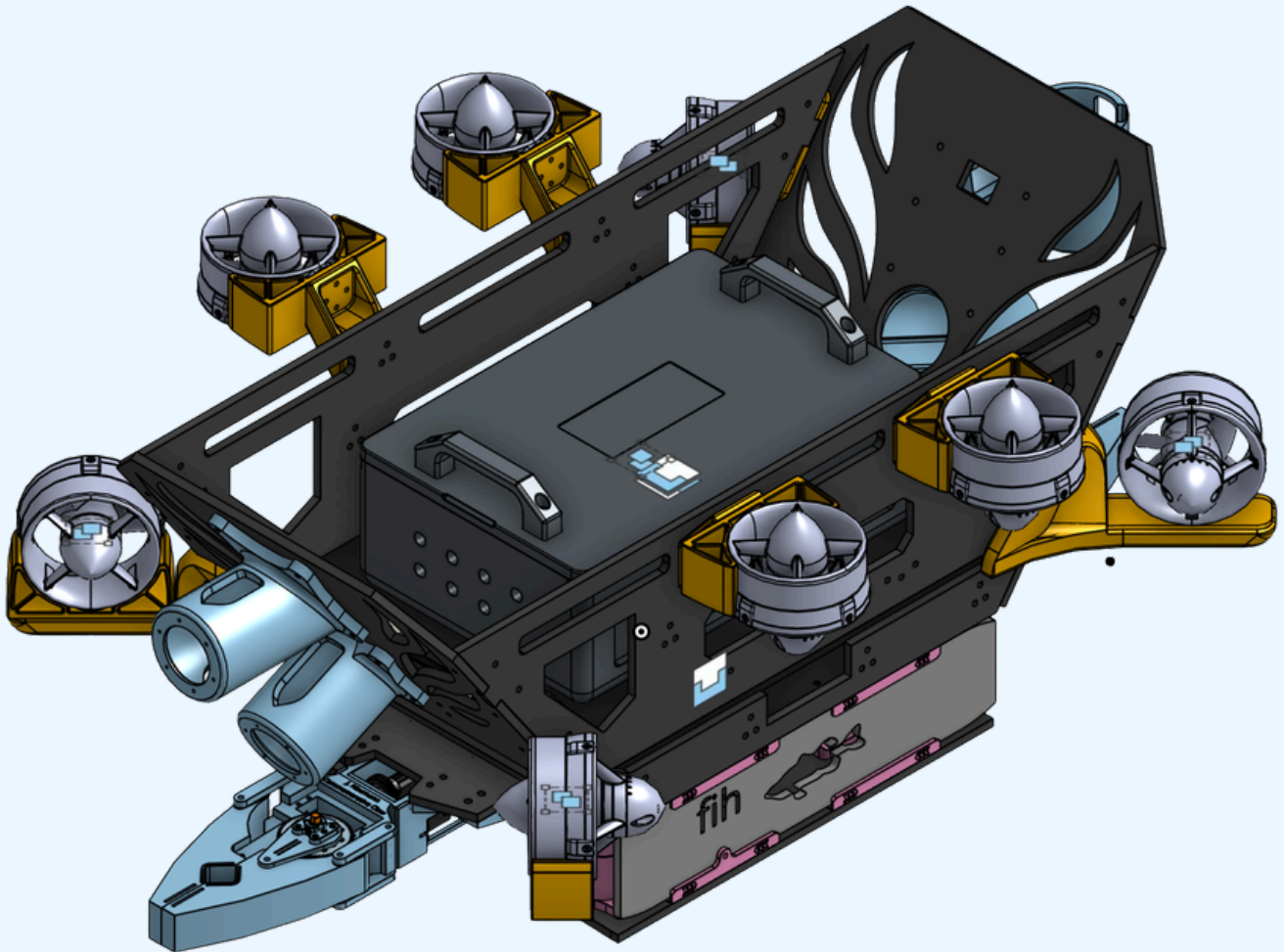


WARRIORTIDES

VALLEY CHRISTIAN HIGH SCHOOL
SAN JOSE, CALIFORNIA, USA



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Anya Li | Co-President & Software | 2026
Sophia Zhang | Co-President & Electrical | 2026
Sean Tran | Mechanical Lead | 2026
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ABSTRACT

WarriorTides is an entirely student-run company based in San Jose, California, specializing in the design and deployment of underwater Remotely Operated Vehicles (ROVs). This ten-member team engineers cutting-edge solutions to address today's oceanic challenges—including monitoring the health of cold-water habitats, operating equipment under the ice, and mapping the seafloor. WarriorTides's latest innovation, Nautilus, is the team's most advanced and reliable system to date, developed through iterative prototyping, comprehensive testing, and troubleshooting. It is built to perform complex mission tasks, such as photogrammetry and flying a transect, with precision and efficiency.

Nautilus, the team's seventh-generation ROV, features eight T200 thrusters enabling movement in all six degrees of freedom. This bi-laterally symmetric, hydrodynamic design features two manipulators with gripping and rotation capabilities and a triple-camera vision system that enables complete pool visibility and accounts for all blind spots. Additionally, a modular Printed Circuit Board (PCB) and laser-cut Delrin frame ensure high serviceability and customizability. Equipped with several custom-designed tools—including a vertical profiling float—Nautilus is built to support the UN's Sustainable Development Goals and the Decade of Action for Cryospheric Sciences goals.

Beyond technical innovation, WarriorTides remains committed to outreach. This season, the team mentored a Navigator-level team (WarriorWaves), hosted a week-long engineering camp for underserved students, held hands-on underwater robotics events, and joined a local creek cleanup initiative.

Building on last year's momentum, WarriorTides continues to evolve. This season marks another milestone, with unique innovations never before seen on the ROV. As WarriorTides pushes the limits of what's possible, Nautilus anchors the company's commitment to innovation and preserving aquatic environments for future generations.



*Figure 1: WarriorTides team photo
Taken by Melissa Chacon*



ROV OVERVIEW

At the start of the season, WarriorTides identified key issues in last year's ROV and brainstormed possible improvements that would allow Nautilus to complete mission tasks more effectively. Drawing upon the team's collective expertise, key design choices were made to maximize Nautilus's capability.

Key Mechanical Design Choices:

- Stayed with the Blue Robotics neutrally buoyant aluminum enclosure to allow for easy access to wiring and electronics.
- Mounted the enclosure on Delrin plates supported by four Delrin beams to ensure structural integrity.
- Features a 3-tier layer structure, any of which can be easily removed to service one section of the ROV at a time.
 - Both claws are mounted on the bottom-most layer, on opposite sides of the ROV.
 - Delrin beams are mounted on the middle layer to support the enclosure.
 - The aluminum box enclosure is mounted on the top-most layer.
- Configured thrusters to enable all six degrees of freedom by developing 3D-printed thruster mounts.

Key Electrical Design Choices:

- Used a modular PCB system with one main board connected to ESC, 12V to 5V converter, and sensor/USB boards.
- Chose modular boards over one fully integrated PCB to improve wire management, isolate failures, and reduce repair time.
- Stayed with Ethernet communication for HD, low-latency video and cleaner separation between camera and control systems.

Key Software Design Choices:

- Use of GUI-sensitive and reactive instances and threading to separate functional components (e.g., thrusters, claws, cameras) from mission-specific tasks to maintain a cohesive and compatible script.
- Use of a single Raspberry Pi 4 managing all 3 camera streams on the Pi server, providing a more reliable system with minimal lag.
- Created a modular control system where features are built as separate plugins, making it easy to add or update functionality without changing the main code.

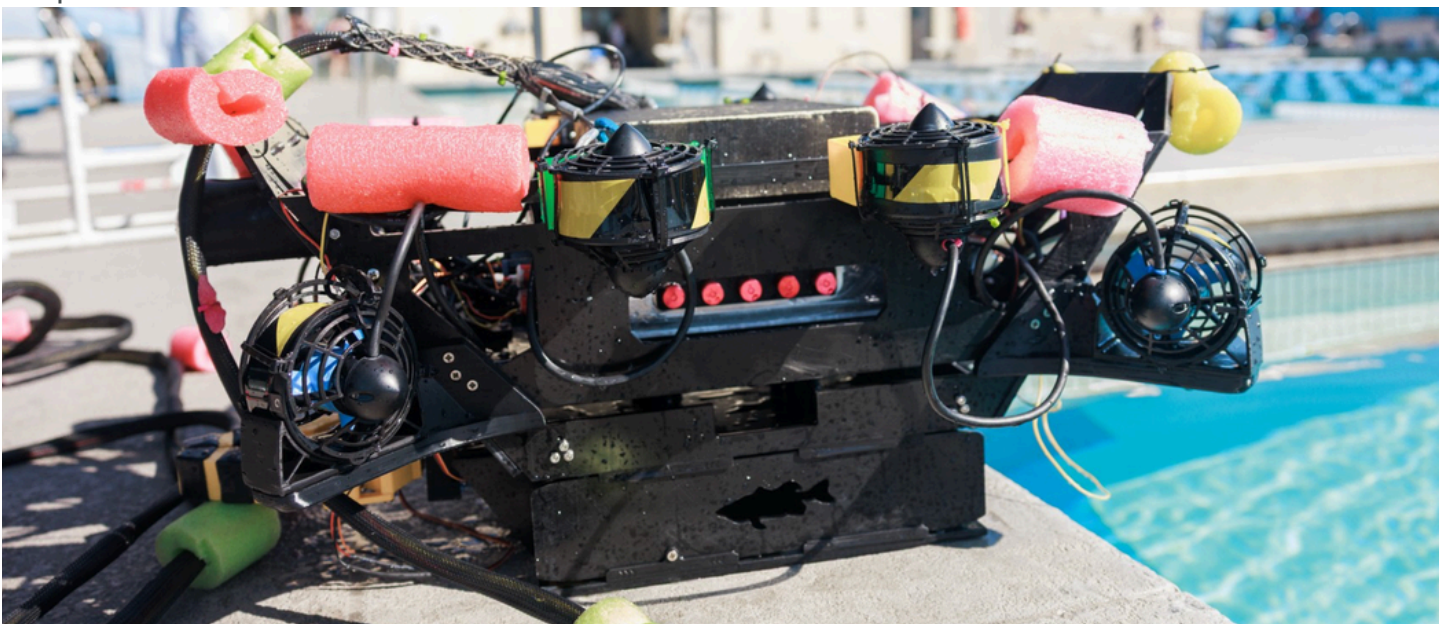


Figure 2: Nautilus
Taken by Melissa Chacon



PROJECT MANAGEMENT

Company Structure

WarriorTides is an eight-year-old, entirely student-run company of ten engineers. The company is run by an executive leadership team consisting of one CEO and two co-presidents. Responsibilities of the CEO include managing overall team progress, setting deadlines, supervising the budget, and advising on final design decisions. In conjunction, the co-presidents provide a second opinion when running day-to-day operations at the company. Simultaneously, an experienced sub-team lead heads each of the three sub-teams (electrical, software, and mechanical) by managing integration between systems, delegating tasks to members, and making overarching design decisions, working together with the executive leadership team to ensure that the company runs as a cohesive, efficient unit.

