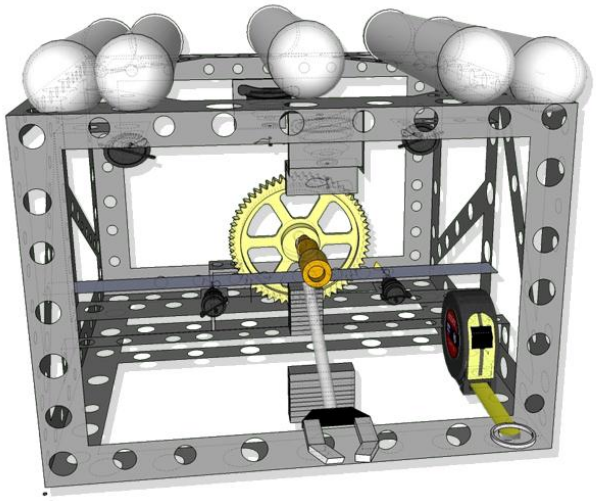
Poseidon Voyager Corporation

Eli Whitney Elementary | Chicago, Illinois

From Left to Right: Top Row: LaTina Taylor, Instructor, Alexis Ceballos, Research & Development, Raul Garcia, Engineer, Ismael Pineda, Digital Engineer, Lizbeth Morales, Research & Development, Felix Bahena, Instructor, Brenda Padilla, Research & Development Middle row: Christopher Martinez, Engineer, Rosa Padilla, Research & Development, Alethea Chicancham, Engineer, Melissa Regalado, Digital Engineer, James Hernandez, Engineer, Kevin Rivera, Digital Engineer From Left to Right: Bottom Row: Martin Garcia, Engineer, Eric Nieto, Research & Development, Deborah Hernandez, Research & Development, Daniel Salazar, Electrical Engineer/Pilot, Edwin Ortega, Electrical Engineer/Pilot, Ericka Corral, Digital Engineer/ Co-Pilot



We used Google SketchUp, 3D design software to help with the design and engineering of our ROV, Moshe.

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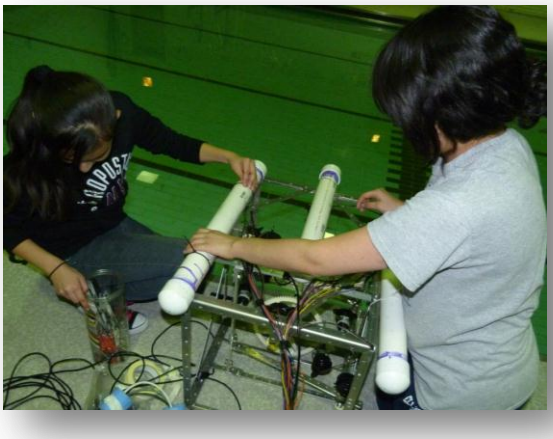
Abstract

This is the fifth school year that Eli Whitney Elementary School, located in Chicago's Little Village community, has participated in the Underwater Robotics program. Our company consists of a diverse group of 6th –8th grade middle school students who have career goals as engineers, forensic scientists, chemist, 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 in exploring and documenting shipwrecks, studying sinkholes, and conserving our national maritime heritage sites.

The inspiration for the name of our ROV comes from this year's theme "Great Lakes"**. Moshe** (pronounced Moses) is an acronym for the great lakes. We call Moshe the **Ultimate Multi-Tasker** because he is engineered and custom built to serve many purposes like measuring the length, width, and height of a shipwreck.

Moshe is shaped in a rectangular prism and his aluminum frame supports his 11 motors, 3 cameras, and 2 different payloads (hand manipulator and measuring tape.) Moshe is equipped with a hand manipulator that opens and closes using a lever system so that it can pick up objects like the debris found in Task 3 of the missions.



Moshe's hand also rotates 360 degrees with the support of 2 custom gears so that it can open and close the cargo container found in Task 1. Moshe has two custom designed remote controls that feel a lot like a video game controller and three cameras for optimal viewing of the underwater course. One camera is used to gain a better perspective of the underwater course the two cameras are used to view the two different payloads (hand manipulator and measuring tape).

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.

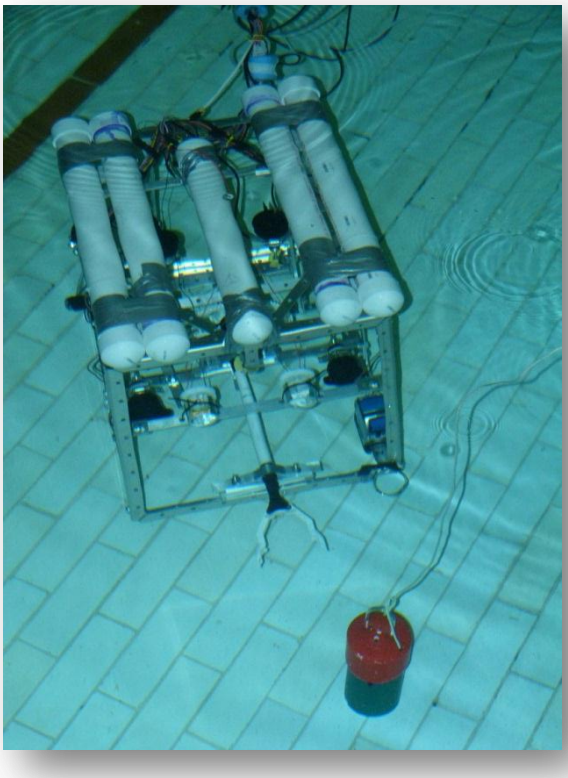
Our ROV’s are custom built to complete jobs companies hire us to do using our passions for science, technology, engineering, and math.

