

TITAN ALLIANCE

UNDERWATER ROV TECHNICAL REPORT

Albany Technical College – Albany, Southwest Georgia

International Underwater Robotics Competition – Canada



TEAM NAME:

Titan Alliance



INSTITUTION:

Albany Technical College

LOCATION:

Albany, Southwest Georgia, USA



COMPETITION:

International Underwater
ROV Competition – Canada



FACULTY MENTOR:

Mr. Dennis Courtney



TEAM MEMBERS:

FAVIN, JAYDAN, NEVOUS



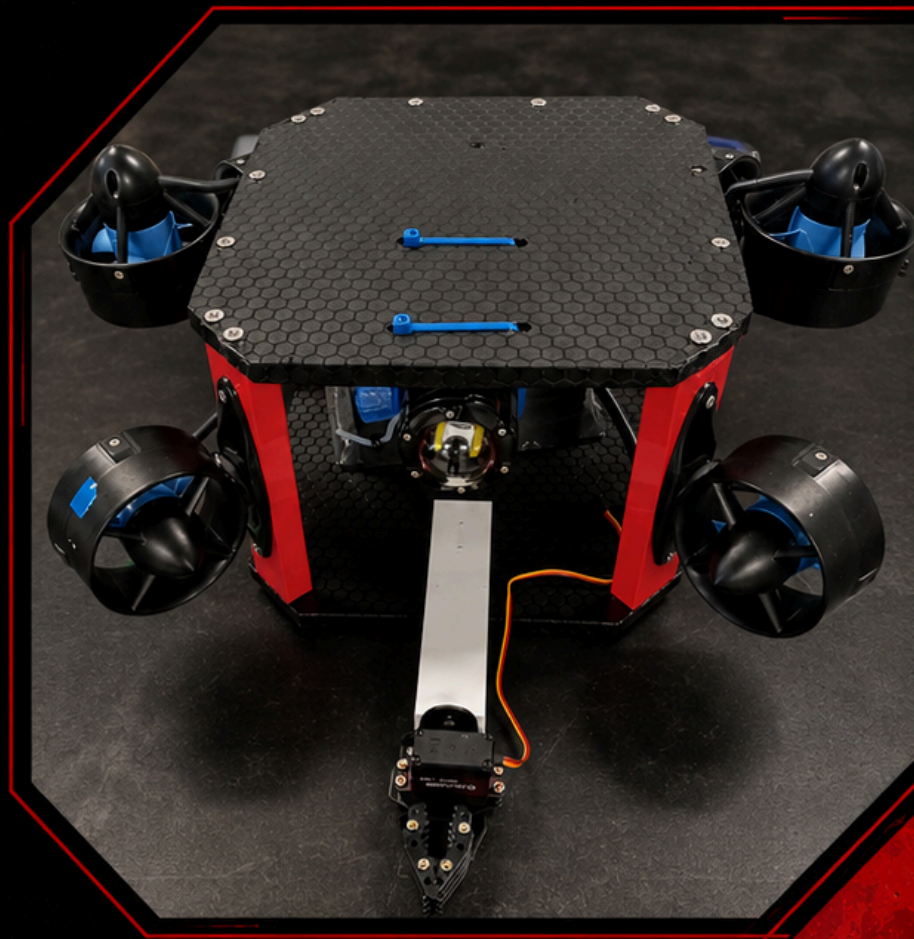
PREPARED BY:

Titan Alliance Robotics Team



YEAR:

2026



INNOVATE • ENGINEER • COMPETE

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Abstract

The Titan Alliance robotics team is a first year MATE Pioneer Class underwater robotics team Albany, Georgia and represent their school, Albany Technical College. The team developed and constructed a remotely operated underwater vehicle (ROV) to compete in the 2026 MATE international underwater robotics competition in Canada. The project focused on engineering innovation, teamwork, leadership, safety, and technical skill development.

The Titan Alliance team consisted of three dedicated students studying engineering and technical programs at Albany Technical College in Albany, Southwest Georgia. Under the leadership and mentorship of Mr. Dennis Courtney, the team successfully designed and built an underwater ROV capable of completing complex underwater missions.

The project involved designing waterproof electrical systems, developing propulsion and control systems, integrating underwater cameras, and constructing a lightweight but durable frame. The team also focused heavily on safety procedures, budgeting, testing, and real-world engineering practices.

Participation in the international competition provided students with valuable hands-on experience in robotics, electronics, teamwork, communication, and problem-solving. The competition also allowed students to represent Albany Technical College on an international stage while promoting STEM education and engineering innovation.

This report documents the design process, budget analysis, testing procedures, competition preparation, and overall journey of the Titan Alliance team.