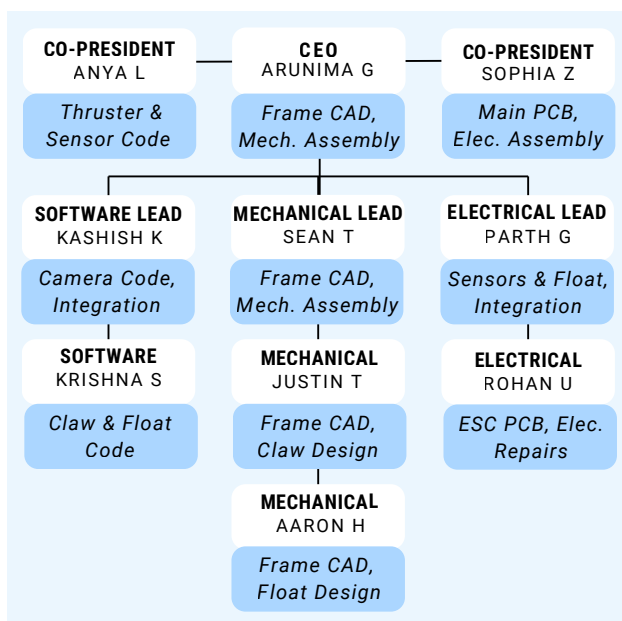


Figure 3: WarriorTides organizational chart
By: Sophia Zhang

Day-to-Day Operations

WarriorTides employees meet from 3 to 6 pm on Mondays and Wednesdays for a total of six hours each week. In the beginning of April, the company met every day to increase the amount of pool testing and work time available.

WarriorTides communicates via Google Chat, as it is an organized environment for company announcements, discussions, and friendly, yet professional communication for employees and mentors. Additionally, Google Sheets and Google Documents are integrated directly into the platform, which streamlines planning and brainstorming.

Team Building

The executive leadership team strives to schedule at least one formal team bonding event every two months. These are intended to boost morale within the company, enable employees to form a community, and establish a collaborative atmosphere. WarriorTides strongly believes that a good team dynamic among all employees enables productive learning and collaboration. Consequently, WarriorTides has held team bonding events such as a Halloween, Thanksgiving, and Christmas party. Similarly, at every meeting, different team members bring in snacks so employees can share a relaxing break together halfway through meetings. At the beginning of the season, the team also incorporated team bonding games during the snack times. The positive team culture of this company and the lifelong friendships between employees are a direct reflection of WarriorTides's commitment to team bonding.



Figure 4: The team poses with their Christmas gingerbread house
Taken by Stuthi Jaladanki



Scheduling

Project management and scheduling strategies refined in the previous year includes continued close collaboration between executive leadership and sub-team leads, maintaining a readily accessible and regularly updated schedule for all company members, and holding overtime meetings to ensure timely progress.

During the 2025 summer, the entire team met several times to plan the schedule for the upcoming season, as well as ensure summer targets were hit. Key deadlines were established for critical components, including the PCB order date and the ROV CAD completion deadline, alongside broader milestones such as the start of pool testing. These were entered into a running Gantt Chart (Appendix A) where more minute deadlines were gradually added, such as “Leak Testing”.

Furthermore, every working week began with the CEO reviewing where the company was in the year and what tasks needed to be completed by the end of the week. After this initial check-in, sub-team leads were responsible for ensuring the completion of these tasks with their team or breaking down these tasks into multiple smaller parts. At the end of every week, sub-team leads were responsible for reporting their task status to the CEO. This consequently enabled all sub-teams to stay on track for big-ticket events like the initial pool test.

Decision Making

WarriorTides’s decision-making approach is to involve employees across all subteams when making key design choices. The company took into consideration this season’s design philosophy of reliability, flexibility, and exploration that was established before the season started. For example, when deciding to reuse the box enclosure from last season for Nautilus, the team prioritized a sturdy and maneuverable structure. Multiple enclosure designs were evaluated using a decision matrix that considered factors such as manufacturing feasibility and mounting options for the

mechanical team (see Figure 5), PCB accessibility and electronics serviceability for the electrical team, and control integration and system stability for the software team. Perspectives from each subteam enables WarriorTides to select a design that balances structural performance, maintainability, and control functionality.

Types of Enclosures	Metal Box	Acrylic Cylinder	Self-fabricated
Electronic Access	9	4	2
Viewing Leaks	3	8	5
Ease of incorporation	9	6	3
Weight	4	5	4
Total	25	23	14

Figure 5: Mechanical enclosure design matrix
Taken by Sophia Zhang

Peer-to-Peer Mentoring

WarriorTides has three mentors adept in unique technical fields who provide advice but do not participate in any day-to-day operations. Being entirely student-led, the company heavily relies on peer-to-peer mentoring to educate the next generation of engineers. Veteran employees host educational workshops such as “Electrical 101”, “CAD Basics”, and “ROV Basics”, preparing incoming employees for a strong start to the season. As the season starts, these veterans take on the responsibility of participating in regular subteam work and shadowing rookie employees. Through 1-on-1 mentoring, members are guided through technical challenges they face and eventually become self-sufficient after three months. This dynamic not only accelerates the growth of newer members through hands-on guidance but also provides veterans with valuable leadership experience as they learn to effectively mentor and communicate technical topics. WarriorTides takes great pride in transforming students with no prior technical experience into engineers capable of designing efficient PCBs, writing complex code, and creating intricate 3D models by the time they graduate through the peer-to-peer mentoring system.



BRAINSTORMING

WarriorTides's ideation process heavily incorporates reflection on previous year's successes and flaws in both design and methodology. The team first held a debrief on the successes and areas for improvement after the previous year's competition, identifying key challenges, including difficult-to-diagnose electronic issues and going over weight. Over the summer, subteams met over Zoom to discuss ways to troubleshoot last year's shortcomings for the new design, researching solutions through internet searches and home R&D experiments. All ideas were compiled into one document before implementing specific ideas based on feasibility and usefulness.

Design Philosophy

WarriorTides this year follows a new tenet to guide decision making—"Iteration is Our Innovation"—which reflects the team's commitment to refining past designs. The goal of this tenet is to encourage team members to continuously evaluate and enhance every aspect of the development of Nautilus's, using lessons learned from previous seasons to create effective solutions.

- *Doubling Down:* **The mechanical subteam** designs with intent and symmetry. By "doubling down" on functionality through a fully bilateral frame, dual grippers, and three cameras, the mechanical team consciously implements and alters design based on agreed-upon design priorities.
- *Design for Efficiency:* **The electrical subteam** has backup boards ready, modular headers in place, and employs a quick-swap system that minimizes downtime.
- *Simplicity Scales:* **The software subteam** prioritizes clear and efficient code, maintains a clean, modular architecture for improved reliability and maintainability, and provides a stable foundation for developing systems such as dynamic power control and sensor fusion to enhance stabilization for components like the camera feed, joystick control, and sensor readings to work together cohesively for smooth and reliable operation.

VEHICLE DESIGN

Frame

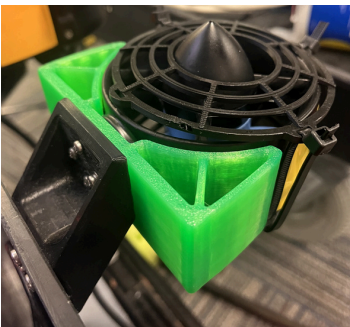
This season, WarriorTides was focused on designing a modular and highly serviceable ROV. The frame consists of a modified BlueRobotics enclosure housing the PCB, a laser-cut Delrin structure, and 3D-printed brackets and mounts that hold the ROV together. Additionally, Nautilus's bilaterally symmetrical frame provides balance in the water and reduces the need for repositioning during tasks. WarriorTides retained last year's BlueRobotics aluminum enclosure due to its instant access to electronics and more spacious PCB layout. Despite the added weight, size, and cost, electronics maintenance became more efficient, saving valuable testing time.

The frame's individual panels are manufactured from Delrin because of its excellent strength-to-weight ratio and machinability, necessary to support the box enclosure's weight (6.89 kg). A tradeoff the company had to make was between weight and serviceability. To address this, the team milled out the enclosure's body to reduce weight and drag. Additionally, components were placed on the outside of the frame to compress the ROV, improving serviceability at the cost of protection.



Both manipulators are placed directly underneath the main subframe, which is elevated off the ground by two supporting Delrin structures containing four Delrin beams. In addition, the front and back plates are outwardly angled to keep the tether above the thrusters and claw, reducing snagging on loose material, such as the recovery line in Task 2.4. To attach components to the frame, the team designed 3D-printed brackets to ensure a smooth contour, increasing Nautilus’s hydrodynamics and thruster efficiency. Furthermore, cutouts were added on all the frame faces to allow clean water flow, trading off more structural support for reduced drag across all planar faces and less weight. Ultimately, Nautilus balances between accessibility, strength, and performance, enabling the team to iterate and operate efficiently in all types of environments.

