



**Carl T. Smith Middle School  
CTS Robotic Scholars  
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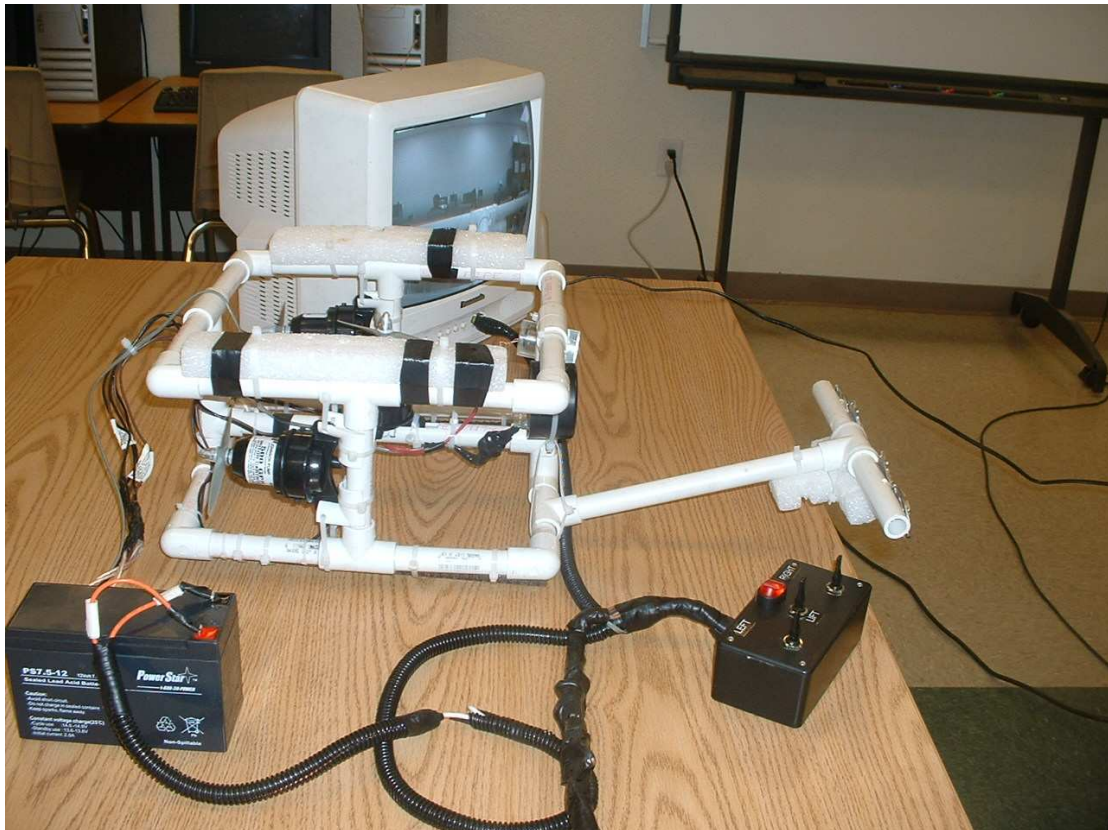


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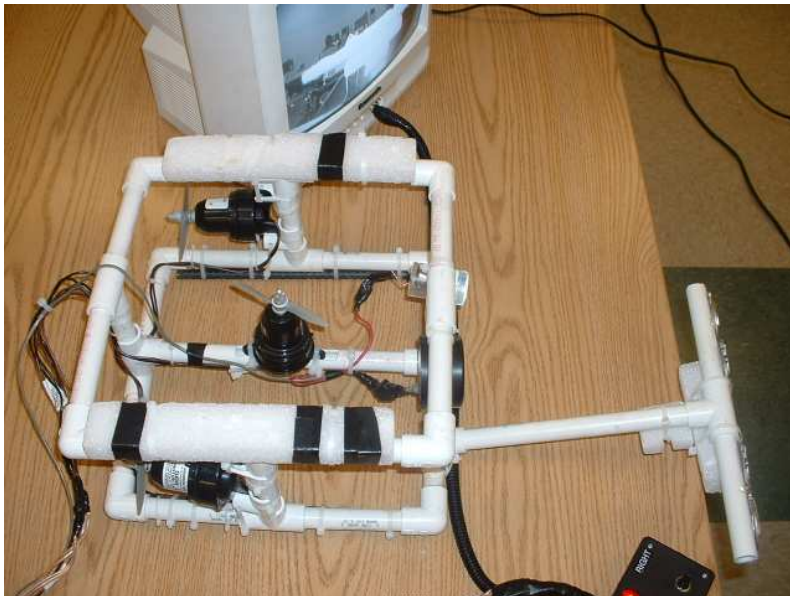
## Abstract:

“Aqua Jet,” the underwater robot constructed by the Carl T. Smith Middle School’s CTS Robotic Scholar’s, was designed and built to compete in **The Honeywell Hometown Solutions National Underwater Robotics Challenge** held at the Chandler High School in Chandler, AZ, June 6-7, 2008. The team purchased the ROV-in-a-Box from Karen Suhm at Inventivity. We kept the basic design but modified the electrical system to suit our specifications. Our mentors spent much time and work on the ROV, and Carl Hayden even donated some components as well as the use of their aquariums. As this is our first very basic attempt at building an underwater robot, we are just excited to be a part of the competition.



