Lakeview Sub-Aquatics Technical Report

Lakeview Sub-Aquatics - Lakeview Technology Academy, Kenosha, WI, USA

Team Members and Roles
Danny Henningfeld (12th): Chief Executive Officer
Isaac Litwiller (12th): Chief Operating Officer
Conner O'Reilly (11th): Chief Technology Officer
Matthew Springer (11th): Pilot & Lead Engineer
Tyerone Chen (12th): Lead Programmer
Lila Verbsky (10th): Chief Financial Officer & Project Manager
Timofey Kudryavtsev (11th): Project Manager & Mechanical Engineer
Kenshin Galgan (12th): Structural Engineer
Ryan Blythe (9th): Electrical Engineer
Lily Roppolo (10th): Engineer
Graham Wunder (9th): Programmer
Elliot Fortner(10th): Manufacturing & Mechanical Engineer

Team Photo - Credit: Dr. Eric Schroeter

Team Mentor(s):
Dr. Eric Schroeter

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Abstract -

Lakeview Sub-Aquatics is an underwater robotics company that specializes in the production of Remotely Operated Vehicles (ROVs). Our team of innovators and entrepreneurs works together to create submersibles capable of analyzing, manipulating, and maneuvering themselves within an underwater environment.

Our work stems from a passion for engineering, robotics, and electrical engineering. One of our primary aims is to help our members learn aspects of both marine engineering and robotics. Throughout the construction of the ROV, we assign each of our members to specific tasks and aspects to work on in regards to the ROV. By outlining their roles in accomplishing our goals, we spread our knowledge amongst our team to achieve greater ends. With these newfound skills, members of our team have worked meticulously to construct our newest product: Pterolycus.

Over 8 months, we built upon our previous product and engineered it to fix previous shortcomings. With a restructured frame, we've increased the stability of our vehicle and made it more maneuverable. Additionally, we've added a variety of new functions to assist in analyzing aquatic environments. Primarily, we've focused on advancing the robot's capability to retrieve objects and aquatic life from underwater. By applying the capabilities of these new additions, Pterolycus 1 can assist with gauging aquatic conditions without the need for direct human contact.

Project Management

Company Overview -

Lakeview Sub-Aquatics has been making ROVs for over a decade. Our collective experience and knowledge have helped to shape the team and our ROV into what it is today. Our company is dedicated to creating our robot with a high percentage of in-house engineering and manufacturing. We have access to a limited amount of resources to design and produce our parts and designs to create our

ROVs. Our Company also utilizes experienced members to effectively organize and complete tasks. Our CEO, Danny M. Henningfeld, currently has the longest tenure of any member of our team. With this experience, he is our most prominent member and leads our team to success. Our CTO, Conner C. O'Reilly, has extensive knowledge about vital systems such as our extensive electrical system and our programmed controls. He has helped to teach our younger members how to properly wire and code the ROV and provides an example to those around him. Our team is formed by many great people who are dedicated and willing to do the work needed to create such a great ROV. Our connectivity and ability to work together have created a team full of different ideas and unique insights that aid us in creating our ROV.

Company Schedule (4/10/2025)

ROV Schedule as of 4/10/2025			
Task	People Assigned	Goal Date	Completion Status
Update Frame	Isaac, Conner, Kenshin	12/31/2024	Completed
Improve Brainbox	Conner, Timofey, Matthew	2/07/2025	Completed
Add More Thrusters	Conner, Matthew	10/3/23	Completed
Install New Claw	Matthew, Lila	1/23/24	Completed
Rewire The Robot	Conner, Timofey, Matthew	03/01/25	Completed
Mechanical Screw of Float	Isaac, Danny, Ryan	12/25/24	Completed
Float PCB Design	Danny, Tyerone	12/31/24	Completed
Mount New Camera	Matthew	1/24/24	Completed
Company Spec Sheet	Isaac, Tyerone	04/15/25	In progress
Technical Documentation	Isaac, Elliot, Conner, Matthew,	03/30/25	In progress
Marketing Display	Lila	03/30/25	Complete
Create Specialized Tools	All	03/30/25	Incomplete
PCB	Conner, Tyerone, Danny	02/15/25	Did not use
Control Systems	Lila, Matthew	04/15/25	In progress
Build Props	Lila	04/1/2025	Complete

Procedures & Protocols

Lakeview Sub-Aquatics has established a system that allows our members to complete our objectives efficiently. We split into small groups that are composed of specialized workers for individual parts of our product, and work to complete our objectives. Representatives between each group help to communicate between these groups and ensure all parts of the ROV will work together properly. If a group is having problems with their task, we will have people from other groups assist and give the problem a second look. For allocating our monetary resources, we come together as a group and vote as a collective whole. This ensures that we properly use our resources and that most people are satisfied with the outcome.

