiently in aquatic environments, capable of maneuvering in various directions with precision, stability, and speed. The mission objectives are the highest priority with each iteration of each component, and especially the design. Below shows our step by step planning and design process for our ROV.

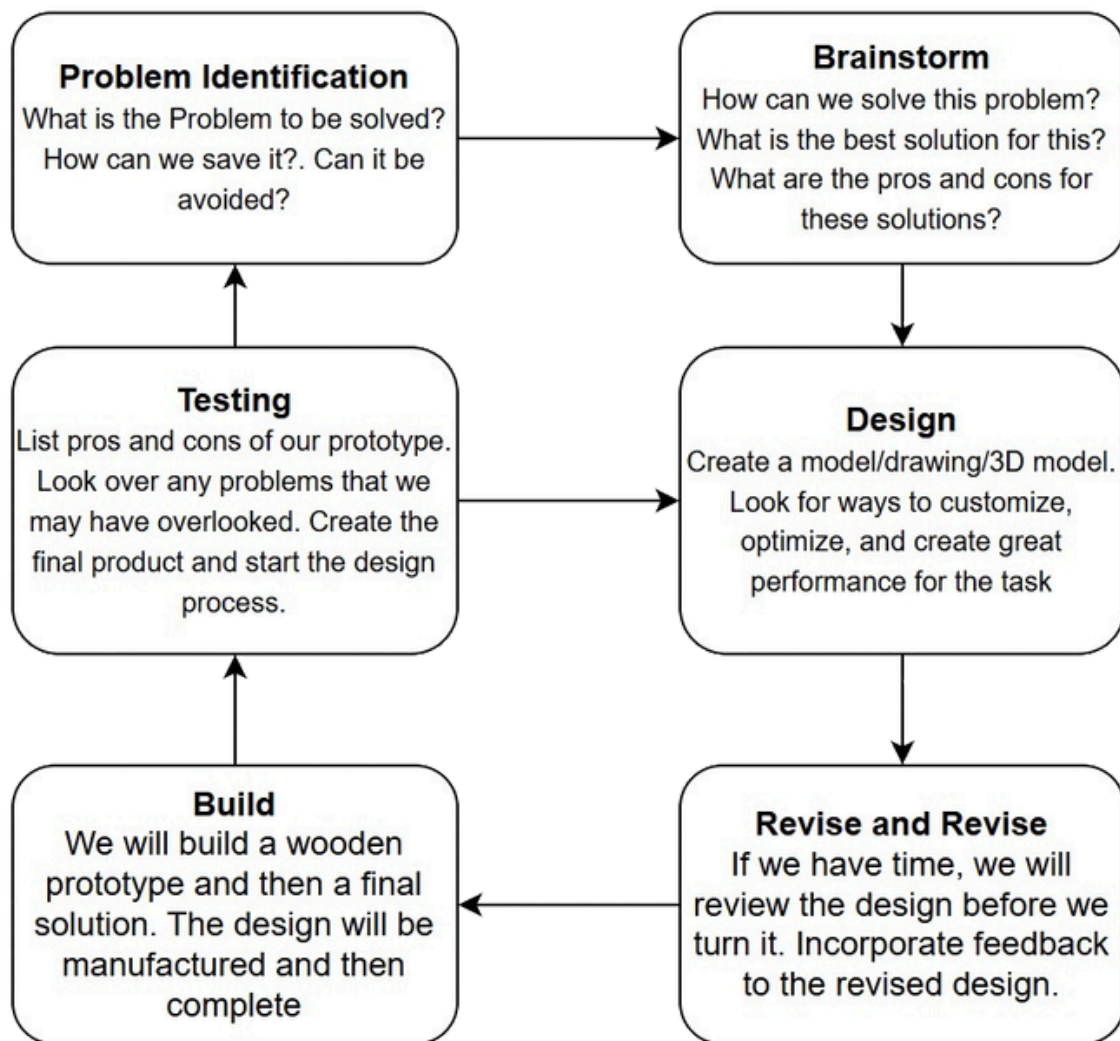


Figure 4: Design Process

Vehicle Structure

FRAME

This year, we decided to substantially change our frame design compared to the previous years. Last year, the TR5-Stingray2.0 had a much more blocky design with sides holding it up, and with a top and bottom. The top and bottom were made of 3d printed rectangles while the sides were made of Lexan Plastic. Although the ROV was effective with its stability, speed, and reliability, we had a slight issue. If anything happened inside the ROV or if we just had any other reason for opening up the capsule, we would have had to disassemble the entire frame. This became a nuisance when we tried to work on the ROV, so we made innovations by going with a completely flat frame where the capsule would be strapped down by 3d printed mounts which reduced frame size by 50%, measuring 61 x 40 x 30 cm. This size and weight reduction substantially improved not only the speed and maneuverability of Hammerhead, but also made it much easier to check the inside of our capsule.

This brand new frame was made of the 1 Lexan Plastic, the same used in previous frames, where all 6 thrusters would be screwed on to. This frame was cut out by our Shopbot after we designed and gained the measurements for it. We printed out 4 black 3d printed arches made to hold the capsule in place and above the plastic frame. The 3d printed mounts were bolted down by 1/4-20 in. x 8 in. Zinc-plated hex bolt and 8 nuts.



Figure 5: Lexan Plastic Frame

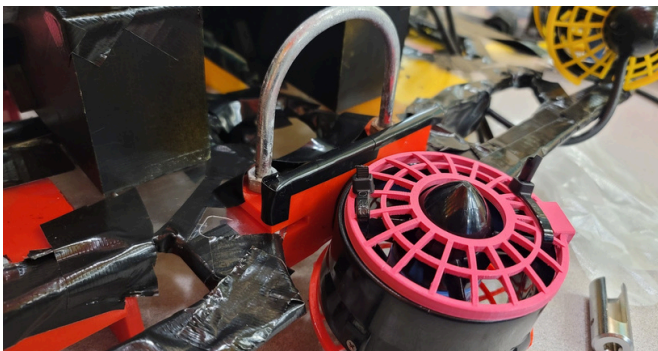


Figure 6: Holding Brackets

On the sides, we have handles to pick up our ROV, which are 1/4 in. x 1 in. x 1-13/16 in Zinc-Plated Steel U-Bolt with Nuts connected to a 3d printed part. This 3d printed part made out of PLA is called our holding bracket and allows us to pick up the ROV and let the heave and surge thruster to have a place to be on the sides. We also have zip ties that tie the tether down, which makes it easier for people to grab the ROV when trying to take it out of the water.

