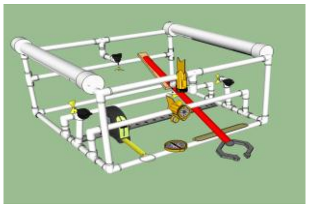


PVC

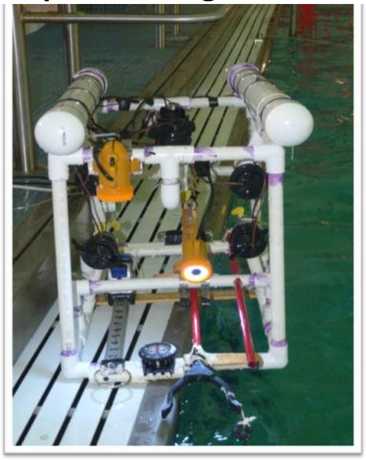
POSEIDON VOYAGER CORPORATION

Eli Whitney Elementary
Chicago, Illinois

CHICAGO PUBLIC SCHOOLS | CPS

From left to right, 1st Row Ms. LaTina Taylor, Instructor, April Iturbe, CEO, 8th Gr., Esmeralda Orozco, CEO, 8th Gr. , Mark Patron, Research Officer, 7th Gr., Nelly Quintanilla, Engineer, 7th Gr., Mr. Felix Bahena, Instructor, Daniel Salazar, Engineer, 6th Gr., Diana Camach,o Research, 8th Gr. 2nd Row Lina Salgado, Research, 5th Gr. , Juan Salgado, Pilot/Engineer, 8th Gr., Raul Bedolla, Engineer, 7th Gr. Edwin Ortega, Digital Engineer, 6th Gr. , Nolberto Lopez, Digital Engineer, 6th Gr., Elena Lara Research Officer, 8th Gr., Rosa Rodriguez, Research, 8h Gr. , 3rd Row Erick Corral, Digital Engineer, 6th Gr., Joshua Martinez, Engineer, 6th Gr. (Not pictured Jonathan Bello, Pilot/Engineer, 8th Gr., Isha , Research, 8th Gr., Maria Guadarrama, Research, 8th Gr., and Celine Mendiola, Research Officer, 8th Gr.

Triton | "Messenger of the Sea"



http://underwaterroboticseliwhitney.blogspot.com/

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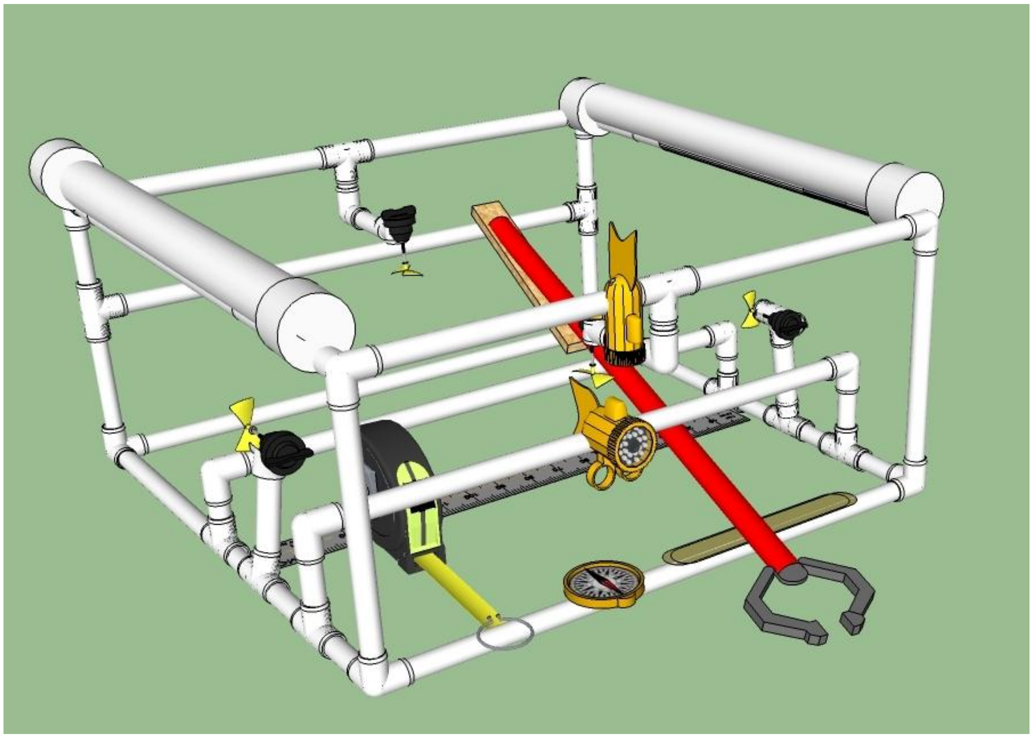


Our Digital Engineering Design Team used Google SketchUp 3D software to help design and engineer our 3rd underwater robot Triton | Messenger of the Sea.