Design Rationale

Overall Engineering Design Rationale

The design rationale of the Lakeview Sub-Aquatics ROV project is driven by a meticulous and strategic approach aimed at optimizing performance and functionality. Our team's diverse expertise in engineering, programming, and entrepreneurship plays a vital role in shaping the design principles of our underwater robotics system. The primary goal is to create an innovative ROV capable of efficiently traversing and analyzing a variety of underwater environments with precision and reliability.

Our focus on electronic design emphasizes meticulous cabling and strategic component placement for optimal performance and seamless system integration. The control system design, incorporating advanced coding techniques, enhances maneuverability and operational control, bolstering the agility and responsiveness of the ROV. Understanding tether design requirements is reflected in the use of sleeved data transmission and a dedicated power line, ensuring robust and uninterrupted communication between the surface and the vehicle.

Additionally, our design approach prioritizes adaptability and versatility in the vehicle structure, allowing for the attachment of new tools and payloads as needed. The frame's construction from lightweight HDPE material balances structural integrity and cost-effectiveness, with safety features like stainless steel screws and chamfered edges enhancing durability. Innovation drives decisions, leading to the development of specialized tools like the claw and rotator to expand the ROV's operational capabilities in diverse underwater tasks.

Innovation

The ROV team has innovated on the frame of the robot by making the frame more compact, allowing for better maneuverability and the ability to navigate into tighter spaces. By reducing the footprint of the frame, the robot can have thicker walls, improving rigidity and structural strength. Another key highlight for the ROV is the complete reworking of the internal wiring systems. The previous ROV had over 50 individual connections, typically linking only one wire, leading to many fault points per device. Initially, the plan to reduce wiring was to implement a PCB. Unfortunately, after designing the PCB, it became clear that the traces would increase resistance to an unusable level and overheat. Therefore, the current ROV uses a system of connectors. The connectors that handle high current are the XT series connectors. A single XT-90 Connector handles the surface power. The brushless motor connections are made using MT-60 Connectors, a 3-pin version of the XT-60 connector. The XT-60 connector provides the bulk of power distribution from the internal terminal blocks. These connectors provide consistent, durable, low-resistance connections. In updating these connectors from the old banana plug style connectors, the robot is now able to use its power allowance significantly more effectively.

Problem Solving -

Throughout our time working on Pterolycus, we've encountered several problems that have influenced our design choices. Whenever members of a project hit a roadblock while working on their present task, we often attempt to gather ideas from other members of the company. We then, collectively, gauge these ideas or use them to inspire new ideas that may be more cost-effective or efficient to perform. After generating a hypothetical solution, we bring the rest of the company together to discuss their opinions on the solution. This allows for productive discourse resulting in improvements upon the design, making it more effective, easier to build, or more cost-effective. One key example of this planning in action was designing the circuit board for the ROV. Initially, a small team of only two members created a prototype circuit board that could be used. Though upon presenting this idea to the full group. Another member identified a weak point in the design. Due to the spacing on the connectors, it was impractical to utilize a PCB for this application. After brainstorming, the team decided to switch from a circuit board to a system of connectors. Along with the improved organization, these connectors have significantly reduced parasitic losses.

Systems Approach

All of the members of our team have the ability to communicate with any other member. Though in creating an efficient structure, dividing into specialized teams has created a much better workflow. By only requiring senior members to coordinate projects together, it leads to a more cohesive approach. Also, by reducing miscommunication and misunderstandings, we were able to allow our team members to know how their specific tasks integrate into the robot . The ROV utilizes several different systems that are vital for the operation of the robot. The primary system for the ROV is the power distribution. Power distribution is done through a 12V 25A rated power supply ensuring the robot cannot draw over this load. This means that in addition to the 25A rated fuse required by the competition the power supply's multitude of protections also are in effect. Inside of the robot there are 2 power distribution blocks. Each block is on separate sides of the plastic tray: isolating the two terminals. The 5V power regulation for the main computer is handled by a small variable voltage power supply. Secondarily, the communication system is vital to the performance of the ROV. Along with the power wires running to the robot, a CAT 5e ethernet cable runs to the robot as well. While CAT 5e is not the most recent standard, it provides a 1 gigabit connection to the surface which is significantly more than the robot is using. In addition, the older standard is more robust. The computational power of the ROV is divided between two separate computers. There is a robot computer for mission critical data processing such as stabilization programs. Computationally expensive operations such as displaying video feeds are handled by the surface computer. This means that much of the load is taken off of the ROV computer improving efficiency.