Mechanical Systems Continued...

Finally the last important part of the ROV frame is the stands that we have under the flat frame. These stands help the ROV stand up, which is needed because without it the ROV would be putting its entire weight and pressure on the thrusters, which would eventually break the thruster holding brackets. These stands are made of 3d printed PLA and are designed like a C with the sides holding up the ROV while also having a top piece that gets screwed onto the plastic frame. Other things added to the frame were the claw and the rebar in the middle of the ROV that help with the weight of the ROV.

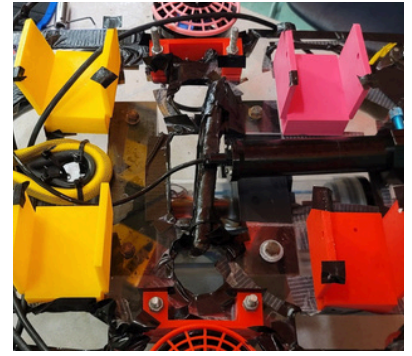


Figure 7: Stands

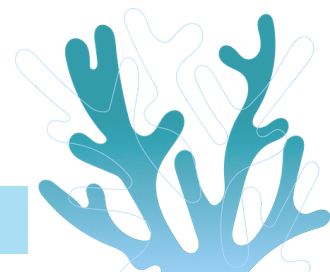
PROPULSION

The ROV is made up of 6 T100 thrusters, with some of them going clockwise and some going counterclockwise. Last year, we were using t200 thrusters which were the most advanced thrusters that we had purchased. However last year we had a very big problem with them, the t200 thruster was incapable of heaving and surging at the same time efficiently since the ROV would disconnect if we went too fast. We learned that the ROV disconnected due to a power surge after using it since it required too much power to go up. This is because the thrusters would draw too much amperage from the system, and we would see this on our watt meter where our amperage would jump from 25 amps to 32 causing it to shut down.

This year, we decided to downgrade to t100 thrusters so that we could be more efficient and reliable in the pool to allow for more pool time. Four vertical thrusters are arranged in a 45-degree vectored configuration, allowing omnidirectional horizontal motion with all thrusters mounted orthogonally. Two thrusters are located forward and at the back of our ROV and facilitate heave and pitch. Four corner thrusters are located port-side forward and at the starboard-side forward and aft, each at an angle of 45°. Speed and polarity of the thrusters are regulated by ESCs (Electronic Speed Controllers). When running at 12V, the RPM of the T200 are as follows: with an ESC PWM (pulse-width modulation) value of 1900 μ s, a T200 operates with a maximum forward speed of 2995 RPM; with an ESC PWM value of 1200 μ s, a T200 operates with a maximum reverse speed of 2975 RPM.



Figure 8: T100 Thruster



Mechanical Systems Continued...

BUOYANCY

Hammerhead receives most of its buoyancy from its Blue Robotics enclosure, which is naturally positively buoyant. So using Archimedes' principle, which states that any object submerged, fully or partially, in a fluid is given a buoyant force equal to the weight of the fluid it displaces. In other words, the heavier an object is to the surrounding water, the more it will sink, and if it's lighter it will float. We applied these principles to our buoyancy and calculated it by adding weights to the ROV to make sure it was just slightly positively buoyant, but not enough to where you can't go down with our thrusters. First, we looked at the tether because when the entire tether was put into the ROV became back heavy and would look up at a 45-degree angle.

To combat this, we decided to fix the center of mass by adding more buoyancy to the ROV from the back. We added 3 pool noodles, all 10 feet evenly away from each other, and it helped the tether stay above the water. While the ROV stayed flat it was difficult for it to go under the water since it required more thruster power, which we could not give. So he decided to test different weights and ballast on the ROV to make it go down. In the end, we found out that a 30 cm rebar was the most effective way to weight down the ROV just enough to be positively buoyant, but not too much for it to sink. This also helped with the center of mass as the rebar was in the middle of the ROV and kept it flat in the water. Overall, Hammerhead is slightly positively buoyant enough to smoothly traverse the water while also staying perfectly flat while performing a mission.