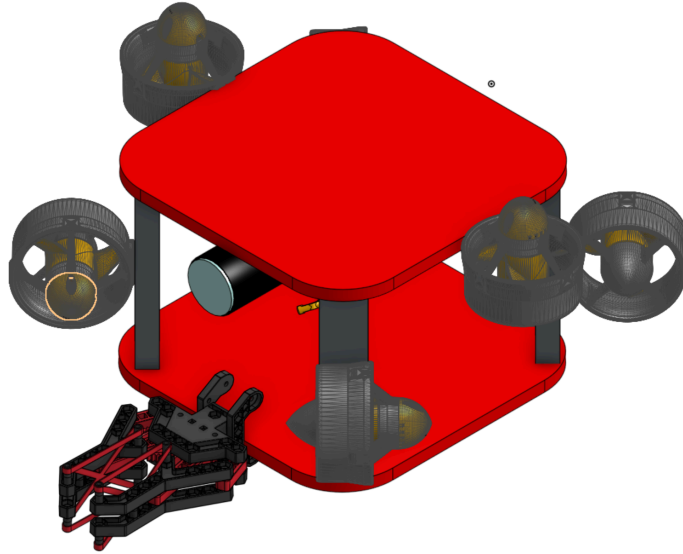
Introduction

Engineering and robotics continue to play a major role in modern technology and underwater exploration. Remotely operated vehicles (ROVs) are widely used in ocean research, offshore energy industries, marine biology, military operations, and underwater inspections. The purpose of this project was to provide students with practical engineering experience through the design and construction of an underwater robotic vehicle.

The Titan Alliance team worked together over several months to develop an ROV capable of operating underwater while completing mission-based tasks. The project

required students to apply knowledge from electronics, mechanical design, programming, fabrication, and teamwork.

This competition challenged students to think creatively while working under strict deadlines, limited budgets, and technical requirements. The experience gave students an opportunity to strengthen communication skills, leadership abilities, and engineering knowledge.



Titan Alliance ROV "TITAN SAIYAN"

Company Organization

Titan Alliance is an engineering and robotics organization at Albany Technical College focused on promoting engineering knowledge, robotics education, teamwork, and innovation. The organization allows students to gain practical engineering experience through projects, competitions, and community activities.

The Titan Alliance team participating in the underwater robotics competition consisted of three student engineers who worked together to design, build, and test the underwater ROV. These three students were responsible for multiple roles on the team.

The team emphasized:

- Teamwork
- Innovation
- Technical excellence
- Safety



(photo courtesy of Y. Bell)

- Professionalism
- Communication

The experience strengthened the students' confidence and prepared them for future careers in engineering and technical industries.

About Albany Technical College

Albany Technical College is located in Albany, Southwest Georgia, approximately 4,500 kilometers (via Air Canada) from St. Johns Newfoundland, Canada, and is recognized for providing high-quality technical education and workforce training. The college offers programs in engineering technology, industrial systems, healthcare, business, and technical education.

The institution supports hands-on learning experiences that prepare students for careers in science, technology, engineering, and mathematics (STEM). Through clubs and organizations such as Titan Alliance, students are given opportunities to participate in robotics, engineering competitions, leadership development, and community outreach.

Albany Technical College encourages innovation and supports student success through dedicated faculty, modern facilities, and real-world learning experiences.

Team Members and Roles

Electrical Design Engineer

CEO / Lead Electrical and Computer Programming -
Nevous Morgan (Sophomore)

Responsible Roles

- All electrical systems design, build, and programming
- Wiring and soldering
- Waterproofing electronics
- Electrical testing



- Controller integration

(photo courtesy of Y. Bell)

Mechanical Design Engineer

CFO / Lead Mechanical Build / Corporate Responsibility - *Favin Grear (Sophomore)*

Responsible Roles

- Mechanical engineering and device
- Frame fabrication
- Propulsion alignment
- Mechanical assembly
- Budget and BOM accounting
- Community Outreach Coordinator



(photo courtesy of Y. Bell)

Safety Engineer

Safety Officer / Lead CAD Designer / Pilot -

Jaydan Jenkins (Freshman)

- ROV systems design
- Responsible for all team safety documents and procedures
- Waterproof housing design
- Mechanical assembly



(photo courtesy of Y. Bell)

Faculty Leadership and Mentorship

One of the major strengths of the Titan Alliance team was the mentorship provided by Dennis Courtney, Chair for the Electrical and Computer Engineering Program at Albany Technical College. Mr. Courtney served as the faculty advisor, mentor, and engineering guide throughout the project.

Mr. Courtney consistently encouraged students to think critically, solve problems creatively, and work together professionally. His dedication to student development helped create an environment where students could grow both academically and personally.

The mentorship included:

- Engineering guidance
- Robotics instruction
- Leadership development
- Safety training
- Competition preparation
- Technical troubleshooting
- Team motivation



(photo by F. Gear)

Mr. Courtney's commitment to student success made a major impact on the team's confidence and performance.

Project Objectives

The primary objective of the project was to design and build a functional underwater remotely operated vehicle capable of completing mission tasks in an international robotics competition.

Additional project objectives included:

- Develop engineering skills
- Improve teamwork and communication
- Gain hands-on technical experience
- Learn underwater robotics systems

- Represent Albany Technical College internationally
- Promote STEM education
- Operate safely and efficiently underwater

Competition Overview

The 2026 international underwater robotics competition hosted at the Marine Institute of Memorial University in Newfoundland, Canada will challenge our team to complete realistic underwater engineering tasks using ROV technology.

