Team Yellow Jacket One

Alvin High School

Alvin, Texas

Members:

Jordan Deaton (2005)
Elmer Haynes (2007)
Hollis Howell (2007)

Instructors:

Mr. Larry Garrett
&
Mr. Ike Coffman

ABSTRACT

The Yellow Jacket One Team is comprised of three high school students of Alvin High School in Alvin, Texas. The team members were all enrolled in an engineering class open to all high school students resulting in four classes of approximately 25 students each. The classes were divided into teams of three or four. During the process, each of the current members were on different teams but others on their teams were not contributing. Eventually they were able to work on the same team. They were in the same class for the first trimester. However, the last of the two trimesters that the team had the class, they were all separated and progress on the project was almost halted. Luckily, the team was able to complete the project days before the regional competition. Although there were many setbacks, they overcame them with their abilities to communicate and problem solve. The R.O.V. building experience has been an interesting and challenging experience for them resulting in the R.O.V. they brought to the regional tournament (where upon the members named themselves after their school mascot). Thanks to their experience there, they hope to do well at the nationals as well as continue in this field of interest.

DESIGN RATIONALE

They first discussed using a cube shaped design that involved a triangular style front and back, but discovered it would not allow a very desirable balance between speed and maneuverability and was incapable of having an arm mounted on it. Believing that all the R.O.V.s would have the same speed capabilities, they changed the design to be able to install an arm and allow for more maneuverability. The final design was a cube with "wings" protruding for the mounting of the motors and a triangular tail for the tether attachment so it would not be so close to the center of the ROV and not create as much drag as the other possibilities. This design not only allowed for more maneuverability, but also let the water flow through the ROV. They then proceeded building the ROV from PVC pipe due to budget constraints at the school.

The team, after building the tether, built the original control box by using three toggle switches: one for the ascending/descending motion and two for the left and right motors which incorporated the forward/reverse motion as well as the turning of the ROV. After a few tests and realizing the downsides of this (engines can only operate at full throttle and time was taken when switching to the other toggles) and the fact there was a design that allowed variable speeds of the engines and quicker times between the activation of the motors, we decided to try and incorporate it into the design. We began the complicated task of building the custom made circuit board with the donated board, chips, and a Play Station 2 controller. We finally succeeded on the second attempt.

Our team's arm was originally designed as a claw that turned on an axis to clench things, but due to the complexity of the design and many tries to improve it without success, we redesigned the arm for something that required little to no adjustment and maintenance. We made the new arm with half of a tool made to grasp objects that are out of reach, called a gopher. We used the front half of the tool and a pneumatic pump to open and close the pinchers on the arm. In order to work the pneumatic pump, we connected it on one end to an air compressor using an air hose and connected the end of its cylinder to the gopher so it would close the pinchers. To open the pinchers we incorporated a valve into the air line to release the air at the desired moments. When we tested this arm, we found it could not pick up certain important things so one team member offered the idea of putting little u-bolt style fingers on the arm that would work but could also be safely turned around for delicate objects also. We decided to add them to the design.

For the video system, we had a camera that we were given to put on the ROV which we connected to a portable DVD screen. Although the camera was color, waterproof, and free, we were still unhappy with it due to the heavy wait of the camera. We however kept it and did our best to work with it even though it affected the center of gravity on the ROV and it became hard to control at first. Since then we have successfully tested it and are satisfied with it, but still see areas for improvement and wish to add these to the ROV.

CHALLENGES

The first challenge faced was the fact that each of these team members were on teams where all participants were not contributing. Eventually they came together into the current team. The first trouble we encountered was that in the hurry to catch up to the rest of the class we accidentally created a tether that contained only seven wires instead of the necessary eight. Because we didn't want to fall behind in class, we decided to terminate two negative wires and two positive wires at both ends of the tether. With this tether design, we had problems with the circuitry overheating due to excessive current being used because we were running two motors on one circuit instead of two individual circuits. After constant battles with keeping the ROV running with this problem, we finally had to run another wire through the tether and rewire the motors and circuit board to get the ROV to operate correctly.

The next problem to overcome was the custom made circuit board was not working when we uploaded the program onto it. The motors would operate at full throttle but could not be turned off. After discovering the circuit board was burned while putting it together, we used another one, wired it up as we did the first one, and uploaded the program on it. After successfully testing it, we continued with the project.

The last major problem we had was one of the motors responsible for the ascending and descending of the ROV was eventually made ineffective by placing the camera on the ROV at the spot that affected its movement in the water the least. The problem with its placement was the vertical thrusters were placed directly in the middle of the front half and the rear half of the ROV, but the camera was also placed in the middle of the rear half directly below that thruster. This blocked any water from being allowed to go to the propeller, effectively neutralizing its performance. After many tries to adjust the camera so it wouldn't block the propeller nor have a terrible view for the driver, we realized our only option was to adjust the engines. After a discussion on the best modification to perform, we agreed that placing the thrusters side by side would accomplish both tasks. We then took the top section of the ROV apart and cut the wires to the motors. We cut the PVC for the new design, crimped the wires back together, and placed the motors in their appropriate spots, where they have proven to be very successful.