Figure 9: Pool Noodles on tether



SYSTEM INTEGRATION DIAGRAM

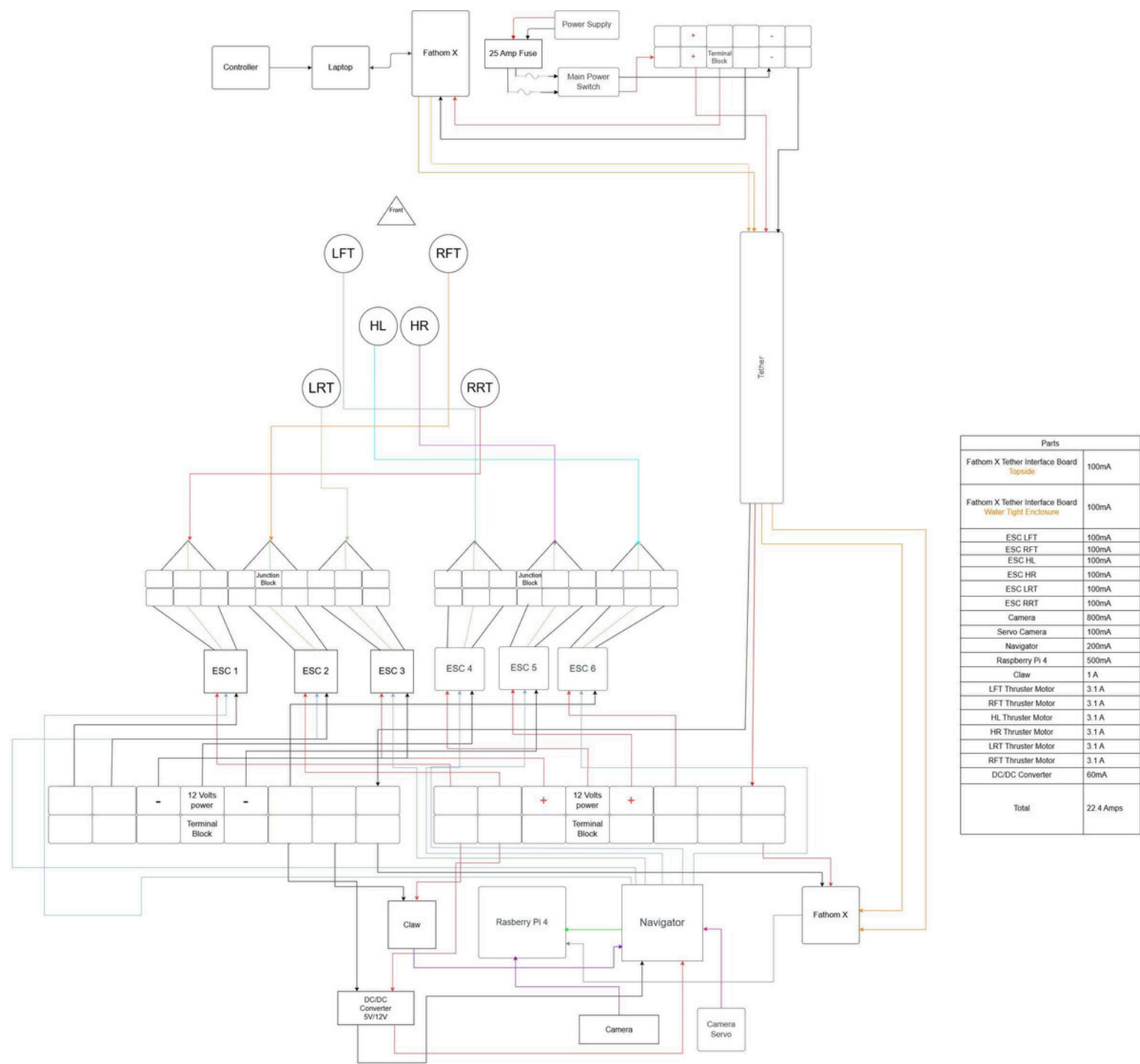


Figure 10: Electrical SID

Electrical Systems Continued...

NAVIGATOR

Hammerhead's electrical system is all based around Blue Robotics ROV electronics and has been serviceable, reliable, and effective in the last 5 years. Inside the main enclosure the electronics are divided into two distinct sections: the starboard side of the enclosure and the port side of the enclosure.

On the starboard side of our enclosure, we have many different electrical components that all serve a purpose and are efficient at the task at hand. Our Navigator is our flight controller's expansion board designed for the Raspberry Pi 4. It has inputs from onboard sensors, outputs to servos or speed controllers, and expansion ports that can be connected to external devices. In our case, the Navigator controls our thruster due to them being connected to our digital output pins. Our camera servo and our blue robotics claw also connect to our 16 digital output pins. Finally, our power source connects to the Dual Power Input and our Auxiliary Power Input.



Figure 11: Navigator

RAPBERRY PI 4

While the Navigator controls most of our components, it wouldn't be able to without our companion computer, which is our Raspberry Pi 4. When paired with the Navigator board, the Raspberry Pi 4 runs autopilot firmware so that our ROV can connect to Blue OS. Blue OS is a web-based interface from Blue Robotics for vehicle configuration, network setup, and real-time system monitoring. The Pi also manages our camera connections because a USB camera connects to it directly, showing high-definition video to the surface control station. The Raspberry Pi 4 is equipped with an SD card set with BlueOS imaging so that the Raspberry Pi can be connected to our program.

Another important component is our ESC or Electronic Speed Control, which are 6-8x Basic ESC 30A, bidirectional motor controllers. They are waterproof, water-cooled, and handle forward/reverse operation in our ROV. On the starboard side there are presently 3 ESC's, with the pin wire connecting to the Navigator. Three wires colored green, white, and blue connect to a motor wire terminal block. This terminal block has two entry ways on both sides, and the thruster wires connect directly to the motor wire terminal block, with it being color coded with the ESC. The other 3 ESCs are located on the Port side of the frame.



Figure 12: Rapberry Pi 4

Electrical Systems Continued...

POWER SUPPLY

Another component is our positive power terminal block which is a secure, screw-down electrical connector used to organize and connect power and motor wires within the ROV. On this side all of the positive wires of the capsule connect to the terminal block and are powered by it. The positive wire of the main power wire that comes from outside of the capsule connects to the power terminal block and powers the entire ROV.

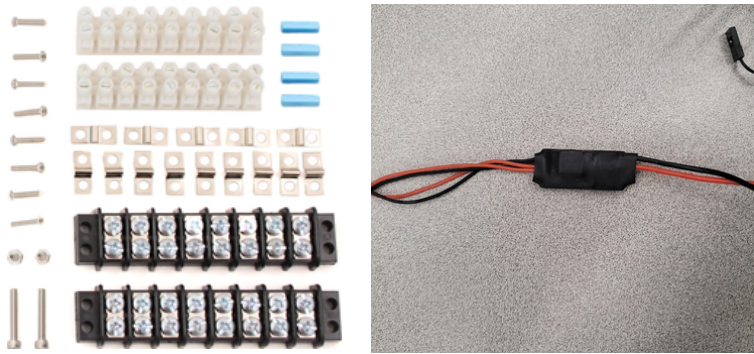


Figure 13: Power Supply/Terminal Block

FATHOM X

The final component on the starboard side of the enclosure is the 5V 6A Power Supply, or what we call our DC to DC Converter. The Power supply is a high-efficiency switching converter designed to step down high-voltage battery power (7V–26V) to a stable 5V, providing up to 6A to power onboard electronics. This power supply connects directly to the Power Input and Auxiliary power input of the Navigator, which powers it. The Positive wire terminal ring connects to the positive terminal, and the negative terminal ring connects to the negative terminal.