Figure 5: Bracket system connecting thruster to frame that prevents rope/wire snagging
Taken by Arunima Garg



Weight in Water	Foam Bouyant Force	Foam Required
3.4 kg	1.278cm³/g	0.04 m³

Figure 6: Buoyancy calculations table
By: Arunima Garg

Propulsion

Nautilus is propelled by eight Blue Robotics T200 thrusters—four vectored horizontally and four vertically—allowing the ROV to maneuver in all 6 degrees of freedom. While this configuration adds some weight and cost, it offers a net performance gain. Blue Robotics’ efficiency curves show that these thrusters are most efficient at lower power levels. With more thrusters running at lower speeds, Nautilus achieves greater overall efficiency and maneuverability, making it a worthwhile trade-off.

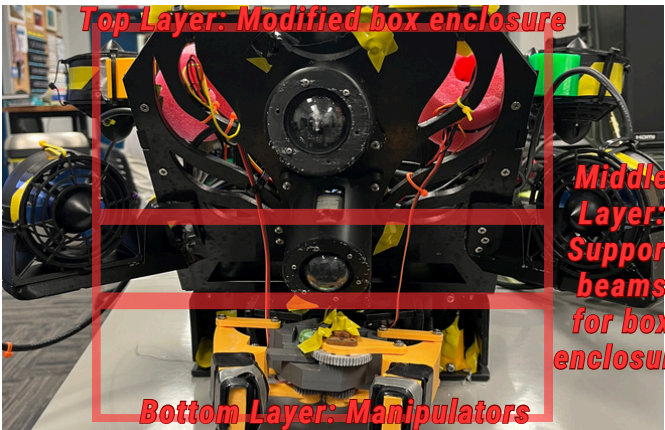


Figure 7: Front view of Nautilus
By: Arunima Garg

Additionally, thrusters are mounted in counter-rotated pairs to balance reactive torque, improving the ROV’s stability and reducing unwanted rotational drift during precise movements.

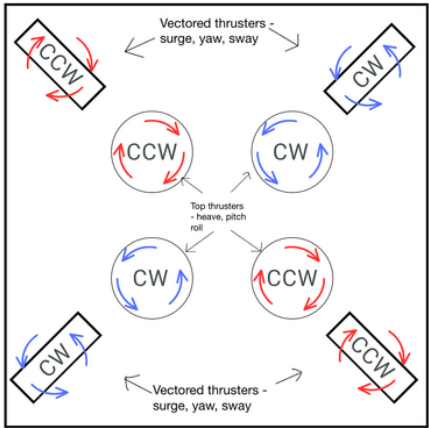


Figure 8: Thruster mount locations
By: Arunima Garg

Buoyancy

WarriorTides achieved neutral buoyancy by adding foam along the top perimeter of the ROV, keeping the center of buoyancy above the center of mass for improved stability. This setup allows the ROV to remain balanced and upright without constant adjustments. The team decided to compromise topside-controlled , electronically-adjustable, and actuator-driven buoyancy engines used in previous years’ design for this approach, which takes up less underwater volume, requires comparatively less attention overall during the product demo, doesn’t use any current draw, and holds less complexity for maintenance and troubleshooting. As Nautilus moves from pool water to salt water for the collaborative bonus mission task, floatation foam can be adjusted and cut off accordingly with ease.

CONTROL SYSTEM

Onboard Electronics

The core of WarriorTides's electronics system is a four-layered main PCB, designed to simplify trace routing and maximize serviceability with dedicated layers for 12V and ground. This board consolidates critical components, including a Raspberry Pi 4 for video processing, an Arduino Mega Pro for control, and an Ethernet switch to minimize latency across the system. This distributed architecture allows the Raspberry Pi to handle high-level processing while the Arduino maintains real-time control of servos and thrusters. To further improve system modularity, the main board includes several solderless, switchable jump connectors that allow for a configurable setup, such as routing sensors to the Raspberry Pi instead of the Arduino. Components are not soldered directly onto the board but are instead connected via headers, allowing for individual component replacement without requiring board-level repairs. While this increases connector count and system complexity, it significantly reduces repair time during testing and competition. This tradeoff matched the team's design philosophy because fast subsystem replacement was more valuable than making the PCB stack slightly more compact.

In addition to the central board, separate ESC modules attach to the main board. Designed for modularity, the ESC modules house all ESCs, which are firmly soldered on for stability. By keeping ESCs on separate boards, serviceability is greatly enhanced through the quick-swap system that enables rapid and simple replacements, while their vertical placement reduces space taken up on the main PCB. A dedicated USB and Sensor Board eliminates the need for external camera cables while reducing clutter and improving efficiency with sensors. All USB signals are routed through the board, with carefully controlled impedance and signal integrity.

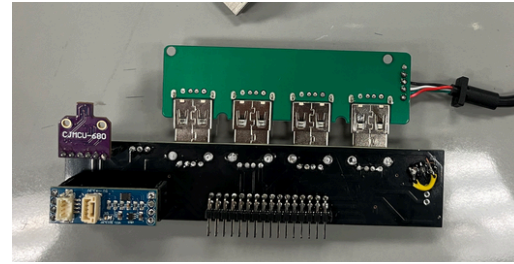


*Figure 9:
Sensor
Hub
(Taken by
Sophia
Zhang)*

A dedicated 12V to 5V converter board also allows power conversion to be replaced without repairing the main PCB, improving serviceability over previous designs.

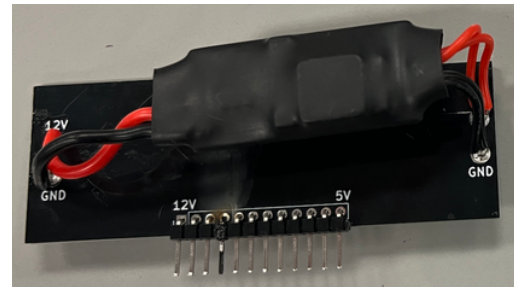


*Figure
10: 12V
to 5V
Converter
(Taken by
Sophia
Zhang)*

Prototyping was key to WarriorTides's success. Prior to ordering, CADs of all PCBs were first generated and assembled in OnShape before laser-cutting a physical acrylic prototype to test that all mounted components fit their custom footprints. As weak points were revealed through extensive testing of the initial electrical system throughout the season, employees implemented various fixes and improvements, leading to a more effective third PCB revision that Nautilus supports today. In the case of an emergency, a set of complete backup boards has been assembled and tested and is readily available to be swapped in, preventing potential mission scrubs. Protecting the electronics stack is the 25A fuse shown in the SID and the topside emergency stop, allowing power to be cut quickly during testing or operation. All of Nautilus's PCBs were designed by employees using KiCad, first by creating an SID for the overall architecture, followed by schematics and layouts. At each step, designs underwent technical review by fellow team members, mentors, and WarriorTides alumni. All PCBs were manufactured by PCBWay but assembled in-house by employees.

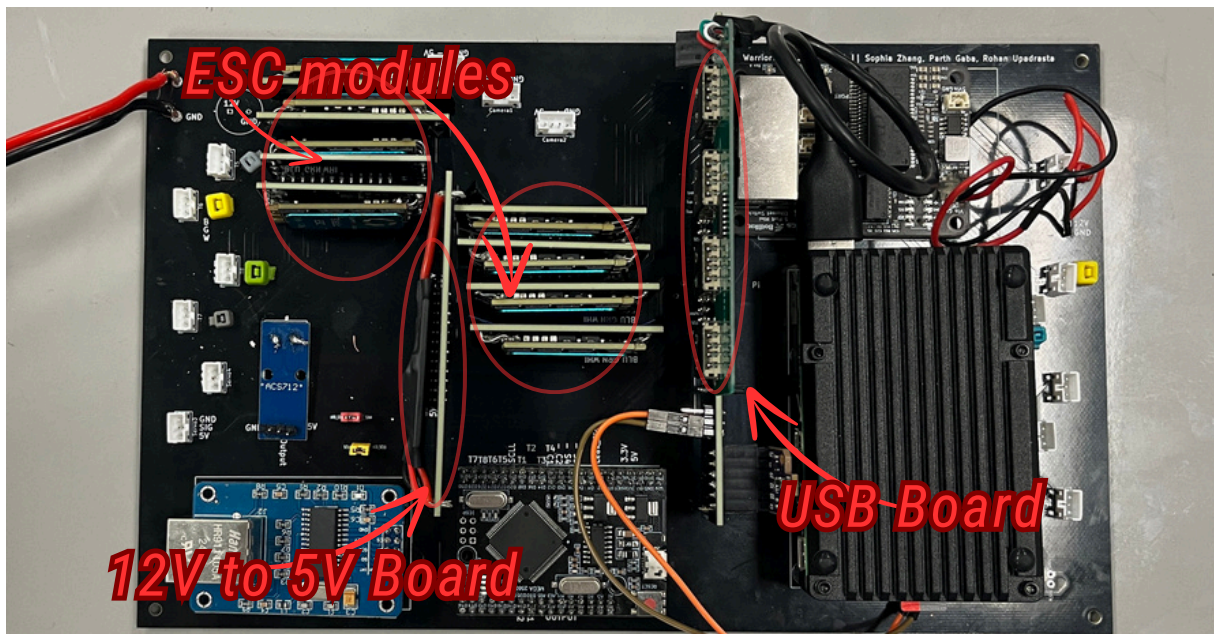


Figure 11:
Assembled
PCB
(Taken by
Sophia
Zhang)

Tether

As there were no issues with last year's tether system, Nautilus's tether system reuses the Blue Robotics Fathom ROV Tether with four unshielded twisted pairs (UTP) and a 50-foot pair of 12-AWG silicone-insulated cables. This tether was chosen because it offers up to 80% more bandwidth than previous tethers used by WarriorTides, while the silicone-insulated cables were chosen based on resistance and voltage drop calculations to ensure optimal balance between power delivery and length. Like last year, to prevent tangling, both the tether and power cables are enclosed in a mesh sheath, with floatation foam added to provide slight positive buoyancy.

