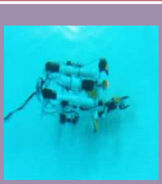
2012



AquaCards Technical Report

Melvindale High School: Melvindale, MI

Team Members: Andrew Barron (Pilot/Electrical Engineer), Nick Kean (Design Engineer), John Felt (Co-Pilot/CEO), Jon Gunther (Mechanical Engineer), Brandon Foster (Electrical Engineer/CFO), and Mr. Randy Thomas (Instructor)

Melvindale ROV team: Nick Kean (far left), Andrew Barron, Jon Gunther (middle), John Felt, and Brandon Foster (far right)

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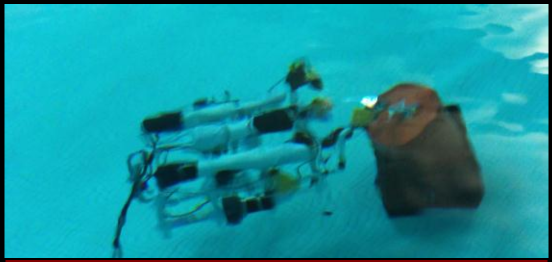
Abstract

At AquaCards Inc., our dedication to innovative design and strategy has led us to an extraordinary ROV specialized for the exploration of this shipwreck. The *SS Gardner* is an enormous task for our company to undertake. From our more advanced robotic arm to something as simple as our camera positions, every element of our design is perfectly adjusted to the task at hand. We have to begin our survey of the sunken ship by taking measurements and then mapping out what we have with a standardized measuring apparatus on the side of our ROV. After measurements and mapping are done we will use our debris composition scanning device to determine if the debris around the ship wreck is metallic or not. We will then scan two separate areas of the ship to determine which are of the ship we will investigate. The next task to be accomplished is removing the fallen mast with a lift bag. To do this we will transport it with our claw and attach the lift bag, which we will then fill with air to pull the mast to the top. We will then use the claw to remove any wildlife from the area to ensure its safety. After this the ROV will use a neutron back scatter device/thickness gauge to determine if fuel is still in the tank. If there is, we will proceed to drill a hole with our specially designed drill pump, (and reseal any leaks that the drill produces), then retrieve a sample for testing.



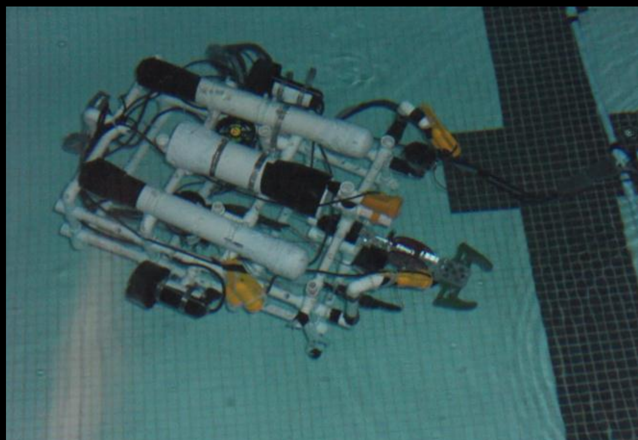
ROV in progress taking a sample from the fuel tank

The famous ROV, Little Hercules, surveys a shipwreck, such as the simulation of the shipwreck in the competition.

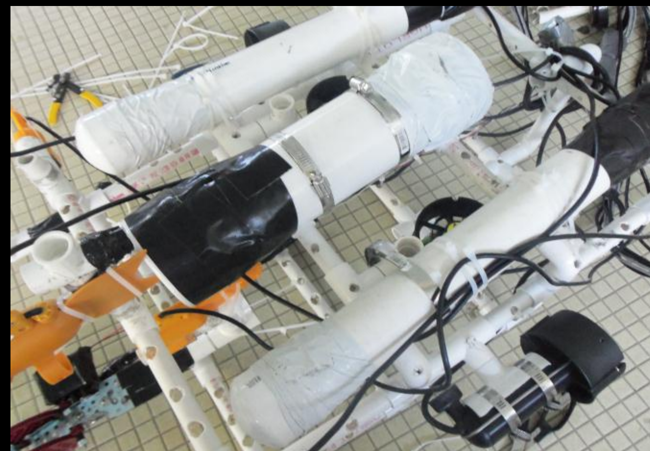
Melvindale High School Underwater ROV Expenses for 2011-2012