Next up is the Port side of our enclosure with the third most important component in our ROV, the Fathom-X Tether Interface Board. The Fathom X enables high-speed, long-distance Ethernet communication over a single twisted pair of wires and is used to transmit video and data over distance. It is powered by a positive and a negative wire. It connects to the positive and negative wires of the tether that stretches 12 meters long and connects the fathom X in our control box. The fathom X in the capsule connects to our Raspberry Pi 4, which is how we can get any connection to the surface and allows us to use the ROV.

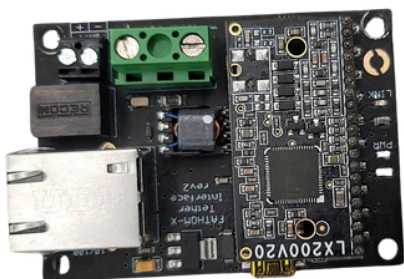


Figure 14: Fathom X

As previously stated on this side, we have 3 more Electronic Speed Controllers. We also have a motor terminal block for the thrusters to connect to, as well as the ESC's. Finally we have a negative terminal block where all of the negative wires in the entire capsule connect to. This negative terminal block is powered by a negative wire that goes outside the capsule and into the control box.

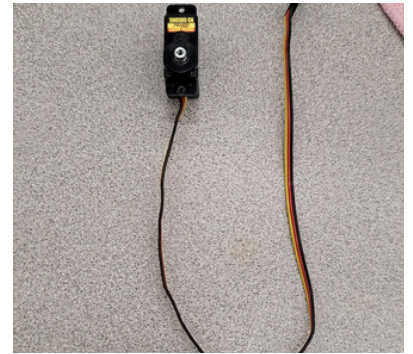
Electrical Systems Continued...

CAMERA

The last important components found within our capsule would be at the front of it which is our USB Low-Light HD USB Camera. This digital HD USB camera gives us visual feed when we are in the water, with excellent low-light performance, and a specially chosen lens to provide great video quality. This camera connects to our Raspberry Pi 4 mentioned earlier with a 1 x 8" (200mm) USB Cable. The camera itself is covered by a camera mount made specifically to hold the USB camera on our camera servo. The camera servo is a camera tilt system that provides up/down pitch tilting and attaches directly to pin 13 on the Navigator. This servo allows us to look forward, up, and down, which allows us to complete certain tasks in the water.



Figure 15: Camera and Camera Servo



CONTROL BOX

The final piece of electronics that should be mentioned would be our control box with our surface team. The control box is made of a clear plastic waterproof container where you can see all of the wiring and electronics. Inside, we have a positive terminal block that connects all positive wires and a negative terminal block that connects all negative wires. These terminal blocks also connect a positive and negative wire that have a 25 amp fuse to a power box, which is how the whole system is powered. Another important component is our kill switch that turns on the entire system while also allowing us to turn it off in case of any emergencies. We also have a watt meter that shows us our voltage, amperage, and watts to see if we have any power surges that require an emergency shutdown. Then we have our previously mentioned fathom x which is power and connects to the tether wire which eventually connects to the navigator at our capsule. The fathom x from here connects to a meter Ethernet cord that then connects to an adapter for it to be plugged into our computer.

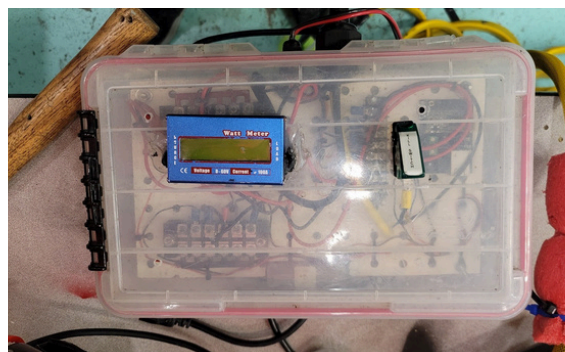


Figure 16: Control Box Outside View

Electrical Systems Continued...

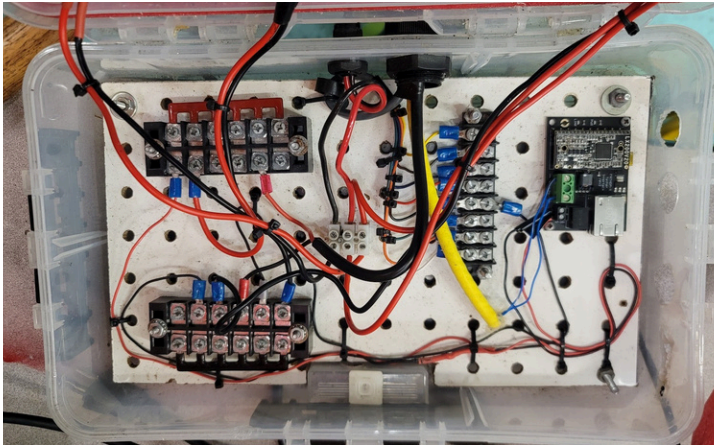
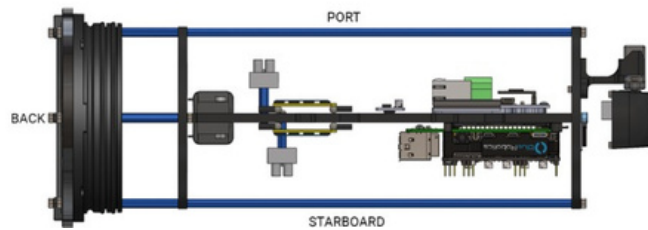