Mission tasks included:

- Underwater navigation
- Object retrieval
- Precision maneuvering
- Equipment manipulation
- Inspection operations
- Sensor integration

The competition also evaluated:

- Technical documentation
- Engineering design
- Safety procedures
- Team presentation skills



(photo courtesy of MATE)

The event brought together teams from multiple schools and organizations from around the world.

2026 MATE Titan Alliance Underwater Robotics Team



(photos courtesy of Y. Bell)

Design Philosophy

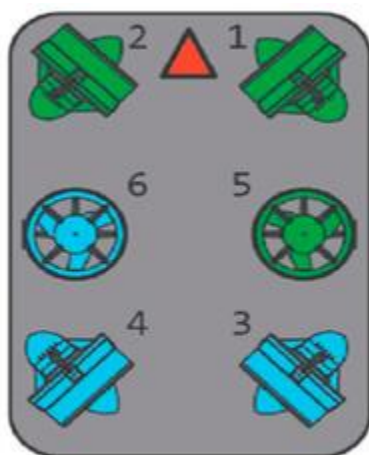
The Titan Alliance ROV “Titan Saiyan” was designed with the following goals:

- Reliability
- Stability
- Lightweight construction
- Cost efficiency
- Maneuverability
- Safety

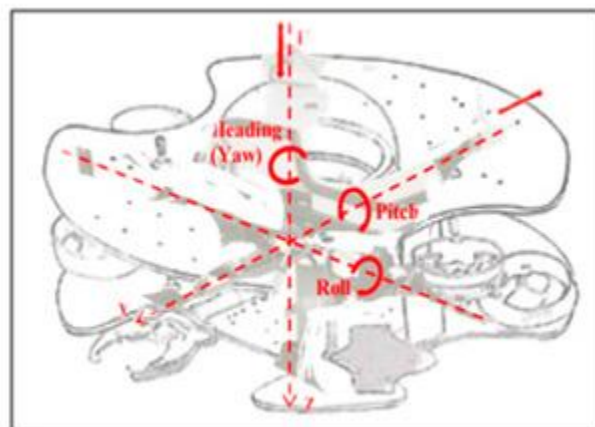
The team focused on creating a simple but effective design that could perform consistently underwater while remaining easy to repair and modify.

PVC and lightweight materials were selected to reduce weight while maintaining durability. The design also prioritized waterproof protection for electrical systems.

Engineering Design Rationale



(a)



(b)

Images depict the original design concept for Titan Saiyan ROV.

The engineering design process followed several major phases:

Research Phase

The team researched underwater robotics systems, propulsion systems, waterproofing techniques, and competition requirements.

Design Phase

The team developed sketches, CAD models, and electrical diagrams for the ROV.

Fabrication Phase

The ROV frame and systems were constructed using PVC, motors, waterproof housings, and electrical components.

Testing and Improvement Phase

Design improvements were made based on testing results.

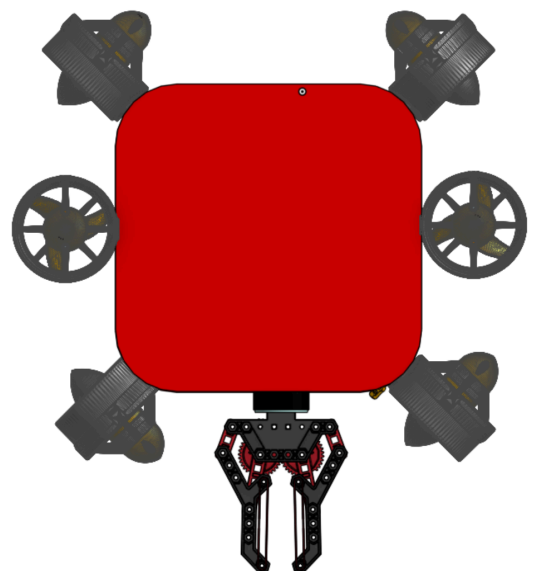
ROV Structural Design

The ROV frame was constructed using lightweight PVC materials to provide strength and buoyancy control. The structure supported motors, cameras, electronics, and tools.

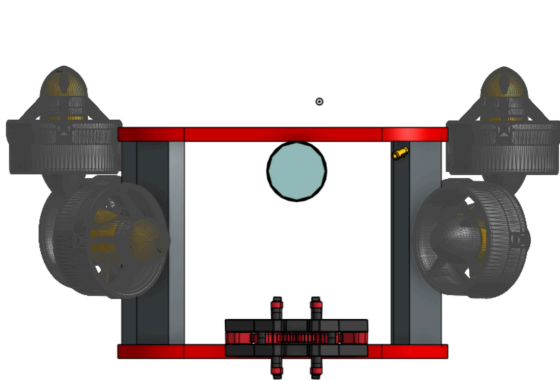
Structural Features

- Lightweight PVC frame
- Open-frame cube design
- Balanced weight distribution
- Waterproof compartments
- Easy access for maintenance