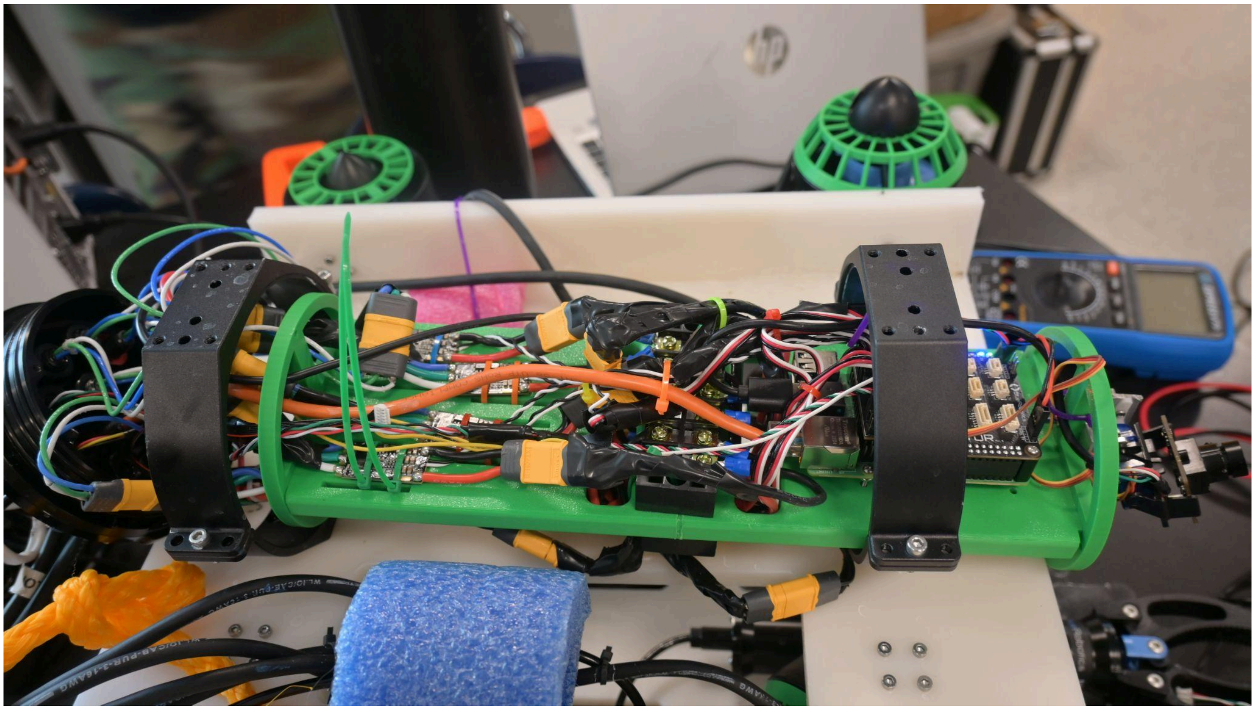
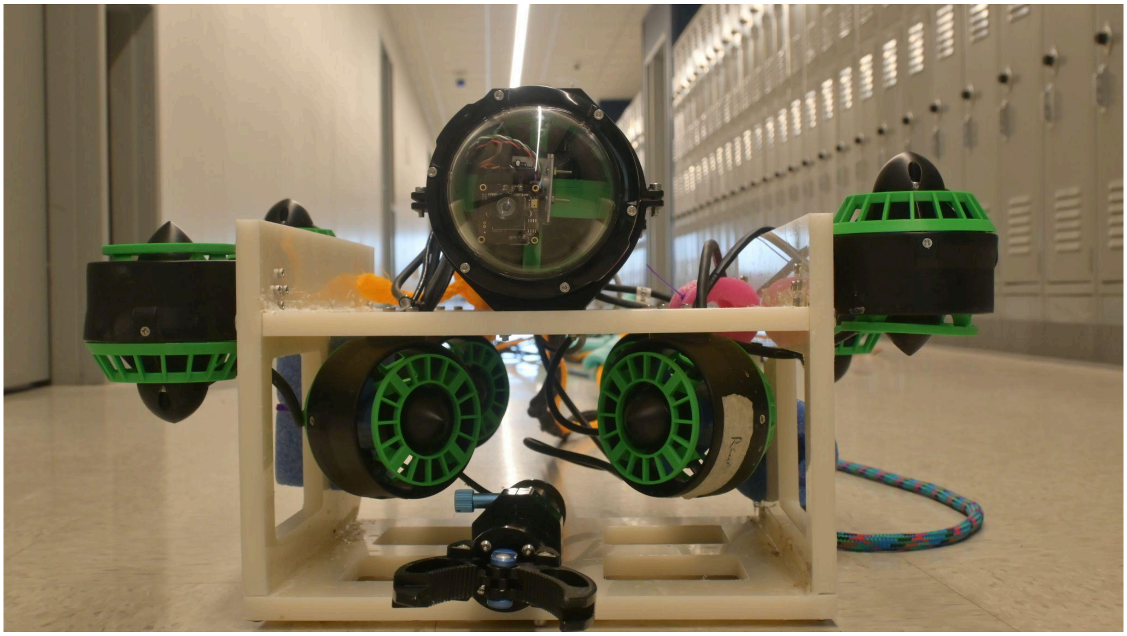