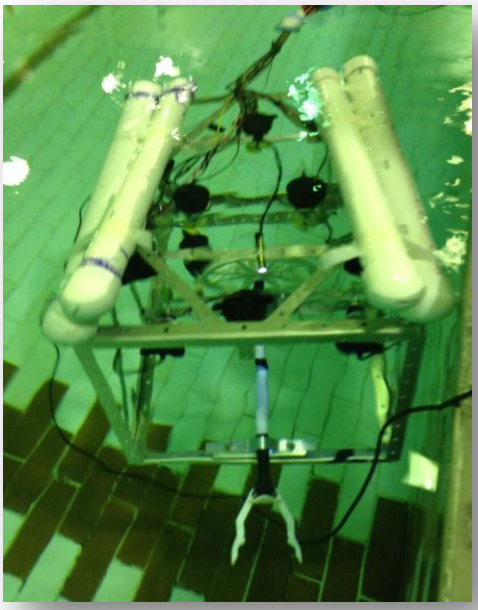
We enthusiastically work collaboratively with our company staff members bringing our innovative ideas to life daily.

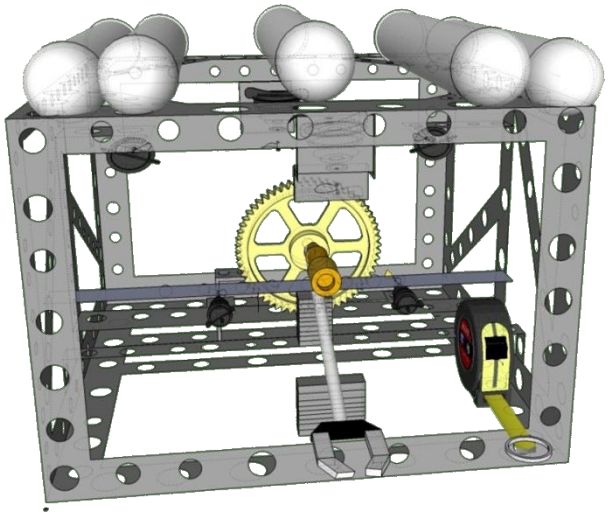
Being responsible and organized is our motto to get the job done. As well as a commitment to being safe.

Success is our middle name.

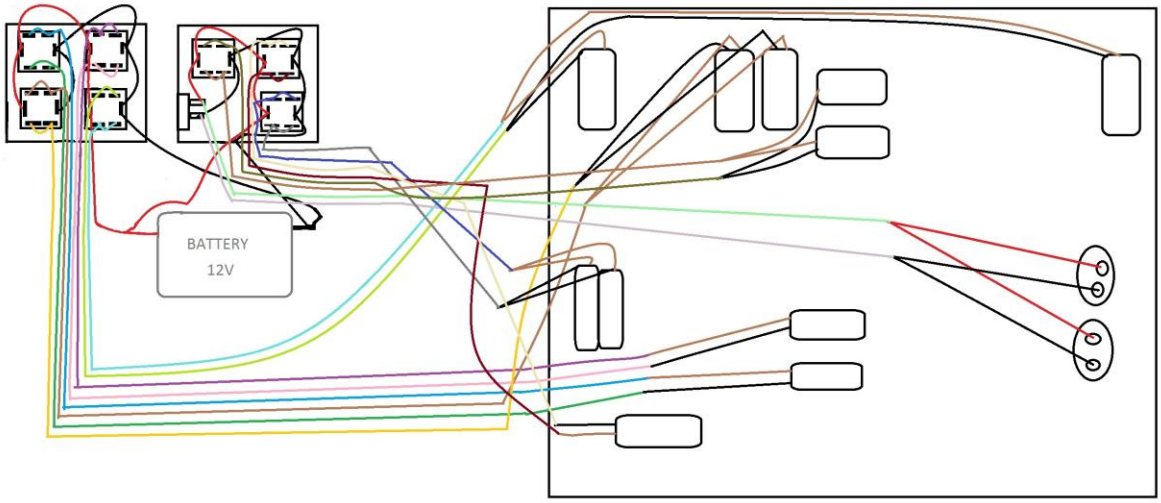
Photos of Completed ROV

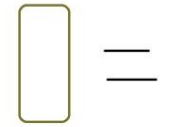


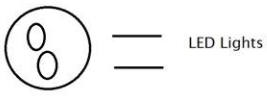


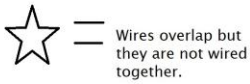


System Integrated Diagram (SID)









Budget

Description	Cost Per Item	Total Amount
PVC 2 Inch Pipes	$ 5.00 each x 5	$ 25.00
2- Inch PVC Pipe Covers	$2.00 each x 10	$20.00
Cameras	$11.66 x 3	$34.98
PVC Glue	$6.00 x 1	$6.00
Stainless Steel Measuring Tape	$20.00 x 1	Reused
Bag Of LED Lights	$9.00 x 1	$9.00
Plastic Cups	$7.50 x 2	$15.00
Switches	$3.00 x 6	$18.00
Remote Boxes	$8.49 x 2	$16.98
Aluminum Frame	$0.00 x1	Donated
Bag Of Nuts	$9.00 x 1	$9.00
Bag Of Bolts	$9.00 x 1	$9.00
Bag Of Washers	$9.00 x 1	$9.00
Bag Of Female Connectors	$9.00 x 1	$9.00
Aluminum Pieces	$0.000 x 1n	Donated
Bag Of Resistors	$8.00 x 1	$8.00
Bag Of Bread Boards	$11.00 x 1	$11.00
Total Expenses		**$ 199.96**

Design Rationale

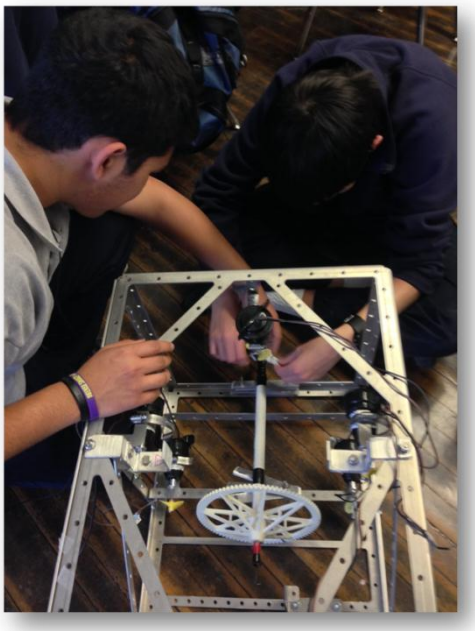
Meet MOSHE! (Pronounced Moses)

