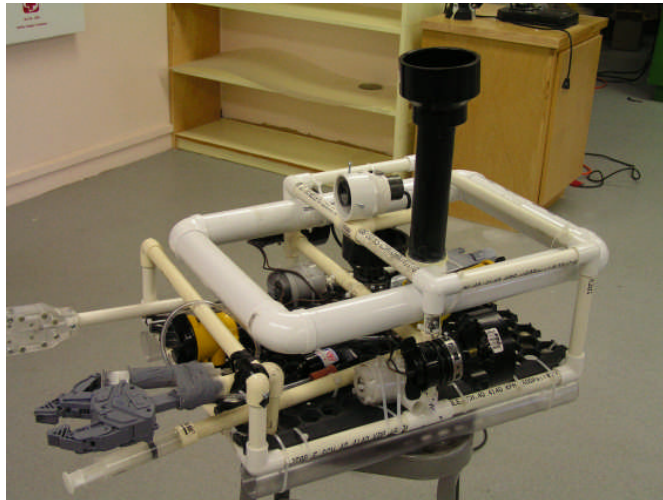


LARHSS ROV

ERIC G. LAMBERT HIGH SCHOOL



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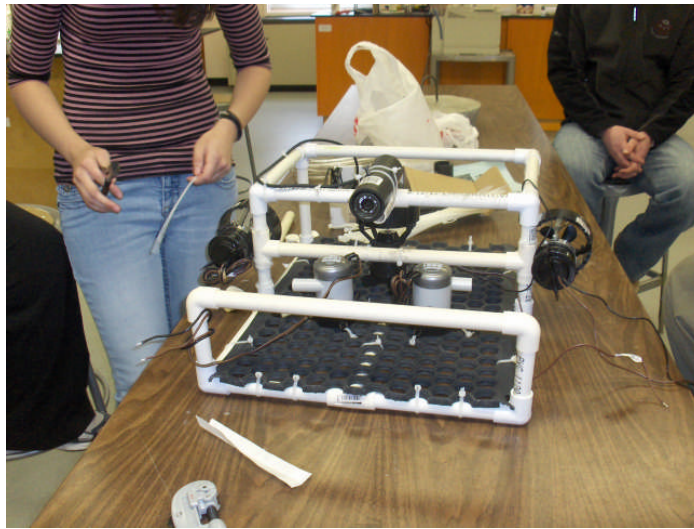
Abstract

“LARHSS” ROV was constructed to compete in the 2007 MATE International ROV Competition. The team’s main goal has been to build an inexpensive ROV, without sacrificing efficiency in completing the set tasks. The use of components such as PVC pipe, and hospital syringes has allowed the team to successfully achieve their goal. The team has been fortunate enough to have the help of various mentors, who work as engineers of different disciplines at the CFL Co. power plant. The team solved their technical problems using a trial and error approach allowed them to gain a better understanding of which structural designs work more efficiently than others. There is still some room for improvement, but the team is ready to participate in their first ROV competition.

Design Rationale

Structure:

The LARHSS ROV is built with $\frac{3}{4}$ " and $\frac{1}{2}$ " PVC piping to ensure a light weight, inexpensive, stable structure. Rubber matting provides the _ with a lower COG as well as ample space for mounting attachments. Clear pipe attached to the underside of the ROV allows for the standing height of the ROV to be adjusted for various tasks.



Basic structure of LARHSS ROV

Cameras:

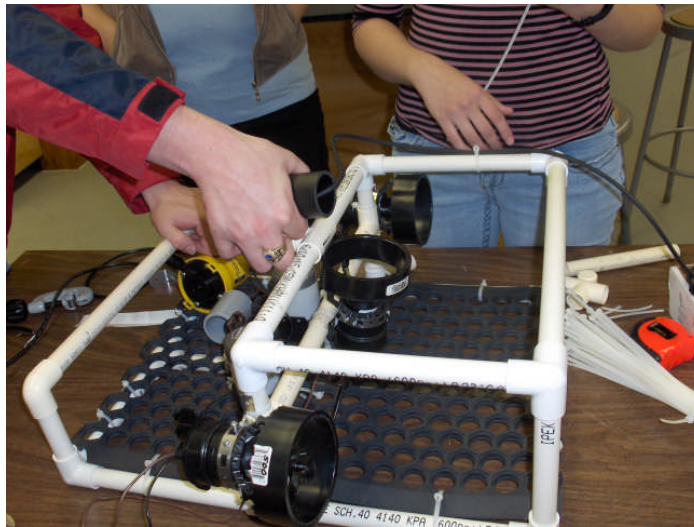
The two underwater digital cameras provide the ROV operator with a colored image. One camera provides a direct view of the attachments, whereas the other is used to supply the operator with depth perception.