Item	Amount	Cost Per Unit	Donations/Grants	Total Cost Per Item	Balance
			Square One Education Network	$3,000.00	$3,000.00
			Anonymous Source	$4,000.00	$7,000.00
			Bartello Family	$500.00	$7,500.00
			Half off on Seabotix Motors from Purdue.edu		
			FloorSource	$200.00	$7,700.00
Submersible Black and white Camera	4	$79.00		$316.00	$7,384.00
Submersible Color Camera	1	$99.00		$99.00	$7,285.00
Seabotix Motors (50% off)	4	$500.00		$2,000.00	$5,285.00
12 Volt Jumper Box	1	$59.00		$59.00	$5,226.00
Vex Robotic Arm Set-up	1	$56.00		$56.00	$5,170.00
Spool 16G 7 Wire	2	$68.00		$136.00	$5,034.00
Fuse holder	2	$2.49		$4.98	$5,029.02
Project Box	2	$7.99		$15.98	$5,013.04
14-16 G Female Disconnect Crimps	1	$8.99		$8.99	$5,004.05
14-16 G Wire Nuts	1	$4.99		$4.99	$4,999.06
#36 Hose Clamp	10	$1.29		$12.90	$4,986.16
10-24 Stainless Steel Screw	1	$3.49		$3.49	$4,982.67
10-24 Stainless Split Lock Washers	1	$2.33		$2.33	$4,980.34
10-24 Stainless Steel Nuts	1	$1.45		$1.45	$4,978.89
PVC 40 1/2 x 10`	2	$1.97		$3.94	$4,974.95
PVC 40 1/2 Slip Cap	10	$0.56		$5.60	$4,969.35
PVC 40 1/2 90 Elbow	10	$0.79		$7.90	$4,961.45
PVC 40 1/2 T	12	$2.19		$26.28	$4,935.17
PVC 40 1/2 45 Elbow	10	$0.89		$8.90	$4,926.27
PVC 40 1/2 Slip Cross	12	$0.56		$6.72	$4,919.55
PVC 40 1x 1/2 T	10	$1.22		$12.20	$4,907.35
PVC 40 3" x 6`	1	$5.66		$5.66	$4,901.69
8.5 Portable DVD Player	1	$89.00		$89.00	$4,812.69
20 A AGC Fuse	1	$1.59		$1.59	$4,811.10
Duct Tape	3	$7.88		$23.64	$4,787.46
Water Noodles	3	$1.00		$3.00	$4,784.46
Airline Travel	9	$329.60		$2996.40	$1,738.06
Vehicle	1	$980.00		$980.00	$758.06
Lodging	4	$518.53		$2074.13	-$1,316.07
Food Costs				$1,080.00	-$2,396.07
Total Expenses				$10,046.07	
Final Balance					-$2,396.07

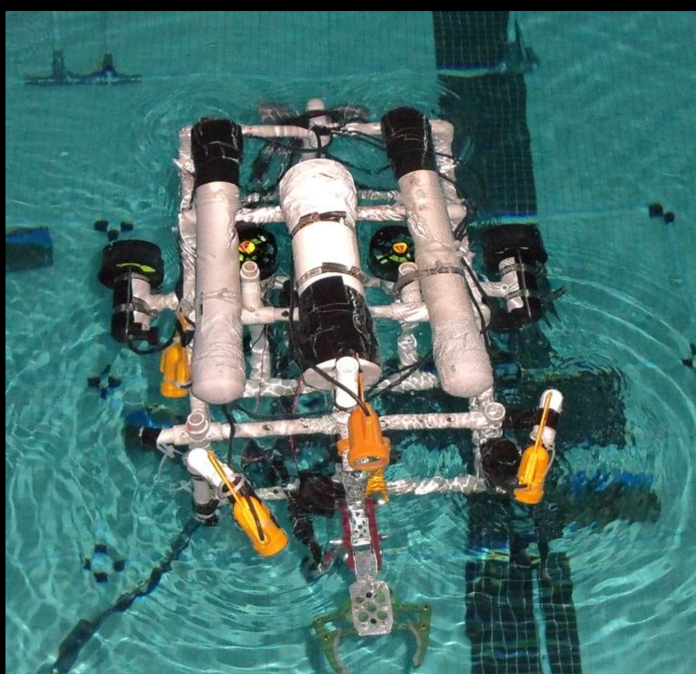
****This expense sheet does not include personal funding (such as each member paying a share), or any donations after the creation. During the making of this sheet we are doing fundraisers and still accepting donations. When the time arrives we should have enough to pay the trip in full.**