Abstract

This is the third school year that Eli Whitney Technology Magnet Cluster School located in Chicago's Little Village community has participated in the Underwater Robotics after school program. We began meeting after school two hours a week since September 2011. Our team members consist of a diverse group of 6^{th}-8^{th} grade middle students who have career goals as engineers, forensic scientists, and astronauts among others.

We learned that a remotely operated vehicle (ROV) is a tethered underwater robot. They are used in the real world often in the military, science research, and collecting data on shipwrecks around the world. The inspiration for the name of our ROV comes from learning about Greek Mythology. ***"Triton",*** son of Poseidon, Water God (our 1^{st} ROV) meaning **"Messenger of the Sea"** was a perfect fit for our 3^{rd} ROV. We call Triton the ***Ultimate Multi-Tasker*** because he is designed and custom built to serve many purposes like collecting all types of data on the SS Gardner and other shipwrecks.

Triton is shaped in a rectangular prism with PVC pipes in the interior to support his 6 motors, 2 cameras, and 6 different payloads (hand manipulator, tape measure, compass, magnet, sensor/"pitch fork" and an oil pump.) Triton is equipped with a hand manipulator that opens closes using a pneumatics system so that it can pick up objects like the lift bag and collect the coral attached to the shipwreck in Task 2 of the missions.

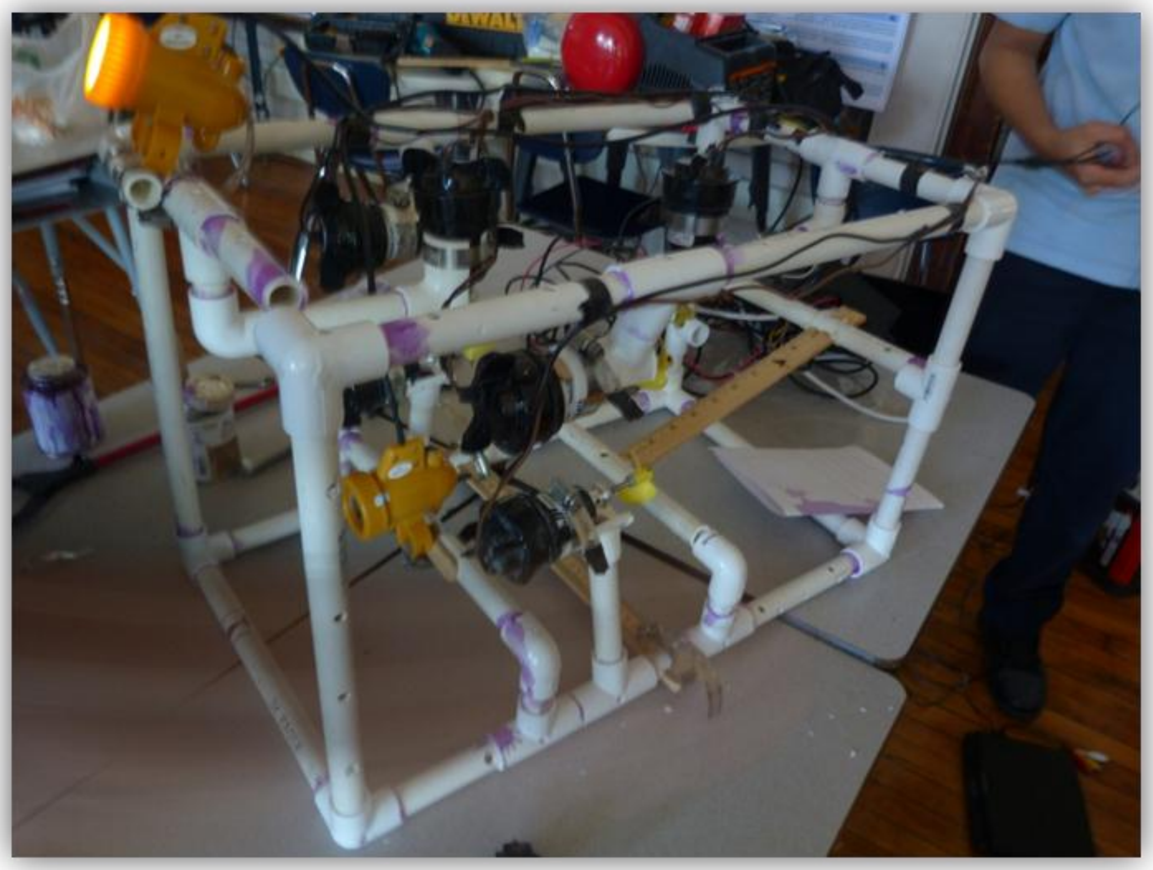
Triton has a special designed remote control that feels a lot like a joystick to a video game and has two video cameras. One camera is used to gain a better perspective of the underwater course and the other camera is used to view the shipwreck site. Our goal is to complete each mission task with thought and speed!