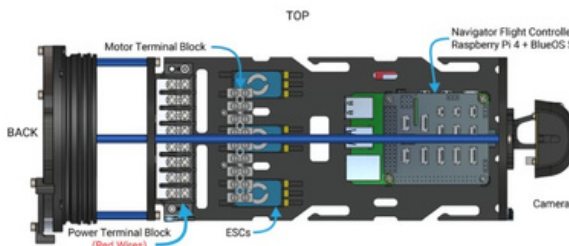
Figure 17: Control Box
Inside View

Top View 🔗

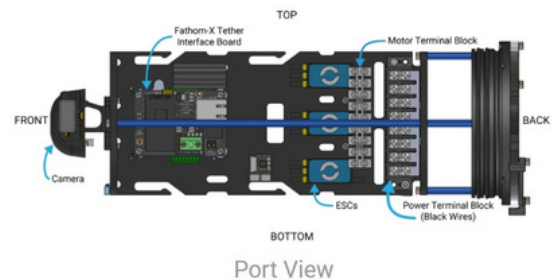


Starboard View

Port View



Front View



Port View

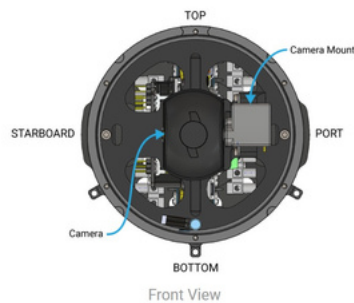


Figure 18: Images showing the
orientation of the main pieces of
hardware From Blue robotics

Electrical Systems Continued...

TETHER

Hammerhead's tether features a Fathom x tether, 12 AWG power wires, and a 3cm yellow braided sleeving that is 12 meters long. The fathom x tether's main purpose is to connect the fathom x in the capsule to the fathom x in the ROV. The power wire is the most important in the entire ROV since it powers the entire ROV so that it can work in the water.

The sleeving helps hold the tether and power wires together, while also protecting the wires from physical damage, and is resistant to water. The tether ensures that the subsea components receive the required voltage to operate at peak performance while preventing burnouts or thruster failures.

The tether is slightly positively buoyant, and we did this by adding cut pool noodles to the tether itself. After entering 12 meters of the tether into the pool, it goes straight down due to its weight dragging the ROV with it. To combat this we decided to add 3 pool noodles, all 10 feet evenly away from each other, which allowed the tether to go above the water. Due to this, there is a less likely chance of the tether getting stuck on the ROV while also not dragging it down with it.

Finally, the tether is held down to minimize the potential for it to get tangled under the ROV. We did this by using zip ties to strap it down to the plastic frame using a tether cable thimble from Blue Robotics. This tether cable thimble provides a secure attachment point for the tether cable and carries any tension directly to your ROV's frame. This thimble does a great job holding the tether in place and makes it easier for our tether manager during deployment. The main job of the tether manager during deployment is to give the right amount of slack so that the ROV has enough tether to roam while not creating hazards and making sure nothing starts looping.



Figure 19: Full tether

Electrical Systems Continued...

SOFTWARE

In previous years, the software we utilized was QGroundControl, and although it was effective for our time, the biggest issue we had with it was that it just wouldn't connect to the ROV very reliably or efficiently. From either faulty visual feed, backward controls, incorrect depth levels, or a leak, we had issues with it over the year, so we finally decided to switch.

Our software utilizes Blue Robotics Cockpit as the primary topside control interface, working together with the onboard autopilot system (ArduSub) and vehicle hardware. The system is separated into two systems: our topside control interface (Cockpit) and the onboard autopilot running on the Navigator flight controller, and the BlueOS extension framework running on the companion computer. All telemetry and command data are transmitted over Ethernet using both TCP and UDP protocols. It sends position and navigation data formatted according to the National Marine Electronics Association (NMEA) 0183 standard to ensure to make sure it is compatible with external sensors.

Cockpit is Blue Robotics' next-generation control interface, which runs in any web browser, allowing the pilot to control the ROV from any web-capable device without requiring software installation on the client device. The interface connects to the onboard BlueOS system via WebSocket, which provides real-time vehicle telemetry, video streaming, and command transmission.

The ROV is controlled by an onboard ArduSub autopilot running on a Navigator flight controller, which provides native support for ROV-specific control features such as the depth hold, heading hold, and auto-depth functionality.

The video stream from the onboard camera is handled through BlueOS, which causes Cockpit to display the feed via a WebRTC-based video widget. There are plenty of parameters that can be configurable through BlueOS's Autopilot Parameters menu, which then get stored on the autopilot firmware.

For the task during the competition, we can configure the gripper control through a combination of joystick mapping and on-screen widgets. This allows us to grab coral species, replace the eDNA, and power the connector. We can also use the video system integrated directly in Cockpit due to the onboard camera feed being streamed through BlueOS to Cockpit's WebRTC based video widget. This helps record, survey, and analyze the size of the coral garden, as well as see how many invasive crab species there are.

While we consider BlueOS as a good alternative to QGroundControl, we unfortunately have a similar problem that we faced previously. Although rare, sometimes when the ROV disconnects cockpit refuses to reconnect and has to be closed which wastes valuable time during the competition. However unlike QGroundControl, we haven't had any inconsistent latency and have always had a clear video stream for us to see everything.

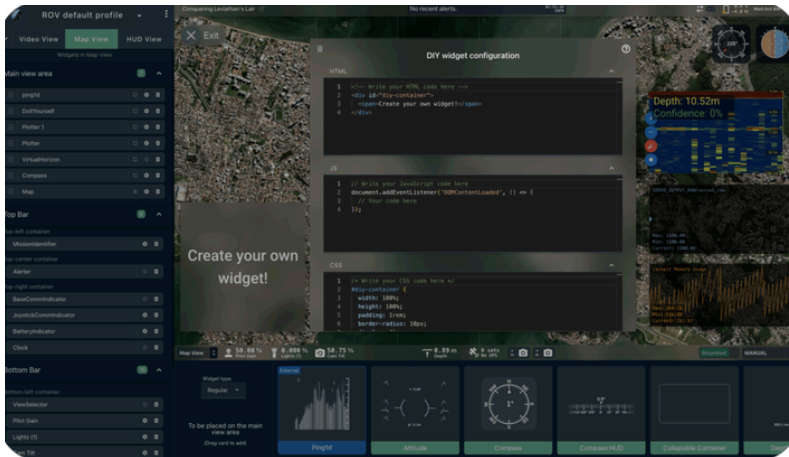


Figure 20: Blue Robotic Cockpit UI

GRIPPER

Finally, one of the most important components in our competition would be our gripper which allows us to gain the most points possible during the competition. For our gripper, we acquired a Blue Robotics claw due to its consistent gripping force, jaw opening, and reliability. We have been using this claw for the last couple of years, and it has always been effective in accomplishing tasks. The gripping force is approximately 2.5 kg, which is more than enough to accomplish any task that requires picking it up. The jaw opening of 45mm maximum width is perfect for grabbing tasks to accomplish in the water.