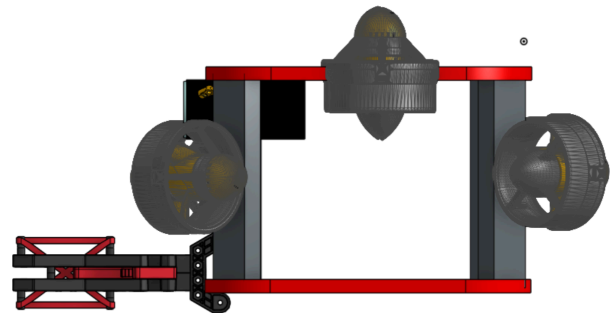
The open-frame cube structure improved maneuverability while reducing drag underwater. The strategic placement of thrusters, cameras, and



manipulators created a very efficient and mission oriented ROV with the ability to turn in a very small radius and consistently retrieve objects from the various mission tasks.



isometric views.



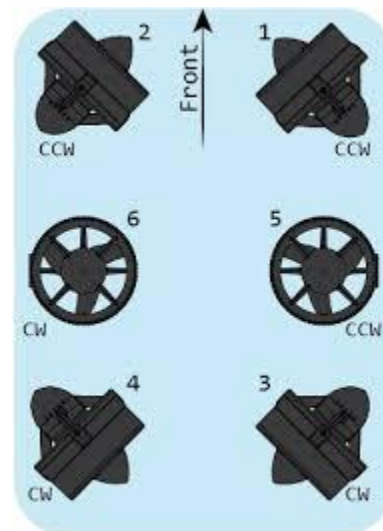
CAD images - front, side, top, and

Propulsion System

The propulsion system used six (6) T200 Bluerobotics underwater thrusters to provide movement in several directions.

Thruster Configuration

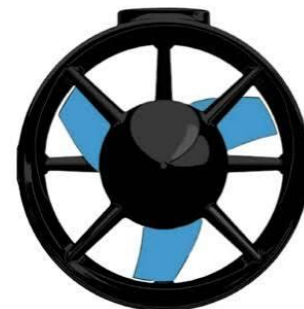
- Forward movement
- Reverse movement
- Vertical movement
- Turning capability
- Precise maneuvering



The horizontal control motors were mounted strategically at 45 degree angles to improve stability and underwater control.

Propulsion Advantages

- Increased maneuverability
- Better balance
- Improved mission performance



- Efficient movement underwater

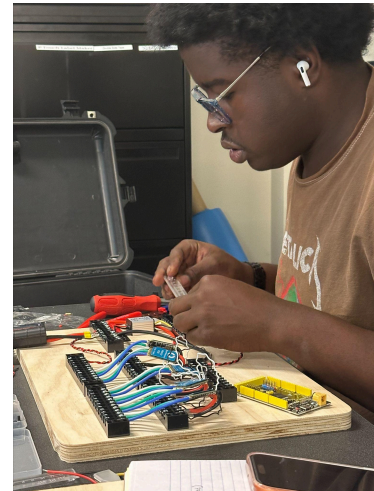
(Blue Robotics T200 Thruster)

Electrical System

The 12 VDC electrical system powered all major components of the ROV including thrusters, cameras, controllers, and sensors.

Electrical Components

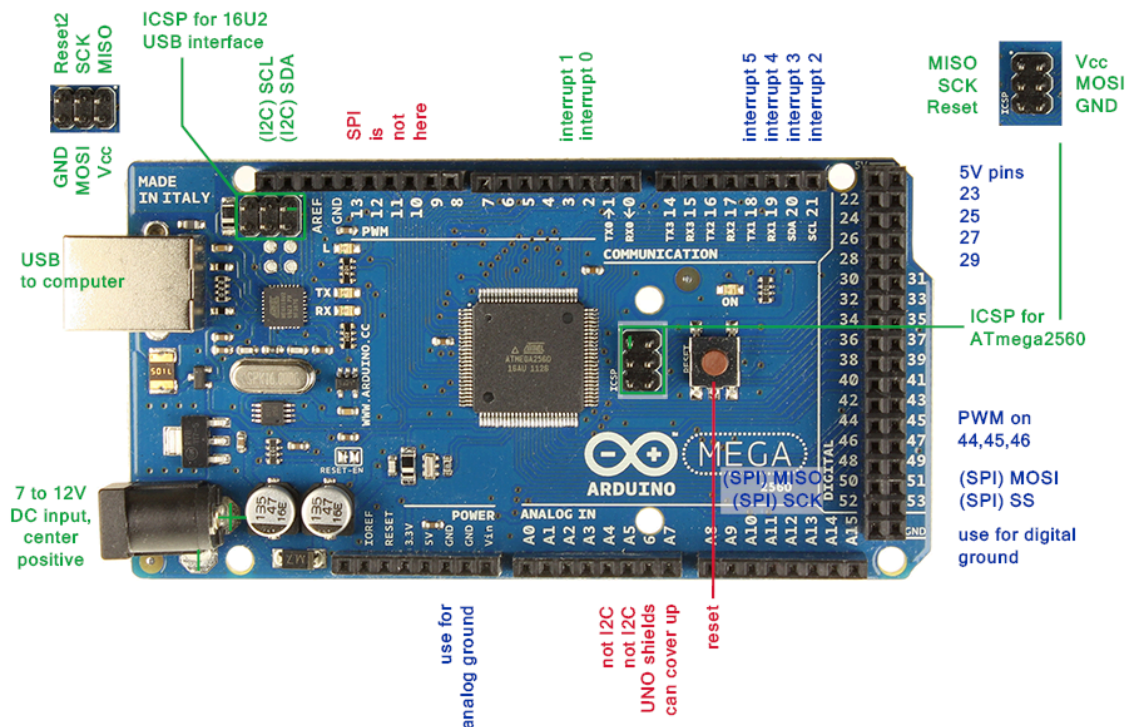
- 12 VDC Power distribution system
- 1.0 mm AWG 18 - 16 Waterproof connectors
- Blue Robotics ESC Motor controllers
- Arduino Mega Processor
- 12 VDC - 5 VDC Converter
- Custom Hardshell Surface control station
- Battery or power supply system



