

East Chicago Central High School

Team Evolution

Project: Third Gen

Team Members

Team Captain: Dominic Garcia

Crew: Jesus Machuca

Joel Perez

Eric Rosas

Mentor

Joe Rojas

Abstract

For several months, a team of four dedicated students worked diligently on the creation of an ROV. Each team member is a student at East Chicago Central High School. The team members were selected based on their eagerness to explore the field of marine robotics and their desire to learn new things. The team spent several months designing and construction an ROV capable of competing in the 2005 MATE Center/MTS ROV Committee ROV Competition.

Together, the team has created a fully functional ROV, and they are fully confident in its abilities. The new members of the team are very excited to be competing in their first ROV competition, and the teams captain is very determined to make this the team's best year ever.

Design Rationale

When we began to brainstorm on how to design our ROV, our team was at a slight disadvantage. This was due to the fact that all of the team members were new to the competition save for one member. Our team captain has been on the team for two years and has competed in the past two ROV competitions. He had to help the rest of us get a strong foothold in this new field.

We first began with making sure every team member had a general idea of what a ROV was and what its basic components were. We discussed props, thrusters, buoyancy, manipulators, and cameras. We also showed the new team members the ROVs that were built in the past years. We finally sat down and starting thinking about what tasks needed

to be completed in this year's competition, and what would be the best ways of accomplishing these tasks.

This year, we decided to construct the hull of our ROV from a single 6" PVC pipe measuring approximately 25.4cm in length. This would house our electronics and one camera. We used a 15.24cm acrylic dome from a compass head to seal one end of the pipe and we created an endcap for the rear end of the pipe. The endcap was made from a 6" PVC coupler and circular piece of plastic used to seal one end.



We connected the PVC pipe to an aluminum frame measuring approximately 61cm in length and 35cm in width. The frame would support the hull and all of the ROV's motors. Our manipulators would also be attached to the frame of the ROV along with one

external camera.

For our thrusters, we decided to buy trolling motors that we would modify for our needs. It seemed more efficient to purchase pre-sealed motors instead of worrying about sealing our own. The motors we chose were 12 V boating motors. They measured 19 cm in length and 6cm in diameter. We decided to use four of these motors, two for forward and reverse and two for vertical thrust. We placed one clockwise and one counter clockwise prop on our forward thrusters measuring approximately 12.7 cm. We used the same clockwise and counterclockwise for our vertical thrusters.

The shrouds for our motors were taken from the inside of spotlights. The plastic interior of these lights measured approximately 14.6cm in diameter



which perfectly fit around our props. We attached the shrouds to our motors using pieces of aluminum.

We decided to use two cameras for our ROV. One camera is housed inside our hull. This camera is a color outdoors CCTV video security camera with a wide angle lens. The camera offers a 170-degree field of view, and it comes with a 1/3" DSP CCD chipset that offers 480 lines of resolution and a stealthy 0.5 lux low light ratings.



The second camera we used was placed on the outside of our ROV to give us a better view our manipulators. We used a Sony Super HAD CCD camera. This camera has a 6.2mm color CCD image sensor, which is equivalent to Svideo quality. The camera has 0.1 lux sensitivity and only consumes 140mA. It has a 3.6mm wide-angle view that gives a 68-degree optical horizontal camera view outside of water and a 55-degree optical horizontal camera view in water.

The tether for our ROV is comprised of two separate wires. The wire that we are using for power is a 14 gauge shielded wire with 4 wires. The other wire has 9-shielded wires that are 28 gauge. This wire is used to control our motors and cameras.

The control system for our ROV consists of three speed controllers and a Futaba receiver from a radio remote control. The remote control was modified to send its signal through our tether since it would be nearly impossible to transmit radio waves through the water. We used the speed controllers to regulate the motors of our ROV. Using speed controllers allowed us to have full control over the ROV's movement.

Figuring out the buoyancy was relatively easy for our ROV. Since most of our motors placed added weight to the rear of our ROV, we placed a lead weight in the front to keep our ROV level. The lead weight weighed approximately 3.6kg. The hull of our ROV created enough lift to create a state of neutral buoyancy.