TROUBLESHOOTING TECHNIQUES

With all of us being new to this program, we were very hesitant about performing anything without making sure it would work. We continuously checked and discussed problems with each other until we came upon an agreement and then proceeded carefully so we would get it right the first time. However, on a few occasions, this was not possible and we had to rework our design. On one occasion, we used two circuit boards because the first one was burned while we were soldering the wires into place. We originally did not know if it was the chips or circuit board so we got help from one of our mentors and read the volts. We were checking and found that the chips were OK but the board was dead so we had to redo the whole circuit board.

LESSON LEARNED

While we were competing in the regional competition, we discovered the circuit board will overheat after 15-20 minutes of steady use. We are in the process of installing a small computer fan because when the circuit board overheats, the engines will not bring up the robot. The circuit board won't push enough power to them when this happens. This was very frustrating, especially under the time constraints during competition and the fact it caused us to not finish at all when we were on the very last task with 10 minutes left. Our biggest challenge was finding time to meet together as we were limited to the last six weeks of the second trimester, and we weren't even in the same class during last trimester. Our engineering class was also located at the far end of our large school campus (we are one of the largest high schools in Texas) and we could only test it in the school pool during regular class time. By the time we reached the pool with it, we were limited to about 20 to 30 minutes each time and, additionally, the pool was being used by the swim team. We were all involved in other activities after school as well.

IMPROVEMENTS

At the regional tournament, we realized just how serious some teams were taking it and we felt the need to try and create improvements. We hope next to put ballast tanks on the top, but due to our lack of knowledge on the exact process of the inputting and taking out of the air and water along with the short time restraint presented to us, we are not sure if we can research, design, and build a system in time for the tournament. The ROV functions well, as is, for the depths that we will be using it for, but for something that is deeper or very heavy, we don't believe it would be very successful. We have also thought of the possibility of making it remote controlled, but our lack of knowledge in this area and the fact that it operates underwater makes us think this is not possible, but we will research this subject anyway. Besides installing prop guards on the thrusters before the competition, we also plan to put a temperature sensor on the circuit board, move the inline fuse to a more desirable spot, and create a quicker and easier way of opening the container that the circuit board is in. We hope to completely waterproof the wiring as well as run new air hose to our pneumatic pump because the present one was damaged by heat in an accident. Next year, we would like to create a swivel for the camera that we can rotate it on so we can have a less restrictive view and the possibility of seeing obstructions we might get hung on. We would also like to see if we can operate the ROV on air pressure rather than electric motors because it would pull less voltage and everything would be run off one abundant product (air).

ACKNOWLEDGEMENTS

Team Yellow Jacket One would like recognize our mentors: Mr. Garrett and Mr. Coffman. Their leadership gave us the ability to overcome the many problems we had, which many times looked like an abyss instead of a regular pool. We also thank them for allowing us to discover things on our own, but guiding us in the right direction.

The same goes for our parents, whose strong support has ultimately gotten us this far and even farther in life. They cannot be thanked enough and they will never realize how grateful we are that we have them.

We would also like to thank Alvin Community College for their support and donations. They have given us indispensable information and products to use on our project, and we are grateful that they were willing to help.

MATERIALS LIST
ROV
YELLOWJACKET1

Control Box	1 ea.	$5.89
Terminal Strip	1 ea.	8.99
PVC Tees	12 ea.	1.92
Hose Clamps	3 ea.	3.18
Propellers	4 ea.	5.96
Propeller adapter	4 ea.	12.00
V625 Motor	4 ea.	50.40
PVC 45 degree elbows	5 ea.	1.45
PVC 4 way cross	1 ea.	.73
PVC tubing cutter	1 ea.	9.97
HD inline fuse holder	1 ea.	1.89
Battery charging clips	2 pk of 2	3.98
Terminals spade	1 pkg	6.46
Machine screws stainless	1 box	18.49
Machine screw nuts	1 box	3.49
Electrical tape	1 roll	1.69
½" hollow plastic rope/50 ft.	50 ft.	9.00
Plastic Sterilite box	1 ea.	8.99
16 gauge wire brown/red/yellow/black/ blue/orange/grey/purple	50 ft. each color	52.00
12 gauge wire red/black	10 ft. each color	2.20
PS-1 Controller	1 ea.	7.97
Fuses	1 pk	1.78
Color video camera	1 ea.	265.00
Compact jumpstart battery	1 ea.	39.99
Threaded adapters	8 ea.	1.52
Custom board	1 ea.	10.00
Electrical parts for board	misc.	5.00
PVC pipe	10 ft.	1.08
Tiewraps	1 pkg.	11.24
Air tubing	60 ft.	25.00
Pneumatic ram	1 ea.	50.00
Gopher	1 ea.	15.00
Styrofoam noodle	5 ea.	5.00
Black plastic junction box	1 ea.	10.00
Air compressor pump	1 ea.	75.00
TOTAL		682.26

USE OF REMOTELY OPERATED VEHICLES IN THE MARINE SANCTUARIES OF AMERICA

Remotely Operated Vehicles (R.O.V.s) are being used in several of the 13 marine sanctuaries to preserve and study the marine life of America which will ensure future generations will enjoy them. There are many advantages in using R.O.V.s instead of divers to accomplish these missions. Unlike human divers, R.O.V.s can operate safely 24 hours a day, seven days a week if necessary at depths much beyond those considered safe for divers. Equipping them with special sensors, cameras, and grasping tools lets them collect detailed data with minimal interruption of the marine life. One of the 13 marine sanctuaries who have used R.O.V.s is the Channel Islands National Marine Sanctuary off the coast of Southern California. In April 2002, during the Sanctuary Quest Mission an ROV and side scan sonar was used to gather information about what was on the sea floor. An ROV will be ideal to use in conjunction with the Channel Islands National Marine Sanctuary's new 62' Teknicraft catamaran scheduled to be used as a research platform conducting research in the Santa Barbara Channel area.