## Buoyancy:

Buoyancy is the tendency of a body to float or rise when submerged in a fluid. We put on the Styrofoam and the two metal rods for the buoyancy. We have cut a little of the Styrofoam to put the right size to float a little to the surface. Then we used the rods to make the robot heavier to float to the bottom of the water. We used zip ties to tighten the rods and the Styrofoam to the robot. Our goal was to get it a little positive and a little negative. So it could stay in the middle and the thrusters will do all the work. We also put Styrofoam on the tether to keep the wires floating in the water.



## The Design:

The design of Aqua Jet (our robot) has a good rectangular prism shape for good movement. The prism is made out of PVC tubes to make it float more and make it more buoyant. Our robot has three thrusters with 500 gallons per hour; to make it go faster and reduce extra buoyancy in the robot. The robot has many aspects in general but the most interesting part about our robot is that its arm accumulates the capsules in one try, because the arm has four powerful magnets that attract the capsules. The controls are also very simple to understand because the controls are designed for comfort and ease of use.



## The Camera:

The name of our robot is Aqua Jet and the camera actually works very well in the water. Although the camera came already made, we do understand how it works. It has four wires that are 24 gauge that you can use for the TV and also the battery. It is just that you have to be very careful with it. To make the camera work, you have to plug the camera to the TV then you plug the two wires to the battery. But first you put the CCD camera, B&W, 45° FOV to the liquid casting resin. There is also an black abs cap, 2" diameter that you put inside the J-B weld to make it look like a mirror it also help because it does not let water go inside. If you do this, the light will also go on at the same time.



## Expense Sheet:

Part description	Quantity	Price	Total price
1/2"pvc elbow	8	\$ 0.25	\$ 2.00
1/2"pvc t	8	\$ 0.27	\$ 2.16
5"pvc pipe	20	\$ 0.07	\$ 1.40
mayfair marine 20112 500gph	3	\$ 13.99	\$ 41.97
Airplane prop, 2-blades,4.25"x1/2"	3	\$ 1.75	\$ 5.25
Collet adaptor 3.175mm shaft	3	\$ 4.49	\$ 13.47
speaker wire-paired 16-gauge 50ft	3	\$ 10.99	\$ 32.97
ccd camera b&w 450 fov	1	\$ 17.95	\$ 17.95
pvc coupler, 1-1/2"	1	\$ 0.70	\$ 0.70
liquid casting resin	2	\$ 0.07	\$ 0.14
liquid casting resin catalyst	6	\$ 0.69	\$ 4.14
polycarbonate disc 1.75" diameter	1	\$ 0.21	\$ 0.21
j-b weld	1	\$ 4.19	\$ 4.19
black abs cap,2" diameter	1	\$ 3.10	\$ 3.10
24-gauge4-wire phon line	50	\$ 0.07	\$ 3.50
superbright 12- led cluster	1	\$ 6.99	\$ 6.99
6"length of 24-gauge wire	2	\$ 0.01	\$ 0.02
liquid casting resin	3	\$ 0.69	\$ 2.07
liquid casting resin catalyst	10	\$ 0.27	\$ 2.70
1/2"pvc t	4	\$ 0.15	\$ 0.60
1/2pvc pipe	125	\$ 0.01	\$ 1.25
zip ties-small	0.5	\$ -	\$ -
control box top template	0.5	\$ -	\$ -
control box side template	1	\$ 3.79	\$ 3.79
6"x3"x2" project enclosure	1	\$ 3.99	\$ 3.99
spst main on/off rocker switch	3	\$ 4.49	\$ 13.47
dpdt switch	12	\$ 0.05	\$ 0.60
labels-main on off left fwd rev right forward	5	\$ 0.01	\$ 0.05
2"16-gauge wire	4	\$ 0.01	\$ 0.04
4"16-gauge wire	2	\$ 0.02	\$ 0.04
6"16-gauge wire	2	\$ 0.11	\$ 0.22
16-gauge wire, 3-ft length	2	\$ 0.11	\$ 0.22
24-gauge wire,3-ft length	1	\$ 0.25	\$ 0.25
Inline automotive 3ag fuse box	1	\$ 0.75	\$ 0.75
rca plug	1	\$ 29.99	\$ 29.99
12v dry cell battery	2	\$ 1.26	\$ 2.52
insulated terminal connector ,female	1	\$ 0.24	\$ 0.24
power connector plug	1	\$ 0.24	\$ 0.24
power connector receptacle	2	\$ 0.08	\$ 0.16
female crimp pin	2	\$ 0.07	\$ 0.14
male crimp pin	1	\$ 0.50	\$ 0.50
fuse,15a,1-blow	2	\$ 0.33	\$ 0.66
flex tubing -3 foot length	5	\$ 0.02	\$ 0.10
electrical tape,2"length	1	\$ 2.97	\$ 2.97

