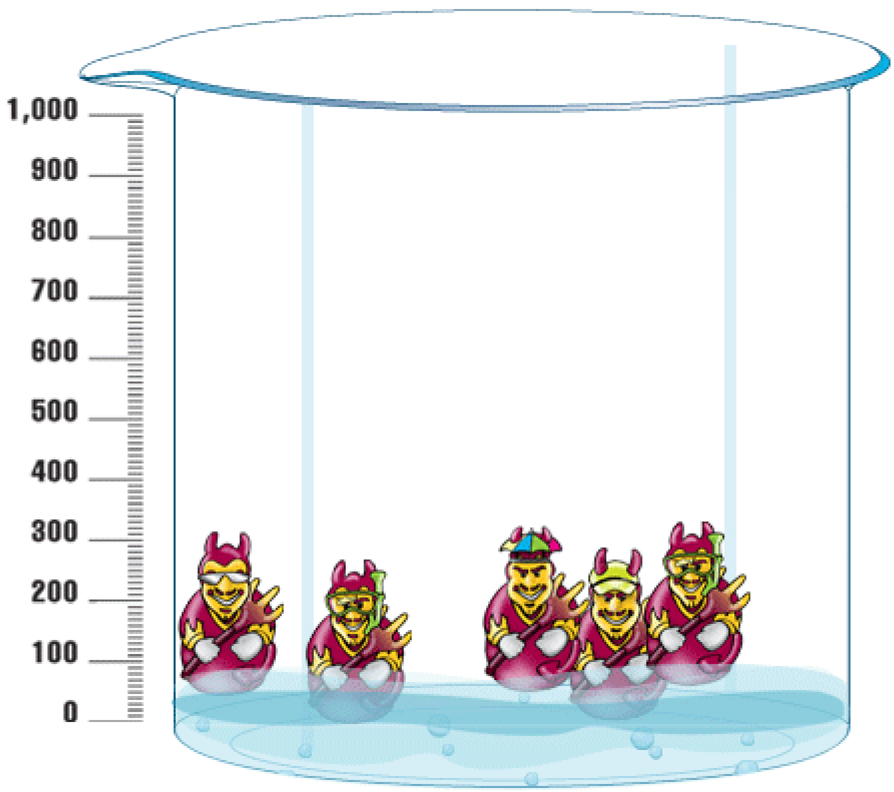
2007 ASU Robodevils ROV Team



http://www.asu.edu/alumni/membership/sparkycontest.shtml

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http://geocities.com/oscarvzqz/

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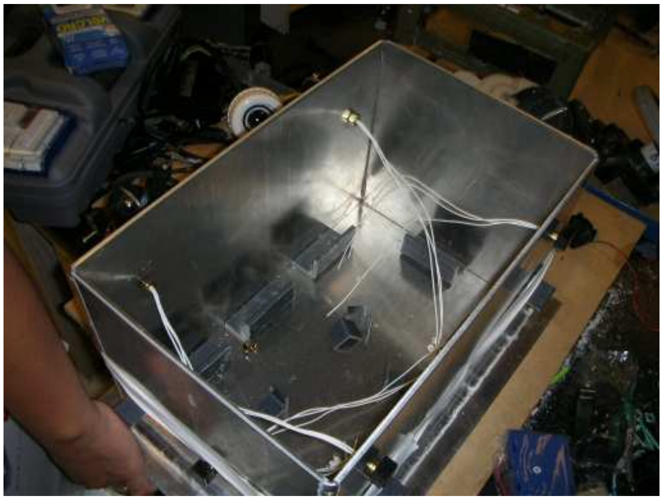
Abstract

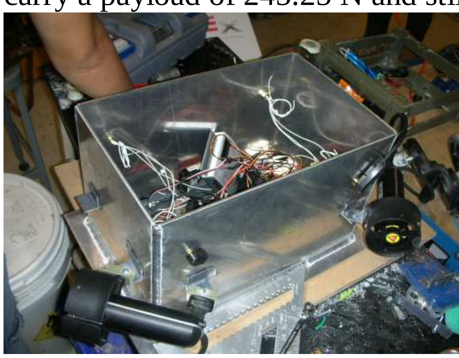
The simplicity of design and structural integrity were the main goals of the building process of this R.O.V. To accomplish these goals we decided on a minimum amount electronic systems and a strong material to constitute the robot frame. Most of the robot was built around these two main goals; however keeping all of this within budget was the biggest challenge that we faced, and this is why low cost materials were chosen. Although some problem were encountered, they all were solved by finding help with people from industries that were more than willing to help and by fellow competitors who in the spirit of improving the competition did not hesitate to offer a hand.

Design

Our robot was built around the aluminum frame, which is basically a container for most of the electronics and all of the batteries. The electronics were elevated 3 centimeters from the container floor, in case that a leak occurs the water will settle into the bottom of the case and therefore allow for some time before it gets to the electronics.



The container also serves as the structure that supports the motors, arm, lights and cameras. This provided for a small, compact yet sturdy design. The outer dimensions of the frame are 40X25X25 centimeters, this dimensions displace 25 litters of water which means that we can roughly carry a payload of 245.25 N and still be neutrally or positively buoyant.