The Thunder Bay National Marine Sanctuary and Underwater Preserve are located in Lake Huron. The temperature of the water is ideal for preserving shipwrecks on the lake floor which are several hundred years old. In October 2000, the National Oceanic and Atmospheric Administration of the State of Michigan entered into an agreement to jointly manage the Sanctuary. There are approximately 116 historical shipwrecks in depths of 12 feet to 180 feet of water. Dr. Robert Ballard and his team joined with the Sanctuary in 2002 for an expedition to explore and document known and newly discovered shipwrecks. In their expedition they relied on Little Hercules, an ROV, collecting video and still pictures of the shipwrecks. The sanctuary's website indicates they will be using R.O.V.s in the future for mapping and viewing new shipwreck discoveries. In addition they hope to set up a live video link from a shipwreck to shore.

Dr. Ballard anticipates ROV dives to average approximately four hours. His two R.O.V.s are Little Hercules (with a color still camera, echo sounder, sophisticated vehicle control, scanning sonar, and lighting system) and Argus (with 3-chip color video cameras, digital still camera, higher powered lights, altimeter, visual and acoustic sensors). They are designed to operate together. Argus is designed to furnish light for Little Hercules as well as towards sites as directed. Dr. Ballard uses these R.O.V.s in conjunction with a side scan sonar tow sled that uses sound to create images of the sea floor and objects on it.

The Gulf of the Farallones and the Cordell Bank Sanctuaries used an ROV during their Deepworker Project when weather made it impossible to launch a submersible (Deepworker). When it was evident the project was impossible as originally planned, Plan B consisted of an ROV borrowed from a local organization. It was used in conjunction with the NOAA ship McArthur.

The above shows the future for R.O.V.s seems "fathomless".

REFERENCES

National Marine Sanctuaries webpage – “Thunder Bay National Marine Sanctuary and Underwater Preserve”, http://sanctuaries.noaa.gov

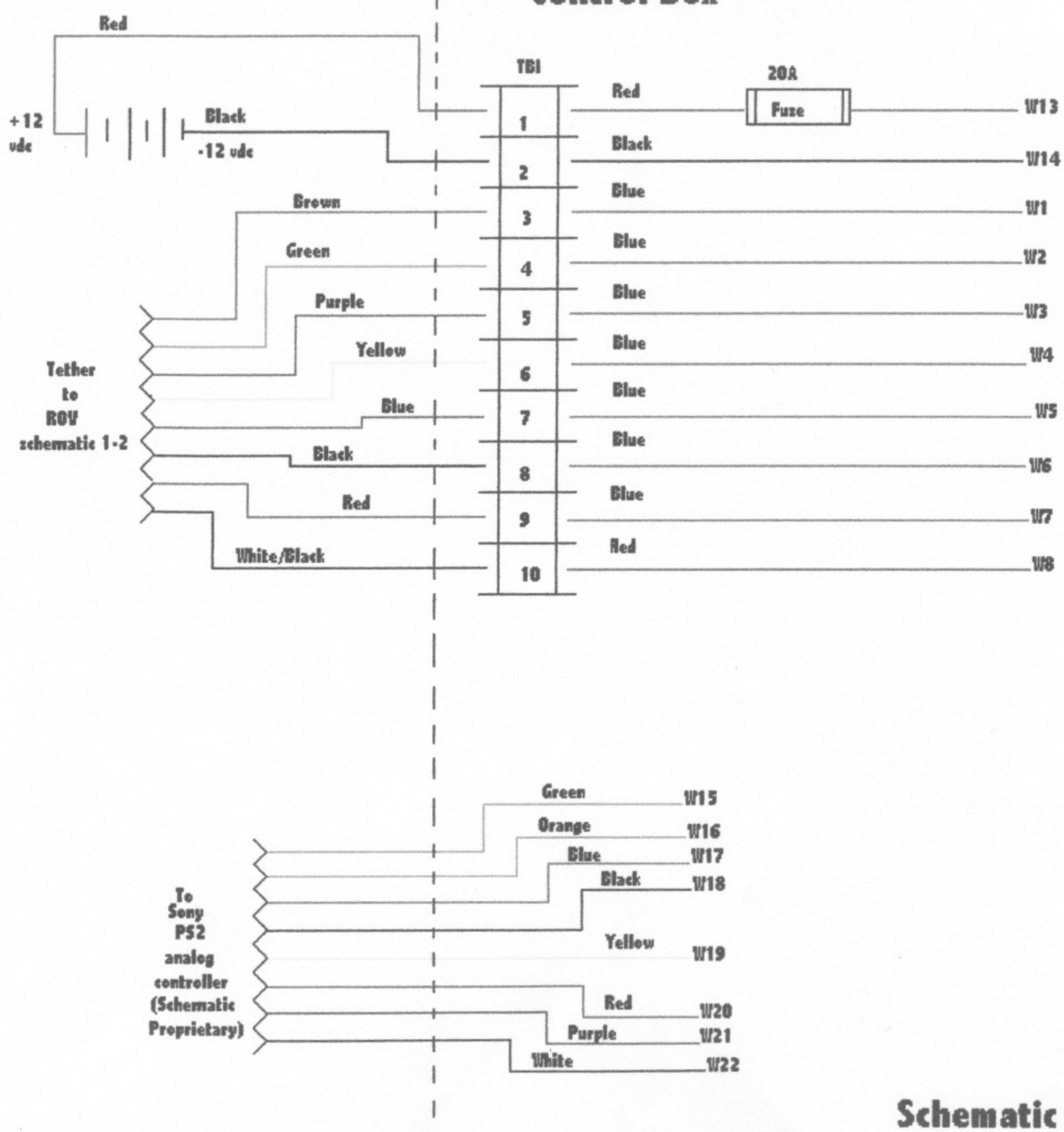
National Marine Sanctuaries webpage – “Channel Islands National Marine Sanctuary”, http://sanctuaries.noaa.gov

