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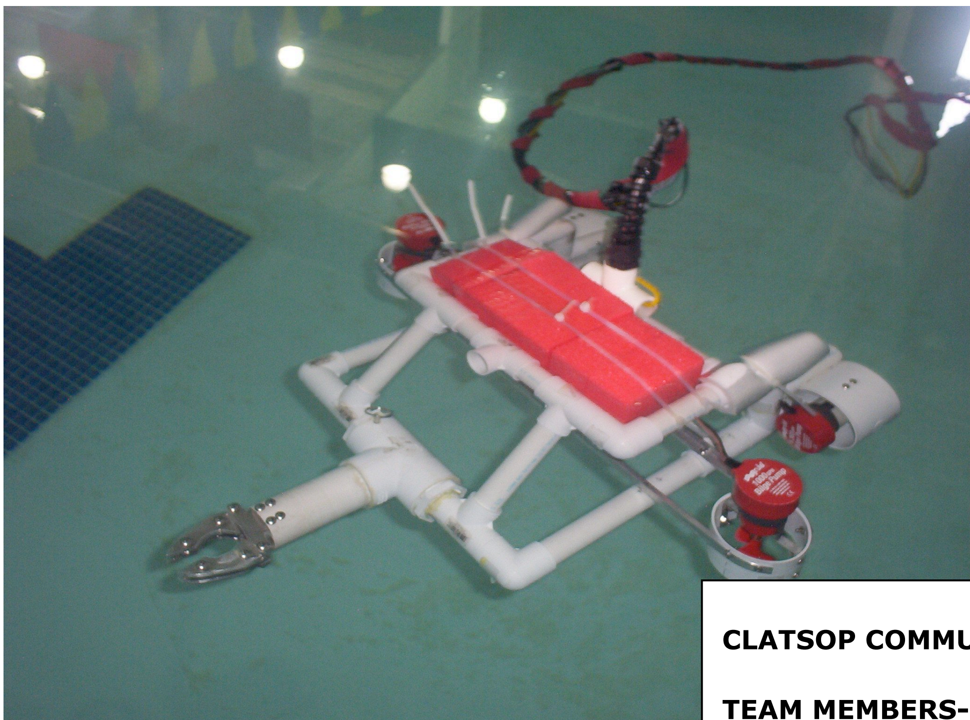
# CCC ROV PROJECT

*Developing Dynamic Aquatic Solutions for the Future*



**CLATSOP COMMUNITY COLLEGE ROV CLUB**

**TEAM MEMBERS-**

- ROV Engineering
  - Jonathan Michalsky
  - Rachel Steiner
  - Phillip Russell
- Technical Report
  - Kim Muessing
  - Melody Harrison-Wooton
  - Crystal Chandler
  - Kellan Frank
  - Jarrod Jackson

**TEAM INSTRUCTORS-**

Pat Keefe – Physical Sciences Department

Dr. Julie Brown – English Department

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# Clatsop Community College ROV Squad


**ABSTRACT**

Building a Remote Operated Vehicle (ROV) is a challenging and enriching process, providing the team members with experience in decision making, planning, and hands-on construction. The Clatsop Community College ROV Club carefully considered an array of ROV designs, with special regard to the two Mission Tasks in the 2006 MATE Center/MTS ROV Competition. After initially approaching the challenge with a two-ROV team, they eventually decided that one ROV was a more efficient solution.