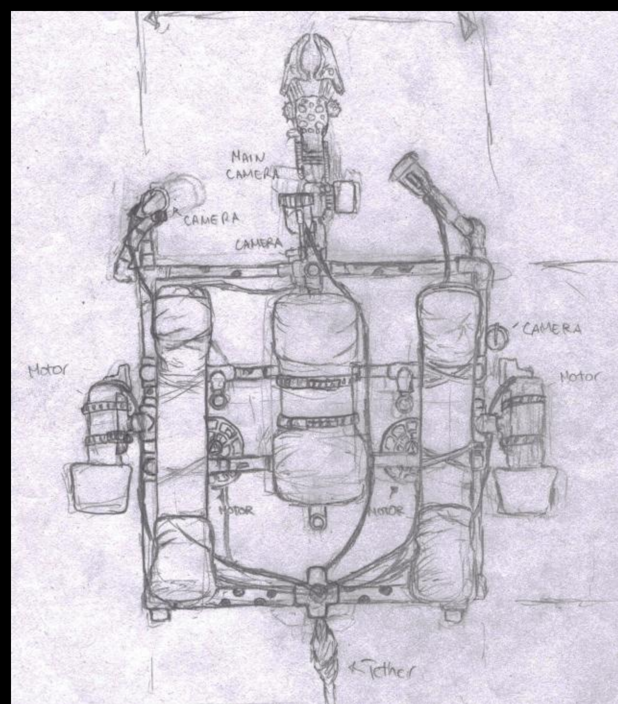
ROV in the pool with the claw open



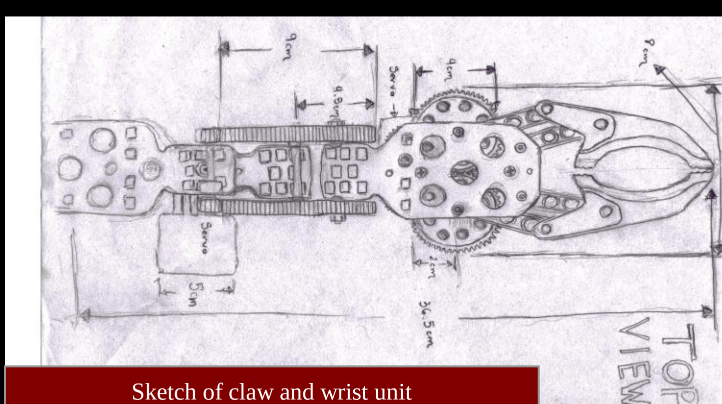
Ballast tanks on top of the ROV



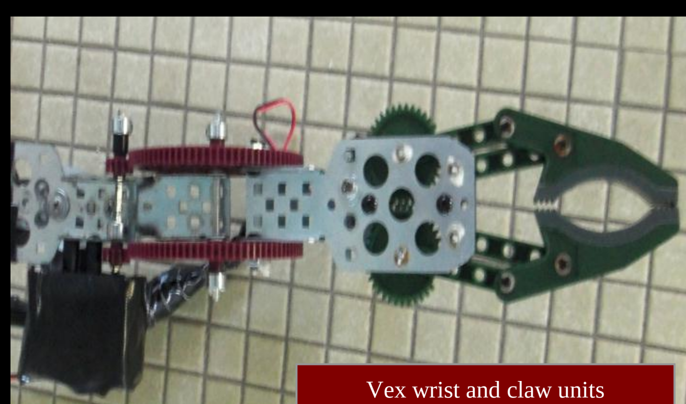
ROV in the water, testing the claw



Sketch of the ROV



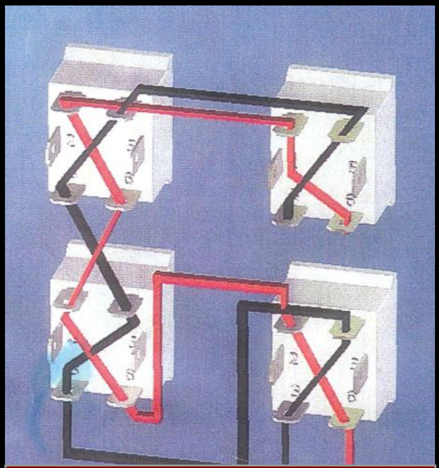
Sketch of claw and wrist unit



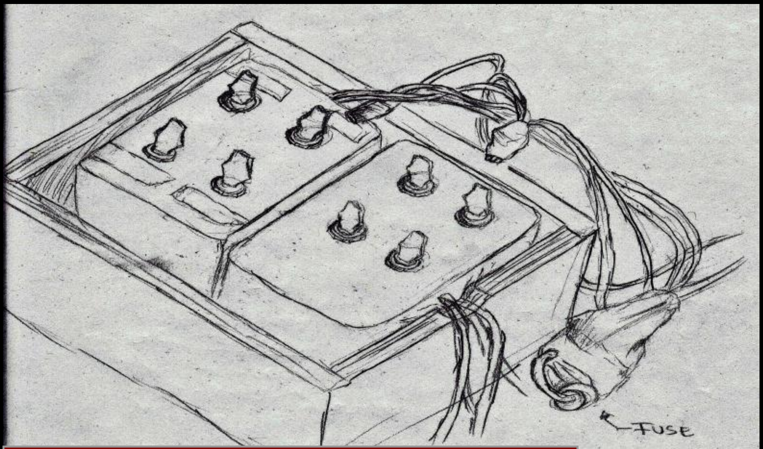
Vex wrist and claw units

Electrical wiring of the ROV

Our ROV consists of two separate boxes which control specific mechanical parts of the ROV. The first box on the right of the diagram controls all of the motors. Up and down are located on the top of the box, and left and right are located on the bottom. The left box consists of the robotic claw and elbow. Four switches on the special box (claw and wrist box) are used to make sure we have open spots for any attachments we wish to add in the future that would require electrical movement. The box was built based on a schematic supplied by our teacher, Mr. Thomas. Our group also has built boxes in previous years because of this we contemplated moving from these basic boxes and attempting to use a more advanced system such as joy sticks or controllers. Ultimately, we decided against this because we felt that a joystick would hinder our movement. This was due to the fact that when using joystick a specific motor cannot be chosen, there is only forward and turn. With the boxes we use, we can easily control each motor to further control the power. If we need to move up slightly (or down slightly) we can select one motor instead of firing both at the same time. This also applies for horizontal movements. We felt our time would be better spent working on the primary functions of the ROV to ensure it would work properly, and work on luxury items (such as the control boxes) when we have more spare time.