To complete the missions in the competition, we decided to build three separate, interchangeable attachments. Each attachment was designed to handle a specific mission. One attachment was created from a thin piece of plastic measuring approximately 35cm in length with two pieces of 1" PVC pipe connected to it. This attachment would be used to close the oil well valve. Another attachment we created is basically a piece of aluminum that was bent in a hook shape. This attachment will be used to reconnect the fiber optics link. The final attachment we created was a tension mechanism that holds the instrument module that is to be transported from the surface to the telescope.

Team Challenges

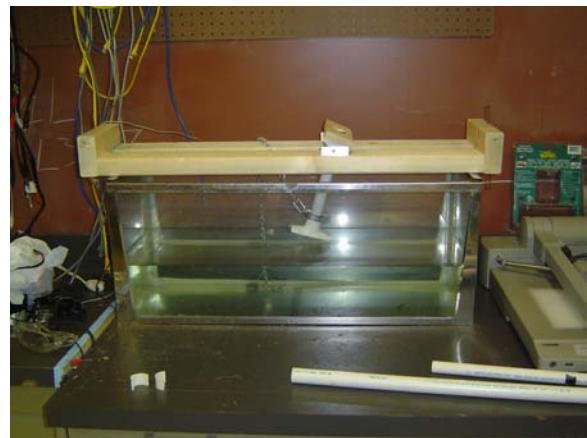
The most prominent challenge that our team faced was creating a unity among team members. The members of our team had very little, if anything, in common. One member was a senior, another was a junior, and the other two members were freshman. The age gap in the team was not extremely large, but it did exist. So, it was a bit difficult to keep everyone on the same page, and it was hard to create harmony among the team. However, as the project progressed and more time passed, we soon came closer together and learned to work together.

On other problem our team faced was finding time to work on the project. Since the members of our team were so diversified, it was hard to find days that were open for

all members. It took a lot of schedule juggling, and sometimes members had to work independently, but in the end we were all able to come together to work on the ROV. Of course, they were several other challenges that our team faced, but these were the main difficulties that challenged our abilities. Overcoming our teamwork obstacles allowed us to face any technical one we met along our way.

Troubleshooting Techniques

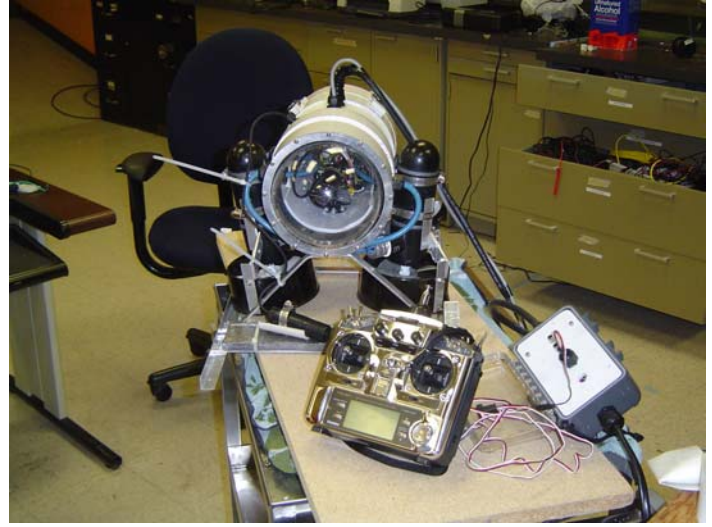
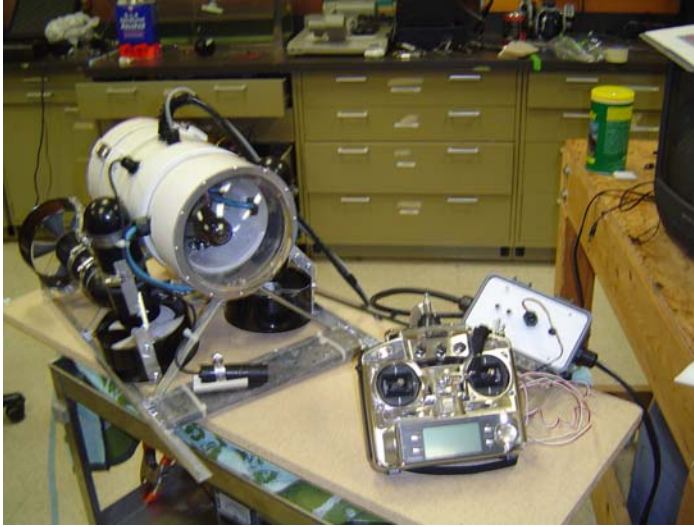
One troubleshooting technique that we used created a testing apparatus to help us quantify the thrust created by our motors with different props. The apparatus was basically made from a couple of pieces of wood that we attached one of our motors to with a piece of