Design Rationale

Motors:

One centrally located motor (1000 GPH) moves the ROV up and down. The side motors (500 GPH) are variably controlled to propel LARHSS ROV forwards/backwards and to turn left/right at any desired speed. A 750 GPH motor controls the opening and closing of the mechanical arm.

Mounting up/down motor



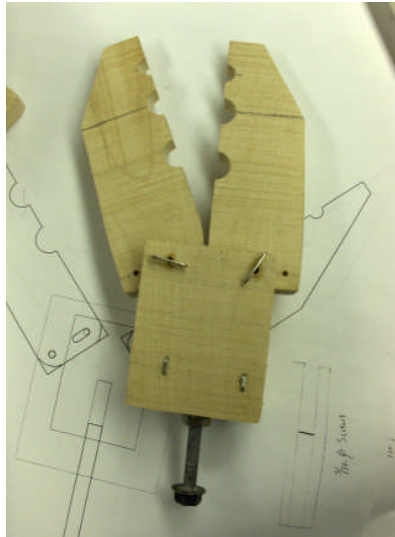
Bilge Pumps:

Two, 600 GPH bilge pumps allow the ROV to move sideways left and right. The front and back mounted 500 GPH bilge pumps allow LARHSS ROV to tilt on the vertical axis (pitch). 2 additional pumps are also used, one to create suction (400 GPH) for picking up objects underwater and one to force the pneumatic arm to open and close (750 GPH).

Design Rationale

Task Specific Attachments:

LARHSS ROV has three attachments for picking up or transporting various objects. Two arms (one mechanical and one pneumatic) with gripping claws, as well as a suction mechanism.



Mock up of central Arm

An Interesting and Unique Challenge

As is with all new experiences, there were certainly no lack of challenges faced by the team. Ranging from the placement of motors to, how the arm was to be constructed and exactly how many arms were need. The team pulled together and collaboratively used their problem solving skills to overcome all obstacles met.

After much discussion the team decided that the use of three motors and four pumps would be the most effective and efficient. However deciding exactly where the pumps to go to attain optimum propulsion, minimum interference, and a correct centre of gravity proved more difficult that anticipated. It was decided that the two motors for forward propulsion would be placed in the centre of the length and on the outside on opposite sides of the structure. The motor up and downward propulsion was placed in the geometric and gravitational centre in order to ensure that the ROV would go upwards and downwards as straight as possible. Finally two pumps used for lifting both the front and rear of the ROV were placed exactly where the force was needed, avoiding the use of hoses which were difficult to manage. Similarly the pumps for side to side movement were placed in the lengthwise geometric and gravitational centre for the same reason. These placements allowed sufficient room for the mounting for other components such as the arms and the suction pump for the second (ping pong ball) task.

The team soon discovered that the arms were to become a very intricate part of the design, as they needed to be virtually used in every task. Because task one and three in particular required the ROV to hold on to two things at once (in order to be truly efficient) it was decided that two arms would be required, both with different designs. The first and central arm was constructed from plexy glass, and used motor to turn a shaft connected to the claw. The motor would rotate in on direction to open the claw and then the current would be reversed in order to close

it. The second arm used a plastic syringe, a purchase plastic claw, and elastic band and a bilge pump. Initially the claw would be open, and in order to close a bilge pump would pump water into the plastic syringe. The free moving portion of the syringe was attached to one side of the claw and would force it closed when the pump was turned on. Once the claw again needed to be opened the bilge pump would be turned off and an elastic band would bring the free moving part of the syringe back to its original position. This second arm allowed the team the option of holding on to one object while manipulating another.

Developing a system for the capture of the ping pong ball in the second task proved difficult. The team eventually decided to use the bottom end of a pump to create a vacuum. A pipe with a funnel at the end was attached to the pump allowing for better control. However the team encountered the problem on how to keep the ball inside the pump once the vacuum had sucked it down, without completely blocking the hole and reducing the amount of suction. Finally they decided on using a small tab that stuck out from the side of the pipe that could allow the ping pong ball to pass down into the pipe, but that had a weight attached to it, making it impossible for the ball to escape. Also a hole was cut in the area just under the tab and securely covered in clear plastic, so that the team could more easily see when they had actually captured the ping pong ball.