Although our claw is quite reliable in doing most tasks of the competition, it does have its limitations. The biggest problem is that we have no way to spin the claw using digital or analog applications. Every time we need to switch its orientation it needs to come back to the surface and be switched manually by our tether specialist. We hope that future Aquabot technicians may learn from our claw design and create a way to move it that doesn't require manually. Outside of that, our claw is effective and reliable in completing tasks quickly and efficiently. Tasks such as collecting the coral species, collecting basket stars, turning the acoustic release handle, recovering and installing the eDNA, powering the old platform, and more.



Figure 21: Blue Robotics Claw

Profiling Float

Our vertical profiling float, Redemption, uses a buoyancy engine constructed from a clear-cut acrylic tube with a 151.9 ± 1.5 mm inner diameter and height of 298mm (See Photo 1). Redemption is composed of internal components sealed between two end capsules (See Photo 2) from all from blue robotics with penetrating screws and O-ring seals (See Photo 3). Redemption's buoyancy engine consists of a 550 mL syringe, which is mounted to a 12 volt 50mm linear actuator (See Photo 4)and is controlled by an Timer Relay (See Photo 5).

The 10 syringe system intakes and ejects water to descend, ascend, and maintain a given depth. In the ascending position, the linear actuator will extend to expel water from the syringe chamber, making the float positively buoyant. The float will surface and relay pressure, time, and depth to the on-deck receiver. To descend, the linear actuator retracts to increase the volume of water in the syringe chamber. The float becomes negatively buoyant as the device's weight increases by 10 mm each.

To begin the vertical profile, the linear actuator will fully extend so the float remains positively buoyant. The float runs on a 2 70-1 70 second interval The Timer Relay will make its first communication and process to extend the linear actuator, the float will be extending for 2 seconds waiting 70 to then, the linear actuator will retract for the float to become negatively buoyant for 1 second then wait another 70 seconds and repeat the actions 3 times.

The float's water-proofing process includes designs being constructed with a water tight enclosure by alcohol grease screws and O rings. Rubber O-rings were used to seal Penetrating screws, and Wetlink penetrators are used for endcap penetrations. Per safety regulations, a 2-amp fuse is attached to the float's power supply and is within 5 cm of the battery pack. Eight 1.5V Alkaline AA-batteries are connected in series to supply a total 12-volt independent power source (See Photo 2). Safety components of the float include batteries being tightly secured to Linear Actuator and Timer Relay, a pressure relief opening at the top of the float which is sealed by a penetrator screw plug with a 2.5 cm diameter complying with MATE regulations (See Photo 3), and the covering of sharp edges.



Figure 22: Profiling Float

Profiling Float SID

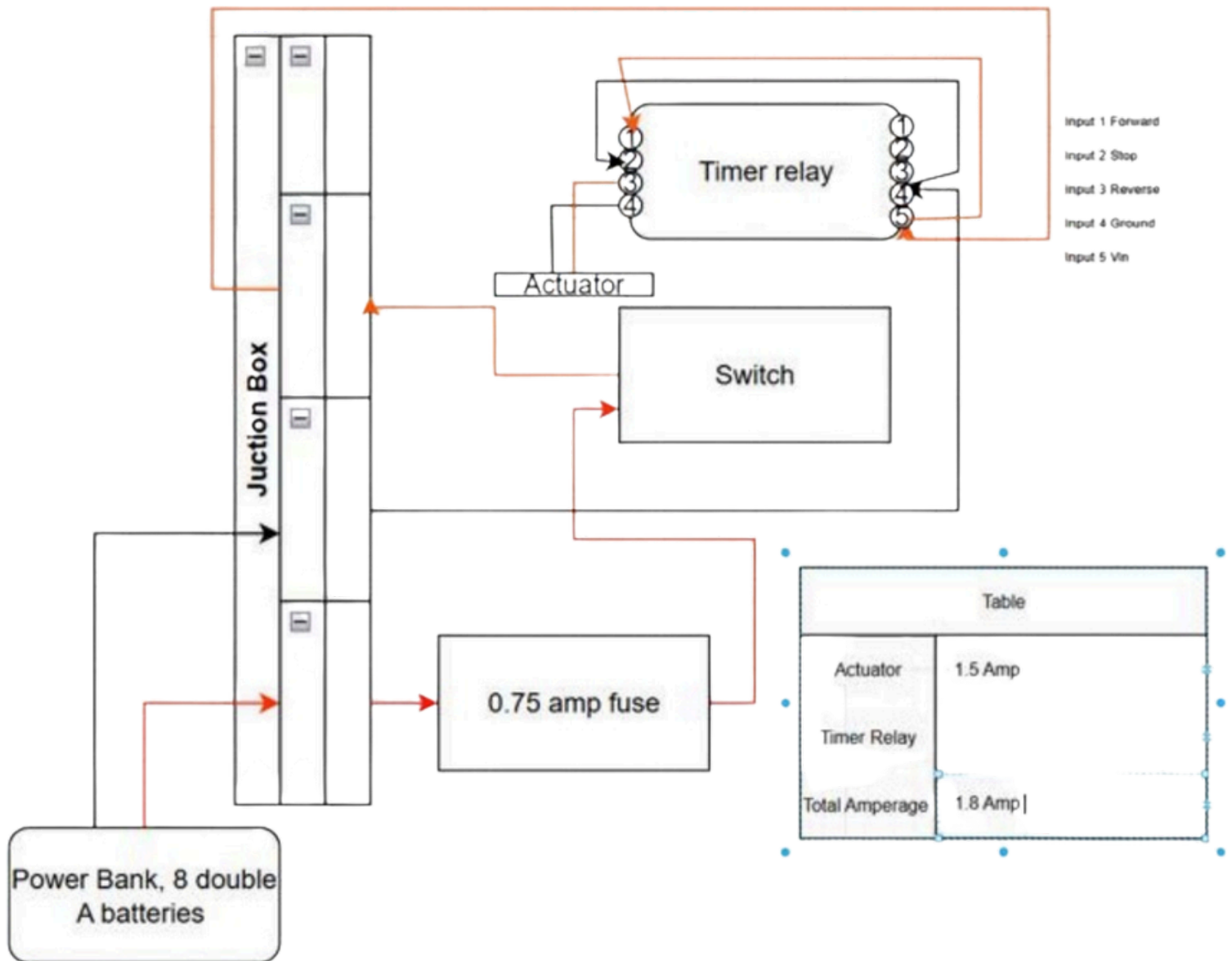
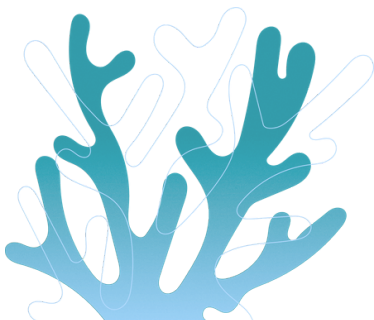