PVC pipe. The apparatus held the motor in a tank of water and we then connected the motor to a scale at the opposite end of the tank with a chain. The motor would pull the chain and give us a reading of how many grams the motor would pull. This would tell us exactly how much thrust our motor was creating.

Completed ROV

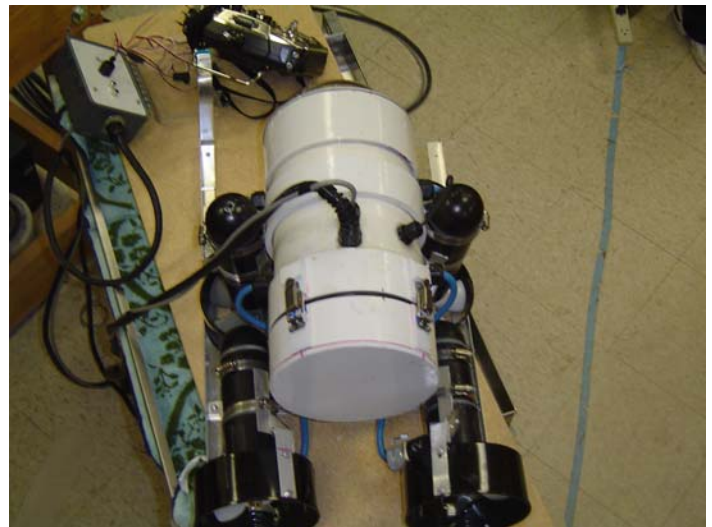
Front Views of Gen



Side View of Gen



Top View of Gen



Lesson Learned

Since many of our team's members were new to the world of ROVs, many of us learned a lot of lessons. One lesson we learned was how fast time can go by. When we started working on the ROV we had approximately five months to work on our ROV, and we felt that this was plenty of time. However, as time went on, we began to see that our time restrictions were a lot tighter than we first thought. Many of us never knew how many errors can pop up when building something. It seemed as if whenever we would solve one problem two more would take its place. This was quite a shock to us.

Another thing we learned was that no matter how big of a wall we thought we faced there was always a solution. We learned that as long as we kept trying and never gave up that we would eventually solve our problems. This was the most important lesson that we learned because it is a lesson that will carry on into the real world. This lesson will help us to face real life challenges, and we are all grateful to have experienced this competition.

Future Improvements

Although our team is very confident in our ROV and the team itself, we know that there is always room for improvement. For one, we hope that in the future, the team will have less difficulty working together. Team cohesion is fundamental when working on any type of project. Without a well oiled team, it becomes difficult work through technical difficulties without creating more among team members. So, hopefully, future team members will learn to work together much quicker than this year.

There are very few improvements for our ROV that we think could be utilized in the future. This is because we are currently unable to determine if there are any problems with our current design. Since this is the third time our team has competed in the MATE ROV Competition, we have altered our design each year. So, until we compete this year, we will not know what are flaws are.

