TECHNICAL REPORT

EXPLORER CLASS

ADRASTEIA

Inescapable

ROV Team Clatsop Community College 2012

Clatsop Community College

Astoria, Oregon

Team Members

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Instructors/Mentors

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ABSTRACT

The team Clatsop Community College designed the ROV Adrasteia to perform the indicated tasks for the 2012 MATE ROV competition. These tasks simulate moving delicate coral, deploying lift bags, surveying wreckage sites, and removing oil from oil tanks are the core components of this mission.

Team CCC designed the components and the ROV as well as the payloads to be delivered. The PVC frame was designed with plenty of space to allow for components, payloads, and maximum mobility . Each member had to learn about and specialize in a specific task while keeping a general oversight of the ROV to accomplish the project. The technical information had to be presented as well as manifested; spec sheets, a poster board, a technical document and an engineering evaluation are required as well.

The overall objective of this competition is to provide a learning environment for problem solving skills, critical thinking and working as a team. The competition also helps to expose students to the opportunities available to them.

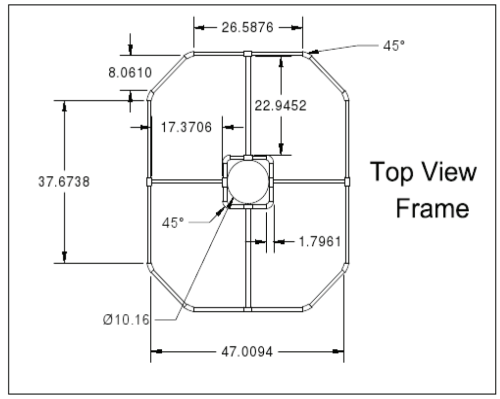
DESIGN RATIONALE

The original ROV we used for regionals was mainly composed of the previous year's ROV. This was just to get us pass the regional qualification. Afterwards we scraped and redesign the entire ROV. This was done to house the extras payloads as well as to design a better thruster system.

Core System

FRAME

-3/4 inch PVC pipe
-Length - 64.45cm
-Width - 54.29cm
-Heigth21.27cm



Frame Design

Regionals-
The frame was reused from the previous year.

Nationals-
The redesign of the frame was to house more payload tools, larger motors, and to set up a vector motor layout. This allows for more maneuverability and power.

PROPULSION

Ruler 2000 Bilge Pump
-32 Volt
-3.1 Amp
-2000 GPH

Bilge pump used for truster motor

Regionals-
The thrusters were reused from the previous year. We had two May Fair Marine Bilge pump motors with 1000 GPH flow and 4 Amp draw.

Nationals-
Five bilge pumps are used to propel the ROV. Four vector thrusters are positioned at 45 degrees to the ROV for forward/backward, left/right, and pivot movment. One thruster in the center will be used for up/down movement. Motors are placed on the inside of the ROV to streamline the vehicle.

CAMERA

Camera used on ROV

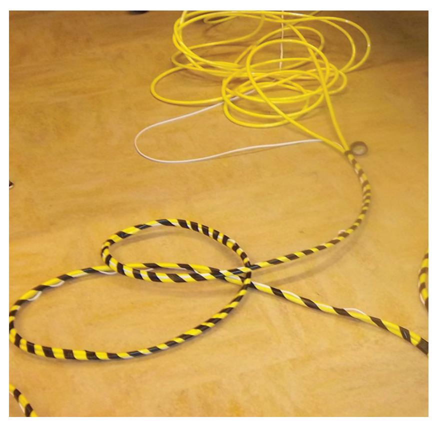
Model SC-420

-12 Volt
-Horizontal Resolution- 420 TV lines
-Pixel Resolution- 920 pixels

Regionals-
One forward camera and one bottom camera were used to view ahead and below while two pariphrial cameras were used to view the sides.

Nationals-
Three cameras are used. The forward camera will help the pilot see what is in front of the ROV as well as to help operate the manipulator. The two pariphrial cameras aid the pilot around obsticals.