National Marine Sanctuaries webpage – “Cordell Bank National Marine Sanctuary”, http://sanctuaries.noaa.gov

National Marine Sanctuaries webpage – “Gulf of the Farallones National Marine Sanctuary”, http://sanctuaries.noaa.gov

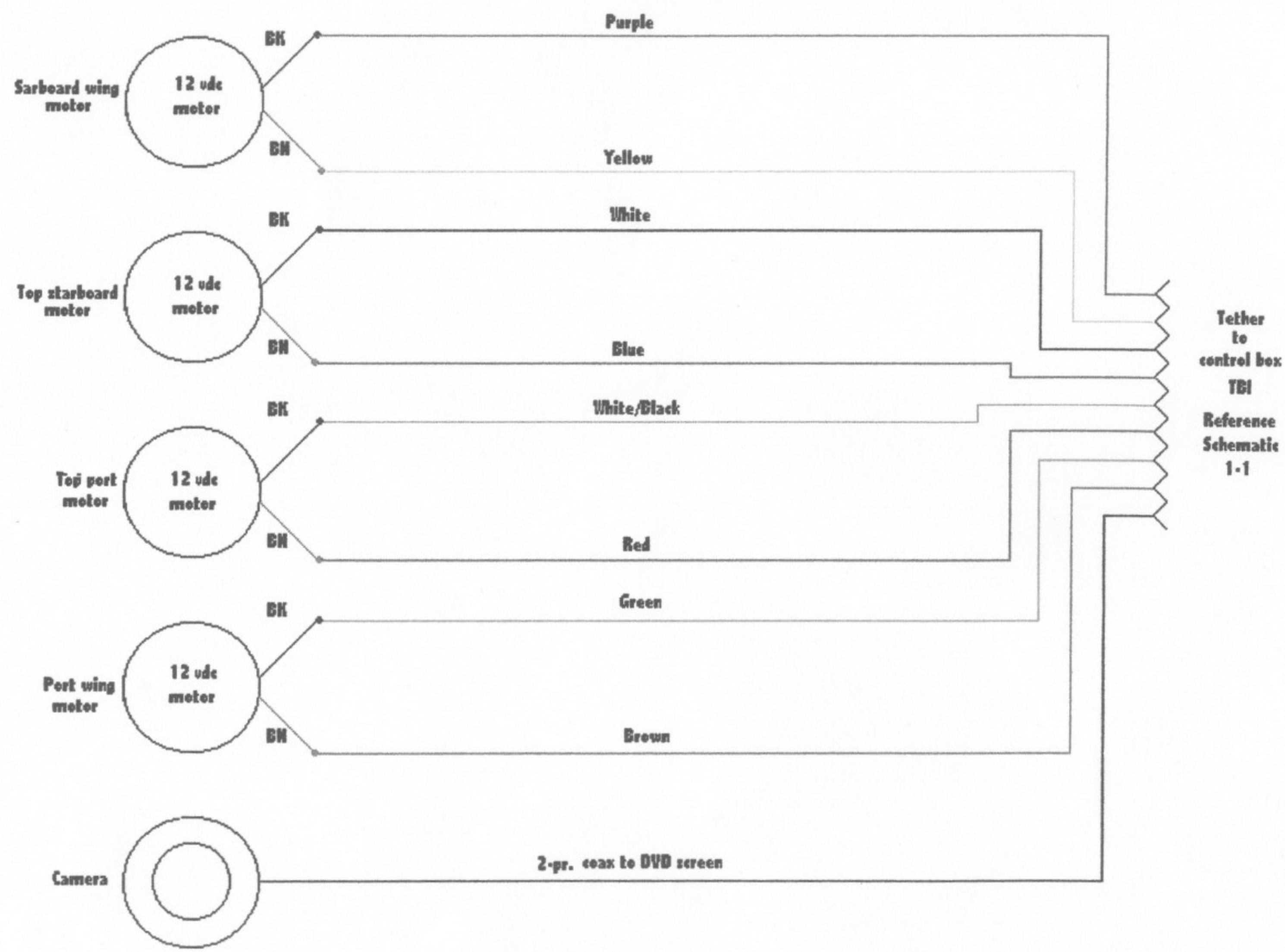
NOAA Ocean Explorer website: http://oceanexplorer.noaa.gov/technology/tools/suction