The team itself was not without problem. Due to the increasingly busy schedules of all the team members, with the approach of final exams other prior commitments, finding times that could accommodate everyone was next to impossible. In order to remedy this problem the team decided to delegate certain responsibilities to each member, according to the skill set. For example one group would work on electrical components while another would focus on the actual structure of the ROV.

A lot has been learned through the building of this ROV. Problem solving skills, and patience have been put to the test, but in the end the team worked well as a unit and was successful in constructing a fully functional ROV.

Future Improvements

As the team has never previously competed in an ROV competition, they had no prior knowledge of which components would work and which would not. As a result of this, improvements were made on the ROV, on almost a daily basis. For example the placements of pumps and motors were continuously changed in order to accommodate for other attachments as well as in order to determine where they would be most effective. Now that the ROV is completed the team is satisfied with its structure; however there are some future improvements that the team may wish to incorporate.

The biggest difficulty the team encountered in the practice of the tasks was with the camera, and being able to accurately see exactly where the ROV and arm were located in relation to the various objects associated with the task. The team believed that this difficulty was the result of using only one camera. The controllers could see what direction they needed to go in, in order to reach the object; however how far, and how deep they needed to go were difficult to determine. In order to fix this problem the team decided that it would be beneficial to mount at least one other camera, but if possible up to four cameras would be ideal. This would provide a much better view of the entire area and task. Also along with the two-four cameras a splitter would be used in order to insure that images from all cameras could be seen on only one screen making navigation easier for the controller.

Trouble Shooting Techniques

Due to various circumstances the team was later in starting the project than would have been desired. As a result of this trouble shooting in an efficient manner became essential. Countless time motors were remounted components were shifted, and change all before the ROV was even placed in the water. The team decided that the best method of trouble shooting would be group discussion. Once a new addition was made, or a new challenge was met the group would take a ten to thirty minute break in order to thoroughly discuss whether or not the idea was the best possible and if any obvious problems would arise. The team found this to and effect method of troubleshooting as all members had equal input and all views and opinions were heard. As the famous saying goes “two heads are better than one” well in our case ten heads worked the best.

HUMAN LIFE AT THE POLES

Due to harsh climates life at the poles has never been easy. The unique cultures and histories consist of different methods for hunting as fishing, spirituality, but most of all life in harmony with the land around them. But this land has never been hospitable, they have had to content with extreme cold temperatures, unrelenting snowstorms, and feeling of isolation. This barren land has never been able to sustain a living environment for any length of time, because of lack of soil. Yet both of the poles are essential in the survival of rest of the planet, as they greatly influence climate and weather patterns all over the world.



A scientific testing lodge

The International Polar Year 2007-2008 is designed to focus on the Arctic and Antarctic. Based on information from www.canadanorth.usvpp.gov/polar_year.asp the year will actually run from March 2007 to March 2009 so that scientist can study both regions during summer and winter. The research will focus on six main things:

1. To determine the present environmental status of the polar regions by quantifying their spatial and temporal variability.
2. To quantify, and understand, past and present environmental and human change in the polar regions in order to improve predictions.

3. To advance our understanding of polar - global interactions by studying teleconnections on all scales.
4. To investigate the unknowns at the frontiers of science in the polar regions.
5. To use the unique vantage point of the polar regions to develop and enhance observatories studying the Earth's inner core, the Earth's magnetic field, geospace, the Sun and beyond.
6. To investigate the cultural, historical, and social processes that shape the resilience and sustainability of circumpolar human societies, and to identify their unique contributions to global cultural diversity and citizenship.



Official Logo of the International Polar Year

According to the official IPY website (www.classic.ipy.org), they are committed to working constructively with northern peoples. They are using techniques such as community monitoring, acknowledgement of protection of traditional knowledge, and through the inclusion of northern people as valued partners in planning the activities and events associated with the IPY.



Testing samples of and ice core. Bubbles in ice core can tell us when we moved from leaded petroleum to unleaded.

Skills Gained and Reflections

“Hands on work was something that was completely foreign to me before this experience. I had, had no prior experience using tools such as pipe cutters, electrical metres or bilge pumps. I learned more about these aspects through the construction of our ROV than I ever imagined possible. It amazed me how much we were able to come together and work as a team, and how quickly our ideas seemed to materialize. The sense of accomplishment I received from the completion of this project is like nothing I’ve ever experienced before. I would not trade this experience for anything.”