The inspiration for the name of our ROV comes from this year's theme: Great Lake shipwrecks.
Michigan
Ontario
Superior
Huron
Erie

Moshe has an aluminum frame with (5) 2 inch PVC pipes used for buoyancy. Moshe is equipped with 11 motors/thrusters and two customized remotes with 7 switches. Our ROV has three cameras: one for view of underwater course, hand manipulator, and the last one for viewing of the tape measure payload. Moshe has a hand manipulator that opens and closes and rotates 360 degrees. Moshe also has an underwater measuring tape used to collect data of shipwreck and site.

After many class discussions and team submissions of various prototype designs using K'Nex and Google SketchUp 3D software we decided to custom build Moshe to complete the missions as the "Ultimate Multi-Tasker".

Frame



Moshe's frame is made of aluminum and is shaped in a rectangular prism to support his 11 motors, 3 cameras, and 2 different payloads. (rotating hand manipulator and measuring tape).

Moshe's aluminum frame weighs about seven pounds. We chose an aluminum frame for different reasons. First, having the aluminum frame supports our buoyancy system. Our previous ROVs were made from PVC pipes. This presented an issue when calibrating our ROV at the pool. With the aluminum frame our buoyancy is set we do not have to change it, For example, because Moshe is made of aluminum and not PVC pipes it doesn't get any air pockets in the frame which can affect the buoyancy.

For this reason Moshe is specifically designed with lots of holes in the frame to avoid us from drilling new holes every time we wanted to add or adjust something (i.e. payloads, motors, etc.) Our aluminum frame is also sturdier

than our previous PVC pipe designs because of our triangular side frame that makes the ROV sturdier. In previous years our PVC pipe frame would bend when we operated our customized lever to open and close our hand manipulator. Adding the triangular side frame (like truss bridges have) makes it sturdier than our previous ROVS design models. Other advantages in using the aluminum frame is that it doesn't rust, it's strong, and it's lightweight.

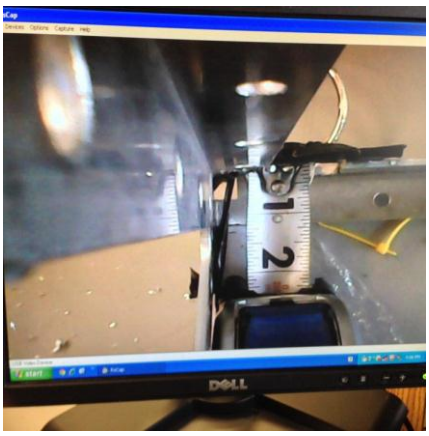
Cameras (vision)

To gain the best perspective of the underwater course, Moshe is equipped with three cameras: two are used to view the different payloads (hand manipulator and tape measure) and the other camera is used to view the underwater course.

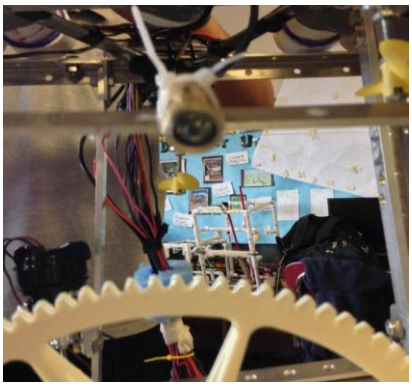
Camera#1: The first camera is strategically placed on Moshe to gain the best view of the measuring tape payload that will be used in Task 1.

Camera#2: The second camera was also mounted special to view the underwater course so that our poolside team can gain the best visual perspective of the underwater course. This camera is located at the back of it of the ROV and resting on top of an aluminum beam inside the frame of Moshe.

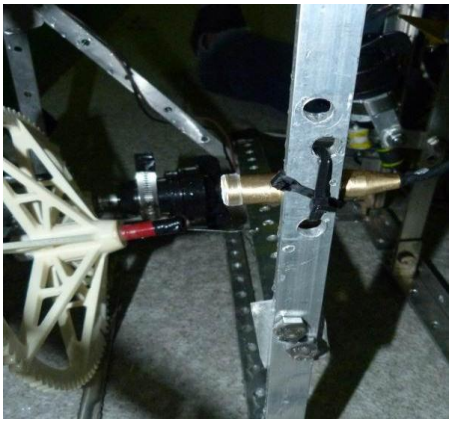
Camera#3: The third camera was strategically placed in the center of the ROV in order to optimize the pilots view of the hand manipulator and any object we would need to retrieve.



View from camera #1.



Camera #2.



Camera #3

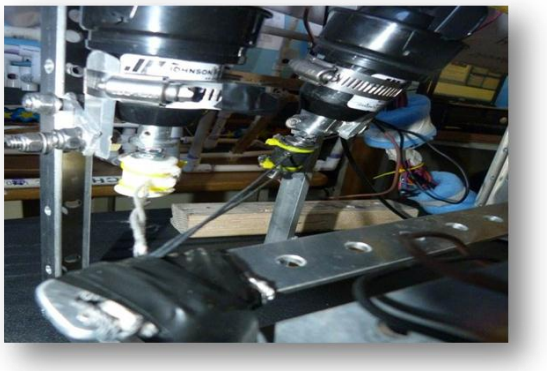
Buoyancy

This year we decided to use four twenty-four inch PVC pipes and one twenty-one inch PVC pipe as our buoyancy system. In the previous years we would use plastic floater however there was a big problem using them. Once we past a certain depth the pressure would be too much and change the buoyancy of the ROV. This will lead to the ROV to collapse and cause it to become negatively buoyant.