**DESIGN RATIONALE**

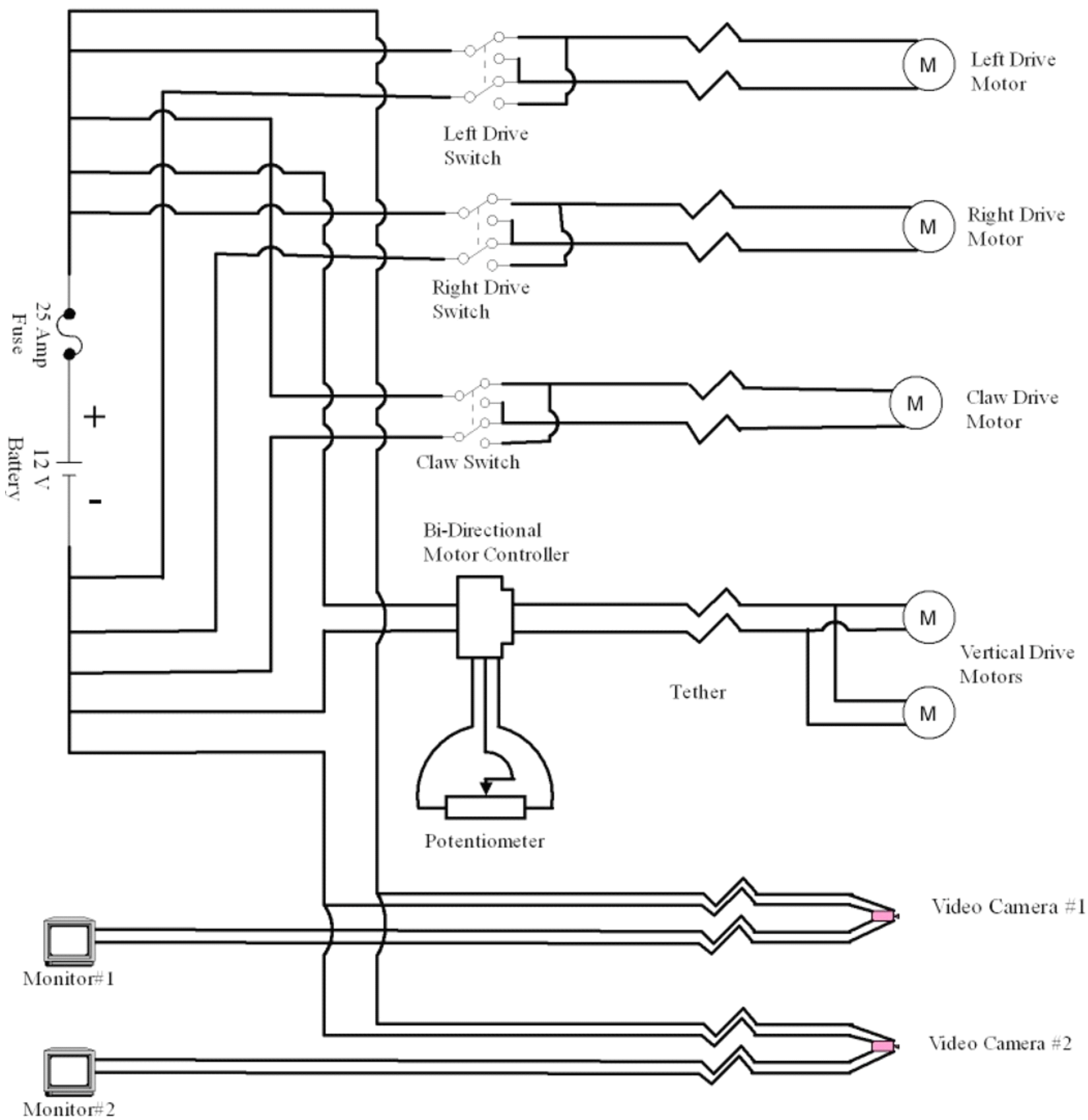
The design of the first ROV is fairly simple, and all the different design aspects were chosen to complete Task #1 - Complete the Central Node, based on the specific information provided by MATE. The second ROV was designed to perform Task #2 – Lay instrument cable through assigned waypoints and connect it to the central node. Later, when the decision was made to use the first ROV for both Task #1 and Task #2, it was augmented with more powerful motors and its design streamlined to handle more deftly in the test environment. Jonathan Michalsky was primarily responsible for its engineering.

The body is made of 1.9 cm PVC pipe, which is ideal for this venture because it is both lightweight and hollow (causing it to float), and because it is cost-effective. The original design included four 3785 LPH bilge pumps (two for vertical propulsion and two for horizontal propulsion) that were recycled from last year's ROV. After modification, the vertical bilge pumps were traded for 5678 LPH versions. These motors work in conjunction to maneuver the ROV through the water.

The bilge pumps are designed for aquatic use, negating the need for further waterproofing. At the very front of the ROV is a metal claw which will be used to grasp and hold the connecter until release. The 12v power supply for the ROV is delivered through an 25 meter tether and a 25 amp fuse is installed inline to protect its components from damage in the event of a short. A camera points directly at the claw arm to allow for precise insertion of the connector; a second camera is affixed to the underside of the ROV to assure a stable attachment to the module.