Topside Station

WarriorTides's topside station houses two laptops, an Ethernet switch, a PlayStation controller, and two 22-inch LCD monitors. The Ethernet switch supports connections between the topside station and ROV, allowing for seamless communication. Through this Ethernet network, both computers are able to receive video feed from the Raspberry Pi, which is then displayed in a custom GUI. The left monitor is for the pilot and displays video feeds at 1080p while also sending the pilot's controller data to the onboard Arduino. The right computer is for the co-pilot and runs various scripts to perform tasks such as the crab identification task

Tether Management Checklist	
Before ROV Launch	
☐	Inspect the tether for any damage or loose floatation foam
☐	Check strain relief is attached on both sides of the tether by pulling to ensure security
☐	Power on and ensure stable connection and power
ROV in Water	
☐	One poolside employee controls the amount of tether in the pool
☐	Pilot calls for more or less tether
Following Pool Test	
☐	Tether is dried and inspected
☐	Tether is re-coiled using velcro straps

Figure 12: Tether Management Checklist
By: Sophia Zhang

Length	Max Current	Tether Resistance	Max Voltage Drop
12.2m	25A	0.0635 Ω	1.5875 V
15.2m	25A	0.0794 Ω	1.985 V
18.3m	25A	0.0953 Ω	2.3825 V

Figure 13: Tether Length Calculations
By: Sophia Zhang

(2.1), in which an object detection model detects, locates, and classifies crabs in underwater imagery. These topside electronics are housed within a Pelican Storm iM3220 Case with 44" x 14" x 8.5" interior dimensions. This case features press-and-pull latches

and rugged in-line wheels for easy and safe transport. Brass hinges were added to support the case's lid while open. Two acrylic panels were also added to safely isolate cables underneath and provide a flat surface for the keyboard, mouse, and PlayStation controller. Alongside this, an emergency stop button was added to the topside station, enabling the pilot to cut all power to Nautilus instantaneously should an emergency arise.

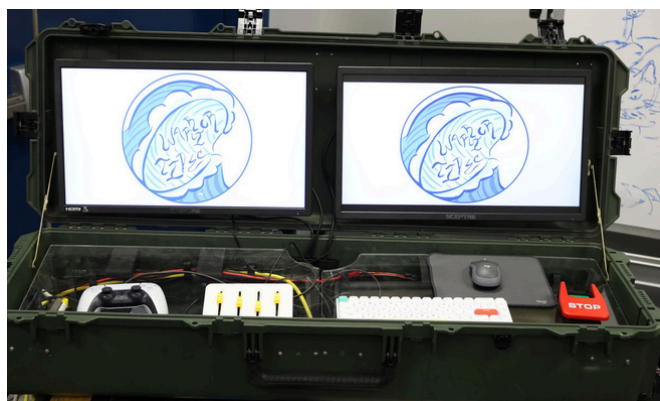


*Figure 14: Topside station set up with co-pilot on the right side and pilot on the left side
Taken by David Yu*

Sensors

Nautilus utilizes four sensors to improve the overall driving efficiency, ensuring stability and accurate environmental measurements. The Adafruit BME680 sensor is used to measure temperature, humidity, and pressure within the ROV. This sensor is connected to an alert system that monitors leaks and overheating electronics, allowing for early detection and shut-off before catastrophic failure. The BarO2 depth sensor is used to measure the ROV's depth in real time, providing critical feedback to the driver for vertical positioning and control. This allows for more precise depth adjustments during operation and helps maintain stability. A current sensor monitors thruster current draw, allowing the team to track power usage during high-power maneuvers and reduce the risk of blowing the 25A fuse.

Additionally, Nautilus incorporates a BNO055 IMU sensor to improve motion control and driving consistency. The IMU provides real-time orientation and acceleration data across all degrees of

motion. Using this feedback, WarriorTides developed a custom PID-based motion control system that continuously regulates thruster output to maintain the driver's intended speed and movement. The system reads joystick inputs as target velocities and dynamically adjusts thruster power using the IMU feedback to compensate for drift, external disturbances, and changes in momentum. This results in smoother acceleration, more stable navigation, and more precise control during operation, especially when performing delicate mission tasks or maintaining steady movement in underwater currents.

Unlike previous designs that explored additional sensors for stabilization, this year's system intentionally minimizes sensor complexity. By eliminating non-essential sensors, Nautilus benefits from reduced electrical overhead, potential failure points, and integration complexity, resulting in a more robust and reliable system under competition conditions.

Software Control Code

This year, WarriorTides developed Nautilus's software control system in-house, leveraging open-source projects such as OpenCV, Pygame, and a variety of other Python libraries to create a modular, networked control architecture.

A central component of this system is an Arduino Mega Pro operating locally on the ROV. The Arduino serves as the primary low-level interface for hardware components, including thrusters, servos, and onboard sensors. It collects and transmits data from the depth sensor, humidity sensor, and current sensor, allowing the system to monitor environmental and electrical conditions in real time. The Arduino communicates bidirectionally with the topside station using an Ethernet module, which transmits UDP packets for efficient, low-latency communication. Alongside the Arduino, a Raspberry Pi operates onboard the ROV to manage higher-level computing tasks. The Raspberry Pi handles the camera systems,



performs computer vision processing using OpenCV, and assists in processing sensor data before forwarding relevant information to the topside control system.

The topside station runs a Python-based control framework that acts as the bridge between the ROV hardware and the user interface. This framework is organized into modular components that manage UDP communication, joystick input processing, sensor data handling, and system monitoring. The software also hosts a WebSocket server that allows real-time data exchange between the control

software and the graphical user interface.

To interact with the system, the team developed a React-based web GUI that connects to the WebSocket server. The interface provides operators with real-time feedback on critical system metrics, including depth, humidity, electrical current draw, camera feeds, and ROV orientation. It also displays the operational status of onboard processes and system diagnostics, allowing the pilot and operators to quickly identify and respond to any system warnings or failures.

CAMERA SYSTEM

Camera Placement

To navigate with maximum efficiency and visibility, WarriorTides implemented a triple-camera system. This configuration allows the pilot to view the environment from both a forward perspective and a top-down view of both manipulators and the surrounding area. The top-down camera allows the driver to view one of the manipulators while also maintaining a view of the bottom of the pool, which will be useful for Task 1.3, flying the transect over the coral garden. The cameras are secured using custom-fabricated mounts fastened to the exterior of the Delrin frame.

The angled downward-facing camera allows the driver to see the claw with accurate depth perception and navigation, while the forward-facing camera allows for proper steering and a larger field of view.



*Figure 15:
Front &
Downward
Facing
Cameras
(Taken by
Sophia
Zhang)*

Camera Enclosure

Due to the opaque box enclosure, the cameras required clear, external housing. Their housing are comprised of a Blue Robotics 2-inch acrylic enclosure, flange, and acrylic dome. Additionally, these enclosures were bandsawed and sealed with custom resin printed end-caps to minimize enclosure size. This end cap is permanently secured to the enclosure with epoxy resin, but allows for a penetrator and a vent plug to be implemented. The front flange can be unfastened, allowing the cameras to be serviced and replaced.

Electronics & Code

Nautilus's camera system streams and displays multiple video feeds in real time using a Raspberry Pi as the central processing unit. Multithreading is implemented so each camera port is handled independently, preventing one stalled feed from blocking the others, a failure mode encountered in previous seasons with single-threaded camera loops. This allows all three feeds to run simultaneously without slowing down the system. These video streams are transmitted to a Python program, which processes and displays the feeds in real time on the interface, allowing for precise maneuvering of the ROV during operation.



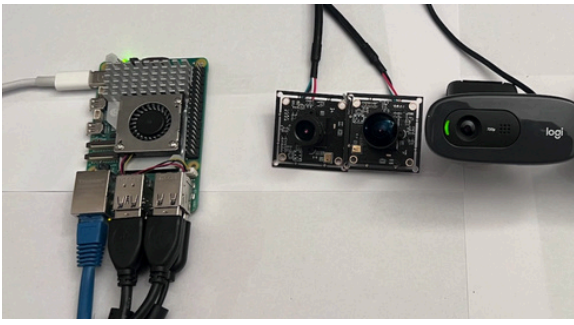


Figure 16: Three camera testing setup
Taken by Anya Li

MISSION TOOLS

Claw

Nautilus is equipped with dual high-torque rotating claws on both ends, custom-made to handle heavy lifting, such as the lobster pot in Task 2.3, and precision tasks, such as pulling a pin in Task 3.1. This configuration aims to enhance agility and manipulation of underwater objects. Furthermore, with two claws, the ROV can complete multiple tasks in one trip, saving time spent returning to the surface and maximizing efficiency while maintaining the balance of the ROV.

Each claw is designed with parallel linkages, ensuring symmetrical geometry and keeping the grippers aligned, ensuring precise control in the water. The opening mechanism features a 30-tooth brass gear driving a 60-tooth stainless steel gear, providing a 2:1 mechanical advantage and increasing torque. Furthermore, the grippers are designed and modified with silicone tape to fit ½-inch PVC pipes, which are commonly used in the competition.

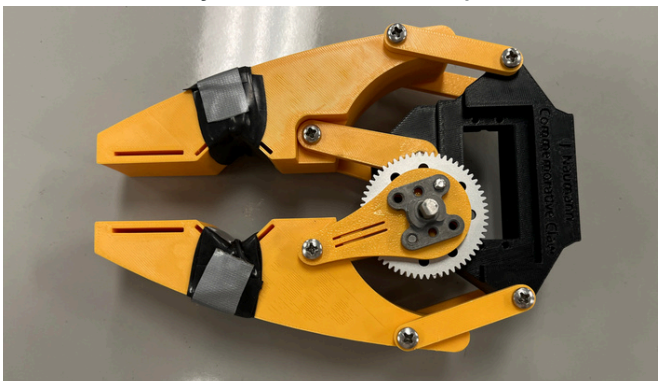


Figure 17: Nautilus's claw
Taken by Sophia Zhang

The wrist features a rotating stainless steel shaft mounted into the gearbox, allowing the manipulator to rotate and orient objects as needed. This added degree of freedom enables the claw to approach and grasp mission components from multiple angles, improving dexterity and making it easier to complete complex tasks, such as turning the disk to remove the biofouling in task 2.5 or turning the handle to release the retrieval buoy in task 2.3.