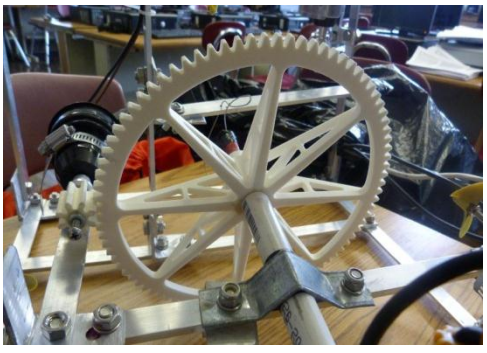
Payloads

Hand Manipulator

We agreed as a team in 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 objects up, a hand would be the most natural tool to use. This is an example of bio mimicry (the study of nature's best ideas and then man imitates these) in that we wanted our ROV to pick up and grab things like our human hands do.

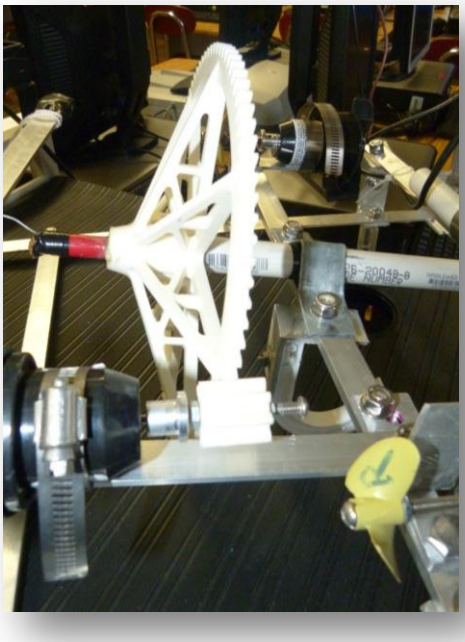


Moshe's hand manipulator is customized to pick up objects that might require a special grip. Moshe's hand rotates 360 degrees with the help of two gears and two motors. (See picture to the left) Our company decided that Moshe needed his hand manipulator to rotate to complete Task 3 which involves turning the handle to unlock and lock the hatch.



We concluded that having a hand manipulator that was able to rotate could open the locking mechanism with ease.

Custom gears were designed by our company to rotate Moshe's hand manipulator. (See image to the right) Additionally, the hand manipulator is our "priority payload" which means we will use the hand manipulator for several of the mission tasks. For example, in task one we will use the hand to recover the plate from inside the ship, in task two our ROV will use the hand to recover the old sensor and replace the new sensor, and in task three we will use the hand manipulator to remove the two bottles and the anchor line.



Measuring Tape

Moshe has a special measuring tape located in front of his large gear that will be used in Task 1. The measuring tape is made of stainless steel and is durable for underwater activity; it can be submerged in water without any problems of rusting. We decided to have a camera mounted directed above the measuring tape to collect the measurement data of the shipwreck. (See image to the left

In this task our pilots will maneuver Moshe to measure the length, width, and height of the shipwreck.

Motors

Moshe is equipped with 11 motors. Two motors are used to allow our ROV to move up and down. There are two motors to move forward and backward. One motor is available for turbo speed. Three motors are used for the hand manipulator.

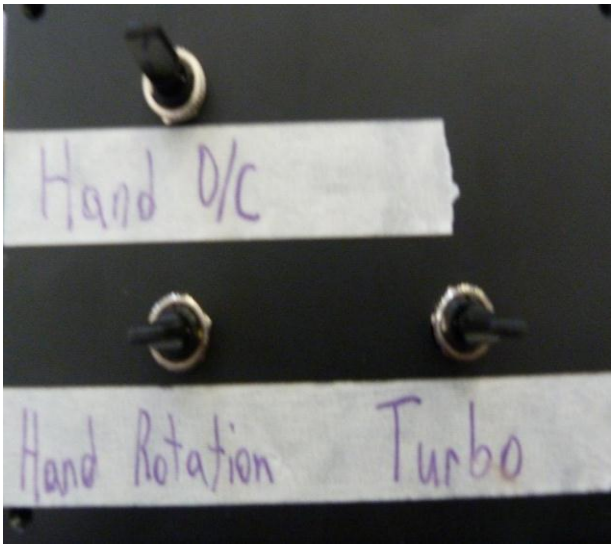
Tether

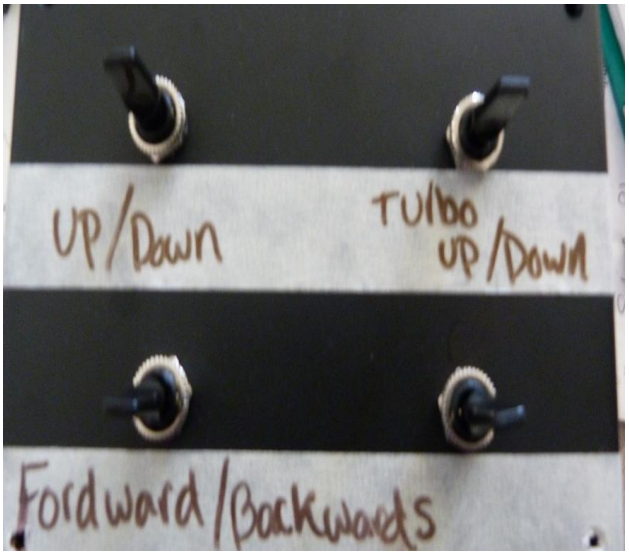
Moshe has a tether that is 50 feet long. The tether includes all of the wires to control the ROV itself along with the remotes. The wires themselves consist of .22 gauge wires which run through two wire packs.