Company Mission | "What We Stand For"

We here at the PVC Poseidon Voyager Corporation believe in using our creativity and ingenuity to build eco-friendly remotely operated vehicles (ROV's) to responsibly solve the marine problems facing our environment every day.Our ROV's are custom built to complete jobs companies hire us to do using our passions for science, technology, engineering, and math.

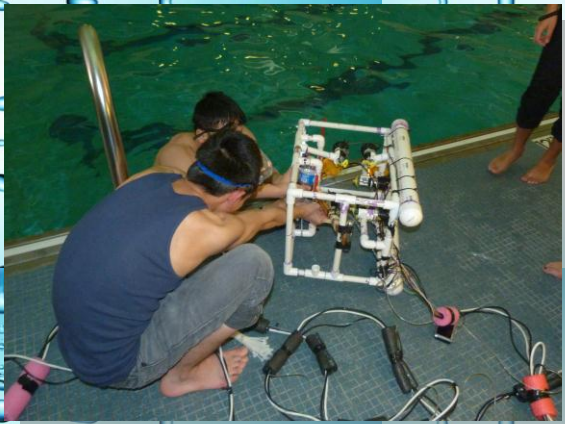
We enthusiastically work collaboratively with our company staff members bringing our innovative ideas to life daily. Being responsible and organized is our motto to get the job done. As well as a commitment to being safe .Success is our middle name.

Photos of Completed ROV



Budget/ Expense

Description	Amount
Additional PVC Pipe	$5.00
Power Drill	$30.00
PVC Glue	$6.00
Mechanical Arm	$7.00
Additional PVC Connectors	$12.00
Additional Plastic Ties	$10.00
Air Piston	$200.00
Plastic Tubing	$20.00
Underwater Compass	$30.00
Stainless Steel Measuring Tape	$20.00
Total	$340.00



Design Rationale

After many class discussions and team submissions of various prototype designs using K'Nex and Google SketchUp we decided to custom build Triton to complete the missions as the **"Ultimate Multi-Tasker".** Triton is shaped in a rectangular prism to support his 6 motors, 2 cameras, and 6 different payloads (hand manipulator, tape measure, compass, magnet , sensor/"pitch fork" and an oil pump).

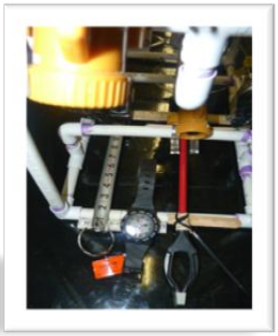
Last year we noticed that the motor and lever system that we designed to open and close our hand. It didn't work perfectly as it wouldn't close completely during our missions. We decided we wanted something that was a little more reliable. We researched pneumatics systems and learned about how air compressors work . We then took the Pneumatic quiz online and passed it with flying colors. Our hand manipulator now opens and closes with the support of a pneumatic piston.

Our previous buoyancy system included using floaters. We noticed that after 8 feet the floaters accuracy diminished and since our competitions are held in 16 feet pools we decided to work on a more stable system. We decided to use 2 inch PVC pipes for buoyancy . We've tested this system in a pool and noticed that our ROV can now go to much deeper depths.