Gatling Float

WarriorTides's vertical profiling float, the AHAVIAN, is designed to automatically adjust its buoyancy for depth control in the water while collecting data such as depth, pressure, and temperature. To minimize failure potential, all of the electronics, including the battery, are mounted inside a singular acrylic enclosure. The buoyancy engine is powered by a 12V linear actuator that exerts a modest 225 lbs of force, which actuates a plunger on a syringe at the base of the AHAVIAN. The onboard BarO2 depth sensor prevents the float from breaching the surface by halting ascent at a set depth.

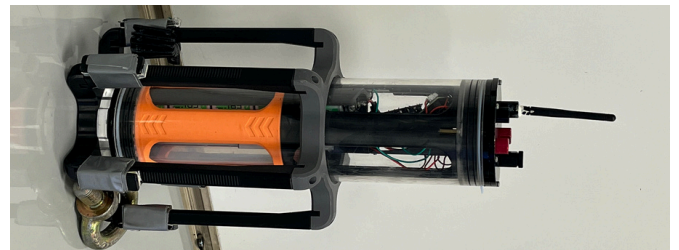


Figure 18: The AHAVIAN Vertical Profiling Float
Taken by Sophia Zhang

To power this linear actuator and meet voltage requirements, the company mounted 10 NiMH EBL Rechargeable C Cell Batteries instead of disposable batteries onto a 3D printed battery pack, as these batteries align with MATE's emphasis on environmentally responsible energy systems, reducing waste and supporting repeated deployments.

The AHAVIAN is controlled by a Wemos D1 Mini Pro, a development board built around the ESP8266 microcontroller. Onboard electronics include a BarO2 depth sensor, an external antenna for wireless communication, a voltage converter,



an H-bridge for bidirectional actuator control, and an LED status indicator. All components are mounted to a custom-designed PCB, which enhances serviceability and minimizes the risk of shorts or entanglement with moving parts.

The topside station contains an identical microcontroller that communicates wirelessly with the AHAVIAN, allowing operators to remotely monitor and control its movement and behavior during tasks.



Figure 19: NiMH eco-friendly batteries within company-made float battery case
Taken by Sophia Zhang

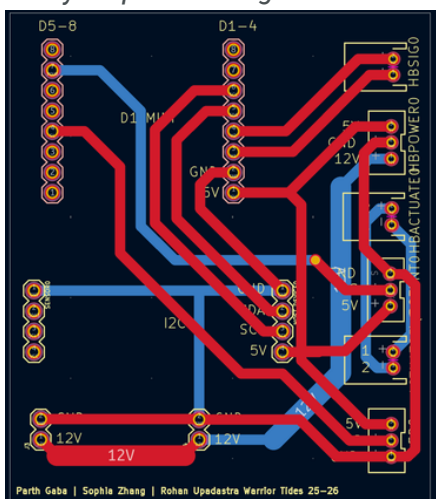


Figure 20:
The
AHAVIAN's
PCB layout
in KICAD

Taken by
Sophia
Zhang

Other Mission Tools

To recover the buoy anchor in Task 2.4, a recovery line was constructed. Four meters of rope coiled around a PVC pipe allows for easy grip from Nautilus in either manipulator. The rope is connected to a carabiner, which is supported by a PVC cross. The carabiner can securely connect to the buoy anchor and is easily attachable and removable, making it the best option to recover the anchor.



Figure 21:
Recovery
Line

Taken by
Rohan
Upadastra

GUI

The GUI provides pilots and operators with real-time feedback on all critical system metrics during missions. Built in React, the interface displays three live camera feeds simultaneously, laid out to mirror the physical camera positions on the ROV. Real-time system metrics like depth, humidity, current draw, and claw status update continuously via a WebSocket server, chosen over HTTP polling for its persistent low-latency connection. A high-visibility humidity alert was added after a mid-season pool test where a minor seal failure went undetected, allowing the team to cut power before damage occurs. The interface also displays the operational status of onboard processes, allowing the team to quickly identify and respond to system warnings. A built-in keyboard-activated recording feature captures mission footage for post-run analysis and task documentation.



Figure 22: Screenshot of the GUI
Taken by Anya Li

Software Systems

Task 1.2: Coral Garden Photogrammetry

Each of Nautilus' camera is calibrated using OpenCV and a checkerboard pattern to calculate intrinsic camera parameters and distortion coefficients. Every frame is undistorted before processing to eliminate measurement error caused by lens curvature. A T-connector with known dimensions is used as a reference object by OpenCV, which calculates the pixel distance between selected endpoints to determine a pixels-per-centimeter conversion factor, allowing for accurate scaling regardless of camera altitude.

For photogrammetric 3D reconstruction, during a controlled rotation maneuver, all four cameras capture overlapping images that are processed through a Structure-from-Motion pipeline: (1) SIFT feature points are extracted from all images. (2) RANSAC filters incorrect feature matches. (3) Camera poses are estimated to generate a sparse 3D point cloud. (4) Multi-view stereo reconstruction creates a dense surface mesh. (5) The T-connector scale reference calibrates the model to real-world dimensions. Afterwards, the final model is displayed in the GUI, allowing operators to inspect and measure coral dimensions directly. To decrease loss of red and orange wavelengths during reconstruction, the pipeline applies CLAHE histogram equalization to each color channel before feature extraction. Testing showed this significantly improved stable feature matching in low-contrast underwater scenes.

Task 1.3: Transect Flight & Current Stabilization (PID Controller)

To maintain stable transects and resist underwater currents, WarriorTides developed a closed-loop PID stabilization system for heading and depth control. The depth controller uses pressure sensor data from the Arduino Mega Pro, which corrects current depth error quickly, eliminates steady-state drift from buoyancy imbalance, and reduces overshoot and oscillation near target depth. The correction output is mixed into the vertical thruster commands while still allowing full pilot override. A second PID loop uses IMU heading data to maintain yaw alignment along the transect. Differential thrust corrections keep the camera array aligned during video capture. PID gains were experimentally tuned through repeated pool testing. The team identified the ultimate gain and oscillation period, applied Ziegler-Nichols tuning rules, then refined gains iteratively until recovery behavior met mission requirements.

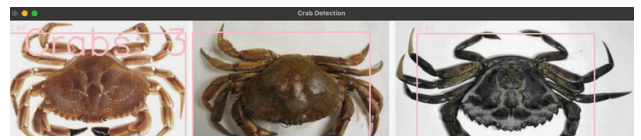


Figure 23: Crab Detection GUI
By: Kashish Kapoor

Task 2.1: Invasive Species Detection for European Green Crab Counting

To color correct, a gray-world algorithm compensates for blue-green color shifting, while CLAHE equalization is applied in LAB color space to restore local contrast without amplifying noise. To detect crabs, species-specific HSV masking isolates crab-colored regions. Then, morphological filtering removes noise and fills gaps for contour analysis to evaluate aspect ratio, solidity, and bounding geometry to reject non-crab objects. Valid detections are counted and displayed with bounding boxes on the live feed. Operators can manually adjust the crab count if false positives or missed detections occur, ensuring reliable mission reporting.

Task 2.2: Iceberg Tracking & Threat Level Calculation

The GUI displays a live checklist and waypoint counter so operators can confirm all five iceberg perimeter points during the survey. Depth sensor data is logged continuously. When the pilot confirms a keel measurement, the software records and locks the current depth reading with centimeter precision. After recording iceberg position, heading, and keel depth, the software projects the iceberg trajectory, calculates the perpendicular distance to each oil platform, compares keel depth against subsea asset depths, and assigns a threat level of High, Medium, Low, or None. Results are shown in a color-coded threat matrix for rapid reporting.

Task 2.5: eDNA Sensor Data Analysis

After recovering the eDNA sensor, the GUI analysis tool parses the sensor data file, identifies organism detections, and calculates percent frequency for each species. Results are displayed as ranked tables and bar charts for quick analysis.



TESTING & TROUBLESHOOTING

Prototyping

A central part of WarriorTides's development process is prototyping. This year, WarriorTides assembled a prototype of Nautilus to assess the feasibility of a new design that contained more custom 3D-printed parts than ever before. Old sheets of acrylic were laser cut as a test for the frame which would be made of out more expensive Delrin, and each custom component was printed several times to ensure soundness in design. These pieces were then assembled into a mock Nautilus, highlighting weaknesses in the theoretical designs that WarriorTides initially develops and creates opportunities for revision, enabling Nautilus to be the most competitive ROV possible.

Testing

WarriorTides has written custom test code for the thrusters, sensors, cameras, and claws to evaluate the functionality of these components. WarriorTides tests the integration of individual components in stages throughout the season, preventing the buildup of errors at the very end of the season. Before pool testing, WarriorTides completes a dry run where the entire system is powered, and all code is run. Additionally, Nautilus undergoes a 15-minute leak test with the PCB unplugged before every driver practice to ensure the system's safety. Nautilus has undergone 35 hours of pool testing to date. These pool tests are recorded in the pool log, along with what was accomplished, to identify how much more testing is necessary and in which areas. As the world championship approaches, WarriorTides shifts to meeting daily to practice full product demonstration runs with setup and teardown.



Figure 24: WarriorTides pool testing
Taken by Melissa Chacon

Troubleshooting

When troubleshooting, WarriorTides strives to remain calm and systematically explore the situation. Power to Nautilus is initially cut to ensure that all employees are safe while inspecting the error, especially in the case of leaks. In the case of an electrical issue, components on the board are all disconnected and then sequentially plugged in to narrow down the source of the error. Visual inspection and joint testing with a multimeter, following identification of problematic components, helps to precisely pinpoint areas to repair. In the case of a software issue, the team works together in a similar fashion, disabling different modules that may be causing errors. For mechanical issues, the team examines structural components for signs of stress, misalignment, or loose seals.