-Samantha Kent

“I’ve always enjoyed working with my hands, but I’ve never had the opportunity to do anything of the sort in school, so when the chance to build this ROV came up I jumped at the opportunity. But I soon realized that it was more than just building the ROV, I learned the importance of time management and teamwork. My ability to work with others improved dramatically through this experience. I am so grateful to have had such and opportunity.”

-Andrew Parsons

“The most important thing I gained from this project was the importance of properly delegating responsibilities. We soon discovered each other’s strengths and areas of expertise, and when could then find out exactly who would be best suited to do each task. Also I learned that in order to complete a task of this magnitude that every member of the team needs to be complete committed to doing the best job possible.”

-Scott Shears

“I loved having the opportunity to finally used some real power tools. I had never before had the experience, and I was amazed at how much fun I had doing it. I never before imagined myself using machines like the electric drill in our lab, and it really opened my minded and made be think about other possible career options. I would not trade this experience for anything”

-Heidi Kent

Skills Gained and Reflections

“At the beginning of this project I felt completely out of element, but as the meeting progressed I found myself beginning to understand, and actually elaborate on what was being said. I was blown away by how much I was able to learn from this experience. I loved every minute of it.”

-Laura Bonnell

“Although the construction of the LARHSS ROV was very time consuming, I found that once we efficiently organized our time, the work just seemed to flow. I enjoyed working with every member of our time, as well as being able to gain something new from each and every one of them.”