Moshe's Remote Controls

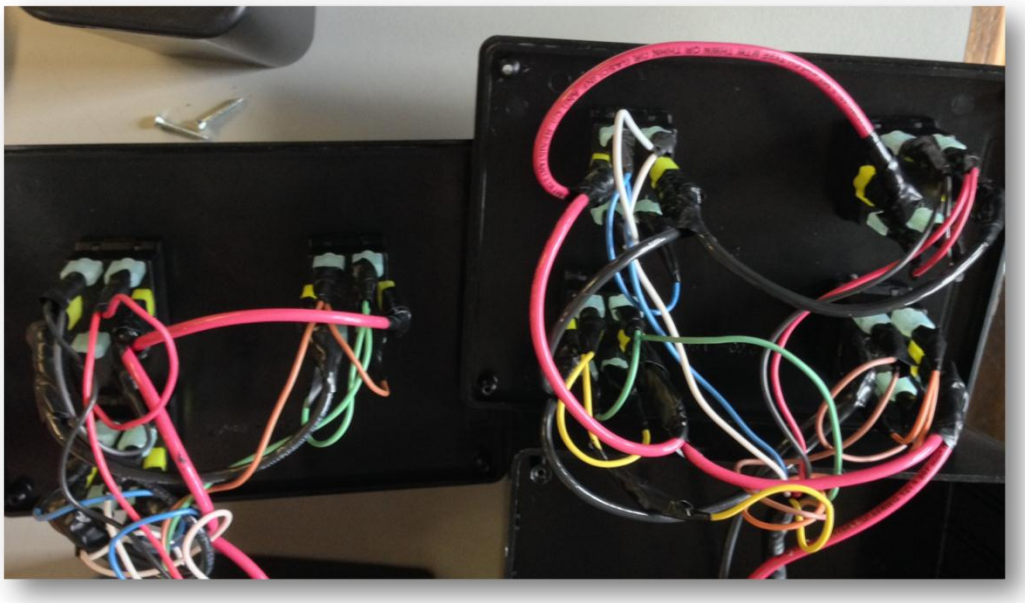
Moshe has two remote controls customized to feel like a video game controller. We named the remote control "Gemini". One remote "flies" Moshe while the other operates the hand manipulator.

Moshe's two remotes total seven switches. There is a switch for the hand manipulator. There is a switch to use the turbo speed which is connected by two motors. The other switch maneuvers Moshe up and down, forward, and backwards.





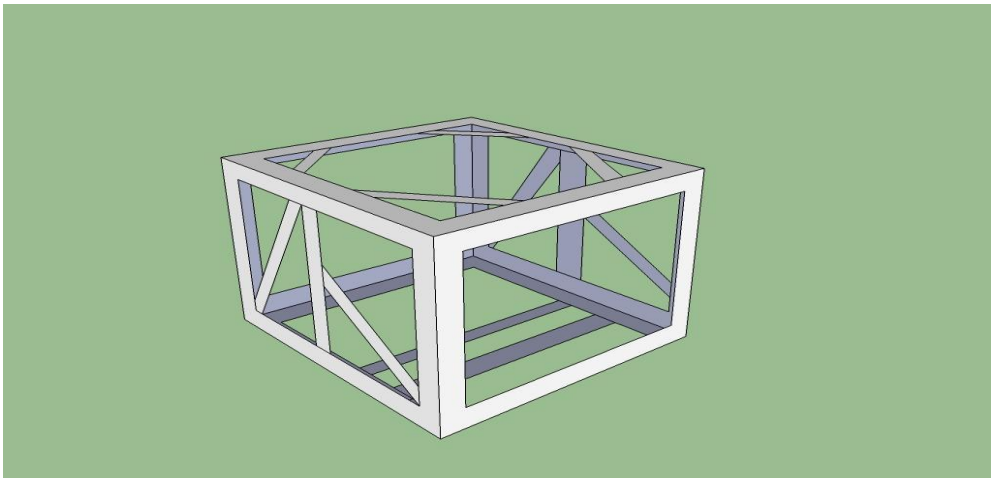
“Gemini” -The two remote controls for our ROV MOSHE. (Above)



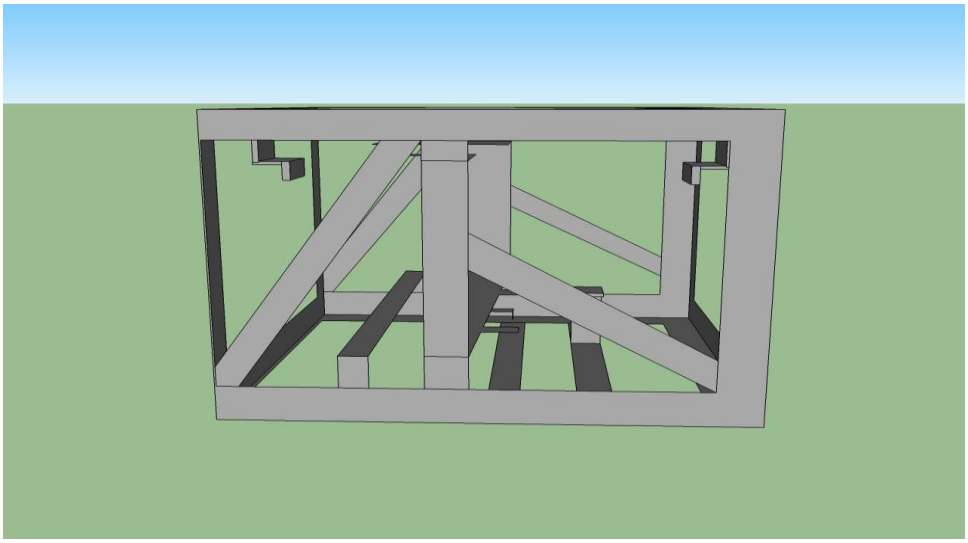
PVC Engineering Team spent countless hours wiring the switches to the motors to make Moshe a reality.