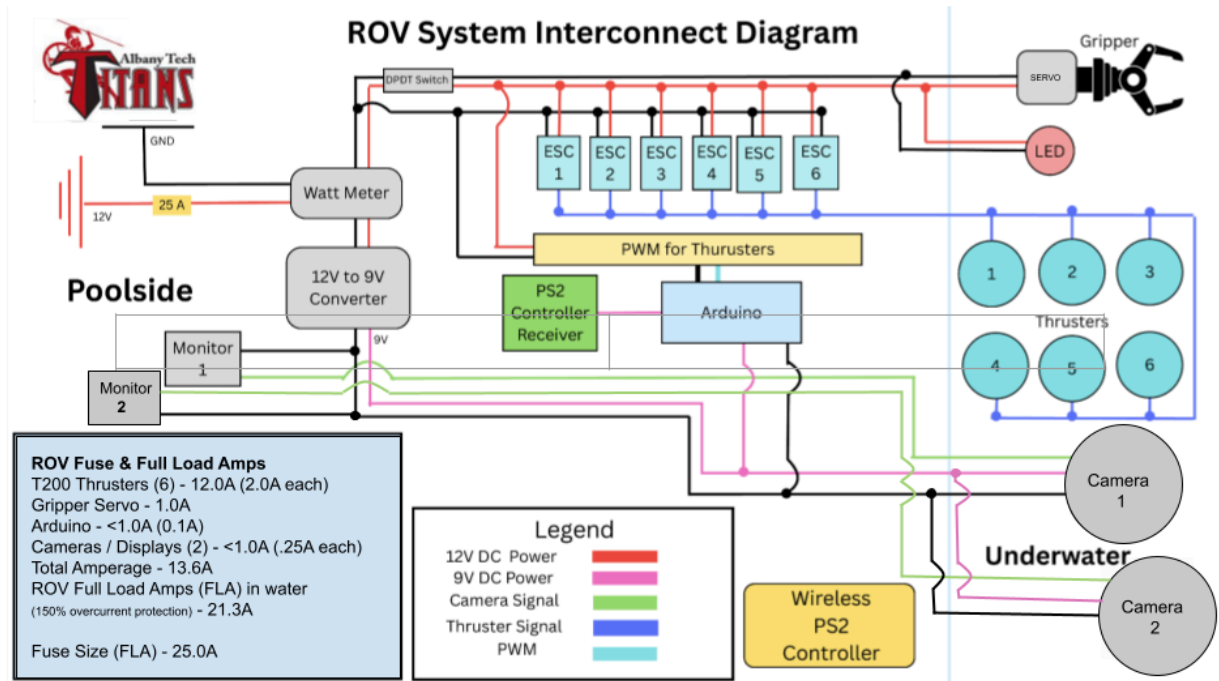
Safety was extremely important during electrical integration.

(photo courtesy of Y. Bell)

Waterproofing methods were used to prevent short circuits and water damage.



Systems Integrated Diagram ROV



Control System

The control system allowed the operator to maneuver Titan Saiyan from the surface using handheld controllers and monitoring equipment.

Control Features

- Real-time wireless movement control
- Camera feedback with two monitoring displays
- Speed control utilizing ESC's
- Precision navigation
- Mission task operation
- Programming code for motors written in C++

The control station was designed to provide quick response and easy operation during competition tasks for the 2026 MATE mission task.

Cameras and Vision System

The underwater camera systems allowed operators to see and navigate underwater, specifically for the 2026 MATE mission task challenges.

Camera Features

- Camera 1 - Live underwater video
- Camera 2 - Wide viewing 45 degree angles for improved manipulator view
- Waterproof camera housing
- Surface monitor display

The camera systems improved navigation accuracy and mission performance.



ROV Underwater Camera

Tether and Communication System

The tether connects the ROV to the surface control station.

Tether Functions

- Power delivery
- Communication signals cabling
- Video transmission



- Wireless PS2 Control system connection
- Secure 12.7mm strain relief

Strain Relief Coupler

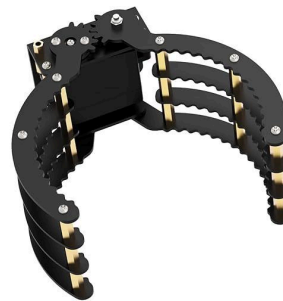
The tether was designed to remain lightweight while minimizing drag underwater.