Photo of completed electronics - Credit: Connor O'Reilly

Vehicle Structure

We attempted to minimize the footprint of the robot, by reducing the size of the frame of the robot by 20% in 2025, as compared to previous year. Learning from past mistakes, the frame of Pterolycus 1 is specially designed to be much far more stable than previous models. The reduced scale of the vehicle frame means that we are able to increase rigidity not only through increased thickness but less leverage acting on each part. The smaller and lighter design and the frame also allows for tighter turn and faster movement. The vehicle frame is still using hdpe, a strong but durable plastic, this material provides a good balance of strength and cost while being almost neutrally buoyant. The more compact frame also means that the structure creates less drag during movement. These benefits from our new frame allowed us to rework our tube mounting system creating a more secure and functional system. In addition a brace that was required before has now been removed reducing mass and complexity.



Vehicle Systems -

To meet the ever-changing mission specifications, our ROV Pterolycus 1 is equipped this year with a Fish Retrieval Device (FRD) and a compact, motor-driven measurement system. The FRD comprises a 3D-printed cage topped with overlapping rubber bands: when pressed against a surface, the bands deform to admit the fish and then contract to prevent its escape. This configuration was selected after rigorous testing of multiple capture methods and materials. The measurement system deploys a weighted line on a motor-driven reel, with markers at key intervals, allowing rapid length assessments of shipwreck features while maintaining a compact and efficient design.

Control & Electrical Systems. -

The vehicle's electronic design incorporates meticulous wiring to ensure optimal performance, while the control system design, including relevant code, enables precise maneuvering. Our understanding of tether design is evident in the use of sleeved data transmission and a dedicated power line running to the strain relief point before connecting to the tether, ensuring reliable communication. Additionally, a detailed tether management protocol has been developed, outlining systematic procedures for efficient handling during deployment and retrieval, enhancing operational reliability and safety. Once the tether reaches the robot it is anchored to the frame ensuring stress is only placed on the supporting rope. The cables are all anchored through a back flange that enables precise wiring within the enclosure. The terminals for the main power are run through an XT-90 connector ensuring additional thermal headroom from operating within an enclosed space. Control is run through a Raspberry Pi 4b with a navigator hat. This system ensures for optimal reliability even though it has longer boot times compared to alternatives. The robot computer is running a beta version of blue-os The surface control is running a beta version of QGroundControl. This system is a well known and vetted system providing the perfect launching point requiring minimal programming. This is optimal because it allows for our team's programming prowess to be directed towards the automated float.

Propulsion

Pterolycus 1 utilizes an 8 motor configuration, enabling 6-axis motion for enhanced maneuverability and precision in underwater operations. The rationale behind this design choice lies in the need to balance power consumption, performance, and mission requirements effectively. By incorporating a higher number of thrusters, our ROV can navigate through water with increased agility and control, meeting the diverse demands of various tasks. This strategic placement of motors not only optimizes the overall performance of Pterolycus 1 but also ensures that power resources are utilized efficiently. Because the motors are running at low load this means that the motors are running in their most efficient operating condition. This aligns with our goal of achieving excellence in underwater exploration.