-Randy Jacobs

Budget Expense Sheet

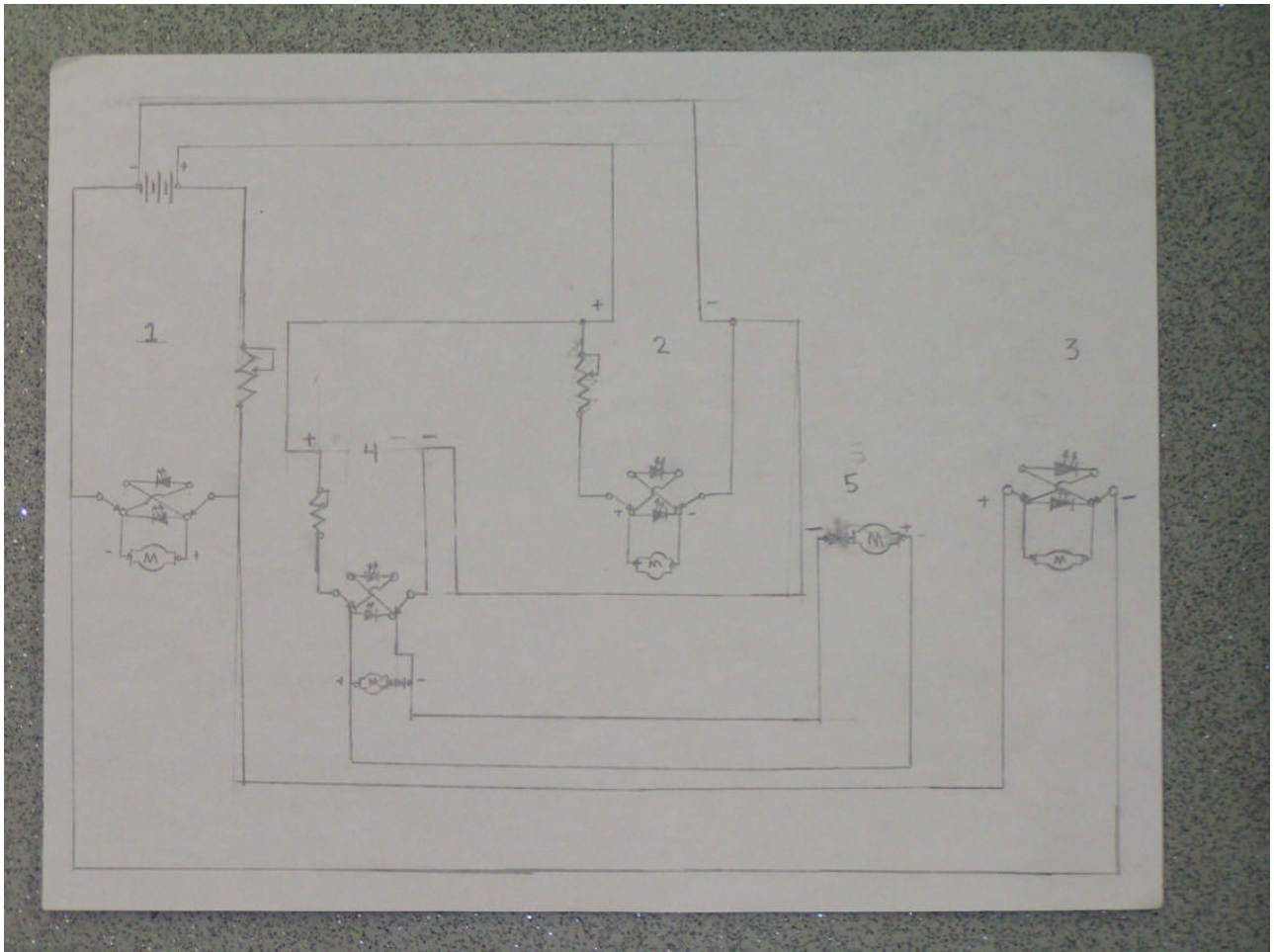
Materials Purchased

Item	Quantity	Unit Cost	Total Cost	Cumulative Cost
500 GPH bilge pump	5	11.99	59.95	59.95
750 GPH bilge pump	3	18.74	56.22	56.22
Propellers and adapters	12	NA	62.07	62.07
200 GPH bilge pumps	2	9.95	19.90	19.90
400 GPH bilge pumps	4	22.95	91.80	91.80
600 GPH bilge pups	4	19.95	79.80	79.80
Plumbing supplies	NA	NA	49.59	49.59
Travel Expenses	7	675.50	4728.50	4728.50
Total				5147.83