TETHER



Tether used to supply power and signal

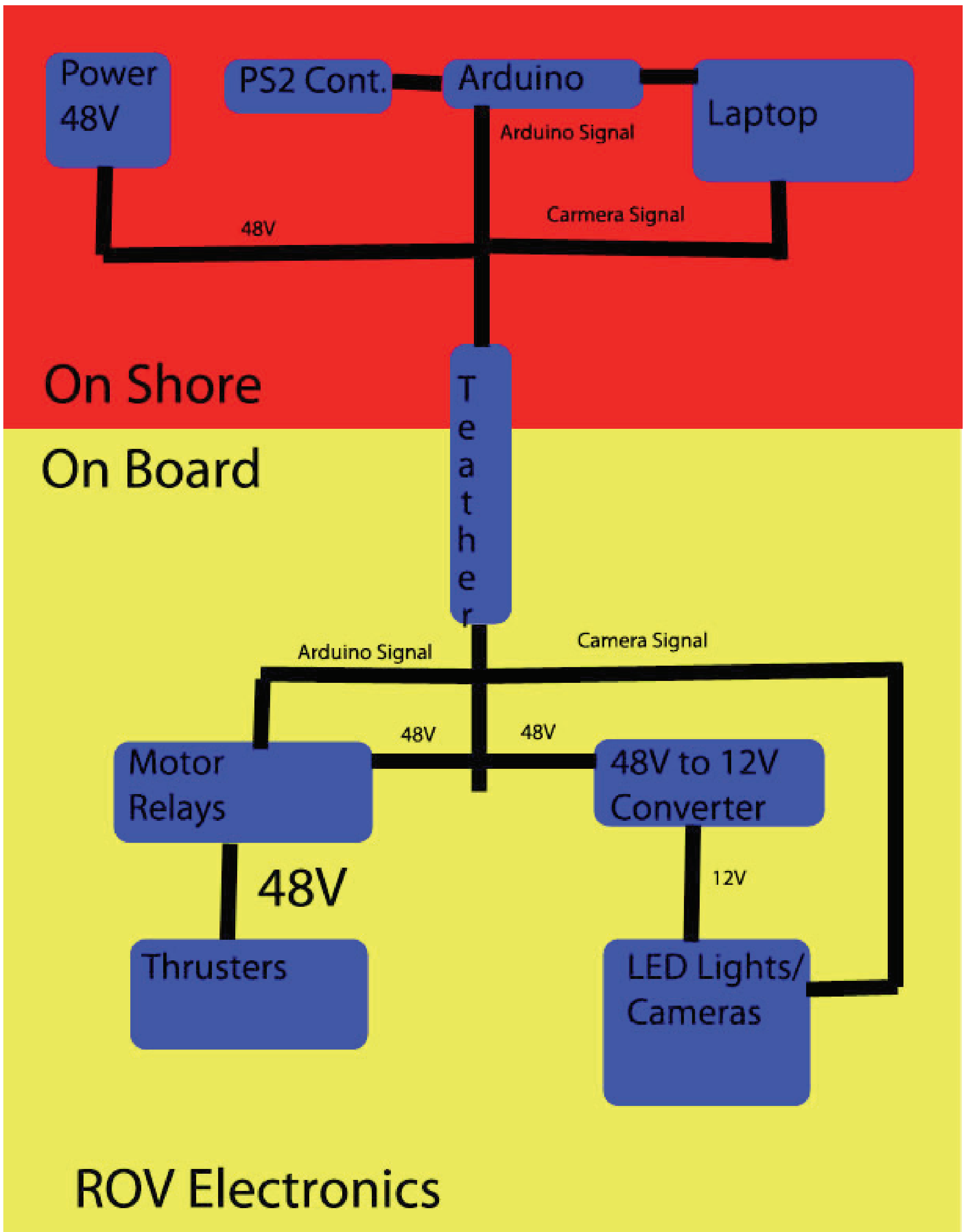
Tether- 1211 Neutral buoyant
Length- 20m

The tether was used for both regionals and national competiotion. There are two tethers in the setup. One tether controls video and the other controls thrusters and manipulator.

This tether was supplied by Erick Schneider a ROV team member. 2 tethers were used one to supply a signal from the control box to 6 relays to a voltage regulator then to the 5 motors. The other tether was used for the cameras to supply power.

CONTROL SYSTEMS

The tentitive plan is to use a Playstation 2 controller to control the ROV trusters and manipulator. It will communicate with a arduino and send signals to the appropiate component to accomplish a given task.