Electrical Schematics (inside the box)



Sketch of the boxes, along with the fuse

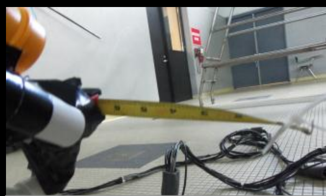
Design Rationale

Our ROV was part of an underwater studies class where the ROV was taken to different key locations on the Detroit River, based on factory locations or heavily traveled areas, and do studies on oxygen levels, pH levels, chlorine levels, etc. We also wanted the ROV to be able to compete in competitions like the Square-One state competition and the Mate Regional and International competitions. To accomplish both we decided that a rectangle shape ROV with open ends for multiple attachments would be the best design. After drawing some sketches and agreeing on the design, motor placements, and buoyancy issues, we started the building process. First, we built the structure of the ROV leaving PVC openings everywhere we could. Since the ROV was larger than the normal ones we built we put PVC across the middle for extra support. While some worked on building the structure, the others started working on the electrical aspects of the ROV, which included the control box, wiring motors, and creating the tether. A basic rectangular box with a specific wiring path to allow for four up and down switches was constructed. Each switch was wired to a specific motor to allow the spinning of the propellers in either direction depending on which way the switch was flipped. Work was started on attaching the motors. SeaBotix motors, was used for extra precision and power. These motors run off the same voltage as the normal motors do except they come with motor guards and aren't as sensitive. Once the motors were installed we constructed the tether which is made up of coated wires. We tip tied and gorilla taped the tether to make sure it would not attach to anything on the ROV or parts of the mission. To stop the tether from dragging on the bottom of the pool we used gray pool noodles for buoyancy. After the structure, the motors, and the tether were placed the ROV was taken to the pool to work on the buoyancy. Three large PVC canisters filled with air and sealed with Gorilla Glue and Gorilla Tape were used for buoyancy. To get the buoyancy just right we kept cutting off parts of the canister inch by inch until it was neutrally buoyant. After the canisters were fastened work was started on the attachments. The first attachment was a Vex robotic claw. A claw was used due to its success from last year. In the previous year was the Vex claw and it proved to be very versatile. The only issue with the claw was that it only opened and closed. This year we added a wrist for extended claw functions. Due to the adding of a claw and a wrist unit, we had to create another box. The box was wired the same as the motors except we only used two switches instead of the four. Due to the fact we used 2 boxes; we created a container to hold the boxes and placed the switches in convenient places for hand movement. The claw and wrist units would be used in multiple situations during the missions.

Overhead view of ROV

Mission One

To decide what attachments we needed for the mission we assessed what needed to be accomplished and what limitations we had. After digesting all of the information, we brainstormed on how each mission could be accomplished. For the first mission we needed a way to measure the ship, find the orientation, and determine metal and nonmetal objects. For the "scanning" we found out that our main colored camera could easily accomplish this task without any further changes. To measure the ship we decided to take a tape measure and attach it to the left side of the ROV. At the end of the tape measure we attached a zip tie to allow us to hook it to the pole. After the zip tie was attached we reverse the ROV to pull the tape measure. Based on the tape measure's placement we placed a black and white camera to look at the numbers on the tape measure, so when the full length is reached we can easily determine the correct distance. To find the orientation of the ship wreck we placed a compass in the claw to allow the claw camera to determine the degree of orientation off of true north. For determining metal and nonmetal we decided to use a small circular magnet. The magnet is suspended by zip ties on the right side of the ROV and was held to the zip tie by Gorilla Tape. We placed a camera looking down at the magnet to see how it reacted to the object. If the zip tie was stressed by the pulling of the magnet then it is metal, if not it is non-metal. To construct the map we had one member watch the cameras while the driver completed mission two.



Tape Measure System

Metallic detection device

Mission Two

For the second mission, we added a few new attachments as well. To transport the lift bag we have a member of our team manually attach the J hook to the claw from the surface. After the lift bag was successfully attached we returned to the surface and repeated the process except this time we put the tubing into the claw. To remove the coral we used the claw to pull and transport them into an open grid space. The claw also carried the ultrasonic thickness gauge sensor and the neutron back scatter device. Both of these devices were in one unit which was built from PVC and thick plastic shaped like a T. The device was placed in the claw at a 90 degree angle, and then placed on the hull, then to the calibration tank, and back to the hull again. The next attachment created was a drill and a series of tubing with a syringe attached at the end. At the end of the tubing there was a modified turkey baster which allowed the tubing to penetrate the petroleum jelly. The drill was simulated by the turkey baster, which allows us to drill and retrieve a sample at the same time. At the end of the turkey baster there was a piece of PVC angled at 90 degrees to allow the claw to get a firm grip of the drill. Extending from