Date	Hours in Pool	Goals of Practice
11/24/2026	1	Initial leak test
12/02/2026	2	Initial drive test of ROV. Establish thrust limits and identify areas of improvement.
12/9/2025	2	Test drive functionality of core ROV
12/11/2025	1	Adjust buoyancy of ROV for stability
1/10/2026	2	Confirm functionality and calibration of all thrusters and sensors
1/15/2026	2	Test camera functionality in the pool
1/22/2026	2	Calibrate PID tuning to maintain a constant depth
2/10/2026	1	Test PID integration with regular driving commands
3/5/2026	2	Test claw functionality in the pool
3/12/2026	2	Pilot and Co-pilot practice for Task 1

Figure 25: Portion of Pool Log Table
By: Arunima Garg

ROV SID

Fuse Determination

ROV Full Load Amps

(FLA) in water =

24.6A

Fuse size selected

based upon FLA =

25A

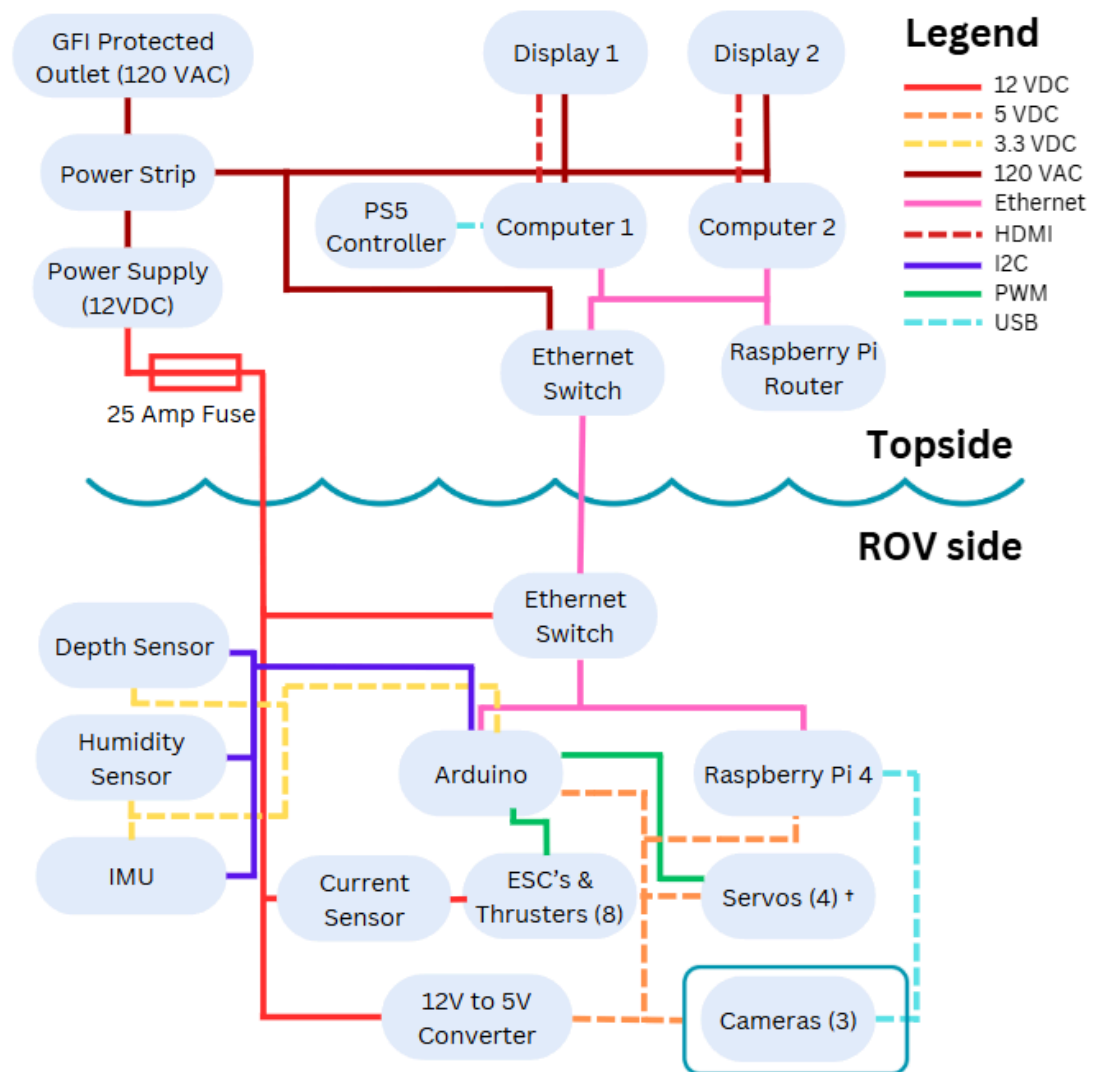
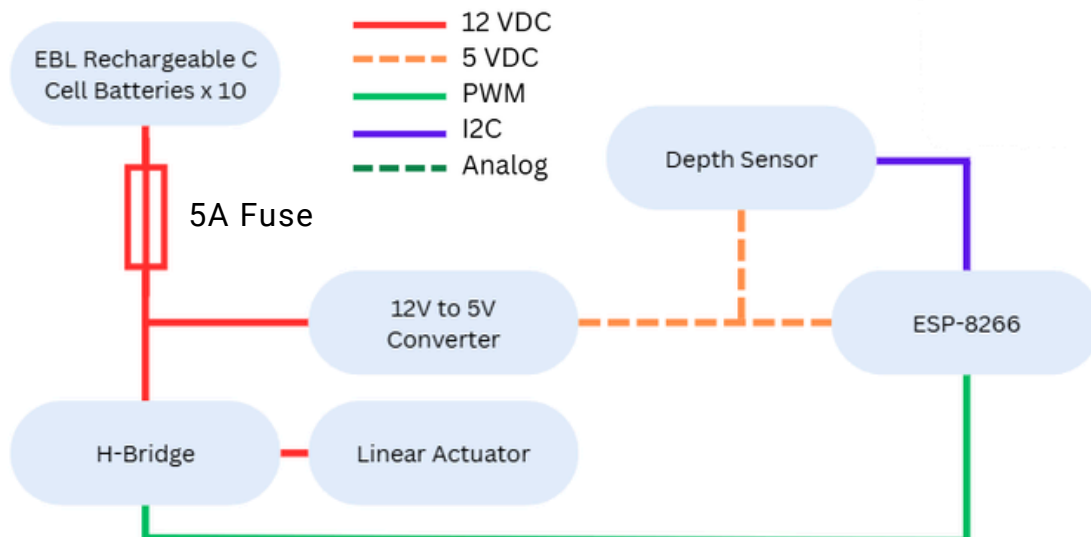


Figure 26: ROV SID
By: Parth Gaba

FLOAT SID

Legend

- 12 VDC (Solid Red Line)
- 5 VDC (Dashed Orange Line)
- PWM (Solid Green Line)
- I2C (Solid Purple Line)
- Analog (Dashed Green Line)



Fuse Determination

Float FLA in waiting

mode = 0.71 A

Float FLA in buoyancy

change mode = 2.7 A

Fuse size selected

based upon FLA = 5 A

Figure 27: Float SID
By: Parth Gaba

BUDGET

WarriorTides began this season with a budget of \$8,000, generously provided by Valley Christian High School. This budget was split into the categories of mechanical, electrical, software, and miscellaneous. Some re-used items from last season include topside materials, T200 thrusters, prop-building supplies, previously purchased tools, and generic electronic components. Additionally, Valley Christian High School provided 3D printers, filament, tools, and equipment transportation to the regional competition.

To avoid unnecessary spending, WarriorTides chose to continue implementing a justification requirement for purchases. When employees put in purchase requests for products over \$30, they were required to write a short memo answering the following questions:

- Why is this part necessary?
- Is it more effective to build this component in-house or purchase it?
- Why is this option preferred over lower-cost alternatives?
- How does this improve the ROV?
- Does this further the subteam's tenet?

These memos encouraged employees to think deeply about the parts they ordered, facilitating budget management and reducing wasteful spending culture. All memos and requests for purchases are reviewed by the CEO, co-presidents, and mentors.

The budget is continually referenced throughout the year to ensure that the development of Nautilus stays within the budget.

Both the budget and cost accounting for this season can be viewed in Appendix B.

Example employee memo for an Arducam Low Light USB Camera:

The item requested is the Arducam Low Light USB Camera. Cameras are essential for any ROV, enabling the driver to view the environment and steer effectively during missions. The "Low Light" feature ensures reliable performance in darker underwater conditions, which is especially valuable in pool environments.

Building a camera from scratch isn't impossible, but it would be unrealistic given time and budget constraints. Instead, the company considered the Low Light HD USB Camera from BlueRobotics, a reliable ROV component supplier. However, its \$99 price is steep, so the team identified a more affordable \$48 Arducam alternative, saving \$51 per unit.

The team plans to include three cameras in the ROV: two on each front, with one facing forward and one toward the claw. We're requesting two now for testing to confirm compatibility. If successful, we'll purchase three more, keeping the first two as spares.

Category	Item Name	Description (if needed, put special instructions here)	Quantity	Total Cost(cost *number ordered)	Link	Leadership Approval	Ordered	Arrived
Electrical	Water Leak Sensor	The SOS Le	1	\$35.00	https://bluerobotics.com/store/	✓	✓	✓
Electrical	Waterproof Servos	n/a	2	\$120.98	https://www.servocity.com/sw0	✓	✓	✓
Electrical	Waterproof Servo	n/a	2	\$39.98	https://www.amazon.com/Hob	✓	✓	✓
Electrical	Servo Test Kit	n/a	1	\$12.49	https://www.amazon.com/dp/B	✓	✓	✓
Electrical	Waterproof Heatshrink	n/a	1	\$13.98	https://www.amazon.com/Hea	✓	✓	✓
Mechanical	Digital Caliper	Please get ti	1	\$25.99	https://www.amazon.com/dp/B	✓	✓	✓
Mechanical	Spare Bulkhead O-Ring	Please orde	5	\$15.00	https://bluerobotics.com/store/	✓	✓	✓

Figure 28: Snippet of Running WarriorTides Order Sheet; Taken by Sophia Zhang



PROCESS & ANALYSIS

Build VS Buy

WarriorTides strives to build as much of the ROV in-house as possible, since it allows for maximum design customization and for company members to develop engineering skills while also providing limitless customization. All components related to specific mission tasks are built in-house to maximize performance. For example, Nautilus's manipulator was built by employees instead of buying one, as a contour could be designed into the pincers for optimal grasping geometry around 1/2 inch (12.7 mm) PVC pieces present in multiple mission tasks. However, some components are not practically feasible to build because they are costly, dangerous, or impractical to fabricate in-house.