Buoyancy

Our approach to buoyancy involves a strategic combination of weights and pool noodles to ensure that the robot maintains a mostly neutral buoyancy with a slight positive bias. By carefully calibrating the amount of weight and the placement of pool noodles, we guarantee that the robot remains stable underwater.

This design not only optimizes the robot's performance but also serves as a fail-safe mechanism. In the event of a system failure, the robot is engineered to gradually ascend to the surface, facilitating easy retrieval and minimizing the risk of damage. This dual-purpose buoyancy system underscores our commitment to both operational efficiency and robust safety measures in all underwater scenarios.

Payload & Tools

Claw:

In our quest for a functional robot, a critical component that underwent significant improvement was the claw mechanism of our robot. Recognizing the limitations of our previous claw, which lacked sufficient grip strength and efficiency, we made a strategic decision to upgrade to a new claw sourced from Blue Robotics. This new claw boasts enhanced gripping capabilities, providing our robot with the power and dexterity needed to perform tasks with precision and speed. This investment additionally removes any hydraulic systems from our base robot. By investing in this advanced claw technology, we have elevated the performance capabilities of our robot, enabling it to tackle a wider range of tasks more effectively, efficiently, and with increased reliability. While the claw is effective there are still issues with the plastic jaws that come with the claw. For this reason the robot is currently in the process of being upgraded to machined aluminum jaws. This process is being done in-house by our members who are proficient in operating CNC machines safely.

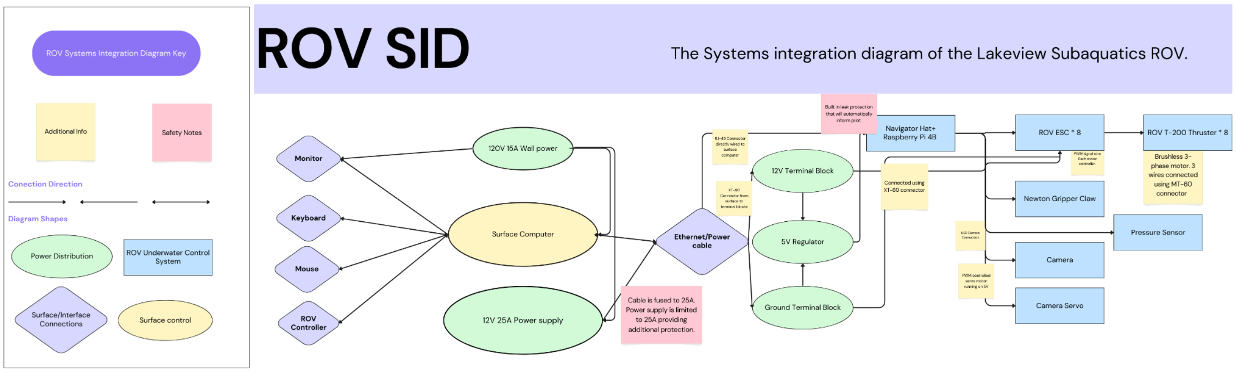
Cameras:

The camera system integrated into our ROV is a simplistic yet versatile component that significantly enhances our underwater operations. With the capability to tilt both upwards and downwards, as well as providing a forward-facing view, our camera system offers unparalleled flexibility and functionality. This design allows us to capture detailed images at various depths, facilitating precise inspections and data collection. The forward-facing camera further enables us to navigate effectively and avoid obstacles, ensuring smooth operation and mission success in challenging underwater environments. The camera is designed specifically for underwater applications with a lower megapixel count than similar sensors. At first this design choice seems counterintuitive, but a smaller sensor means more light is able to reach each individual pixel. This leads to reduced noise. Because our lens and aperture are fixed, our only way to adjust the camera is through iso. The bigger pixels mean a lower iso is needed as well as less noise at higher iso settings in extreme conditions. The camera only displays at 1080p though given this is the resolution of our monitor this is not considered a drawback.