Mission Careers

Wellhead pumpers must be able to handle a variety of tasks. One task is the monitoring of control panels during pumping operations in order to ensure that materials are being pumped at the correct pressure, density, rate, and concentration. They are also



in charge of operating engines and pumps in order to shut off wells according to production schedules and to switch flow of oil into storage tanks. Wellhead operators perform routine maintenance on vehicles and equipment, repair gas and oil meters, and they unload and assemble pipes and pumping equipment using hand tools.

Wellhead pumpers also attach pumps and hoses to wellheads, start compressor engines, and they divert oil from storage tanks into compressor units and auxiliary equipment in order to recover natural gas from oil. They are in charge of opening valves to return compressed gas to bottoms of specified wells in order to repressurize them and force oil to surface. They supervise oil pumpers and other workers engaged in producing oil from wells. They also drive trucks in order to transport

high-pressure pumping equipment, and chemicals, fluids, or gases to be pumped into wells.

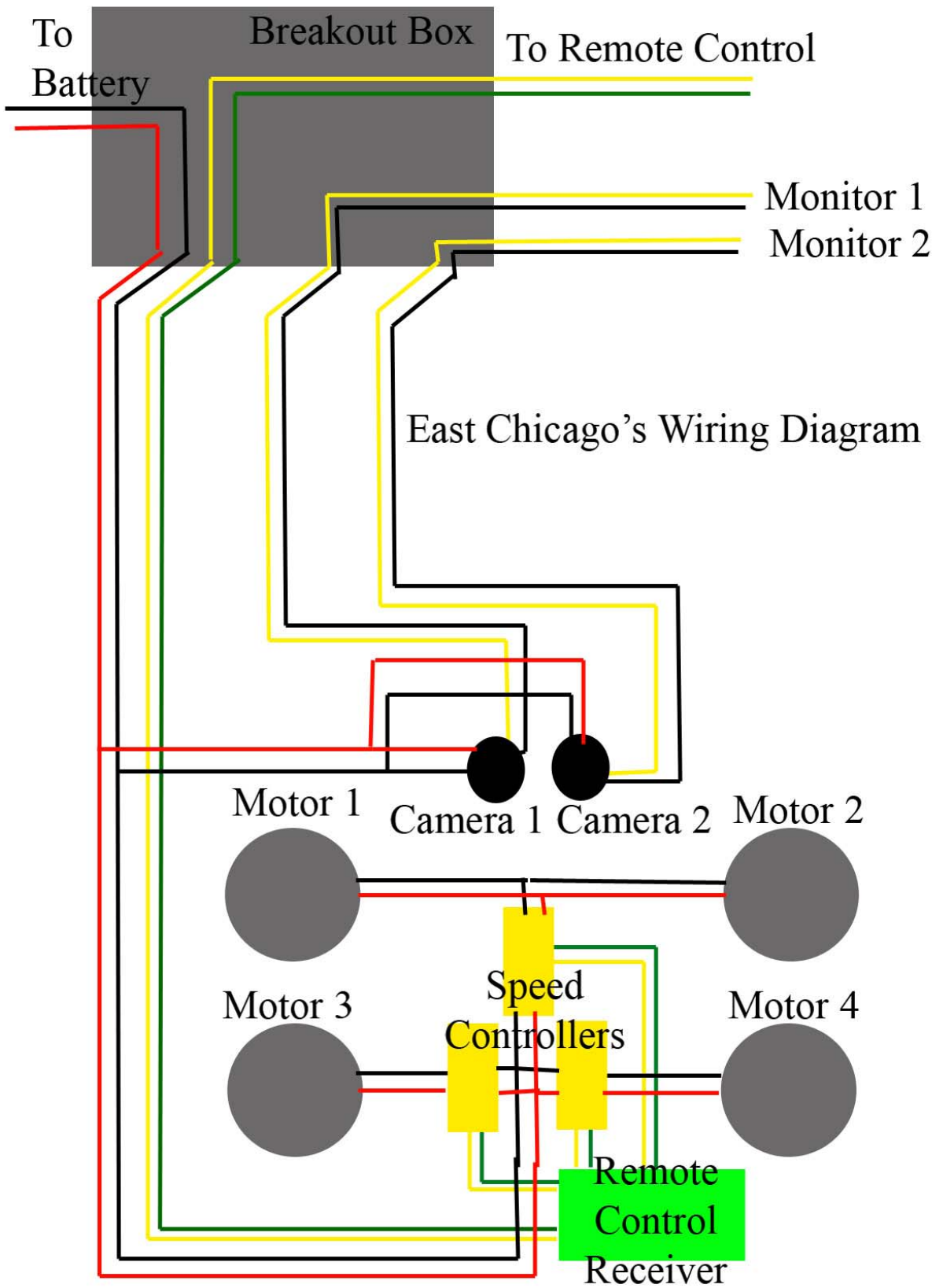
Sources

<http://www.iseek.org/sv/46001.jsp?id=537073>

<http://online.onetcenter.org/link/summary/53-7073.00>

Acknowledgements

Team E.C. Central would like to thank the MATE/MTS ROV Committee for hosting this event and providing funding. We would also like to thank the East Chicago Education Foundation for their financial support and encouragement. A very special thanks goes out to Aquatic Research Interactive, Inc. and its entire staff. Without their support and guidance, none of this would have been possible.