Control Box

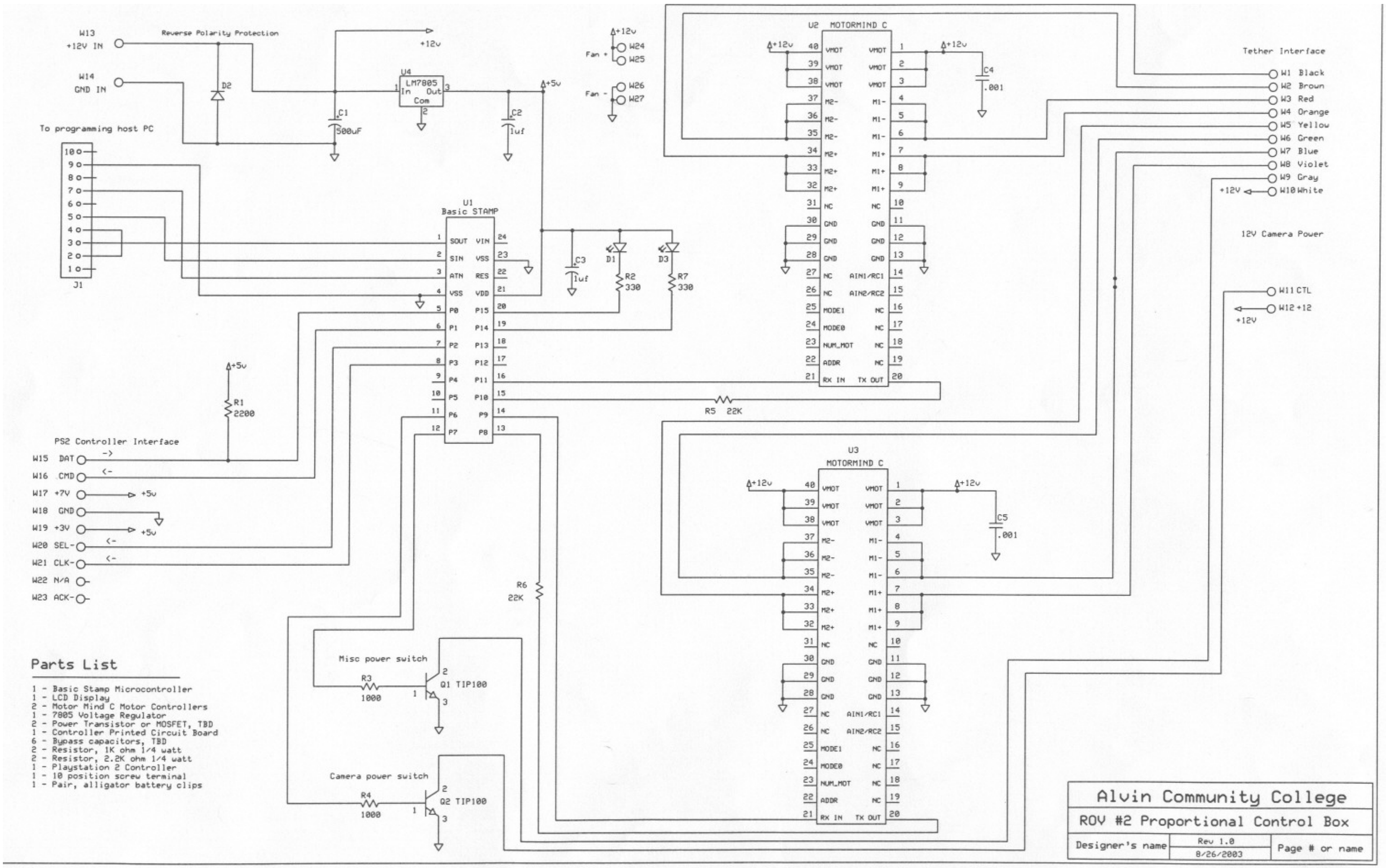


Schematic 1-1

Romotely Operated Vehicle



Schematic 1-2



Parts List

1 - Basic Stamp Microcontroller
1 - LCD Display
2 - Motor Mind C Motor Controllers
1 - 7805 Voltage Regulator
2 - Power Transistor or MOSFET, TBD
1 - Controller Printed Circuit Board
6 - Bypass capacitors, TBD
2 - Resistor, 1K ohm 1/4 watt
2 - Resistor, 2.2K ohm 1/4 watt
1 - Playstation 2 Controller
1 - 10 position screw terminal
1 - Pair, alligator battery clips

Alvin Community College		
ROV #2 Proportional Control Box		
Designer's name	Rev 1.0 8/26/2003	Page # or name