Build v. Buy Decisions

The decisions of what to build in-house and what to purchase mainly relied on our manufacturing abilities. At Lakeview Sub-Aquatics, we try to build as much of the robot in-house as possible. However, we are not able to produce advanced devices such as our motors. When determining whether we want to produce an item or purchase it, we first brainstorm if there is any way to build it ourselves. If we determine that we can then we will start engineering and manufacturing the part. Otherwise, if we cannot build it or if it would take too much time and resources we outsource the production. We attempt to use our specialized designs to complete the mission requirements because we believe that we can apply the tools that we made ourselves better than outsourced tools that are not as specialized for the task. This year we have redesigned and cut out a new frame in house in order to improve stability and weight distribution. However, due to spending significant time designing the robot frame, we decided to buy a new electronics housing since in past years we have had problems with leaking and this project taking up too much time with lackluster durability. Lakeview Sub-Aquatics is dedicated to making as much as we can ourselves and only buying components when necessary. We believe that in doing so, we are able to elevate our product to a higher standard that is better suited for our operations.

System Integration Diagram



Safety

General Safety

The Pterolycus 1 ROV was designed with safety in mind. We have created proper motor covers to protect people's hands from getting caught in the motor. The electronics are housed in waterproof containers with fuses in case of emergency. We also chamfered the frame to ensure that people cannot cut their hands when interacting with the ROV. Lakeview Sub-Aquatics also followed proper safety procedures during the production process, including the use of safety glasses and other PPE when it is applicable. We made sure that the use of all hand and power tools and CNC machines was properly supervised. This was done so that no unnecessary risks were taken during the production process of the robot. These methods have successfully allowed for zero injuries during the development of the robot, as well as no catastrophic failures resulting in injuries to divers during testing.

Safety Checklist

- ☐ Is everyone wearing the applicable PPE, including safety glasses
- ☐ Are all electrical components fused at the proper rating
- ☐ Is everything securely attached to the ROV
- ☐ Are there any sharp edges or components protruding from the ROV

- ☐ Are the motor guards in place and secure
- ☐ Is the tether properly connected
- ☐ Ensure that the tube is fully sealed to prevent a short circuit

Operational Checklist

- ☐ Check all wiring connections inside the Brain Box
- ☐ Check for tears or wear on sealing components
- ☐ Check the power supply for the robot and ensure proper fuse is in place
- ☐ Power on the robot and test all onboard equipment
- ☐ Go through the Safety Checklist
- ☐ Run small tests in water to ensure safety
- ☐ Ensure all movement directions and capabilities are functional
- ☐ Deploy robot

Testing and Troubleshooting

This year, the troubleshooting procedure has stayed very similar to previous years. Initially, the team member encountering the problem is given one day to brainstorm solutions to the roadblock. If these solutions do not provide a clear pathway, a larger brainstorming session is held to find the best way forward. This also means that other members' expertise and knowledge can be applied, leading to quicker and more efficient problem-solving. Unlike the problem-solving methods, the testing methodology has completely shifted this year. During our school's move between buildings, we lost the ability to maintain a small tank to test the robot on a small scale. This means that all testing has to be done at a proper pool. Our team currently has two certified lifeguards, meaning that visiting the pool is possible in a safe environment. Though testing time is significantly limited compared to previous years. In order to test the robot or other devices in water, we must make an appointment with a nearby school with access to a pool. Though as a team, we have managed to utilize our effective communication foundation to use this time as efficiently as possible. This means that despite the more strenuous testing process, more testing has been done this year compared to any prior year.

Accounting

Budget

This year, Lakeview Sub-Aquatics received $5,000 dollars in funding from Lakeview Technology Academy. Additionally, we received sponsorships from our team members' families and Gateway Technical College. This enabled us to make critical purchases that improved the robot and saved us precious time and resources. Our main purchases were: an electronics housing, raw material for our frame, and new tools to replace our aging fleet. The decision to replace our housing was made after analyzing the previous plastic tube and noticing wear outside of tolerance after less than ten uses. Because of this, we sourced a more durable aluminum housing. Additionally, we acquired spare parts to allow for fault tolerance in our design. For travel costs, Gateway Technical College and Lakeview Technology Academy have promised to pay for any transportation and housing needs the team has.