Manipulator and Tooling

The ROV included an electric motor manipulator system designed to interact with underwater objects.

Tool Functions

- Object retrieval
- Task completion
- Underwater manipulation
- Precision handling



Mechanical Gripper

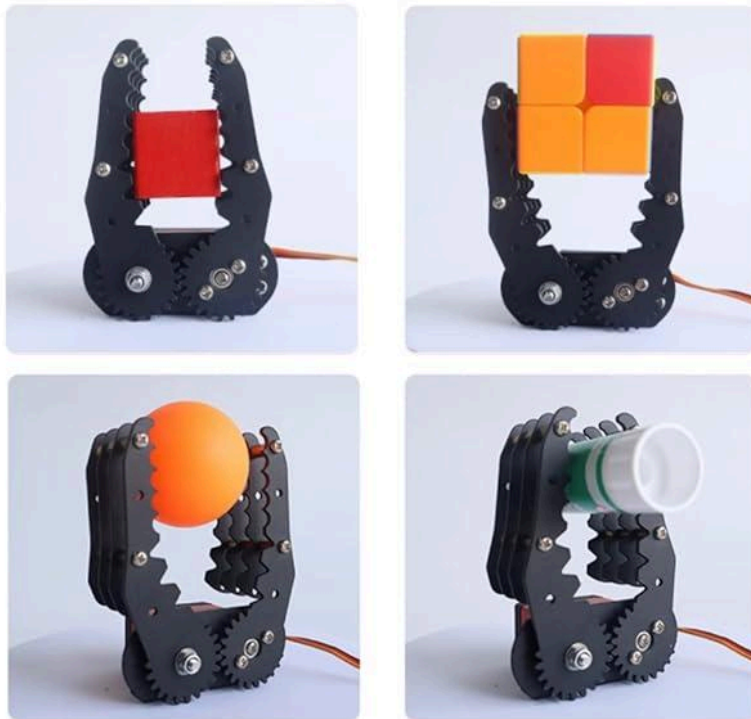
Mechanical Gripper

Product Material Hard Aluminum Alloy	Drive Method Gear + Linkage
Gripping Range 20 - 100 mm	Control Method PWM Pulse
Maximum Gripping Force 800 g	Product Dimensions 95 x 70 x 58 mm

Servo Motor

Dimensions 40mm x 20mm x 40.5mm	Control Angle 180 deg
Gear Type Metal Gears	Operating Voltage 4.8V - 6.8V
Control System	Weight

PWM (Pulse Width Modulation)	60g
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The manipulator improved the team's ability to complete competition mission tasks to include capture and recovery of the Buoy anchor and eDNA sensor.

Vertical Profile Float

The Titan Alliance MATE Underwater Robotics Team designed and developed a Vertical Profiling Float (VPF), an autonomous underwater device engineered to descend, hover, collect environmental data, and safely return to the surface without direct tethered control. Inspired by real-world oceanographic systems such as Argo profiling floats used by marine scientists around the globe, the student-built VPF demonstrates the practical application of engineering, electronics, programming, and underwater robotics in a hands-on STEM learning environment.

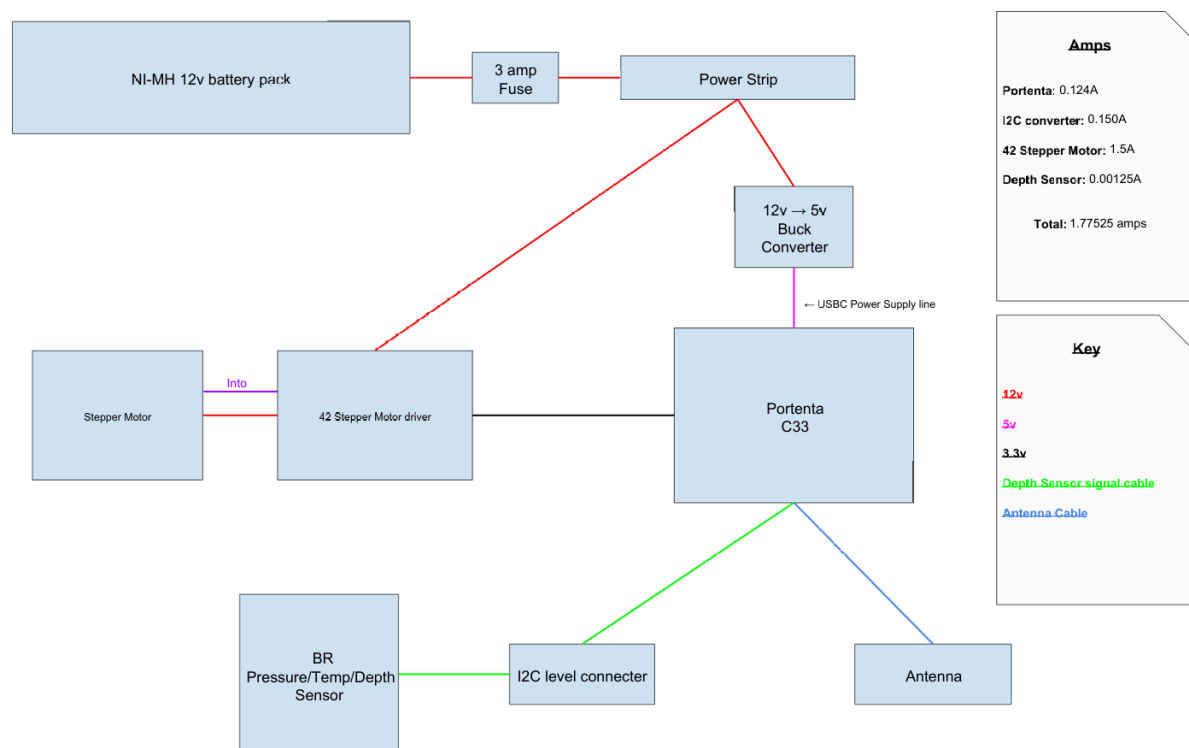
The VPF is built around a watertight enclosure fabricated from durable PVC pipe designed to safely house onboard electronics and sensor systems. Students integrated microcontrollers such as Arduino platforms along with sensors capable of measuring depth, pressure, and temperature throughout the mission. To maneuver vertically through the water column, the Albany Technical College Titan Alliance team explored