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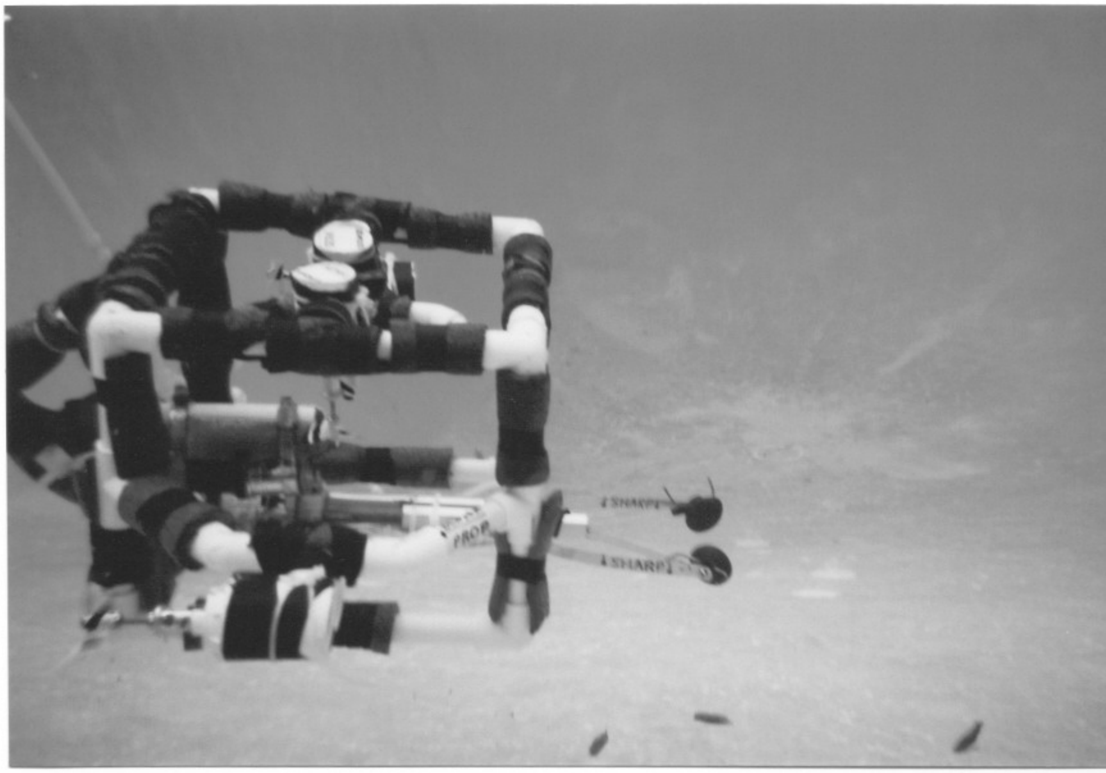
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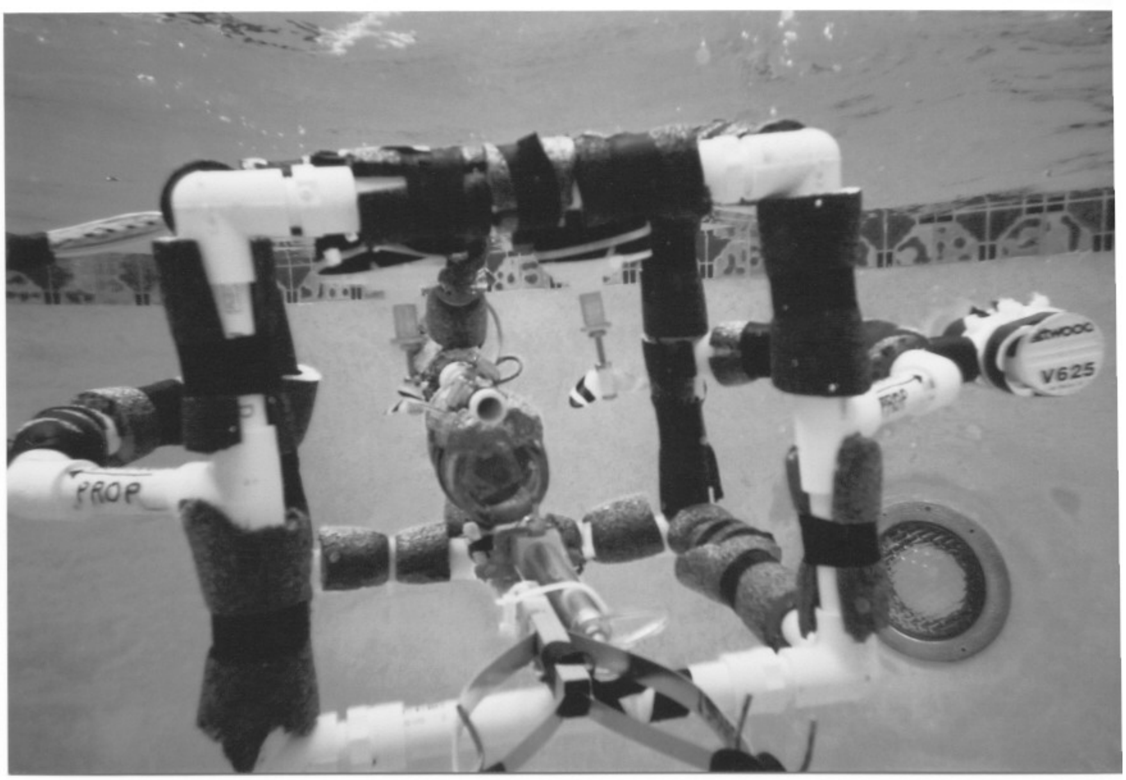