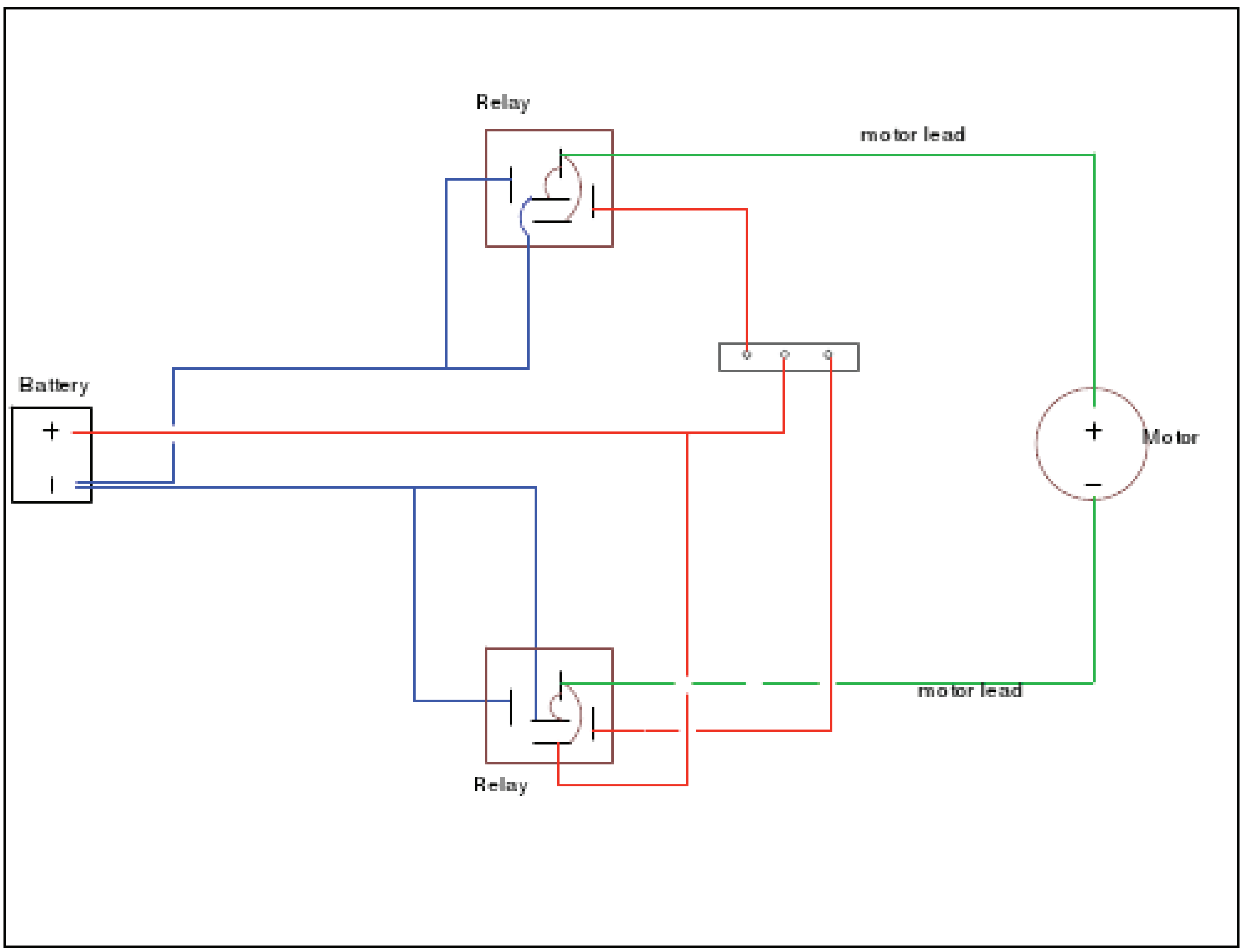


Software Flowchart for the Control System

ELECTRICAL SYSTEMS

The ROV's electrical system is simple and straight forward we take 48 volts form on shore and send it thought the tether to a voltage regulator which then converts the 48 volts to 12 volts. 12 volt power is supplied to the cameras and the manipulator while 48 volts supplies power to the electric motors that run thrusters.

The diagram here shows frm the switch in the control box to the battery, down to the relays, and to the motors.



Electrical Schematics

MISSION TASKS

The plans for payload tools is still under development. However, here are our ideas concering the mission tasks

Task 1: Survey the wreck site

i.Overall length

Using parallax to judge the distance from one pole to the next (the length of the ship)

ii.Determine orientation of the shipwreck on the seafloor

Compass positioned next to the claw in view of the camera

iii.Determine whether or not objects in the debris field are metal or not, hence part of the shipwreck

Magnet on a pivot will be used to detect ferrous materials.

iv.Make a map of the wreckage site

The team will draw map from the information they gather surveying the site.

v. Scan the shipwreck with sonar

Using our precision motor control system via pulse width modulation and vector motor placement we hope to be able to hold the ROV steady for the 10 seconds required to scan the ship.