Pneumatic Piston | Air Compressor | Buoyancy System | "Sensor Pitch Fork"

We agreed from the beginning that our ROV needed to have a hand. We wanted the ROV to have a hand so that if the missions included tasks that required the ROV to pick things up, a hand would be the most natural tool to use. This is an example of biomimicry (the study of nature's best ideas and then imitates these) in that we wanted our ROV to pick up and grab things like our human hands do.

To complete specific tasks in the missions we needed several payloads to add to Triton in order to survey the shipwreck SS Gardner. To determine the orientation of the ship we added an underwater compass that glows in the dark. To measure the length of the ship we added a tape measure and positioned it in view of the camera 1. To transport the lift bag we decided to use our hand manipulator and to determine if the debris piles are metal or non-metal we decided to add a magnet to our hand manipulator.

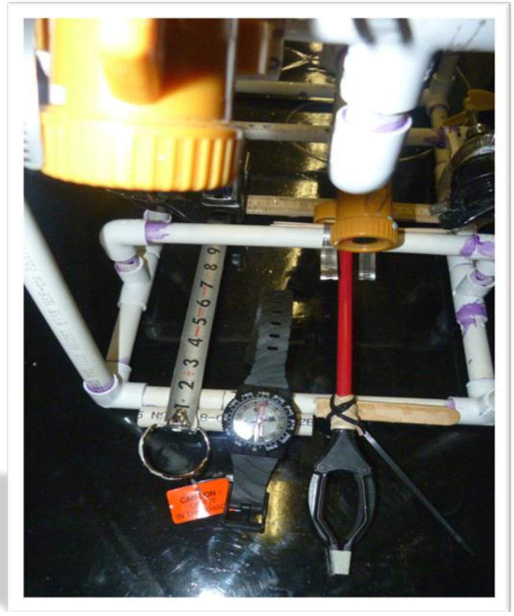


Hand manipulator | measuring tape & compass | magnet | cameras 1 & 2

Design Rationale

Triton in greek-(Τρίτων, gen: Τρίτωνος) is a mythological Greek god, the messenger of the big sea. He is a merman! He is the son of Poseidon, God of the sea, and Amphitrite, Goddess of the sea. (The names of our 1st and 2nd ROVs.)

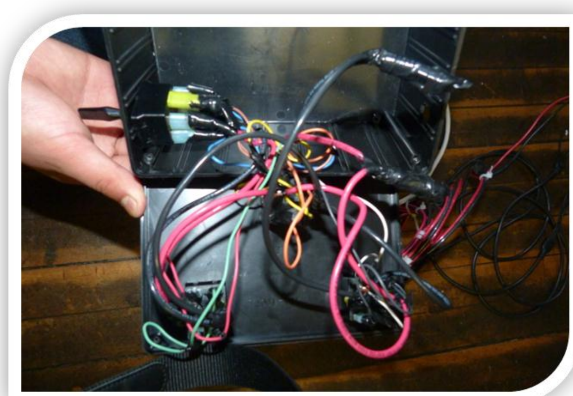
- ✓ Triton is equipped with 6 motors and a customized remote with 5 switches.
- ✓ Triton has a mechanical arm that opens and closes to grab material and organisms in the waters.
- ✓ To measure the length of the ship Triton is equipped with an underwater measuring tape.
- ✓ To detect the orientation of the ship Triton has an underwater compass.
- ✓ To collect the coral attached to the shipwreck Triton has a hand manipulator that opens and closes using a pneumatics system.
- ✓ To get a better perspective of the underwater course, Triton is equipped with two cameras: one to view the different payloads and the other camera to view the shipwreck site.
- ✓ To detect if the debris piles are metal and non-metal Triton has a magnet attached to his hand manipulator.
- ✓ To take an accurate scan of the shipwreck in 3 locations of the ship Triton is equipped with a sensor "pitch fork".