Cost Accounting

All Items purchased by Lakeview SubAquatics through school funding of $5,000

Date Ordered	SUPPLIER	ITEM	QUANTITY	PRICE	SUBTOTAL	TOTAL
ordered 10/11/24	BlueRobotics	ROV PASSTHROUGH	12	$6.00	$72.00	$2,408.45
ordered 10/11/24	BlueRobotics	T-200 THRUSTER	2	$200.00	$400.00	
ordered 10/11/24	BlueRobotics	ESC FOR T-200 THRUSTER	2	$38.00	$76.00	
ordered 10/11/24	BlueRobotics	REAR FLANGE	2	$32.00	$64.00	
ordered 10/11/24	BlueRobotics	FRONT DOME	2	$40.00	$80.00	
ordered 10/11/24	BlueRobotics	SD CARD	2	$10.97	$21.94	
ordered 10/11/24	BlueRobotics	DISPLAY PORT CABLE	3	$8.99	$26.97	
ordered 10/11/24	Amazon	Motor	2	$14.99	$29.98	
ordered 10/11/24	Amazon	500 ml Syringe with blunt needle	2	$12.99	$25.98	
ordered 10/11/24	Amazon	SOLDERING IRON	1	$79.99	$79.99	
ordered 10/11/24	Amazon	PLASTIC WELDING MATERIAL HDPE 1/8"	1	$11.99	$11.99	
ordered 10/11/24	Amazon	COMPUTER BATTERY	1	$37.89	$37.89	

ordered 10/11/24	Amazon	Tips for soldering	2	$15.99	$31.98	
ordered 10/11/24	Amazon	Soldering Iron KSGER	1	$79.99	$79.99	
ordered 10/11/24	Amazon	Breadboard Jumper Wires	1	$13.99	$13.99	
ordered 10/11/24	Digikey	(Electronic components)	10	$0.30	$2.95	
ordered 10/11/24	Digikey	(Electronic components)	10	$0.77	$7.66	
ordered 10/11/24	Digikey	(Electronic components)	50	$0.15	$7.57	
ordered 10/11/24	Digikey	(Electronic components)	100	$0.02	$1.60	
ordered 10/11/24	Digikey	(Electronic components)	10	$0.68	$6.80	
ordered 10/11/24	Digikey	(Electronic components)	10	$0.47	$4.70	
ordered 10/11/24	Digikey	(Electronic components)	10	$0.15	$1.50	
ordered 10/11/24	Digikey	(Electronic components)	10	$0.10	$1.00	
ordered 10/11/24	Adafruit	Male headers 10/pk	2	$4.95	$9.90	
ordered 10/11/24	Adafruit	Female headers 5/pk	4	$2.95	$11.80	
ordered 10/11/24	Lowes	ROV CART	1	$120.00	$120.00	
ordered 10/11/24	The Antenna Farm	ROV POWER SUPPLY	1	$100.00	$100.00	
ordered 10/11/24	Vilros	RASPBERRY PI 5	3	$80.00	$240.00	
ordered 12/11/24	Amazon	LEAD SCREW W/ BRASS NUT	2	$25.75	$51.50	
ordered 12/11/24	Adafruit	ARDUINO M0 FEATHER	2	$34.95	$69.90	
ordered 12/11/24	Adafruit	MICRO SWITCH ROLLER	6	$1.95	$11.70	
ordered 12/11/24	Adafruit	MICRO SWITCH WIRE	6	$2.95	$17.70	
ordered 12/11/24	Digikey	Resistor	100	0.0198	$1.98	
ordered 12/11/24	Digikey	Resistor	100	0.0196	$1.96	
ordered 12/11/24	Digikey	Capacitors	10	0.241	$2.41	
ordered 12/11/24	Digikey	Capacitors	50	0.08	4.00	
ordered 1/10/25	Amazon	NEW LEAD SCREW W/ BRASS NUT	2	$12.99	$25.98	
ordered 1/10/25	Amazon	COUPLER	2	$9.99	$19.98	
ordered 1/17/25	Blue Robotics	4" enclosure clamps	4	$50.00	$200.00	
ordered 1/17/25	Amazon	Plastic welder	1	$90.00	$90.00	
ordered 1/17/25	Amazon	Plastic	2	$13.00	$26.00	
ordered 1/30/25	McMaster-Carr	Steel Bushing	4	$4	$15	