Figure 23: Profiling Float SID



Build vs Buy vs Reuse

In our project, we faced a crucial decision between building, buying, and reusing materials. This led to talks among the team, with us creating a list for each component and listing all of the pros and cons for using them against our budget and schedule during that time. Ultimately, we decided to rely heavily on reused items due to limited funding and broader financial constraints within our school. As reflected in the expense report, many of the core electronics—such as the Fathom X, ESCs, Navigator, T200 Thrusters, Electronic Enclosed Capsule, and a PS5 controller—were reused from previous years to keep costs manageable. Items like the gripper claw, power supply, and various cameras were also salvaged to avoid additional expenses.

Component Name	Reuse		Build		Buy		Decision
	Pros	Cons	Pros	Cons	Pros	Cons	
Thrusters	Saves money and lets us use older thrusters to try out	We are unable to use last year's ROV for drive practice or education	Potential for better mounting options	Require prototyping, money, testing, and time-consuming	We can get brand new thrusters to replace our old ones	Expensive	We decided to make a switch to an older thruster, which led to us reusing
Claw	Saves money	Completely unoptimized for certain mission tasks	Customization gives us better adaptability and allows us to complete more tasks	Takes time for prototyping, testing, and is time-consuming	We get a brand we claw	Really expensive	We decided to reuse the claw from last year
Control Box	Saves Money	The inside looks a little messy	It would look brand new and much cleaner	Takes time and requires money	We can buy a new box for the control box	Searching and money	We decided to reuse the control box due to its effectiveness last year
Electronics	Saves Money	Some components are too old or don't work	Customizable solution	We lack the knowledge to make new electronics	We get brand new electronics to test out	Incredible expensive	We decided to buy a new Navigator and an SD card
3d Printed Parts	Saves money	They are wearing down	Incredibly customizable for our ROV	Takes a while to make	We can get them done fast	Not many things fit what we need for our ROV	We decided to build new 3d printed parts due to them wearing down or breaking

Budget restrictions meant we couldn't afford the latest equipment or upgrades, so we adapted by incorporating more reused components, including a monitor screen, servo motors, waterproof casing, and a frame structure from a previous build. While reusing parts required extra time for testing and modifications, it enabled us to move forward without compromising the overall functionality of our project. We also never made any in-house decisions for important components in our ROV because we did not need them for our competition. Most of the tasks we aimed to complete needed just a claw, which we had already decided to reuse from last year, and outside of 3d printed parts we never made any in-house items for our ROV. This reuse approach not only minimized costs but also encouraged resourcefulness and sustainability within our team. All the reused components were able to meet our mission requirements efficiently and reliably.

Testing and Troubleshooting

This year we had one of the biggest troubleshooting sessions we had seen in a very long time. In the beginning of the year we decided to start testing our old ROV so that we could find ourselves a new pilot after our old one had graduated. We turned on Rov, and it didn't want to connect to our program QGroundControl, so we started testing different things to see why it didn't work. If our ROV refused to connect like last year's our methodology around testing starts with looking at every single electronic component and troubleshooting them. We tested different navigators, Raspberry Pis, fathom x, ethernet cords and adapters. When that didn't work, we went to control systems, so we tried different computers and even different programs, which is how we found Cockpit. We then decided to just start over and build a new ROV for this upcoming season, but when the moment came to test in the second half of the year, it still wouldn't connect. We changed the IP address of the computer, and used the command prompt on our computer to see if there was a link to the IP address of BlueOS, which there wasn't. Our team's electric department went on solo missions to find out the issue and the heart of the problem and why the ROV was ignoring the computer. In the end, we found out that the SD card had an old version of BlueOS that was no longer compatible with our program and subsequently all of our SD cards were running on old firmware that BlueOS couldn't connect to. We reflashed all of our SD cards with a brand new version of BlueOS, and for the first time in months our ROV finally connected.

Other testing we did was with our thruster and whether we should stay with the t200 or downgrade to the t100. The T100 thruster had the functionality of being able to heave and surge. In contrast, the T200 thruster required too much amperage to complete the same task and would either disconnect the ROV or overheat our ESC. We did trial runs of us in the pool to simulate the competition to see how many tasks could be completed with either t200 thruster or the t100 thrusters. We found out that even though the t200s were faster they were more prone to disconnecting the ROV than the t100. In the end, we made the switch to downgrade to our t100 thruster to have an easier and more reliable time in the water.