The ultrasonic thickness gauge sensor and the neutron back scatter device

Drilling device

the PVC was the tubing which traveled to the surface. At the surface there were two team members who worked on extracting the sample. We left the end of the tubing open to allow the syringe to be placed inside the tubing creating a temporary air tight seal. Once the syringe was inside of the tubing we pulled back on it extracting a sample from fuel tank. The member who was not operating the syringe then pinched the tubing to stop water from back flowing. Once the tubing was pinched the syringe is removed, pushed in, then placed inside the tubing again. We repeated this process about 4 times to ensure a sample of 100ml was inside the tubing. The sample was stored inside the tubing and not inside the syringe itself. Once a sufficient sample was stored inside the tubing the claw released the device and allowed the other members to pull the sample to the surface. Once the sample was returned to the surface gravity was used to let the liquid flow out of the tubing and into the graduated cylinder. To seal the drilled hole we placed the magnetic patch into the claw and then proceed to insert the patch into the hole.

Completing the Mission

While practicing the missions we also practiced the fastest route to rack up the most points in the quickest time. Since the order of Mission One can be completed in any order, we rapidly switched from mission to mission based on the location of each mission in the pool. The first thing we did was attached the lift bag and inflate it. After completing the lift bag we started testing for metal and nonmetal. To do this we will took a look at the grid to allow the sketch artist to see the correct placement of the objects. We then tested a couple of objects to see if they were metal or nonmetal. We jumped from taking the coral to a grid and testing the objects until all the coral was moved and all the objects were tested. While ascending and descending from collecting attachments the sketch artist started sketching the shipwreck. After the grid was completed we returned to the surface to collect the neutron backscatter device/ultrasonic thickness gauge then return to the ship and finish the mission with this device. Before getting our liquid extraction device from the surface we scanned one of the two sensors. Once the turkey baster was placed in the claw we drilled and extracted a sample from the fuel tank. After the sample was taken we scanned the last sensor and returned to retrieve the patch to reseal the hole. As soon as the hole was patched we will then determine the orientation of the ship and measure the ship by using the tape measure apparatus. Following this procedure allowed us to complete all the missions in the time allotted as long as there were no unexpected complications.

Safety Features

The main concern with our ROV was safety. We used many different tactics to ensure everyone was safe including: using a 20 amp fuse, using safety goggles, double checking all wiring, double taping all wiring, motor guards, filed and taped zip ties, taking care with the water and power system, and not having open wires. Attached to the end of our control box a fuse holder with a 20 amp fuse was wired to cut the circuit if it overloaded. While we are working with any dangerous tool or building something that could harm our eyes safety goggles were worn. To make sure all the wires were safe to enter the water, electrical tape was applied to all wires where they were split and then gorilla tape was added as an extra precaution. Once these precautions were taken we other members double checked the wiring to make sure no mistakes were made. Since our ROV last year did not come with motor guards, we made sure the new motors we used this year came with them, as homemade motor guards can prove to be obstructive. Once the ROV was completed we found that the zip ties that held the cameras and the buoyancy tanks in place were rather sharp so time was taken to file them down and tape them so no one could be cut. When we were at the pool practicing assurances were made that our power system was at least 10 feet away from the pool and that no metal was near it to arc on.

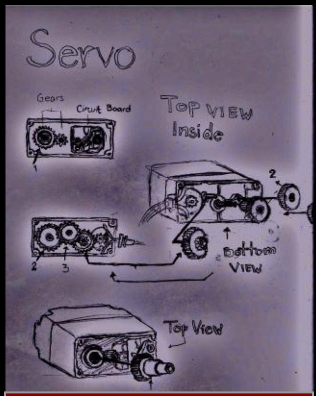
Vehicle System

When building our ROV each person on our team was assigned a specific job. These jobs were as following: Andrew Barron, Pilot and Electrical Engineer; Nick Kean, the Design Engineer; John Felt, Co-Pilot and the CEO (Chief Executive Officer); Jon Gunther, Mechanical Engineer; Brandon Foster, Electrical Engineer and CFO (Chief Financial Officer). Our jobs were assigned based on their interests and skills. The Pilot and Co-Pilot jobs were assigned after the ROV was built and given to the most talented drivers.