To aid in attaching the arm and the cameras, two lips were left on the container, one on the top and one in the bottom each measured 5 centimeters from the container. A 36X23 Centimeter hole was cut on the top of the container to allow us to get to the electronics a 2 millimeter deep grove was cut to help retain an O-ring that helped seal the container; when a 40X25X.635 centimeter piece of Clear lexan was screwed in to the top part of the robot were the opening was made.

This also allowed us to see the electronics to look for any signs of trouble, i.e. Smoke.

Given the dimensions of the robot we found out that the inertia of the robot could place a challenge when moving back and forth, but we think that this is an advantage because we need finesse when executing some of the maneuvers need during the competition.

We decided that six thrusters should be used. Four were be used for lateral and horizontal movement, all of the motors were placed at each of the corners of the container at a 45^0 angle with the closest face of the container, this help with forward and backward motion

as well as with lateral motion. These motors provide 28.4 Newtons of thrust each. To aid with ascension and dissension two higher output thrusters were selected,

http://www.seabotix.com/products/btd150.htm

these motors are located in the middle of each of the longer sides of the container; the purpose of the higher output is to minimize the time it takes for us to come to the surface and to go back down to the submarine. We do not know the thrust exerted by these motors but if they are strong enough to move a boat through the water we figure that they are enough to move our 25 kilogram robot.

The arm is a SeaBotix Design its mass 500 grams in air. It clamps with a force of 63.765 Newtons. It has an internal screw drive mechanism that allow for the jaws to grip.

http://seabotix.com/products/tjg301-2.htm

The cameras we used are called “Falcon Cameras” and they are of the simplest and lowest cost that we have found. The cameras consist of a camera housing, which is the male half of a PVC pipe connection, a piece of plexy glass placed between the female end and the male end that helps to put even pressure on the O-ring that keeps it watertight and a small 2.5X2.5 centimeter board camera that fits inside of the housing. The back end of the housing is then sealed with epoxy and acrylic.

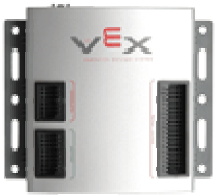
All this provides a very cost effective camera that is easy and fun to make.

Our temperature sensor consists of a Kitchen Thermometer attached to heavy weights; the weight will keep the thermometer in place next to the volcanic vent until it gets a reading. After a reading is taken the thermometer will be returned to the surface.

In order to light our way we decided to use 2 LED Flashlights. These flashlights were made watertight by sealing all possible leak openings with plumber’s goop, and self vulcanizing tape. The flashlights are reliable, light weight and most important they are inexpensive.

In choosing a tether we knew that we would be choosing one of the most important aspects of the robot. We needed a small and flexible yet strong tether that would still have enough cable elements for us to keep all communications to the robot within that one tether. First we decided to use onboard power the allowed for us to use smaller cable elements and also reduced the voltage drop that could be encountered over 15 meters of cable. Se we decided to use a 15 meter long piece of printer cable. This cable has 22, 22 gauge elements which are more that enough for this application.