Regarding testing with component, we decided to change from Raspberry Pi 5 to the Raspberry Pi 4, another older component. This is because the Raspberry Pi 5 would draw too much power and would start to overheat much faster than the Raspberry Pi 4. Due to this we decided to make the downgrade and the functionality of the ROV is much better as it can now stay alive longer in both the short and long term, which is what we needed in the water.

Figure 24: Zane Hosey testing the ROV



Safety

Safety Philosophy For the Aquabot Technicians, safety is not just a requirement, it's a mindset shared by every member of our 9- person team. We are fully committed to protecting the well-being of our crew and the environments we work in throughout every phase of development, testing, and operation. Aquabot upholds strict safety standards that meet and often exceed industry and MATE regulations. Our team follows comprehensive safety procedures and engages in thorough training that covers essential topics such as proper lifting techniques, electrical safety, tool handling, hazardous materials protocols, and workspace organization.

RULES DURING CONSTRUCTION

- Go over the proper plan with all the employees to ensure everyone is on one task
- While everyone is working, the safety officer goes around making sure everyone is following proper safety protocols
- When everyone is finished, they make sure to unplug tools and put them back
- Clean whatever mess they made
- When completing each task, and an employee has trouble preventing mistakes, they should get a second opinion if needed

LAB SAFETY CHECKLIST

- Hair must be up and out of face
- No Jewelry
- No Baggy/Open Clothing
- Closed-toed shoes
- No Horse Playing
- Safety Goggles and/or safety gloves when needed

ROV SAFETY

- All sharp edges filed down
- The Lexan frame is surrounded with rubber on the edges to round the sharp edges.
- The thrusters have plastic shrouds above and below them to avoid any harm or injuries to marine life.
- All wires and the control system are labeled



Cost Accounting

The Aquabot technicians are a SCHOOL-FUNDED organization from Foy H Moody High School. We are funded by Citgo Innovation Academy and also funded by ourselves as the club dues that this team has are 100 dollars a year. Due to THIS LIMITED FUNDING, we try our hardest to limit the amount of money we use. We REUSE PLENTY of components and only buy them if absolutely NECESSARY. Every item that we PURCHASED was logged INTO our Google Sheets, and we coordinated our efforts to REDUCE cost through reuse. Below in figure 24 is an estimate of the cost of the ROV from the base value of what it would cost to buy one right now, even though we only spent about 500 this year for new components.

School Name	Foy H. Moody High School	Sept 11 , 2024	4/26/2025		
Instructor	Madeline Martinez				
income	Citgo,CCISD, Marine Technical Society company , and A & B Plastics				
					Amount
Elelectronics	Dell laptop			Donated	349\$
Material	lexan sheet			Donated	63.99\$
Material	camera enclosure			Re-used	97.00\$
Electronics	Power switch			Re-used	5.08\$
Material	power wire			Re-used	40.24\$
Material	Tether			Re-used	30.24\$
Hardware	SD Micro Card			Re-used	8.94\$
Hardware	Electronics tray			Re-used	55.00\$
Electronics	120 RPM 12 Volt DC Motor			Re- used	12.67\$
Electronics	Digital Camera Servo			Re-used	64.00\$
Material	Control Box			Re-used	41.56\$
Material	4" Acrylic Tube			Re-used	90.00\$
Material	Penetrating Bolts			Re-used	31.75\$
Material	Nuts/Bolts/Screws			Re-used	41.69\$
Sealant	Marine Grade Epoxy			Re-used	43.21\$
Electronics	SOS Leak Sensor			Re-used	32.00\$
Electronics	Thruster Commander			Re-used	60.00\$
Material	Electronics Tray Terminal Blocks And Hardware			Re-used	45.00\$
Material	Wet Link Penetrator			Re-used	95.00\$
Hardware	Waterproof Adjustable NPT Cable Glad			Re-used	\$17.30
Material	Double Sided Duct Tape			Re-used	\$4.78
Material	Door Trim			Re-used	\$7.17
Electronics	Dc/Dc Converter			Re-used	\$11.99
Electronics	Timer Module DC			Re-used	\$19.35
Material	Seal Wire Connections			Re-used	\$39.99
Material	Switch			Re-used	\$20.00
Material	M10 Enclosure Vent			Re-used	\$9.00
Sealant	Molykote Glue			Re-used	\$32.00
Material	Double A Batteries			Re-used	\$18.10
Electronics	Fathom-X x2			Re-used	\$392.00
Hardware	Power Box			Re-used	\$68.99
Electronics	Low-Light HD USB Camera			Re-used	\$99.00
Electronics	Gripper Claw x1			Re-used	\$219.00
Electronics	Digital Camera			Re-used	\$19.99
Electronics	ESC x6			Re-used	\$216.00
Electronics	T200 Thrusters x6			Re-used	\$833.94
Material	White HDPE			Re-used	\$52.71
Material	Roller Transport Cart			Re-Used	\$267.27
				Total cost	\$3,554.95

Figure 25:
Spreadsheet of our
Budget and Costs

Acknowledgements

Our Company would like to express a special thanks to all those who donated to The Aquabot Technicians development of the Hammerhead. This company would not have been successful without their generous support. Aquabot Technicians would like to thank Corpus Christi Independent School District (CCISD) for providing us with the travel expenses and most of our funding. We would like to thank Foy. H Moody High School, our home campus for supplying us with intelligent and considerate mentors. Additionally, the company would like to thank Blue Robotics for providing us with most of our components for our ROV from their website. Finally, we would like to thank MATE for hosting this competition, as it supplies our company and others with exceptional opportunities and experiences that will benefit us for the rest of our lives. Aquabot Technicians would not have advanced as far as it is without the help. The members of Aquabot Technicians would like to thank Citgo for making our innovation program possible as part of Project Lead the Way. This wouldn't be possible without the creation of our program and the teachers and staff of the Citgo Innovation curriculum.



REFERENCES

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