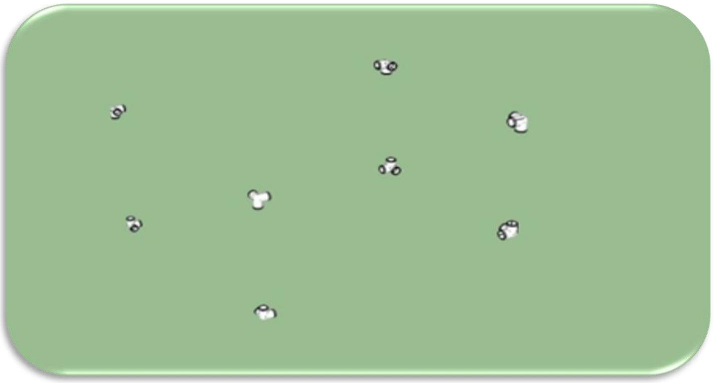
Design Rationale

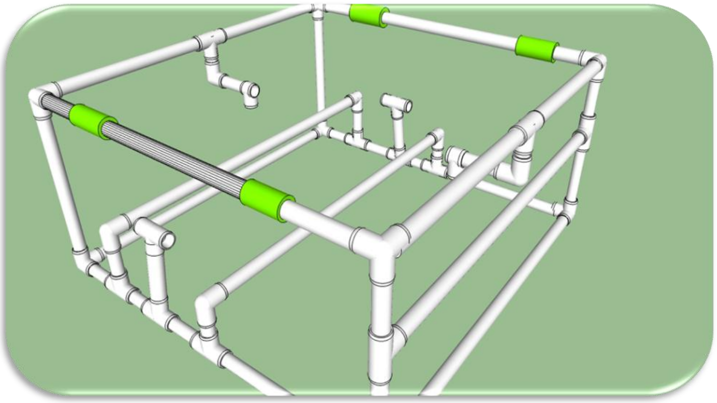
Triton’s “Joystick Style” Remote & Power Schematics

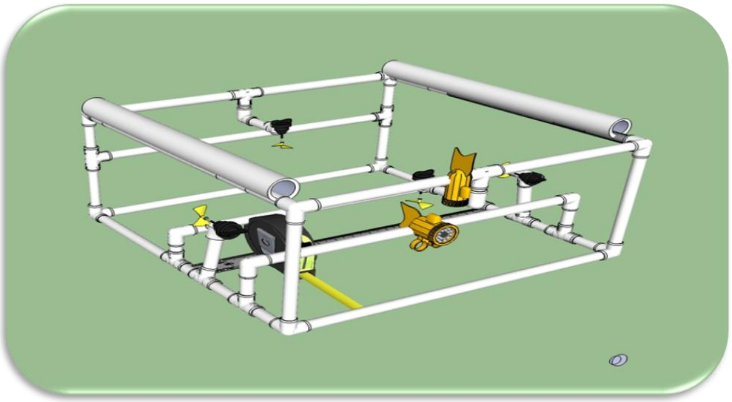
Triton’s remote control is customized to feel like a video game controller. Triton’s remote has 4 switches on the box and one separate switch for the air compressor. The three switches on top of the remote are used to maneuver front, back, turn, and plus it has turbo speed. 1 switch on the side of the remote is used to move Triton up and down.

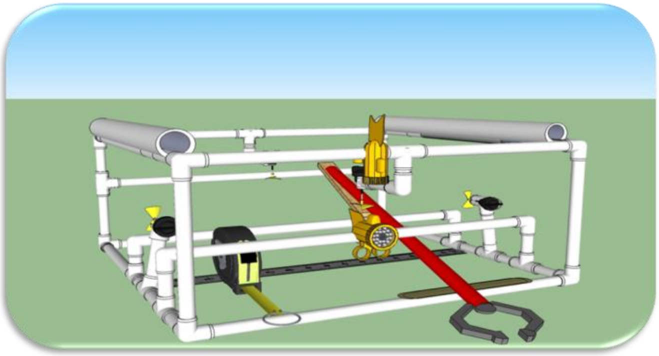


Design Rationale









Challenges & Trouble Shooting Techniques

One challenge we had was how to control the buoyancy. We experimented by using noodles and placing them in different spots of the ROV. (sides and top)

After many trials the noodles were positioned on top. This helped it be balanced when we put it inside the water. If we wouldn't have added the noodles, our ROV would have not only have sunk down to the bottom and it would have put more weight on one side than on the other three.

This would have made it pretty hard to maneuver underwater because there would be more eight on one side so the ROV would tilt that way.

One of the challenges that we had with the ROV was getting our hand manipulator to work properly. Last year we noticed that the motor and lever system that we designed on our ROV to open and close our hand didn't work well. The hand did not close completely.To overcome this challenge our hand manipulator now opens and closes with the support of a pneumatic piston.