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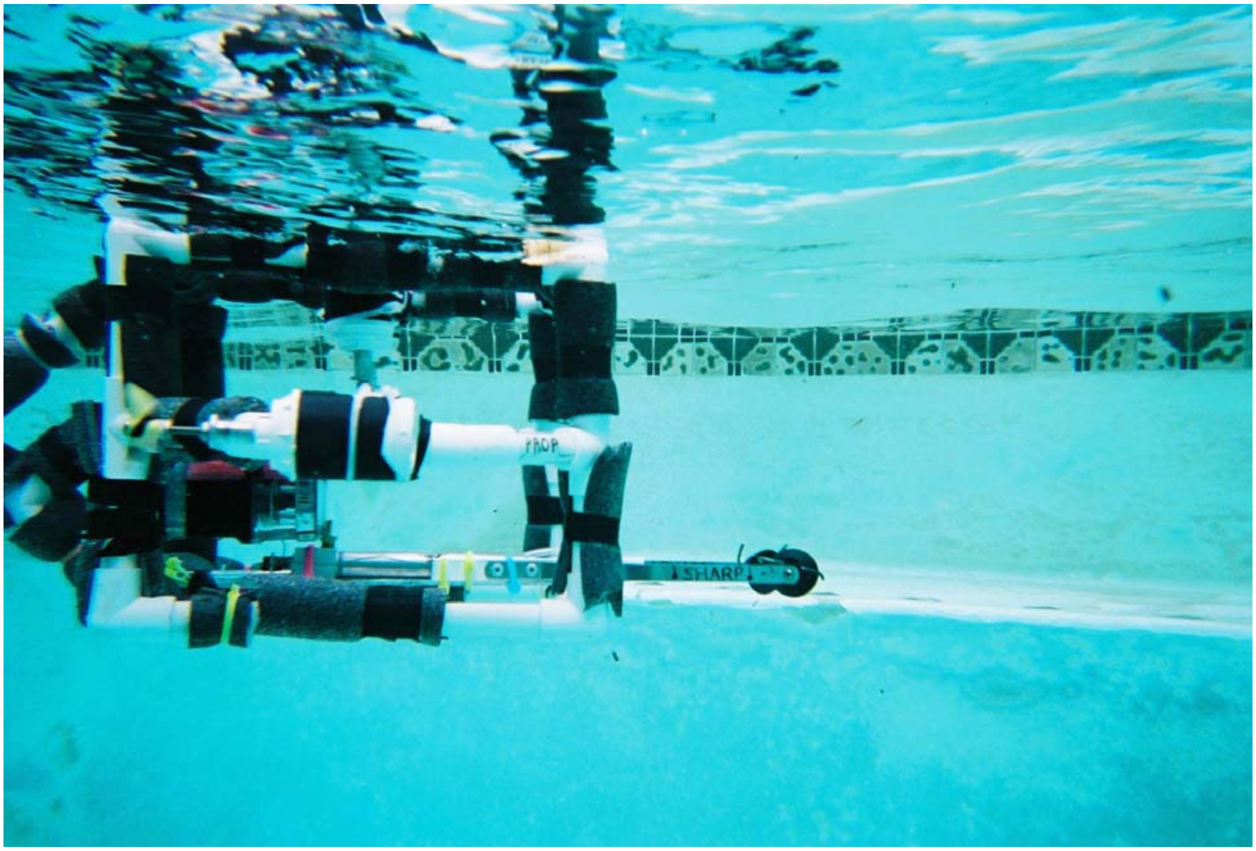
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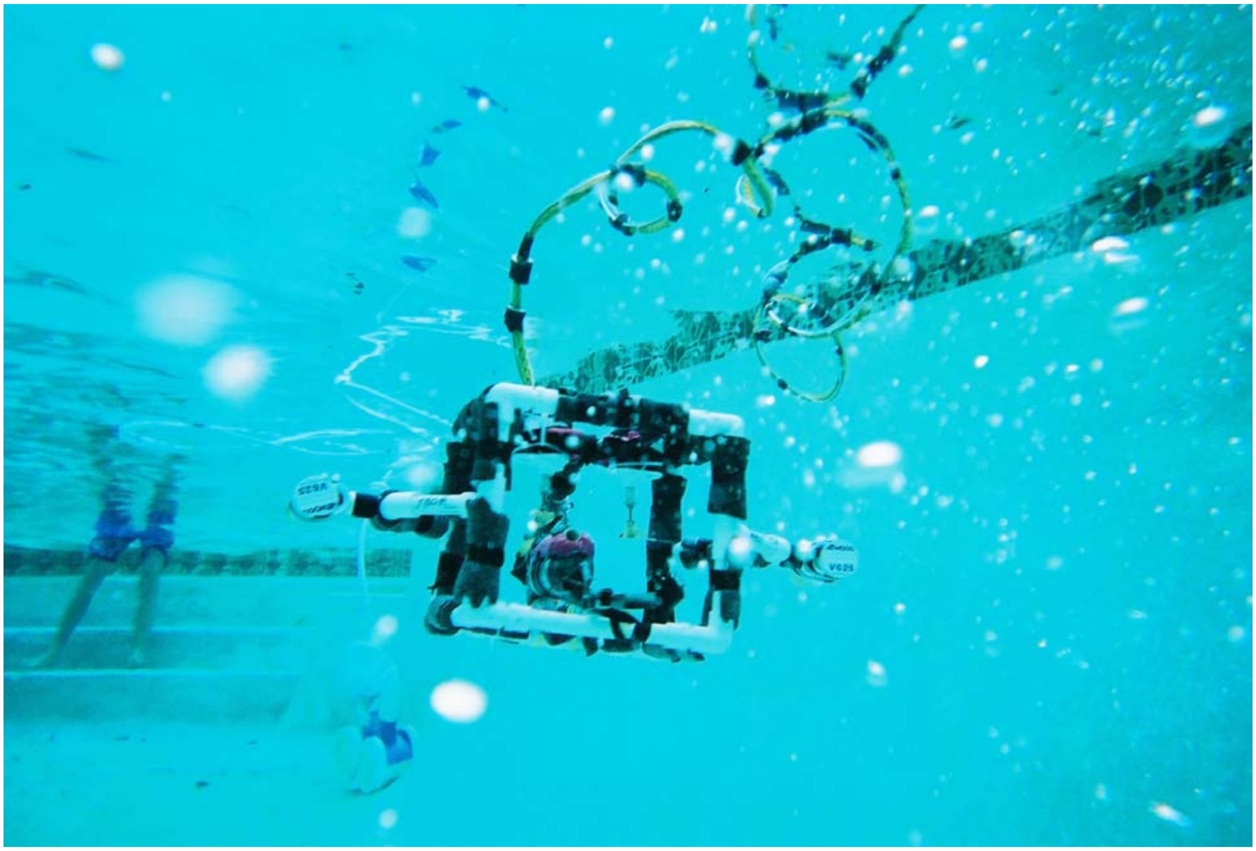