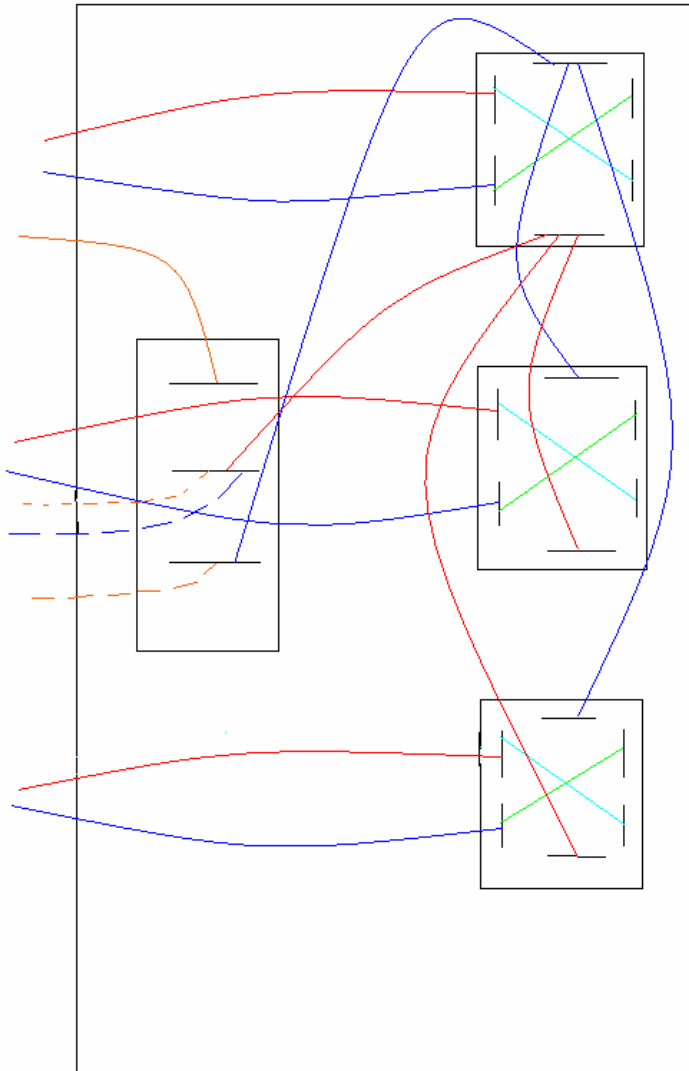
clear epoxy	2	\$	1.67	\$	3.34
self- vulcanizing tape	2	\$	1.28	\$	2.56
metal ballast rod- jbolt-10"x5/8"	4	\$	0.28	\$	1.12
styrofoamcut to 1"x1-3/4"x1"	30	\$	0.06	\$	1.80
styrofoamcut to 1"x1-3/4"x2"	8	\$	0.01	\$	0.08
zipties- large	1	\$	0.50	\$	0.50
				\$	217.12

## Thrusters:

The thrusters help move the robot. Aqua Jet has 3 thrusters (motors). The thrusters are Mayfair Marine 20112 500GPH. There are three thrusters inside Aqua Jet. One thruster is at the left pointing back. Another is at the right pointing back also. Another is at the center that points up. The thruster at the left makes the robot turn to the right when you press forward and when you press backward the robot turns left. When you press forward on the right thruster it makes the robot turn left and when you press backward the robot turns right. The center thruster makes Aqua Jet ascend (up) and descend (down). When you press forward on the center thruster it makes the robot ascend and when you press backward it makes the robot descend.



# Electrical Schematics:



## The Light:

Our robot is equipped with a light that helps the camera and the pilot see in the dark. We actually didn't build the light but we understand why it was built the way it was. The light was made of an LED cluster and liquid casting resin. It was built like this so water wouldn't go into wires that were connected to the chip and destroy the whole circuit.



## Acknowledgements:

We would like to take this opportunity to thank the following people:

- Dr. and Mrs. Norman Lifshutz for their tax donation,
- Mr. Gestson, our principal, for supplying time and money to work on the ROV,
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- Mr. Erick Dean for being a great mentor and helping us with everything,
- Ms. Wojciechowicz and Ms. Covarrubias for being drivers and chaperones for the competition,
- And Mrs. Murphy who is just plain cool!