Google Sketchup 3D Timeline

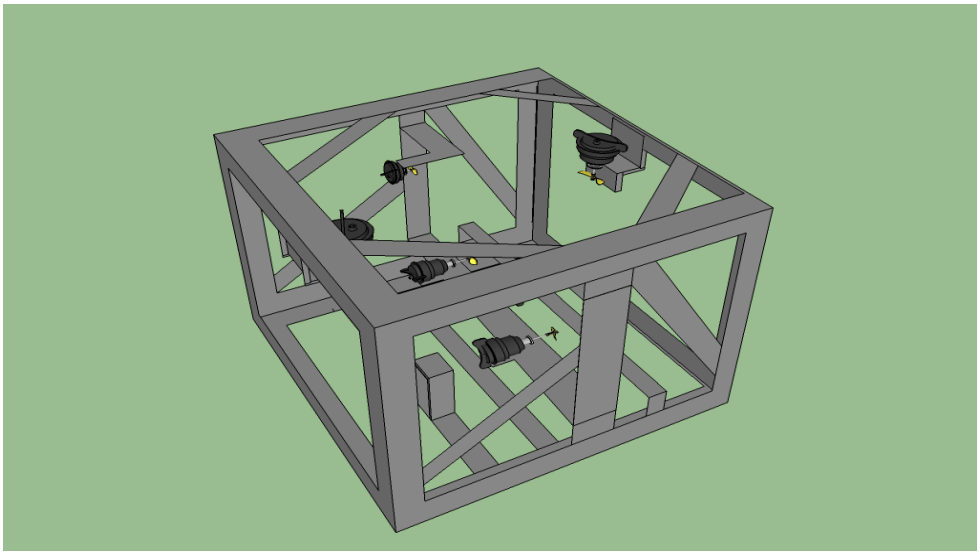
Our Digital Engineering Team used 3D graphic design software called Google SketchUp to help design and engineer our remotely operated vehicle M.O.S.H.E. This team consulted and met with the our Engineering team to discuss the goals of each mission and decide mathematics dimensions of M.O.S.H.E frame and location of payloads and cameras and motors.



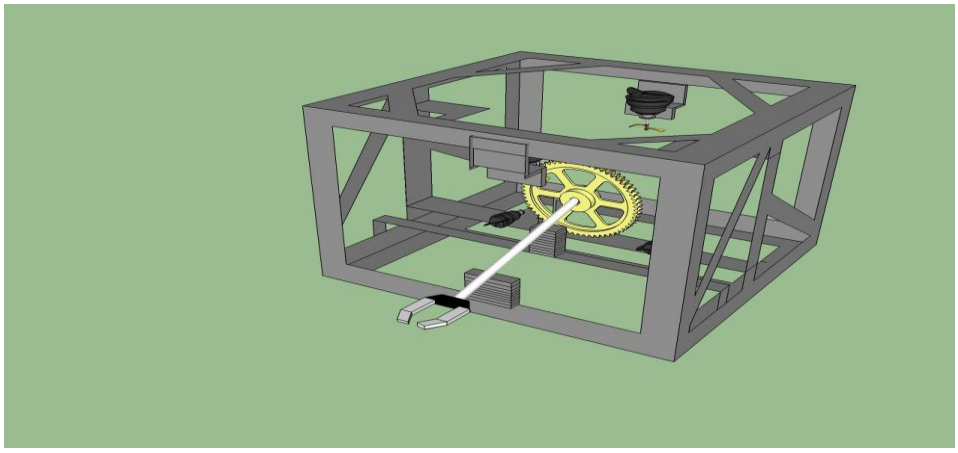
This is the beginning of our ROV M.O.S.H.E .We added the triangles to make the R.O.V sturdier.



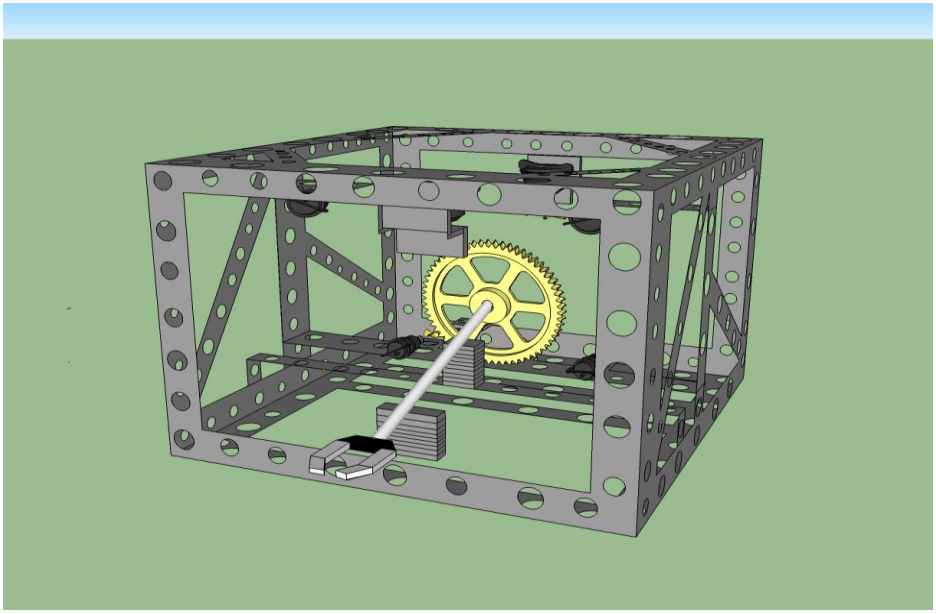
We colored the main frame and added four more supports for the R.O.V's motors so they can perform successfully perform during competition.