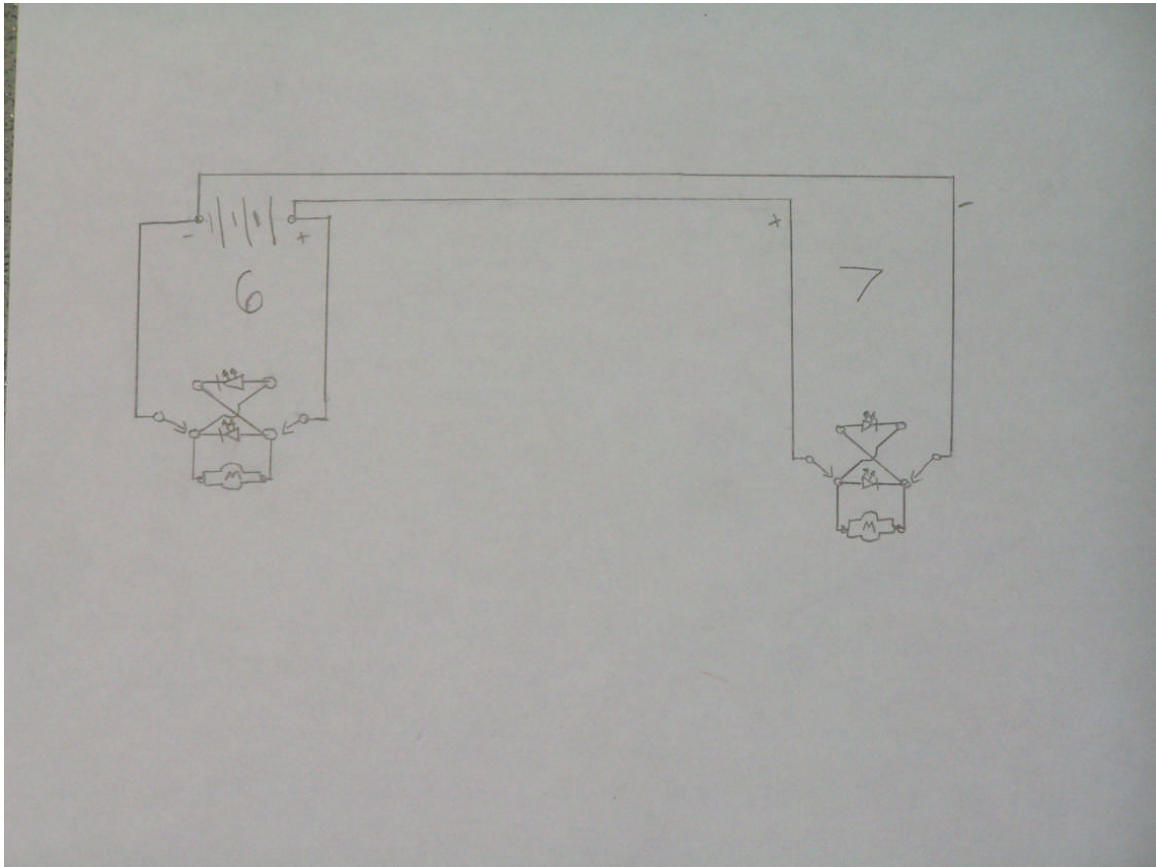
Acknowledgements

The team would like to acknowledge CFL Co. for all their help and support in allowing our teacher time away from work, as well as their financial support in our travel costs. Also they allowed us to use various competent that we found at their scrap metal dump. We would like to thank Eric G. Lambert School for allowing us the use of their science lab. Thirdly we would like to acknowledge The Marine Institute, for their financial support in purchasing material and for hosting the event. Most importantly the team would like to extend their thanks to the wonderful mentors we were so fortunate to have. Their guidance was instrumental in the construction of LARHSS ROV and we're very grateful.

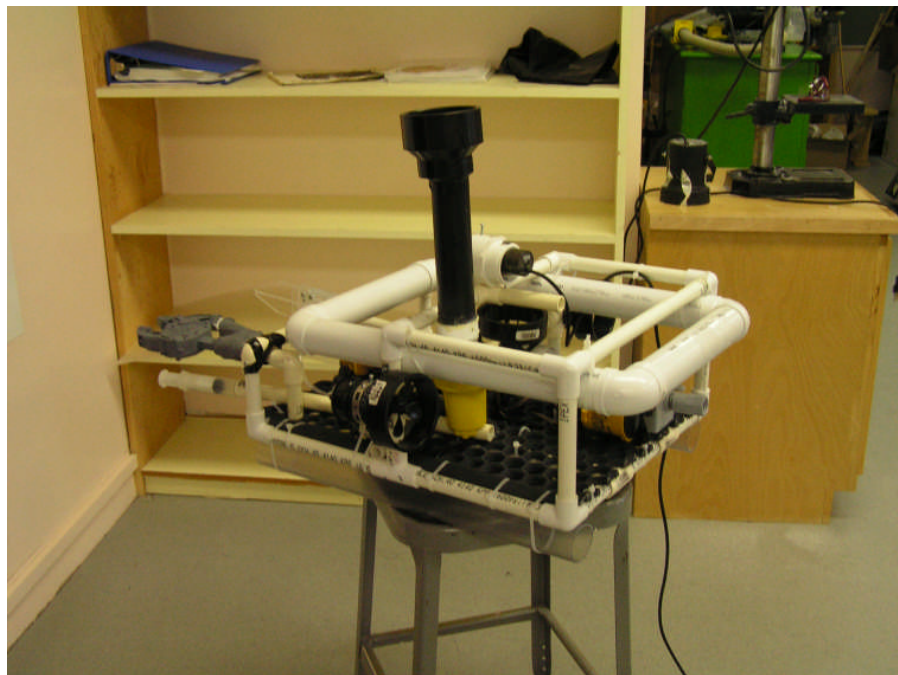
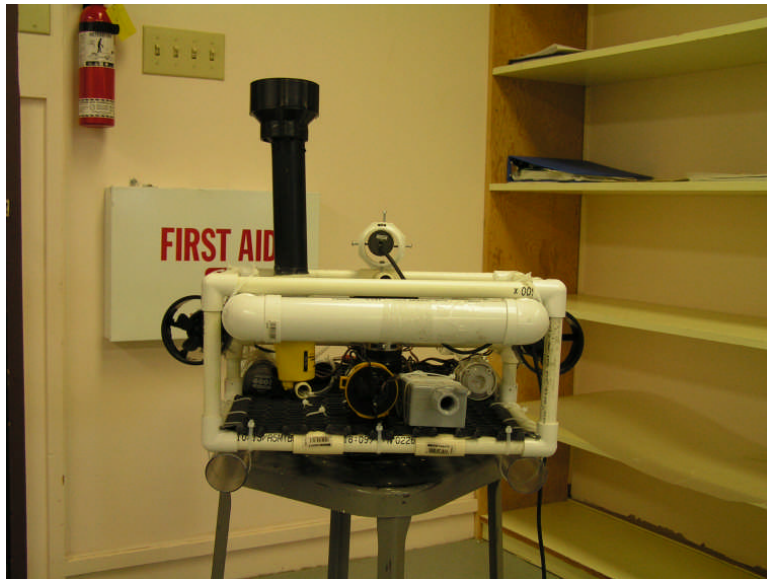
Electrical Schematic



Electrical Schematic



Final Pictures



Final Pictures