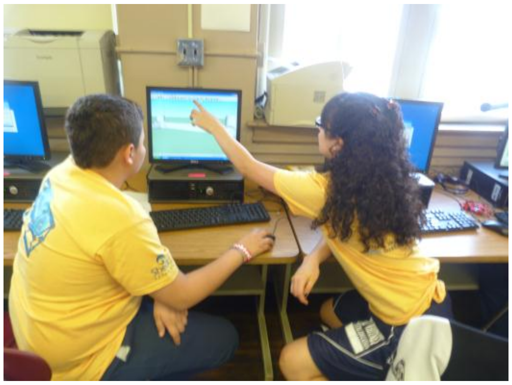
Another constraint was buoyancy. We noticed that after 8 feet the floaters accuracy diminished and since our competitions are held in 16 feet pools we decided to work on a more stable system. We decided to use 2 inch PVC pipes for buoyancy . We've tested this system in a pool and noticed that our ROV can now go to much deeper depths.

Pnuematic Piston

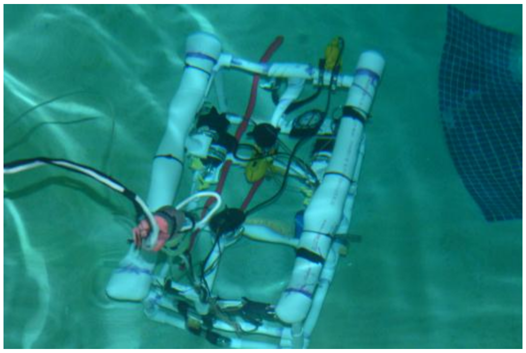
Buoyancy System

Lessons Learned/Skills Gained

We learned many skills during the process of designing as well as building our ROV. One skill we learned was how to use Google Sketch-Up. When we first started using it, we all seemed pretty much clueless, but as our instructors taught us we got the hang of it and how to use it to help design our ROV.



Another skill we learned was something we learned during the process of building our ROV was working as a team. We really learned how to listen to each other's ideas and agree on how we wanted our ROV to work. We also learned about polarity! We learned how positive and negative wires really work and how the motors are connected to our remote!



We learned how to cut and put together the PVC pipes as well as where to position the camera and motors as well as the mechanical hand. The lessons we've learned have helped us design and build our ROV.

We researched pneumatics systems and learned about how air compressors work took the Pneumatic quiz online and passed it with flying colors. Our hand manipulator now opens and closes with the support of a pneumatic piston.

Mission Theme | WW2 Shipwrecks

The devastation of World War II continues today. Over 9,000 vessels were sunk in all of the world's oceans, creating many potential threats. Hazards include oil spills, chemical releases, unexploded bomb, and coral reef degradation. At present, there is not an international treaty to manage the potential threats from these shipwrecks. A new treaty, the Wreck Removal Convention, was signed by all nations in May 2007; however, this treaty does not address World War II wrecks.

This is a picture of an underwater robot used to collect data on a shipwreck.

With the help of ROVs we can see the inside of shipwrecks, take photographs, and see if the ships are deteriorating.They collect data animal samples that humans can't reach. They help us research the area and go inside shipwrecks that are too deep for divers to go into.They have also been used to locate many historic shipwrecks, including the RMS Titanic, the Bismarck, USS Yorktown, and SS Central America.

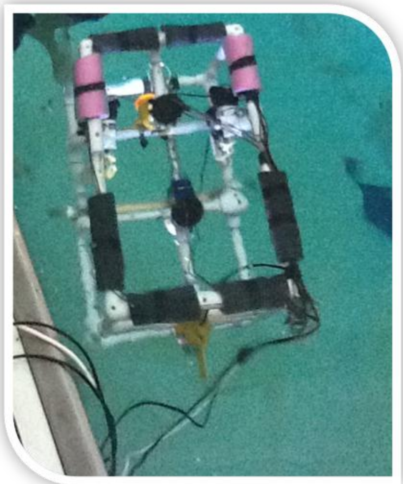
World War II shipwrecks sunk in 1942 off the coast of North Carolina during the Battle of the Atlantic. High resolution (Credit: NOAA)