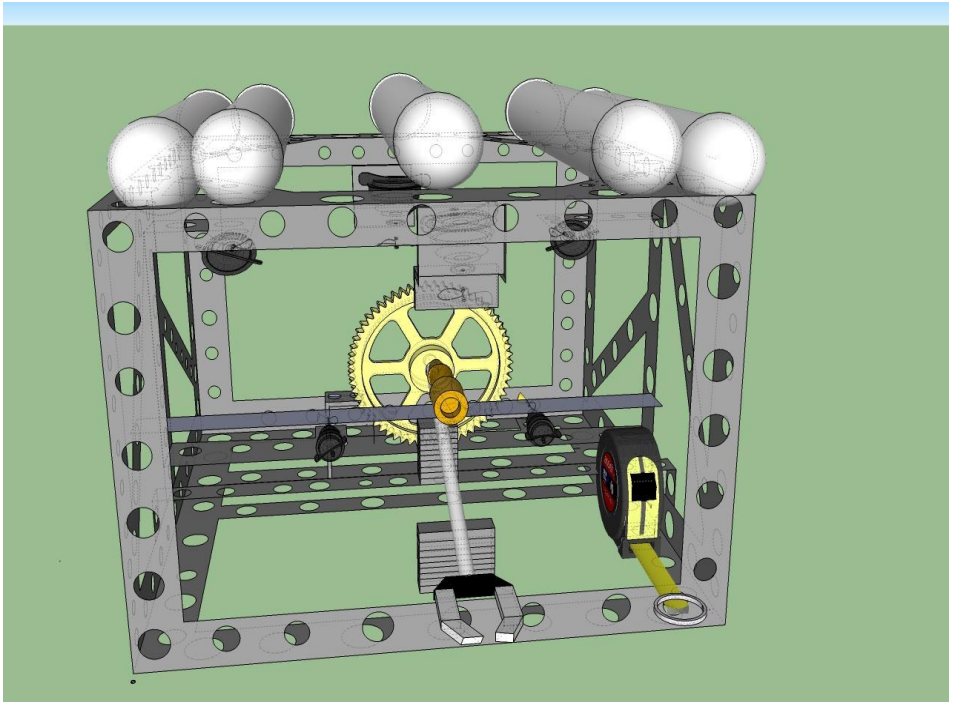
At this point we have added the motors in their designated areas.



In this image we have added the hand, the hand supporter, and the gear. The gear is made to be able to open and close the hand including rotate it.



We added the holes to the frame and we rotated the motors because they were facing the wrong way.



In this picture we added the buoyancy, measuring tape, also a camera. We added the measure the length, width, and the height of the shipwreck.

Mission Theme

Thunder Bay Shipwreck Alley | Facts

- ✓ More than 100 shipwrecks were discovered in Thunder Bay Alley.
- ✓ They have been resting as close to the surface at 12 ft. and some as deep as 180 ft.
- ✓ The shipwrecks that have been discovered is only a small selection of the shipwrecks that have actually occurred over the years.
- ✓ Many sinkholes have occurred at Thunder Bay Shipwreck Alley.

Map of Thunder Bay Shipwreck Alley
Image Credit :oceanexplorer.noaa.gov

Sinkholes

This is a picture of a ship that is about to be swallowed by a sinkhole**.** Image Credit: www.telegraph.co.uk

- ✓ A sinkhole occurs when underground water washes away soft rocks like limestone, carbonate, rock, and salt.
- ✓ As rock and salt are worn away it leaves behind a cavern when the cavern becomes too big it collapses causing a sinkhole.
- ✓ The most vulnerable places for sinkholes are Florida, Texas, Alabama, Missouri, Kentucky, Tennessee, and Pennsylvania because they have many rocks and salt.
- ✓ Sinkholes can be as deep as 663 ft. and can be as wide 35 meters.
- ✓ There are three types of sinkholes Cover-collapse sinkholes , Cover-subsidence sinkholes and Dissolution sinkholes

*Cover collapse - Occurs where the overburden is made of soft material
*Cover subsidence - Characterized by small dimensions the presence of water and gradual collapse
*Dissolution sinkhole- Don't sink the overburden washes away exposing the bedrock to erosion

Image credit: ddvsworld.blogspot.com

Types of Ships Lost in Thunder Bay Alley

Steamer

A steamer is a boat that is powered by steam.

Image credit: www.kilduffs.com

Schooner

A sailing ship with two or more masts typically with the foremast smaller than the main mast.

Image credit: www.edhat.com

Freighter

A ship or aircraft designed to carry goods in bulk.

Image credit: mb50.wordpress.com

Shipwrecks @ Thunder Bay Alley

Name: The John J. Audubon
Date Lost: October 20,1854
Cargo: iron
Type: A wooden 2-masts bring

The John J. Audubon shipwreck.
Image credit: www.thunderbay.noaa.gov

Name: W. P. Rend.
Date Lost: September 22, 1917
Cargo: stone
Depth: 17 ft.
Type: bulk freighter

The remainders of the W. P. Rend.
Image credit: www.thunderbay.noaa.gov

Name-William A. Young.
Date lost-November 17 1911.
Type-A wooden two mast schooner-barge, bulk freige.
Cargo-Coal
Depth-40 ft.

The William A. Young when it was found.
Image credit: www.sandreefs.com

This is a image of an ROV surveying a shipwreck called e Grecian in Lake Huron. This ROV was entered in an expedition to look for lost shipwrecks by five students. Image credit: Advanced Imaging and Visualization Lab, Woods Hole Oceanographic Institution

How ROV's Document Shipwrecks

ROVs document shipwrecks by going into deep ocean depths that humans can't reach. They serve as an archaeologist's eyes and hands in the deep ocean.

Archaeologists use ROVs to recover artifacts and record all exposed archaeological features (cannon, anchors, concretions, pottery and other artifacts, brick, wooden hull structure, and other visible items), as well as debris often scattered across a wreck site.

ROVs also examine shipwreck environments, the sediments, biological growth and marine species

This is an underwater image of the Middle Island sinkhole in Lake Huron showing purple cyanobacterial mats on the lake bottom, with some parts of the mats raising into 25 cm-high fingers/ridges buoyed by microbially-produced gasses within the mat-sediment complex. Image credit: © 2012 Nature Education Rob Paddock, University of Wisconsin.

attracted to wreck mounds

Safety

The Poseidon Voyager Corporation considers the safety and health of all company staff to be the most important aspect of our work. We believe that it is the responsibility of everybody on the team to look out for one another's safety. We built our ROV under safety standards to ensure that everyone is safe while working on or piloting our ROV.