buoyancy-driven concepts that allow the float to naturally sink and rise by adjusting displacement and overall density.

During competition missions, the Vertical Profiling Float is tasked with descending to designated depths, maintaining stability, collecting environmental data, and resurfacing safely and efficiently. More advanced mission scenarios challenge students to operate in simulated under-ice environments requiring precision control, systems engineering, troubleshooting, and mission planning.

Through the design and development of the VPF, students on the Albany Technical College Titan Alliance team gain valuable real-world experience in ocean engineering, autonomous systems, electronics, coding, fabrication, and problem solving while preparing for future careers in advanced manufacturing, marine technology, robotics, and other STEM-related industries.

Systems Integrated Diagram VPF



Safety Procedures

Safety remains a top priority throughout the project. The team starts every meeting and ROV event (practice, demonstration, etc.) with a safety briefing. All team members are encouraged and have autonomy to stop any team activity where there might be a risk of injury or death. All team members are administered a lab safety handout and are required to pass a quiz. Proper PPE (Personnel Protective Equipment) (safety glasses, safety gloves, etc.) are required when working on the ROV or in the lab. All team members must know what actions to take in the event of electrical shock or immediate first aid, i.e. bleeding, burns, eye wash station procedures, etc.

Team Safety Procedures

- Electrical safety checks
- Waterproof testing
- Proper tool handling
- Battery inspection
- Personal protective equipment
- Safe lifting procedures

Competition Safety

The team performed safety inspections before every test and competition run utilizing the JSEA.



Danger areas and propeller guards are incorporated into the design and function of Titan Saiyan ROV.

Testing and Troubleshooting

During the 2026 build season, the Albany Technical College Titan Alliance Underwater Robotics Team used a continuous testing and troubleshooting process to improve the safety, reliability, and performance of the team's MATE Pioneer Class ROV. Testing was performed throughout the design, assembly, and mission practice phases of development.

The team began with subsystem testing before integrating the complete ROV. Electrical circuits, thrusters, cameras, tether connections, and buoyancy systems were tested individually to verify proper operation. Digital multimeters were used to perform continuity checks, verify voltage levels, and identify wiring or soldering issues before powering the system.

Waterproofing and leak detection tests were conducted regularly on electronic housings, cable penetrations, and tether connections. When leaks or failures were discovered, components were repaired, resealed, and retested until reliable performance was achieved.

Pool testing allowed the team to evaluate propulsion, maneuverability, buoyancy, and tether management. Students adjusted ballast placement and foam distribution to improve vehicle stability and reduce drag. Thrusters were also tested to ensure correct rotation and thrust performance.

Mission practice testing simulated real competition conditions. These exercises helped identify weaknesses in camera positioning, manipulator operation, and pilot communication. Based on testing results, the team improved tool mounting systems, cable organization, and overall ROV handling.

Troubleshooting sessions encouraged teamwork and problem-solving. Team members documented failures, discussed possible causes, implemented corrective actions, and repeated testing to confirm solutions. This iterative engineering process provided valuable hands-on experience similar to real-world marine technology and industrial robotics operations.

Budget and Cost Analysis

The Titan Alliance team carefully managed project expenses while maximizing performance and reliability.

Budget Goals

- Minimize unnecessary spending
- Use cost-effective materials
- Maintain quality and safety
- Track all expenses

Budget Table

Travel & Competition Budget

Budget Category	Description	Amount
Airfare	Team travel airfare expenses	\$7,980.00
ROV Equipment	Underwater ROV materials/equipment	\$2,345.00
Lodging	Hotel accommodations	\$1,486.00
Rental Vehicle	Ground transportation	\$468.00
Food	Team meals and food expenses	\$1,300.00
Miscellaneous	Supplies, incidentals, and unforeseen expenses	\$350.00

Total Estimated Budget: \$13,929.00

Detailed Budget Analysis

The Titan Alliance team carefully monitored expenses throughout the development process to ensure the project remained within budget while still meeting engineering and competition requirements.