Task 2: Removing oil from shipwreck

i.Transporting and attaching a lift bag to a fallen mast.

Claw will be the tool used to transport the lift bag provided by MATE to the mast

ii.Inflating the lift bag and removing the fallen mast from the worksite.

Air will be pumped into the lift bag from shore. Once the mast has been lifted, we can move it to a safe location.

iii.Removing endangered encrusting coral from the ship's hull

Pulse width modulation may be used to gentaly lift the coral and place it in a safe location.

iv.Transplanting the coral.

Using the propulsion system and manipulator we can deposit coarl in a safe loaction

v. Using two simulated sensors, determine if fuel oil remains inside the fuel tank.
Under development

vi.Simulation drilling two holes into the hull and underlying fuel tank by penetrating a layer of petroleum jelly.
We will use the claw to place “drilling” apparatus to pipe that will contain the “oil.”

vii.Removing fuel oil from within the tank and replacing it with simulated seawater.
Will use apparatus to inject seawater from a tank on ground which will push out “oil” into another tank on ground.

viii.Resealing the drill holes with a simulated magnetic patch.
We will use the claw to stick velcro drill holes.

CHALLENGES WE OVERCAME

Unfortunately we decided to scrape the original ROV that we used for Regionals and entierly redesigned it from the frame up. This caused a huge challenge for the technical report. Because many of the payload systems were not developed at the time the document was written, the report had to be a compilation of the regional ROV, the beginning stages of the new ROV, and what was expected to be developed in the future. The arduino programming proved to be a work in progress as well. This meant that most of the payload systems would be developed twice. One based on an arduino communications system and another based on a hardware approach. Even these systems have yet to be developed fully. The challenge of compiling information on systems that used to be, systems that are, and systems that will maybe be, was quite difficult. Organizing all of it into a professional and concise document was even harder.

To overcome these challenges we seperated the pre-regionals and post-regionals ROV specs. The information was scattered quite a bit so we had to do some research on the previous ROV as it had been mainly bulit from last years parts. Also researching the potential components

TROUBLESHOOTING TECHNIQUES

My trouble shooting technique was mostly involved with the electronic side of the ROV, and my approach from the beginning was to take all of the different parts of the circuitry and isolate them to their smallest possible parts then to try and get each and every one of those working on their own before then attempting to combine them into the full ROV. I did encounter some interesting problems when I did incorporate the full circuit, such as a residual current traveling to the motors after they where activated resulting in "powering down" of the motors before they stopped, which is of course was a problem that would cause the ROV to continue propelling itself after pressure was released from the controller. This particular problem I found to be irreconcilable and the design had to be scraped, however there were many instances of "flipping the switch" and having absolutely nothing happen. I found the best way to deal with these situations was to hook up a voltmeter and start from the source of the signal and then trace my way through the circuit till I found the disconnect. If all else failed we just began to systematically replace all of the parts until we found the problem.

-Wade Padgett

LESSON LEARNED/SKILLS GAINED

Arduino/Programming-

I decided to take on the project of the arduino early on [as] it had what was initially a steep learning curve for one with no background in electronics or programming, so the arduino was where the majority of my effort and learning took place. After this last year I feel that I have at least some mastery over programming and wiring, although I will perhaps allow myself a greater amount of time per week to work on the task in the future. I learned a great deal about the mechanics of underwater electronics and engineering as well; from buoyancy issues, to keeping an object level underwater, to sealing an electronics compartments, and propulsion in a dense marine environment. The ROV has proven to be a challenging and enlightening project that has left me with respect for the engineering prowess of today's human minds.

-Wade Padgett

Team Skills-

As a whole team CCC learned the value of a team effort. If each team member did not put the effort and time needed into this project we could not have accomplished so much. Everyday was a learning expereince; each problem to overcome was a goal to work toward. Some of us had to learn how to reliquish control while others had to learn to take control. The group dynamics involved could be quite overwhelming sometimes but through preserverence we managed to come together and make it through.

FUTURE IMPROVEMENT

Propulsion-

We would like to add Pulse Width Modulation to the motors in order to gain variable speed control. All that would be required would be to take the analog inputs from the playstation controller's joysticks and code the arduino to turn that into a pulse width signal to a switch capable of flipping on and off at high speed that would complete the circuit to the motors varying their speed.

Another addition would be to include a vector motor layout for vertical movent. This would increase the degree of movement for the ROV. We could gain forward/backward yaw and left/right roll. This coupled with Pulse Width Modulation would improve the ROV's mobility emencely.