The Poseidon Voyager Corporation complies with all safety requirements and has set forth a "Safety Manager" who is responsible for maintaining all safety issues. He uses our company's safety check list daily to conduct routine inspections. The Safety Manager ensures that company staff is equipped with necessary protective equipment and that everyone uses tools in a safe way. He enforces safety rules and investigates accidents to prevent them occurring in the future.

During construction and while at the pool we exercised great caution!

- ✓ We made safety our priority in all of our discussions asking questions like "Is this safe?"
- ✓ During construction we made sure to wear safety goggles while cutting and welding of mechanical parts.
- ✓ We only operated power tools under our mentors close supervision.
- ✓ While at the pool we made sure to wear gym shoes to prevent us from slipping.
- ✓ No hazardous or toxic chemicals when constructing.
- ✓ Appropriate behavior: no running/horsing around
- ✓ Long hair tied up; no loose clothing
- ✓ Safe material handling: heavy parts/ ROV moved by two people

The Safety features of the ROV:

- ✓ Tape on the corners of The ROV to avoid any injuries
- ✓ Safety triangles

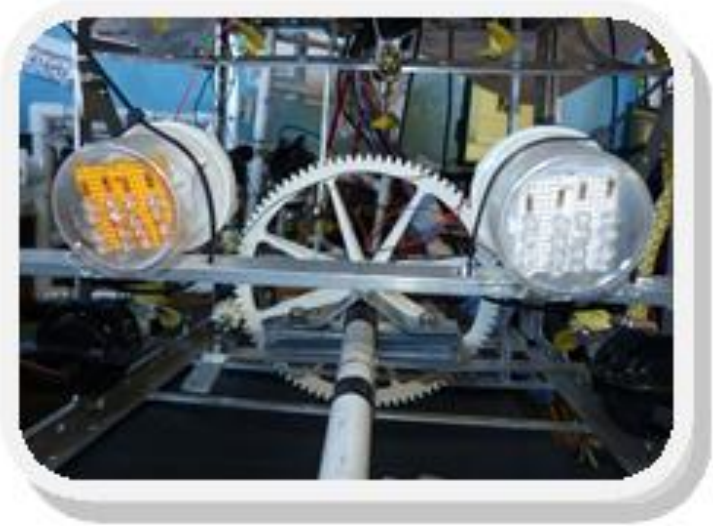
Challenges

One challenge our team faced was the amount of time it took for us to construct our ROV. This presented a problem for us because it limited the amount of time we had to practice driving our ROV in a pool setting.

Our company was only able to go to the pool 5 times before our regional competition. Upon reflection, if we were to do this experiment again, we will try to design and construct our ROV faster so that we can have more opportunities go to the pool to practice our missions tasks and analyze what necessary adjustments we would need to make to our ROV before the regional competition.

Another challenge we saw that needed improvement was the buoyancy system what we saw when we got to go to the pool was that after 8 ft. the floaters accuracy would diminished and since the pool we would perform in was 16 ft. we decided to make the system more stable so we went ahead and used 2 inch PVC pipes for our buoyancy system.

A technical challenge we faced happened one day before our regional competition. We accidentally crossed the negative and positive wires on our L.E.D. headlight system and a short circuit occurred causing an electrical meltdown in our system but as a team we were able to locate the issue, devise a plan on how to solve it, and make the necessary repairs to have our ROV MOSHE operational just in time to compete in our regional competition.



Moshe has an aluminum frame , 11 motors, 3 cameras, and two payloads.

Discussion of Future Improvements

In the future we would like to improve the speed of the ROV. We can do this by adding more motors. This would help us complete the missions faster. Additionally, if we finish missions faster, we get bonus points. The faster the ROV goes, the more tasks we can do in less time. Therefore, increasing the speed of the ROV is something we are looking forward to doing in the future.

Also, reducing the size of the ROV can help with the movability. It will also be helpful when trying to get in small places in the missions. Reducing the size might help us get a closer look at objects during missions. The ROV having a smaller frame might also allow us to use less motors which in return will use less battery power.

Another thing that we might change is buoyancy. If we get a better buoyancy system then the robot will be more stable. With the robot being stable, completing the missions will definitely become easier to complete. Apart from that, a better buoyancy system means less problems underwater. The robot won't have any problems while it's trying to rise to the surface or going to the bottom of the pool. One idea would be a sealed system that allows air to be pumped in at will to change it depending on loads.

The last thing that we might change in the ROV is the hand manipulator. We might change the hand manipulator so that we can grab bigger and heavier items. In the future, there might be a need to pick something up and with a strong hand manipulator it should be no problem. Also, making the hand stronger might give us an advantage while carrying what we grabbed up to the surface.

Testing our new three camera system that gives our team different perspectives at the pool.

Reflections on the Experience

Upon reflection, we concluded that in the future we would like to complete the designing and construction of our ROV sooner. This will insure that we acquire more time practicing the actual missions in the swimming pool. This would help our pilots gain more driving experience, as well as giving them a better flow on how to execute the missions in a logical manner. In order to do this we would have to meet more times a week. We currently meet two times a week however, we think three times a week will be more beneficial.

Secondly, we can outreach to the community. We want our community to be more informed about our team. For example, why are we creating the ROV? We can do that by announcing our team in local newspapers, fliers distributed in local libraries, and interview on local news stations. This could lead to opportunities to have more fundraisers to support our team. A well informed community will lead to the encouragement of more students getting involved in STEM based programs. Students increasing interest in STEM will open more opportunities in Science and Math fields, ultimately giving more successful career choices.

Third, our company could benefit from more classes on electricity. This year we had an electrical issue the day before the competition the regional competition. To prevent this we want to have classes on electricity. We want the entire team to have a better understanding so later on we don't have electrical issues.

Using Google Sketch up 3D software to design and engineer our ROV.

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