When the ROV was being built, the electrical engineers worked on the wiring of the system which included the box and the tether connecting the motors. At the time the robotic claw and wrist units were not taken into consideration and were later added. While the electrical engineers worked on those tasks, the design engineer and mechanical engineer started working on the actual ROV itself. This included the design, mechanics, placement of motors, buoyancy issues, and other aspects of the ROV. The CEO helped out in both of these areas lending a hand where he could. Although we had specific jobs we offered suggestions throughout the construction. The wiring of the box was finished before the ROV was designed completely so the electrical engineers helped with the construction of the actual ROV. Because the jobs were divided were able to complete the ROV in a short amount of time. After double checking everything it was to the pool to test out the buoyancy. At the pool the design and mechanical engineers worked on creating neutral buoyancy by using three air canisters. They concluded that two long canisters on either side of the ROV and one large, but shorter canister in the middle, would be optimum for the best and most versatile set up for buoyancy. The canisters were designed to be moved if more attachments were added. They could be placed at different parts of the ROV to help balance the buoyancy which would later come into play when the wrist and the claw were added. While the buoyancy was being handled the electrical engineers and CEO started working on the other attachments and experimenting on how they could be wired into the box. We concluded that creating a second box, identical to the first box, would be the best to allow for multiple attachments to be controlled. The first attachment added was the wrist and claw units. The CEO and one of the electrical engineers worked on wiring the second box. While this was being constructed, the mechanical and the other electrical engineer worked on constructing the claw and wrist unit. The claw and wrist units were not supposed to be connected but they were mended in a way that they could work together. Both the mechanical and electrical engineers worked together to mend the claw and wrist units together. They also worked out a way to water proof the servos. Their solution to this was using silicon, electrical tape, and Gorilla Tape to ensure no water could leak into the servo. Once the unit was successfully built, the design engineer worked on a method to attach it to the ROV. The claw and wrist units were originally created for land purpose only, so the design engineer ended up using the bent part of the end of the wrist unit to fit a piece of PVC in it. Once the PVC was placed, holes were drilled and screws were placed to fasten them together. Since the PVC was at the end of the unit, it could now be placed onto the front of the ROV. Once this was completed the electrical engineers worked on connecting the servos to the box and connecting it to the tether. After all of these things were completed, we started working on the attachments needed to complete the missions. Each attachment was built as a group effort where we brainstormed ideas until we came up with a good solution. All the aspects of this ROV are unique ideas created from members of our group. Using the claw was an idea resurrected from last year's project (which was made up of the same people) where we found the unit online and decided to take a chance and attempt to water-proof it. This year we added the wrist which was also found by the same means. The design of the ROV was created through our own thoughts and ideas based on last years' experience. The buoyancy idea was thought of through seeing more complex units and deciding to create a similar, less expensive system. Each other basic attachment was created through brainstorming in class about how each mission could be accomplished in the fastest time possible.

Challenges Faced

As we started to add features onto our ROV, we wanted to build a claw and elbow system. Fortunately during our research, we happened to find a vex claw and a vex wrist which was part of a whole land robotic arm. The problem with the claw and wrist was that its original purpose was designed for land usage only, which meant we had to find a way to waterproof them. We discovered that the claw and wrist themselves were waterproof already, due to the fact that they were made up of plastic and metals, but the servos were susceptible to water and would malfunction if water reached the motor. To solve this problem we decided to completely seal both servos in a series of methods. The first thing we did was seal every opening to the servo with silicon to prevent any basic leakage. Next, we electrical taped over the silicon to prevent the silicon from being cracked or slit open. Lastly, we covered the whole servo in Gorilla Tape as an extra precaution. After we did this, we discovered that the claw servo was not strong enough to support the weight we needed to carry and the motor eventually failed due to its efficiency. Further research was done and we found another



Sketch of the inside of the vex servos that we use

Vex servo that was more efficient than the last. Another challenge with the wrist was that it was designed to be attached to the whole arm unit, which we did not use. We only wanted the claw and the elbow but in order to attach both of them together, it required them to be attached to the bracket on the arm. Instead of ordering the whole arm, we decided that the task could be accomplished without further unnecessary purchases. To substitute the arm, we mended an artificial bracket that could house the claw and the wrist while remain safely attached to the ROV.

Practice time was a non-technical challenge we faced as our school does not have a pool. Finding a pool was rather difficult because most schools use their pools for after school activities. We would practice at River Rouge's High School pool but this year the school was going through some hardships and was not available. Due to this we could not practice there this year so we had to search for a new location. In searching for a pool we found another ROV team using their pool for practice time in Oak Park. Our teacher, Mr. Thomas, contacted them and they generously allowed us to practice at their pool.

Testing and Troubleshooting

Creating an ROV is a difficult process. A lot of things can go wrong in creating an ROV, so a lot of tests and troubleshooting is required. Things can be thought of and seem to work, but a lot of variables can come into play and ruin those ideas. The first bit of testing we did was making sure the ROV's motors worked and everything was waterproofed. The next testing we did was the buoyancy, which took a lot of time to get just right. After all of that was created, we drove the ROV underwater to make sure nothing went wrong as time went on. To make sure each of our new ideas worked, we tested them thoroughly. To do this we first created each component on land, and took the time to make sure it would work underwater. We also took into consideration how it would affect the buoyancy. Once we knew it would work, we attached it to the ROV and tested the component on the mission for which it was intended. If it worked successfully, we would keep it on the ROV and modify as we practiced. This applied for every attachment we used. Since almost everything did not work on the first attempt, we ended up modifying each attachment until it was to our liking. We knew what needed to be done because we built a version of the mission at our practice pool. We would run through each mission like it was competition and adjust things to decrease the time spent on it. Once each mission was completed in an acceptable amount of time we would be satisfied with the attachment and could move on.