Organization and Collaboration-

Organization is the key to any success. We need to archive our information so that we have refrences to our own material when troubleshooting as well as we can more easily design the technical report. Breaking down into smaller teams is advatages, however, keeping ideas and communication organized better could have reduced the discontinuites of the project. We need to remember we are a team; not just one person can be an expert in all things.

REFLECTIONS ON THE EXPERIENCE

This may go without saying but building a working ROV is pretty awesome. This has been the single most difficult creative engineering challenge we have ever undertaken and to be accepted into an international competition against schools from all over the world has us all feel very nervous but acomplished. However, given our modest budget I think we are very confident in our design.

BUDGET AND FINANCIAL STATEMENT

Expenditures (Materials)

Item	Quantity	Unit Price	Total
Propellers	7	$48.50	$339.50
Hook-Up Wire	1	$39.00	$39.00
32 Volt Motor	6	$122.00	$732.00
Power Line Modem	1	$180.00	$180.00
Underwater Robotics Text	1	$116.00	$116.00
Potting Compound	2	$40.00	$80.00
Arduino	3	$56.00	$168.00
Propeller Circuit Board	1	$105.60	$105.60
Video Camera	3	$49.00	$147.00
Video Monitor	1	$100.00	$100.00
Fuses	3	$3.06	$9.18
Wire	6	$3.19	$19.14
Cable Ties	2	$12.99	$25.98
Paint	2	$4.99	$9.98
Bolts	12	$0.24	$2.88
Heat Shrink	3	$2.65	$7.95
Electrical Solder	2	$13.99	$27.98
Butane Iron	1	$22.99	$22.99
Wi II accessary	1	$19.99	$19.99
Clamps	6	$1.85	$11.10
Diodes	15	$0.55	$8.25
Relay	1	$8.99	$8.99
Umbilical Cable Shipping	1	$55.00	$55.00
PVC Parts	29	$0.75	$21.75
		Total Expenditures (Materials)	**$2,258.26**

BUDGET AND FINANCIAL STATEMENT

Anticipated Expenditures (Non-material)

Item	Quantity	Unit Price	Total
Mileage (per mile)	658	$0.58	$381.64
Airfare	3	$582.00	$1,746.00
Lodging (per night)	10	$72.00	$720.00
Taxi	2	$45.00	$90.00
Airport Parking (per day)	4	$20.00	$80.00
Excess Baggage (per bag)	4	$25.00	$100.00
		Total Expenditures (Non-material)	**$3,117.64**

Total Expenditures	**$5,375.90**

Donations (Materials)

Item	Source	Quantity	Est Value
Umbilical Cable	Video Ray	2	$900.00
Arduino	Schneider	1	$37.00
Triple Axis Accelerometer	Schneider	1	$19.00
Breakout Board	Schneider	1	$35.00
9 Degrees of Freedom	Schneider	1	$105.00
Triple Axis & Gyro	Schneider	1	$16.00
Easycap Audio Video Capture Adaptor	Schneider	1	$9.00
Mygica EZgrabber	Schneider	1	$35.00
EasyCap 4 channel USB DVR	Schneider	1	$9.00
		Total Donations (Materials)	$1,550.00

Income

Source	Amount
Annabel Myers (Cash Donation)	$400.00
Barbara Wilson (Cash Donation)	$100.00
Rochester Trust	$2,500.00
CCC Physical Science Instructional Supply	$50.00
Home Depot	$50.00
CCC Clubs & Organization Fund	$500.00
Total	$3,600.00

ACKNOWLEDGEMENT

We are very appreciative and share our gratitude for guidance from our beloved mentors Pat Keefe, Julie Brown and Cindy Moore who continually inspire and bring the bright light of education. We would like to give heartfelt thanks to those in the community, who during tough times opened their pocket books to help fuel the fire of education. Thanks to Annabel Meyers, Barbara Wilson, Rochester Trust, Clatsop Community College Physical Science Instructional Supply fund, Clatsop Community College Clubs and Organization Fund and our local Home Depot, Warrenton, Oregon. We would also like to give great thanks to our dear friend and fellow student who left us to do what this competition is all about, Erick Schneider.

REFERENCES

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-http://www.billporter.info/playstation-2-controller-arduino-library-v1-0/

People
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-Pat Keefe
-Julie Brown
-Cindy Moore

Books
-Arduino CookBook
Underwater Robotics - Steven Moore, Harry Bohm, Vickie Jensen
-2010 Marine Advanced Technology Education (MATE) Center