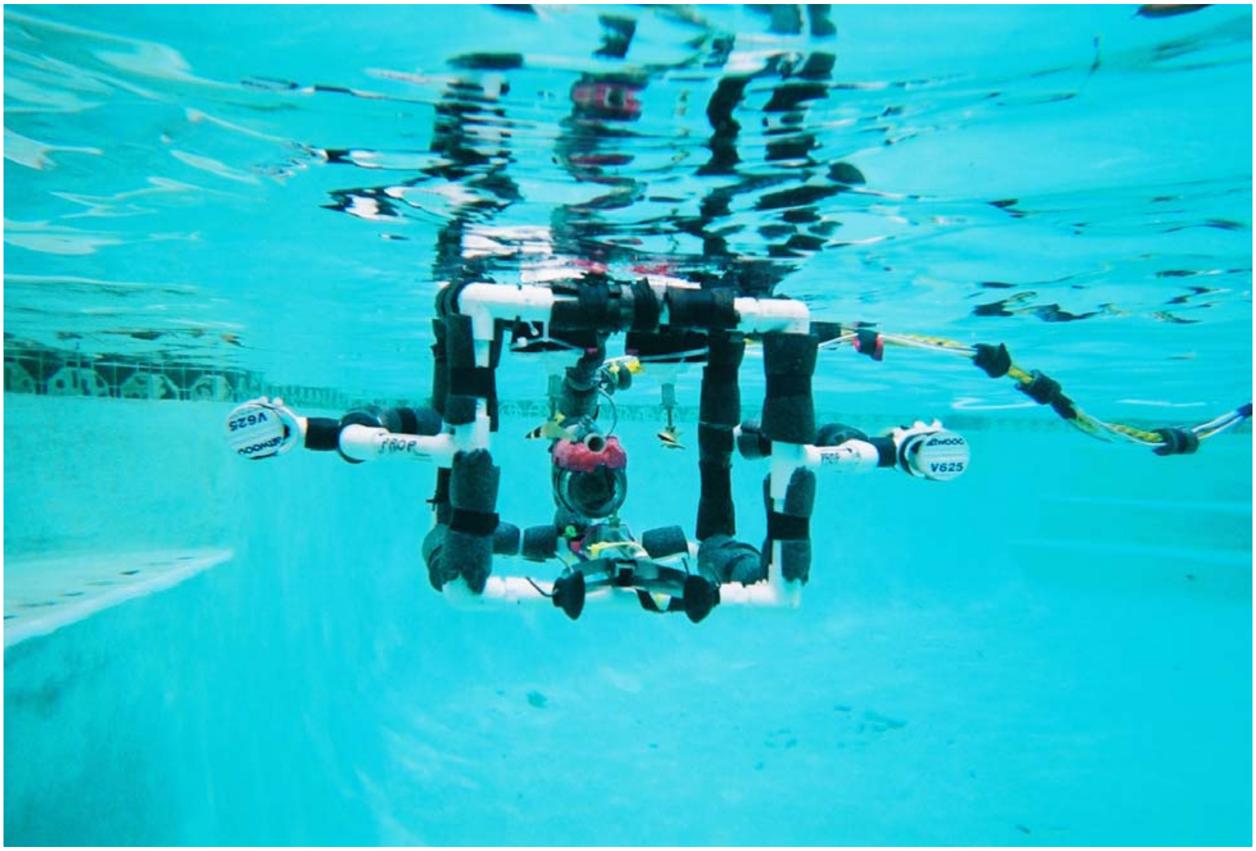
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