During testing we also ran into many problems. Some of these problems included the servos dying, bad camera placement, difficult camera angles, and various small predicaments. When a problem was found, we had a troubleshooting checklist we went through. The first part of solving an issue was to identify the problem. Then, we went through the possibilities to eradicate the problem. Once the problem was fixed, we thought of how to prevent it from happening again. The main problem that occurred was that our servos kept frying and we could not find out how or why. Servos are easily replaced, but can ruin a practice day and set us behind schedule.. When we knew water was leaking into the servos, we could open them and look inside. The first thing we tried to do was seal them with Gorilla Glue, but we later found out that the glue itself was leaking into the servo and causing an issue. The next tactic used was electrical tape covered in Gorilla Tape. This worked for a while, but after a long time using them, they still took in a bit of water. Finally, we decided we would try using silicon because it would allow a water tight seal; it would not crack, and would not leak into the servo itself. As an extra precaution we added electrical tape and Gorilla Tape. The next issue we had was camera placement. Some of our attachments in the claw were a bit out of the reach of our cameras. We could move them to get an angle, but the cameras were so far away from the claw that it would mess with our vision of the object. To solve this we created a PVC structure that would house a camera to get a good angle on the claw and any attachment stretching out from it. This was extremely important in the using of our liquid extraction device. Using these same processes, we solved multiple issues that occurred during this project.

Future Improvement

During this project we have learned a lot. As this is our second year as a team, we have already implemented some ideas from the previous year. We have also come up with new ideas for next year already, including adding more to the robotic claw and developing a more advanced control system. Each year we have brought something new to the claw to allow for extra movement. We are considering a way to add side to side movement of the claw through a belt system. We have not looked into this idea a lot, but it is still a possibility. The next idea we had was to create a mixture of a box like we have along with a joystick. A lot of teams have just joysticks, but we thought it would be beneficial to keep the box we have (to allow for full control of the motors) but also add a joystick (to allow for combined functions). It will save a bit of time when we want to go full out in one direction. With the box system we have now, we must push two switches at once to go in one direction. Even though it is only a minor inconvenience it would still be beneficial to add a joystick. Another idea we are considering is to downsize the ROV. The ROV right now is a slow due to its size. Doing this would increase its speed but it would also make the ROV touchier when controlling due to each switch having more effect on its movement. This may make it a bit more difficult to be precise in certain missions, but it would also allow us to move from mission to mission a lot faster. Working as a team gives us the opportunity to come up with many new ideas that can someday be implemented.

Lessons Learned

Brandon Foster (Electrical Engineer)
Lessons Learned: Personally, during this experience I have learned a lot about engineering overall. Two years ago if you asked me what I wanted to do with my life, I would have had no idea what to say. However, now I know for sure that I want to go into a field that involves engineering and making innovated designs. Looking at the technical aspect of this, I have learned a lot about propulsion units, electrical wiring, and designing. When I started High School I had no idea what an underwater ROV was. However, now I can, not only tell you what it is, but I can tell you how make one, from start to finish. Before I began, I had no idea how to wire anything. Now, I feel somewhat of an expert.

Jon Gunther (Mechanical Engineer)
Lessons Learned: During the whole experience of building the ROV, I have learned many things involving engineering and how to actually build an ROV. In the process of building the ROV I have learned how to wire things together so they can run off of one power source. Also, I learned what an ROV is and how to build one. I never knew that you had to figure out buoyancy so that it would float right in the water. I also learned a lot from working in groups with others. I learned that you will not all agree and you will run into some arguments, but I now know how to get out of those and figure out what we need to do.

John Felt (CEO & Co Driver)
Lessons Learned: During the whole experience of building the ROV, I have learned a lot about robotics and how to build a successful ROV. When we started building ROVs last year the design wasn't good. So then we had to design a ROV that could have multiple attachments, but also be able to stay buoyant. I learned how to create a design for underwater uses. I also learned how to make adjustments on the ROV in little time to make certain attachments operate without hindering the movement of the ROV. Another lesson I learned was how to problem solve under pressure.

Andrew Barron (Pilot & Electrical Engineer)
Lessons Learned: Before this project I was pretty unaware of many aspects that are involved in an ROV. Actually I didn't even know what an ROV was. When building the ROV I learned a lot of technical and non-technical skills that I can use in my future. One of the technical aspects I learned was how to properly wire which included crimping wires, splitting wires, stripping wires, and many other things. I also learned how servos work which also helped me understand how to fix them. Working with all of these wires underwater also helped me understand how electricity and water work together and how to waterproof all of the electricity. Since we worked as a team I also developed better communication skills and teamwork skills. In addition to working as a team we worked as a company so it allowed me to get a better understanding of how a real company works.

Nick Kean (Design Engineer)
Lessons Learned: My experience in the MATE ROV program has taught me many skills that I can use inside and outside of the competition spectrum. One technical skill that I learned from doing these competitions is the concept of buoyancy and how to make the ROV neutrally buoyant. A skill that I have really perfected while doing this program is my presentation skill, which I can use in many more areas outside of ROV. Another skill that I have honed in on through the help of the MATE program is design and planning of a project, which can be used in many other applications as well.

Reflections

Brandon Foster (Electrical Engineer & CFO)
Reflection: During this experience, I have met people I would not have met had it not been for this program. For example, not too long ago I met the vice president of General Motors along with some of the employees from General Motors. These people gave me an opportunity for an internship at General Motors. I have also gone places I normally would not go such as Square One State ROV competition, MATE Regional ROV competition, Michigan International Speedway, and many more. Also, I now have something more in common with my father, because he was a mechanical engineer in the Navy. He likes all the mechanical engineering aspects of this. Now I can sit and have a conversation about engineering with him.