ordered 1/30/25	*McMaster-Carr*	*M3 6mm screw*	*1*	*$100*	*$15*
ordered 1/30/25	*McMaster-Carr*	*M3 8mm screw*	*1*	*$100*	*$12.62*
ordered 1/30/25	*McMaster-Carr*	*M3 12mm screw*	*1*	*$100*	*$17.04*
ordered 1/30/25	*McMaster-Carr*	*M3 20mm screw*	*2*	*$100*	*$15.90*
ordered 1/30/25	*McMaster-Carr*	*M3 Nuts*	*4*	*$200*	*$12.64*
ordered 1/30/25	*McMaster-Carr*	*M3 locknuts*	*1*	*$100*	*$11.55*
ordered 1/30/25	*McMaster-Carr*	*2.5mm hex bit*	*2*	*$2*	*$5.44*
ordered 2/14/25	*Amazon*	*XT90-S Connector*	*1*	*$9.99*	*$9.99*
ordered 2/14/25	*Amazon*	*XT60-L Connector Set*	*1*	*$15.59*	*$15.59*
ordered 2/14/25	*Amazon*	*MR60 Connector*	*2*	*$15.99*	*$31.98*
ordered 2/14/25	*Amazon*	*Wiring 14awg*	*1*	*$22.98*	*$22.98*
ordered 2/14/25	*Amazon*	*NIMH Battery*	*2*	*$21.99*	*$43.98*
ordered 2/14/25	*Amazon*	*NiMH Charger*	*1*	*$18.99*	*$18.99*
ordered 2/14/25	*Amazon*	*Zip Ties*	*1*	*$15.99*	*$15.99*
ordered 2/14/25	*Amazon*	*Fuse Kit*	*1*	*$4.99*	*$4.99*
ordered 2/14/25	*Amazon*	*Fuse Holder*	*1*	*$5.89*	*$5.89*
ordered 3/10/25	*Amazon*	*T8 Lead Screw 1mm pitch*	*1*	*$14.70*	*$14.70*
ordered 3/10/25	*Amazon*	*500 ml Syringe with blunt needle*	*1*	*$12.99*	*$12.99*
ordered 3/10/25	*Adafruit*	*MPM3610 5V Buck Converter*	*2*	*$6.95*	*$13.90*

Items Donated to Lakeview SubAquatics at no cost to the company

SUPPLIER	ITEM	QUANTITY	PRICE	SUBTOTAL	TOTAL
Gateway	AdaFruit 21v -> 5v Converter	6	$6.95	$41.70	$5,616.88
Gateway	AdaFruit Arduino	3	$34.95	$104.85	
Gateway	VNH5019 Motor Controller	3	$29.95	$89.85	
Gateway	2000 mAh NiMH Battery	1	$21.99	$21.99	
Gateway	NiMH Battery Charger	1	$18.99	$18.99	
Gateway	Robot Back Flange	1	$55.00	$55.00	
Gateway	Robot Status Light	2	$18.00	$36.00	
Gateway	Dedicated ROV 3D Printer	1	$539.00	$539.00	
Gateway	Passthrough	12	$6.00	$72.00	
Gateway	Robot Main Lights	1	$350.00	$350.00	

Team Members	Calipers	4	$250	$1,000.00	
Team Members	Imperial Tape Measures	2	$48.75	$97.50	
Team Members	Cordless drill	2	$592	$1,184	
Team Members	Auto Ranging Digital Multimeter	2	$280	$560	
Team Members	Drill bits	2	$410	$820	
Team Members	Adjustable wrench	3	$142	$426	
Team Members	Locking Pliers	2	$100	$200	

Appendix

Acknowledgments

We extend our heartfelt gratitude to all individuals and organizations who have contributed to the success of the Lakeview Sub-Aquatics ROV project. Special thanks to our dedicated team members for their unwavering commitment, innovative ideas, and collaborative spirit throughout the project. We express our appreciation to our mentors for their guidance, expertise, and continuous support in steering us toward excellence. Furthermore, we acknowledge the invaluable assistance of our sponsors, supporters, and Lakeview Technology Academy for providing resources and encouragement. We would also like to thank both our team members' families and Gateway Technical College for their financial support and resources provided. This project would not have been possible without the collective effort and dedication of everyone involved.

We wish to express our deepest appreciation to Dr. Ormseth, Dr. Eric Schroeter, and the entire ROV team for their generous contributions that have significantly impacted the Lakeview Sub-Aquatics project. Their donations have been a cornerstone of support, driving the progress and success of our underwater robotics initiative. The benevolence and support extended by Dr. Ormseth, Dr. Schroeter, and our dedicated team members have been pivotal in elevating our project to new heights. Their kindness and assistance have not only strengthened our endeavors but have also exemplified the spirit of camaraderie and teamwork within our community. We are profoundly grateful for their contributions, which

have been instrumental in shaping the trajectory of our project and empowering us to realize our objectives with diligence and passion.

Finally, a special thank you to the MATE ROV organization for providing us with the opportunity to develop and compete in a competition that allows for our dedicated team members to gain priceless experiences and friendships that otherwise would not have been possible

Photo Credits: All Photos by Connor O'Reilly