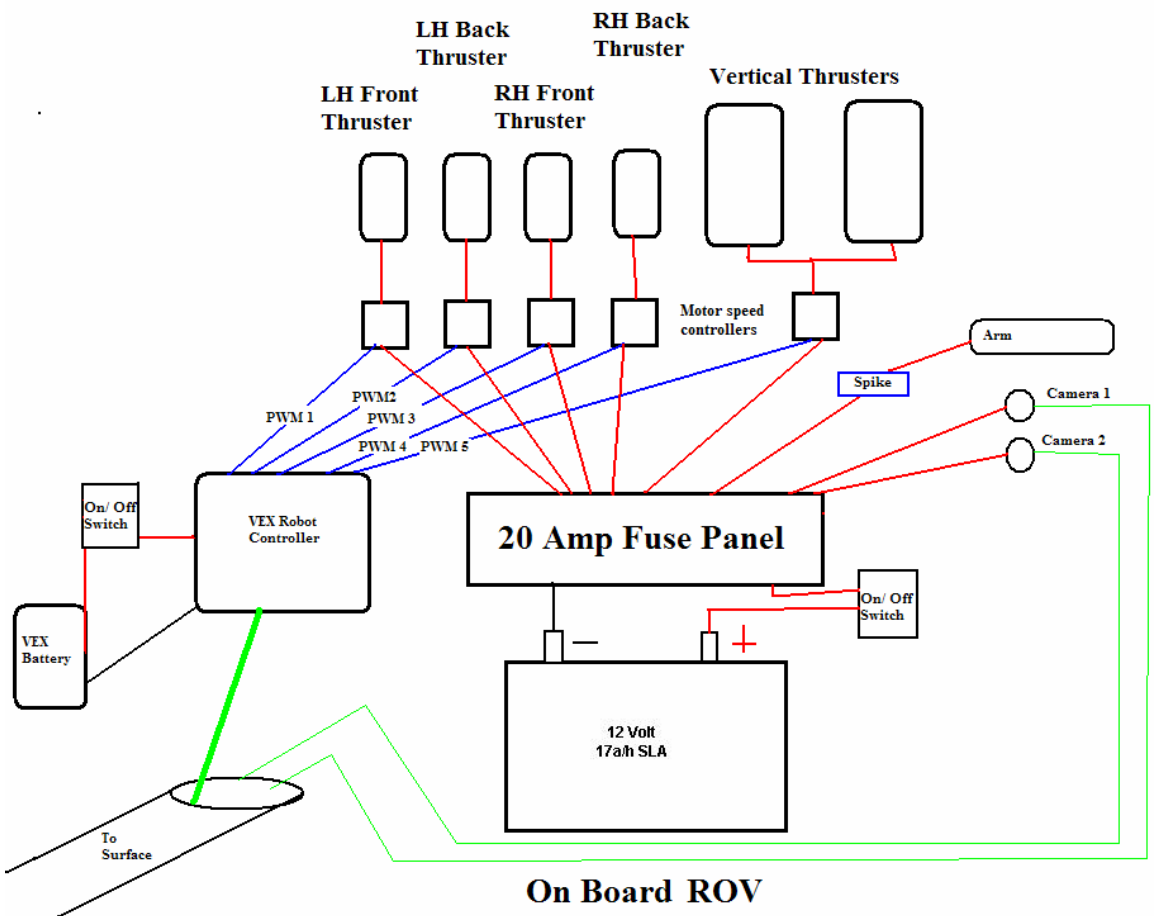
Vex Controller System

The VEX Controlling System was something new to us. This system is so easy to work with that it for sure decreased the time need to make the robot. The system consists of a controller module  http://www.vexlabs.com/vex-robotics-starter-kit-parts.shtml 

and a transmitter . The tether needed for this system is basically a phone line consisting on four very small diameter wires (22 gauge). The Controller module has Power with Modulation (PWM) out puts that control the amount of power given to the motors via a Motor speed controller, and those PWM outputs can also control Spikes that basically serve as remote ON/OFF switches.

The reason for which we chose this system is because it is very easy to work with and would free up some time for us to work and other aspects of the Robot.

Electrical Schematics



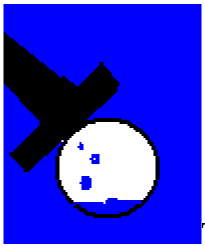
The Experience Earned

In entering this competition there were two clear objectives that we would try to achieve; to have fun and to learn something.
The first objective was accomplished from the beginning, there something about using your hands to build working product from other wise inert pieces of metal and plastic.
The other objective did take a little longer to be accomplished, in the beginning there were some of us that did not know the difference between direct and alternating current, or that piloting an R.O.V. is pretty much the same as piloting a remote controlled plane. There were many other lessons learned in that sense.
Time management was a big one; we had to find a work schedule around final exams and later around summer school.

We also found out that some of the things we are learning in school do apply to real life scenarios. The Buoyancy Equation $m_b = m_{\text{object}} \cdot \left(1 - \frac{\rho_{\text{fluid}}}{\rho_{\text{object}}}\right)$ that we learned some time during freashman year was of special interest being that we didn't want to sink to the bottom like a rock or float on the top like beach ball.
Other things like finding the strain that could be expected on the aluminum at a give depth was a little more challenging. Later we found out that the force exerted by the water at a 5 meter of depth is not enough to cause any significant deformation to be of a concern, for sure at a couple hundred meters it would be.

"In the end we found out that learning is also fun, and soldering wires became our new art form".

Future Improvements

In the future we would like to make a better, frame/container design. We would like to use a round frame to give more resistance to the compressive force that we may find at grater depths. We could use a piece of metal pipe and round end caps to house the electronics. The reason that this was not attempted this year is because in the pipe would provide not flat surfaces in which we could drill holes for our tether, therefore leaks could develop.  This presents the biggest challenge that we will face if we do decide to do this design in the future. With time and with the knowledge that we are acquiring day to day we hope that we could use this design in the future to come.

Expenses

5 Seabotix Brush Thrusters……………………………………1000.00
2 trolling motors……………………………………….…..... Borrowed*
VEX Starter Kit……………………………………………... Borrowed*
1 1.82X1.82X.3175 centimeter piece of 5052 Aluminum……..Donated[1]
Machining……………………………………………….….. 60.00
2 Cameras…………………………………………………..... 35.00
2 Flash Lights………………………………………………..28.00
2PVC pipe Connections………………………………………. 30.00
1 Seabotix Grabber…………………………………………… 1400.00
1 40X25 Piece of .635 Thick Centimeter Clear Lexan……. 15.00
1 15 Meter piece of Printer cable …………………………… 20.00
2 TVs/ Monitors……………………………………………. 190.00
Miscellaneous …………………………………………………75.00
Total……..$2853.00

* Borrowed from Carl Hayden Community High School Falcon Robotics
[1] Donated by Industrial Metal Supply

Acknowledgments

Phoenix Az. **602-454-1500**

Quality Machining and Fabrication LLC.
Phoenix AZ. 602-2259786