Future Improvements/Reflections

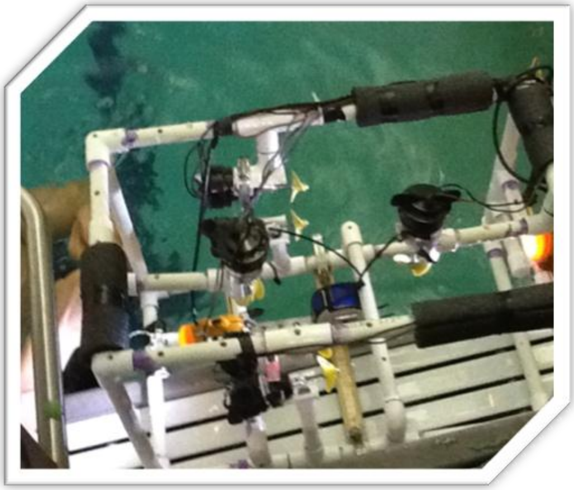
We decided that the most rewarding part of the Underwater Robotics experience was working in a team in order to create our ROV Triton . We all had the chance to really get to know each other better; and grew as friends as well as a team. Go PVC Corporation!!!

Another rewarding part of this experience was learning that ROV's are important in the real world and that people have jobs that require them to build ROV's and use them for discovering new things.

In addition, actually seeing our robot fly underwater was rewarding too! It showed that all of our hard work was paid off. Being part of Underwater Robotics is an amazing opportunity that everyone should experience



We decided that if we were to do this experience again, we would try to finish the ROV faster. This would give our team more opportunities to practice driving it in the pool on more occasions. This year we were able to get to the pool for a total of 3 times before the competition. Additionally, we would like to meet more often. Instead of meeting only twice a week e thought that maybe meeting 3 times a week could help us in completing our robot faster and then we can get to the pool to practice driving our ROV more frequently



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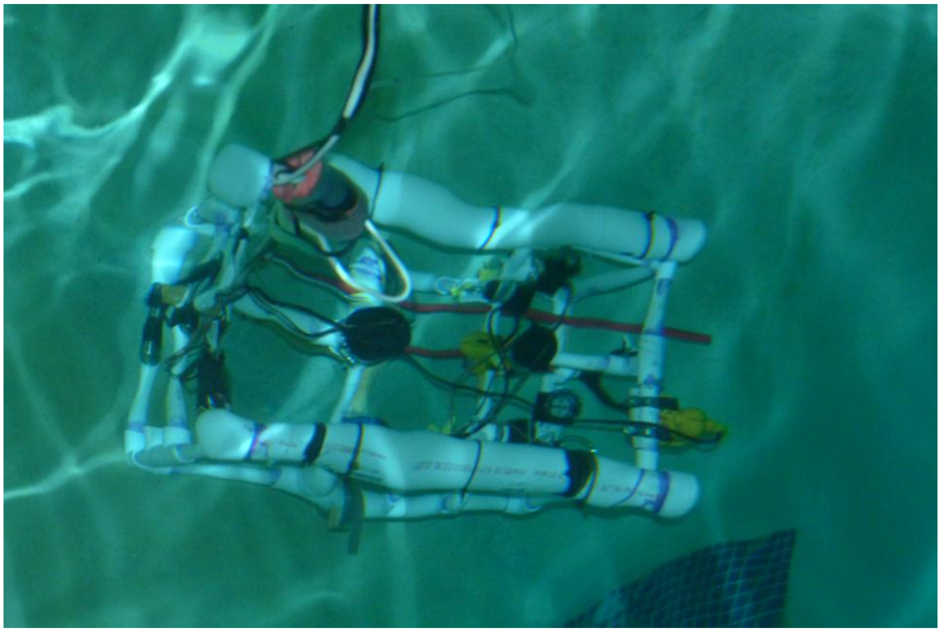

Acknowledgements

We would really like to thank our instructors, Ms. LaTina Taylor and Mr. Felix Bahena for helping us with any questions we had and also helping us with the construction of our ROV Amphitrite. Our team would also like to thank Mr. Luis Mendez, our mentor from the Shedd Aquarium for helping us and explaining many things to us like parallel circuits and helping to answer any questions that we had about our ROV design and the MATE competition. We would also like to thank MATE Center for sponsoring a competition like this for us to learned about STEM ideas and learn about engineering.

Special acknowledgements goes to *Little Village High School* in Chicago, Illinois who graciously granted us access to their swimming pool for practice and ensuring that our ROV was neutrally buoyant and giving us time to drive our ROV. A special thanks goes to the Purdue University ROV Team for donating to us our air compressor and for being our mentors. We would like to thank our parents for supporting us with providing us transportation and moral support. We also want to thank our classroom teachers for encouraging us to sign up for Underwater Robotics after School Science Club. We would also like to thank our principal Mr. Jorge Ruiz who supported this program at our school from the beginning.