Electrical

- Purchased components such as ESCs, as they are more cost-effective and time-efficient than developing them in-house.
- Designed and assembled the PCB in-house in order to tailor it to the team's needs and make specific modifications, but outsourced its fabrication as it would be unsafe and expensive.

Mechanical

- Bought a watertight box enclosure and T200 thrusters, as they are too complicated and time-consuming to design and manufacture ourselves. Manufacturing these components also raises safety concerns as faulty designs may result in accidental electrocution and water damage.
- Bought raw Delrin material, but laser cut in-house for a custom frame.
- Designed and manufactured custom 3D-printed parts, such as brackets and mounts, as it is a cheap and efficient method to prototype and implement.
- Designed and built the claw, but purchased gears and servos, as they are difficult to manufacture with precision.

New VS Reused

WarriorTides aims to be as environmentally conscious as possible. The company is aware that discarding any functional parts or materials may add to the global marine pollution crisis, an issue Nautilus is attempting to remediate. Thus, a significant number of components are reused between years; however, systems are never reused wholesale as they are modified and improved yearly.

Electrical

- The Topside Pelican Case and monitors were reused, as there is no increase in usability by replacing them, and all are still in excellent condition.
- Tools such as soldering irons, heat guns, and crimpers were reused as they were in good condition.
- ESCs were also reused, as previous years' were still in good condition. Similarly, electrical consumables like heat shrink, solder, and loose wire were used from last year's inventory, but were bought when needed.
- Newly implemented sensors, like the voltage reader, were purchased, while recurring sensors, like the depth sensor, were reused.

Mechanical

- All eight BlueRobotics T200 Thrusters were reused and showed no significant drop in thruster output or signs of wear.
- BlueRobotics's aluminum enclosure was reused as it showed no signs of damage.
- New Delrin was purchased to create a new frame design.
- Penetrator blanks and o-rings were reused unless they showed leakage issues.
- Tools like vacuum pumps, screwdrivers, drill bits, and hammers were reused as they were still in good condition.
- Fasteners such as zip ties, screws, and locknuts were purchased.



SAFETY

Safety Philosophy

WarriorTides approaches safety with the philosophy that safety is a continual process of improvement. The company takes pride in maintaining the safety and health of its employees in all situations. WarriorTides has a dedicated Safety Captain responsible for answering safety questions and ensuring all members follow safe practices.

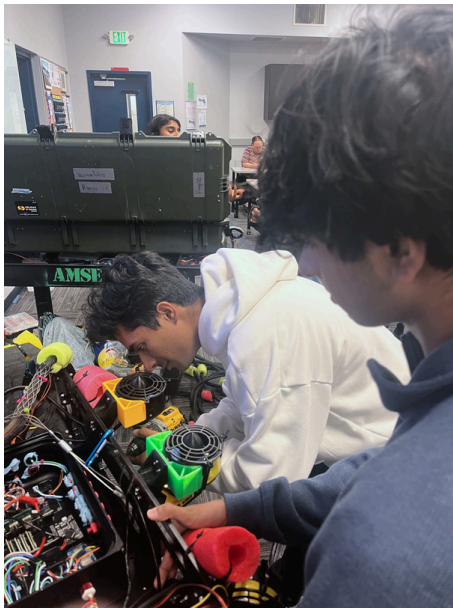


*Figure 29:
Safety
Captain
Rohan
Upadstra
oversees
Parth Gaba's
use of power
tools*

*Taken by
Arunima Garg*

Existing safety procedures, such as requirements for adult mentor supervision, continued this season. Concurrently, in alignment with this year's philosophy, WarriorTides considered situations where new safety measures might be applicable. For example, after realizing the dangerous possibility of tools like soldering irons being left unattended, the company instituted a new policy. At the end of a meeting, the CEO, Safety Captain, and mentors are responsible for completing a full rundown of all work areas to ensure no equipment is carelessly left on. This proactive stance of recognizing shortcomings in existing team policies and making corresponding changes enables WarriorTides to maximize safety in all aspects of operation.

ROV Safety Features

Intentional design choices were made during Nautilus's construction to maximize safety, including:

- **Dremel-sanded Delrin frames:** Delrin panels and frame components were carefully sanded and rounded to remove sharp edges, ensuring that team members are not accidentally cut while handling or transporting the ROV.
- **Thruster Shrouds:** All T200s are fitted with 3D-printed shrouds that meet IP-20 standards to prevent debris (mission props such as pins or ropes in Task 2) and fingers from getting caught in thruster blades.
- **Emergency Stop Button:** Present on the topside station is a highly visible and easy-to-reach emergency stop button to cut ROV power instantly.
- **Eye-catching Labels:** Neon yellow hazard labels are present on any parts that could be a safety risk, such as T200s.
- **Desiccants:** Moisture-absorbing desiccants are always present in the ROV's electronic enclosure and reduce the chance of short circuits by absorbing any water or humidity. A humidity sensor also alerts to leaks within the ROV, so power may be safely shut off.
- **Fuse:** In accordance with the MATE ROV competition guidelines, a 25-amp fuse is installed on the positive power line of the ROV, next to the power supply.



*Figure 30: Emergency Stop Button
Taken by David Yu*



SAFETY

Operational Safety

☐	Safety glasses are worn when soldering, when using drills/dremels/bandsaw, and when thrusters are on to protect from flying debris
☐	Fume extractor is always turned on when soldering
☐	Team members always wear closed-toed shoes
☐	No running in the workspace or on the pool deck
☐	No food/drink in the workspace
☐	Employees must be trained and certified on machinery by mentors before using it
☐	JSA is accessible at all times

Construction Safety

☐	ROV has no exposed wiring
☐	ROV has no sharp edges
☐	Tether has proper strain relief
☐	A fuse with overcurrent protection is connected to the power supply

ROV Operation Safety

Before Leaving Workspace	
☐	Insert desiccants into the enclosure
☐	Vacuum test for fifteen minutes, ensuring that the reading stays constant at fifteen mmHg
☐	Check that vent plugs on all enclosures are tightly fastened
☐	Ensure that strain relief is fastened to both the ROV and topside station
☐	Coil tether safely to prevent tangling during transportation to the pool
Before ROV Launch	
☐	Ensure that the pool deck is clear of all possible hazards
☐	All swimmers must be out of the pool or separated by a bulkhead
☐	Plug into a GFI-protected power outlet. Pilot must call "POWER ON"

☐	Test connectivity between topside and ROV.
☐	Confirm that thruster, camera, and claw code works as intended.
ROV In Water	
☐	Poolside team calls "ROV IN"
☐	Poolside team maintains a grip on tether at all times, and is prepared to pull out of the water in an emergency
☐	Poolside team watches for bubbles exiting the ROV
☐	Drive team calls out changes in the mission plan, and requests for more or less tether
☐	Drive team informs everyone on deck that the mission has ended and that they are returning the surface
☐	Pilot disables ROV control and poolside team calls "ROV OUT"
Following ROV Launch	
☐	Poolside team checks for any moisture within the second O-ring and any color change to the desiccants
☐	ROV is thoroughly dried with towels to prevent rusting and corrosion of components and buildup of chlorine and other pool chemicals
☐	Poolside and drive team regroup to discuss the mission run and any optimizations for future runs

Figure 32: Formal Poolside Checklist
By: Sophia Zhang



Figure 31: Nautilus's topside strain relief
Taken by Anya Li



CORPORATE RESPONSIBILITY

At WarriorTides, corporate responsibility is highly emphasized. Though intellectual growth is essential to the company, WarriorTides believes it is equally important to give back to the environment and community.

Volunteering

Beyond engineering, WarriorTides partners with Keep Coyote Creek Beautiful and the City of San Jose to help clean up Coyote Creek. This allows employees to recognize the prevalence of plastic pollution stemming from human impact. During this trip, the organization cleaned up 2,720 pounds of trash, and it was an essential reminder that the company's work as a company extends far beyond the technical aspects of building an ROV, reinforcing the team's commitment to protecting and preserving the environment.



*Figure 32: The team volunteering at a creek clean up in Coyote Creek Park
Taken by Jessica Ruppert*

Engaging Community

WarriorTides ran "Dreams to Design", a week-long engineering camp that hosted 25 students from low-income families, inspiring them to pursue engineering through projects such as helicopters, towers, and circuits. Additionally, to emphasize the significance of underwater robotics, WarriorTides continues to host annual Drive Days, inviting members of the community to learn about marine environmental concerns and offering the opportunity to

drive an ROV, as well as deliver presentations at the Valley Christian High School Open House and Valley Christian AMSE Xperience Showcase.



*Figure 33: Dreams to Design Campers
Taken by Sophia Zhang*

Mentoring

To continue the MATE ROV mission of engaging students in using marine technology to remediate environmental challenges, WarriorTides founded WarriorWaves, another company that competes in the MATE ROV Navigator class. WarriorTides employees take on the significant responsibility of mentoring this team by hosting workshops, providing design advice, and offering technical training. The organization also provided further assistance by designating one WarriorTides employee from each of the three sub-teams to spend half an hour once a week with WarriorWaves to help them with more in-depth technical challenges.



*Figure 34: WarriorWaves member receives advice
Taken by Sophia Zhang*



REFLECTIONS

Major Challenges

This year, WarriorTides prioritized proactive planning and allocating leeway time to ensure that major setbacks would not derail the company's development timeline. This strategy has proven to be successful, although there were some hurdles. The company struggled to design the new ROV to be lighter in weight than last year's, and this was achieved by removing the buoyancy engines, as their slight benefit did not justify the added weight. Instead, the team used buoyancy foam and experimented with how much would be necessary to achieve neutral buoyancy. The team also struggled to integrate eight new employees, who moved up from WarriorWaves (a Navigator-class company). In order to learn new competition requirements and design constraints of WarriorTides, the summer was spent in constant meetings with WarriorTides alumni, who took time to explain everything to us.

Future Improvements

Although Nautilus is an exceptional work of technical innovation, WarriorTides sees several opportunities to push its performance further. One key area is design for assembly—while assembly is currently manageable, simplifying the process could significantly reduce build and repair time during high-pressure situations. The team also aims to explore size reduction, as the current footprint can create challenges in maneuverability. This may involve rethinking the electrical system to be more space-efficient by integrating functionality directly through surface-mount components rather than modular boards.