Engineering and Construction Costs

Engineering materials represented a large portion of the project budget. Motors, electrical systems, waterproof components, and tooling materials were necessary to ensure the ROV could operate safely and effectively underwater.

Travel and Competition Costs

Travel expenses included transportation to Canada, hotel accommodations, meals, registration fees, and equipment transportation. International competition travel required careful financial planning and scheduling.

Safety and Testing Costs

Safety inspections, waterproof testing, electrical protection materials, and pool testing sessions contributed to the overall project expenses. These costs were important to maintain safe operations during testing and competition.

Sponsorship and Fundraising

Support from Albany Technical College, sponsors, faculty members, and community supporters helped reduce financial pressure on the student team. Fundraising efforts and donations allowed the team to purchase higher-quality materials and travel internationally.

Cost Distribution Chart

Category	Percentage
Engineering Components	30%
Travel and Lodging	40%
Safety and Testing	10%
Team Branding	10%

Miscellaneous	10%
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Future Improvements

The Titan Alliance team identified several improvements for future ROV development.

Planned Improvements

- Advanced camera systems
- Stronger manipulators
- Improved waterproofing
- More efficient propulsion systems
- Enhanced control software
- Additional sensor integration
- Improved organization for competition preparation

Future teams can continue improving the design while building upon the knowledge gained from this project.

Conclusion

The Titan Alliance underwater ROV project was an important educational experience that allowed students to apply engineering concepts in a real-world environment.

Through teamwork, dedication, and strong mentorship from Mr. Dennis Courtney, the team successfully designed and constructed an underwater robotic vehicle capable of competing internationally.

The project strengthened technical skills, leadership abilities, communication, and problem-solving. It also provided valuable experience in robotics, engineering design, safety procedures, and project management.

Representing Albany Technical College in an international competition was a major achievement for the Titan Alliance team. The experience will continue to inspire future students interested in engineering, robotics, and STEM careers.

Acknowledgements

The Titan Alliance team would like to sincerely acknowledge the generous support and grant funding provided by the Marine Technology Society (MTS) and the MATE (Marine Advanced Technology Education) community supporters and sponsors. Your continued investment in student STEM education, underwater robotics, and workforce development opportunities has made a lasting impact on our students and program.

We extend a very special thank you and appreciation to Albany Technical College, MetroPower, and the TEAAMS (Teaching Empowering African American Males to Succeed) initiative. Without your direct financial support, encouragement, and belief in our students, this incredible journey and opportunity to compete at the highest level would not have been possible.

Your partnership is helping inspire and prepare the next generation of engineers, technicians, innovators, and leaders.



(photo courtesy of Albany Technical College Public Relations)

The Titan Alliance team would like to thank:

- Albany Technical College Faculty and Staff
- Marine Advanced Technology Education Competition organizers
- President, Dr. Emmett Griswald
- Vice President, Lisa Harrell
- Dr. Quanta Bell, Director TEAAMS (Teaching Empowering African American Males to Succeed)
- Mr. Greg Greenway, MetroPower V.P.
- Titan Alliance Family members
- MetroPower
- STREAMWORKS Education Staff and Interns

Their support, encouragement, and guidance helped make this project possible.

Appendices

Appendix A – Technical Specifications

Component	Specification
Frame Material	Wood
Number of Thrusters	T200 Blue Robotics (6)
Camera Systems	Waterproof HD Camera / SeaMATE Store Camera
Power Supply	12 VDC Surface Power System
Communication	Tethered Control / Arduino C++
Control Method	PS2 Joystick Controller

References

Information used in the preparation of this report was based on engineering design practices, underwater robotics competition standards, Albany Technical College student organization information, and educational robotics research.

References include:

- 1) 2026 MATE Pioneer Competition manual and event documents

<https://materovcompetition.org/pioneer>

- 2) T200 Blue Robotics Thrusters

<https://bluerobotics.com/store/thrusters/t100-t200-thrusters/t200-thruster-r2-rp/>

- 3) Arduino programming

<https://docs.arduino.cc/programming/>

- 4) OnShape CAD tutorials

<https://learn.onshape.com/>

- 5) Introduction to Engineering

[Engineering Fundamentals: An Introduction to Engineering - Product Details - Cengage Instructor Center](#)

- 6) Project Management for Beginners

<https://youtu.be/0zF06TOKKOE?si=Uigf0OZLsTc-uxQn>

- 7) Overcoming Conflict

https://youtu.be/I5_BiNA0c9c?si=wpGTnIMB-0Vo7FTG

- 8) Don't Sweat the Small Stuff - Richard Carlson

[Don't Sweat the Small Stuff . . . and It's All Small Stuff: Simple Ways to Keep the Little Things from Taking Over Your Life: Carlson, Richard: 9780786881857: Amazon.com: Books](#)