2005 MATE/MTS ROV Committee Student Competition
Budget/Expense Sheet

School Name: East Chicago Central High School
Sponsor: Aquatic Research Interactive, Inc.

From: 1/07/05
To: 6/20/05

Date	Items	Dep/Exp	Amount	Quantity	Extended	Balance
1/7/05	ARII Grant	Dep	\$ 3,500.00	n/a	n/a	\$ 3,500.00
1/11/05	PVC Parts: tubing, couplers	Exp	\$ 125.00	misc	\$ 125.00	\$ 3,375.00
1/25/05	Dome: Ritchie Compass	Exp	\$ 35.00	1	\$ 35.00	\$ 3,340.00
1/25/05	O-Rings: various sizes & Sealcons	Exp	\$ 25.00	misc	\$ 25.00	\$ 3,315.00
1/25/05	Trolling Motors	Exp	\$ 75.00	2	\$ 150.00	\$ 3,165.00
2/1/05	Adhesives: Aquaseal, PVC cement	Exp	\$ 35.00	misc	\$ 35.00	\$ 3,130.00
2/15/05	Speed Controllers	Exp	\$ 34.00	4	\$ 136.00	\$ 2,994.00
2/22/05	Aluminum Rails	Exp	\$ 5.00	5	\$ 25.00	\$ 2,969.00
2/22/05	Hardware: Nuts, bolts, hinges	Exp	\$ 20.00	misc	\$ 20.00	\$ 2,949.00
3/15/05	Props	Exp	\$ 10.00	6	\$ 60.00	\$ 2,889.00
3/29/05	Tether	Exp	\$ 60.00	1	\$ 60.00	\$ 2,829.00
5/3/05	Camera: Sony 180• lens	Exp	\$ 180.00	1	\$ 180.00	\$ 2,649.00
5/26/05	Airfare R/T Chicago - Houston	Exp	\$ 250.00	4	\$ 1,000.00	\$ 1,649.00
5/26/05	Office Supplies	Exp	\$ 25.00	1	\$ 25.00	\$ 1,624.00
6/19/05	Housing	Exp	\$ 75.00	4	\$ 300.00	\$ 1,324.00
	TBA Shipping R/T	Exp	\$ 250.00	1	\$ 250.00	\$ 1,074.00
	TBA Poster Materials	Exp	\$ 50.00	1	\$ 50.00	\$ 1,024.00
	TBA Transfers	Exp	\$ 20.00	8	\$ 160.00	\$ 864.00
	TBA Meals	Exp	\$ 20.00	45	\$ 750.00	\$ 114.00
	TBA MATE STIPEND	Dep	\$ 1,500.00	n/a	n/a	\$ 1,500.00
EXPENSE SUB-TOTAL:					\$ 3,386.00	
BALANCE TOTAL:						\$ 1,614.00