On the software side, this year's implementation of directional PID controllers greatly improved driving smoothness. Expanding this system to offer more comprehensive stabilization, even while actively piloted, will be a focus

next season. Together, these enhancements will help WarriorTides continue refining both the form and function of future ROVs.

Lessons Learned

In reflection, WarriorTides has learned the value of pushing boundaries while staying grounded in structure. Embracing bold ideas—like bilateral control systems—taught the team that innovation requires calculated risk and confidence in pursuing the unknown. While taking on these ambitious and technically daunting tasks, the team discovered that success hinges on thoughtful scheduling. By setting clear deadlines, defining milestones, and building in leeway for unexpected setbacks, members created the space to prototype, fail, iterate, and improve—without falling behind. This balance of ambition and planning enabled the team to take on more complexity than any previous season while remaining focused, efficient, and united in the team's mission.

From the CEO...

It has been a privilege and an honor to lead WarriorTides for one final season, creating the most technically advanced ROV the company has produced to date. Participating in the MATE ROV competition has pushed our team's engineering skills to new heights and opened doors to future careers in STEM. But beyond the technical growth, WarriorTides has become a close-knit community—a team that genuinely enjoys working together, learning from each other, and rising to challenges as one. I am incredibly proud of all that we have accomplished this season and even more excited to see what the next generation of WarriorTides will continue to achieve.

- Arunima Garg, WarriorTides CEO 2025-2026



ACKNOWLEDGMENTS

WarriorTides would like to thank the program manager, Ms. Siemer, for her ceaseless support and guidance in scheduling and leadership as well as logistics for Worlds this season. WarriorTides would also like to thank Zachary Martino and Dr. Okoro for their technical mentorship and assistance. Thank you to Valley Christian High School for providing WarriorTides with funding, a workspace, and numerous opportunities to educate the community about underwater robotics. Thank you to the MATE ROV team for hosting the annual MATE ROV competition and challenging WarriorTides to build an ROV capable of remediating global environmental concerns. Finally, WarriorTides thanks the MATE Center for striving to improve marine technical education and providing the company with the opportunity to learn and compete.

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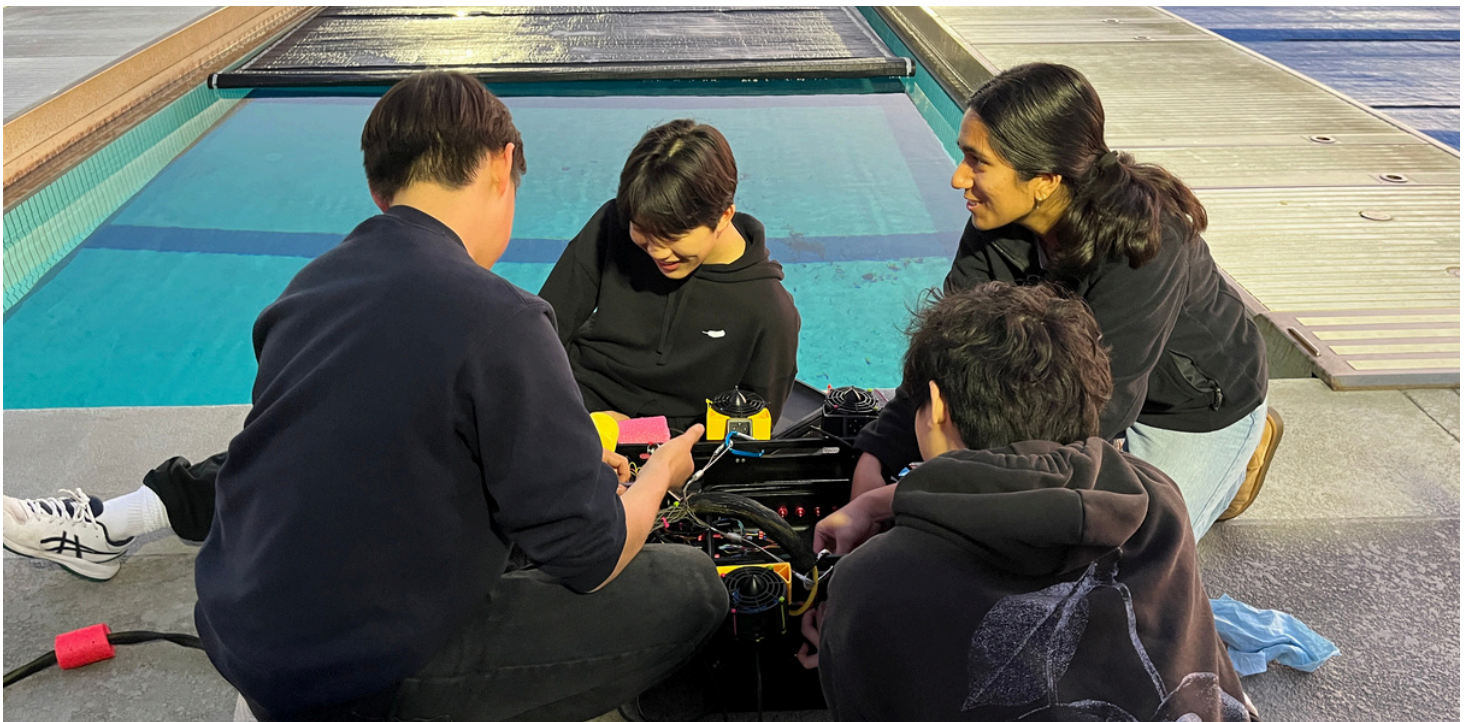


Figure 35: WarriorTides testing in the Pool
Taken by Sophia Zhang



APPENDICES

Appendix A: Portion of 2025-2026 Gantt Chart

WBS NUMBER	TASK TITLE	TASK OWNER	START DATE	DUE DATE												
					August 3-9	August 10-16	August 17-23	August 24-30	Aug 31-Sep 6	September 7-13	September 14-20	September 21-27	Sep 28-Oct 4			
					25	27	1	3	8	10	15	17	22	24	29	1
1	Mechanical															
1.1.1	ROV Design		6/15/25	7/5/25												
1.1.2	ROV CAD		7/6/25	8/23/25												
1.2	Frame	Arunima	7/6/25	10/27/25												
1.3	Box Baseplate Support	Arunima	7/6/25	11/12/25												
1.4	Frame Connector Pieces	Arunima	7/6/25	10/27/25												
1.5.1	Camera Enclosure Holders	Aaron	7/6/25	10/13/25												
1.5.2	Internal Camera Mount	Aaron	7/6/25	10/15/25												
1.7	ROV Assembly (without claw)	Whole Team	7/7/25	11/15/25												
1.9	2 Claw Assembly	Sean + Justin	7/11/25	12/23/25												
1.1	Mission Task	Aaron + Sean	7/12/25	1/31/26												
2	Electrical															
2.1.1	Main PCB	Sophia	6/25/25	10/27/25												
2.1.2	Update Main PCB	Sophia														
2.2.1	Sensor Hub	Parth	6/25/25	10/27/25												
2.2.2	SEnsor hub 2	Parth	9/10/25	10/27/25												
2.3.1	ESC Board 1	Rohan	6/25/25	7/11/25												
2.3.2	ESC Board 2	Rohan	7/7/25	10/27/2025												
2.7	SID	Sophia	march	april												
3	Software															
3.1	Camera Testing	Kashish	7/6/25	9/26/25												
3.2	Sensor (IMU, BME, depth)	Anya	7/6/25	10/1/25												
3.2.1	Sensor Testing	Anya	10/1/25	11/19/25												
3.2.2	Thruster Testing	Anya	8/24/25	10/1/25												
3.3	GUI Design	Kashish	8/17/25	9/20/25												
	Claw Code	Krishna		9/8/25												

Appendix B: Budget

Income	Type	Description	Amount	
School Funding	Grant	Valley Christian High School Funding Grant	\$8,000.00	\$8,000.00
TOTAL Income				\$8,000.00
Expenses	Type	Description	Projected Cost	Budgeted Value
Mechanical	Purchased	Frame Materials/Fasteners	\$800.00	\$800.00
	Purchased	Watertight Aluminum Enclosure	\$1,200.00	\$1,200.00
	Purchased	Weights	\$50.00	\$50.00
	Purchased	Bouyancy engine and Float Supplies	\$650.00	\$650.00
	Re-Used	Claw Servos	\$240.00	N/A
	Purchased	Claw Gears	\$180.00	\$180.00
	Re-Used	8 T200 Thrusters	\$1,600.00	N/A
	Donated	Printer Filament	\$200.00	N/A
	Purchased	Mission tools	\$50.00	\$50.00
	Purchased	PCB Manufacturing & PCB Components	\$900.00	\$900.00
Electrical	Purchased	Topside Computer	\$600.00	\$600.00
	Purchased	Electrical Consumables	\$50.00	\$50.00
	Re-Used	Pelican Case, Monitors, Tether	\$505.00	N/A
	Re-Used	ESCs	\$456.00	N/A
	Purchased	Ethernet Switches, Arduino, Electronics Modules	\$500.00	\$500.00
	Re-Used	Power Supplies	\$300.00	N/A
	Purchased	Acrylic for Topside	\$60.00	\$60.00
Software	Re-Used	Cables, Adapters, Controllers	\$200.00	N/A
	Purchased	Sensors	\$200.00	\$200.00
	Purchased	Camera System	\$435.00	\$435.00
	Purchased	Raspberry Pis	\$150.00	\$150.00
Miscellaneous	Purchased	Ethernet & USB Hub	\$150.00	\$150.00
	Purchased	Team Bonding	\$200.00	\$200.00
	Purchased	Prop Building Supplies	\$290.00	\$290.00
	Re-Used	Prop Building Supplies	\$180.00	n/a
Travel	Donated	Regional MATE Entry Fee	\$450.00	n/a
	Donated	Transportation to the Regional	\$100.00	n/a
TOTAL Expenses:			\$10,696.00	\$6,465.00
			Total Income:	\$8,000.00
			Total Expenses:	\$5,265.00
			NET Profit:	\$2,735.00
			Total Fundraising Needed:	\$0.00