Jon Gunther (Mechanical Engineer)
Reflection: During the process of building the ROV, I have had many experiences that I will take with me through my whole life. With ROV I have met many people and have gotten many opportunities for the future. I have a chance to get an internship with GM and I have figured out what I want to study in college. I am hoping that doing all of this and with my teachers help, I can get scholarships and be able to go to a college and earn a degree in mechanical engineering.

Nick Kean (Design Engineer)
Reflection: The MATE program has provided my other teammates and I with countless opportunities and accomplishments. It has strengthened my application for internships and colleges by an unparalleled amount. It provides me with an engineering education background, which is great for making my application to any technological school better by a vast margin. It also has helped us to show off our ROV at events like the Maker's Faire in Dearborn, Michigan and many presentation events around the metropolitan Detroit area. This not only shows off our ROV, but also our group as a whole and our members individually. It gives us the opportunity to meet professionals in many fields of study and reinforces our path for future education and employment.

Andrew Barron (Pilot & Electrical Engineer)
Reflection: For the past two years I have been involved in many programs and events involving ROV. A lot of these programs have given me countless new opportunities and possibilities. Some of the events I've been to include: Square-One ROV competition (2

years), MATE Regional competition (2 years), Makers Faire in Dearborn, High School Enterprise, GM conference, and Square-One MIS Speedway competition (2 years). This year I will be adding the MATE International competition to this list. I will also be attending Michigan-Tech over the summer for the high school program. At all of these events I have met many professors and other professionals. Seeing all of these things have exposed me to technologies I would have never experienced. It has also made me further pursue my education in the field of being an engineer.

John Felt (CEO & Co- Driver)
Reflection: The past two years of being in this program I have involved myself in many programs and events involving the ROV. There have been many programs that gave me countless opportunities. Events I have been to include: Square One ROV competition, MATE Regional competition, High School Enterprise, GM Conference, and Square One MIS Speedway. I have met many professionals during the time I have been going to the events. If it was not for this program I would have never met any of them. It has helped me chose the career field I want to go into.

Team Effort

Building a ROV requires a lot of team effort. If a team does not properly work together, they will ultimately fail. During our project we used a lot of team work. We all practiced together and shared the work load. Melvindale High School offers a class correlating to ROVs, which is how our team was formed. The class we took this year was called Research ROV; it is a step above the normal ROV class. In this class we build the same ROVs except we can build them much faster with better quality. We also look into new technologies such as our robotic elbow. The main purpose of this class is to attend competitions, such as this one; but we also do research on the local water sources. The main source of water we study is the Detroit River where we take water samples to test the pH levels, oxygen levels, and other contaminants in the water. During the process of building this ROV, our instructor, Mr. Thomas, gave us guidelines on where we should be. For example, he gives us approximately two weeks to fully wire the box and test it. To accomplish this task you need to work hard and get it done thoroughly and accurately. As a group we formed a system to increase our speed however to still maintain accuracy. So the system we did involves one person strips the wire, one crimps the wire tightly and securely, one will tapes it with electrical tape, and one uses the electrical schematic to place the connectors into place. Our ROV group wanted a little more time to practice and less time actually wiring and building the structure. Since, this was not our first ROV we built we knew that there were going to be more challenges along the way.

At the pool, working on the drill attachment

Wiring the box

So using teamwork our group built an ROV in roughly three weeks to a month. So that we can take it to the pool to test the buoyancy and to test that our wiring was accurate. But building an ROV isn't all that takes teamwork. You also have to use teamwork when driving the ROV. This is the procedure that we use: one must be working the tether at all times, one must instruct the pilot what to (but not where to go), one to be on safety patrol to warn anyone of a fatal accident, and one piloting the ROV. Teamwork is what an ROV consists of. On this report all of us have put in a lot of work, we worked in class on it every day, after school, at the pool, and even at houses on the weekend. If you need to learn teamwork I would suggest anyone to build and compete in a group. To sum it up, if your ROV group has no teamwork, the ROV will never succeed when you need it to.

Ambassadorship

Ambassadorship is a great factor in our program. We want the younger generations to get involved early so that they have the same opportunities. We recently went to Allendale Elementary School (the elementary in our school district) to get the young kids interested in our program. Surprisingly, most of the kids showed great interest into the program. To us that was very inspiring to know that no matter how old you are, you can show an interest in innovated designs. Another school district that we show ambassadorship in is Oak Park Schools, the school that lets us use their pool. The Oak Park Middle School is there when we practice, and they are new to the program so they have a lot of questions. We are more than happy to help them with any questions that they have. It is actually inspiring to know that you have just helped a younger kid that has the same inspiration you have, to innovate and discover. We are also creating a program this summer at our local pool. This program includes children doing activities to learn the basic concepts of an ROV. Such as, filling a water bottle with vegetable oil and then attaching weights to understand buoyancy in fun ways. We hope to expand this program so we can get as many kids in this ROV program as we can.

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