**ELECTRICAL SCHEMATIC**

When considering the many design possibilities for the CCC ROV project, 'simplicity' was the keyword. The ROV's propulsion is handled in 3 circuits: left drive, right drive, and vertical drive. Through this combination of controls, the ROV can be easily maneuvered in the test environment. The right and left drives are operated independently by switches to rotate the ROV on its center axis and propel it forwards and backwards. A Bi-Directional Motor Controller varies the current being delivered to the vertical drive motors, determining the ROV's rate of ascension or descension. One circuit is dedicated to the claw drive motor, closing and opening it as necessary for the individual tasks. Two circuits are also used by the ROV's video cameras. All of these components are illustrated in the following schematic:



## CHALLENGES

The main challenge of the building and subsequent testing of the ROV was getting it to rise once it was attached to the module. To counteract this issue, more foam was added to give the ROV extra buoyancy. This worked well--however, when the time came for the ROV to once again submerge, the buoyancy made it impossible. It was decided that the vertical drive bilge pump motors needed to be replaced with larger, more powerful ones. This enabled the ROV to ascend and descend as needed in the water.

## TROUBLESHOOTING

Based on some of the troubles we encountered, we developed a general flowchart for the most common ROV errors. A flowchart like this is useful for efficient troubleshooting in the event that a complication arises again. Below is our present flowchart:

| **Symptom** | **Solution** | **Resolution** |
|---|---|---|
| ROV doesn’t float | Increase buoyancy by adding foam | Foam made the ROV more buoyant. |
| ROV won't submerge | Decrease buoyancy by removing foam | Removing foam decreased the buoyancy of the ROV. |
| Not enough power to manipulate the objects. | Install larger, more powerful motors | Larger motors increased the maneuverability of the ROV. |

*Table 1 Troubleshooting flowchart for ROV.*

## LESSONS/SKILLS/IMPROVEMENTS

In the process of creating the ROV, the CCC ROV Club gained many new skills and experiences. Mistakes were made, and, hopefully, learned from. In the future, these things will be taken into account:

- **Design**
  - A buoyancy issue can be resolved in many different ways, including, but not limited to:
    - Increased propulsion
    - Variation of flotation
    - Implementation of a ballast system
  - Concentration of available resources into one ROV unit is an efficient use of materials.
  - Inspection of the ROV for potential leakage is a worthwhile endeavor, as it can save time and preserve resources over the long run.
- **Teamwork**
  - Communication and cooperation are essential elements of an effective engineering project.
  - Collaboration on a project will often reveal engineering flaws or improvements which can be made in the earliest stages of production.

**CAREERS**

ROV's or (remotely operated vehicles) serve many purposes and are widely varied in their uses. From the undersea mapping of the ocean floor to rescue and salvage missions, ROV technology is versatile. ROVs have been used to examine the wreckage of ships lost at sea and have even been called upon by our military to examine ship hulls for repairs. The technology is always expanding as we find more and more tasks for them to perform. The companies who develop and explore the capabilities of the ROV make a significant contribution to society.

One company, called Phoenix International, offers a variety of services to the government, military, and commercial clients. Phoenix International has its own fleet of ROVs that it operates and maintains as well as a contract with the US Navy, for maintenance of their equipment. ROVs range from low horsepower models that are used primarily for inspection and observation to high horsepower models used in heavy work situations and potentially dangerous environments.

**The SMD Nereus II** (pictured right), is a 400 horsepower "heavy work" ROV. Its capabilities include: submarine cable and pipeline detection as well as tracking, burial, and excavation.

**The Ramora** (left) is a 25 horse-power ROV outfitted with very sophisticated high definition video and HMI lighting systems. The Remora operates at depths of up to 6000 MSW. It uses dual manipulators and can be quickly deployed from a vessel. Its uses include sampling and forensic studies of sunken ships, aircraft and submarines. It is also a primary support tool in Phoenix's recovery of objects at large depths (pictured right).

*Salvage operation*

VideoRay is another company that uses ROV technology. Using the latest in video and fiber optics, VideoRay allows anyone to explore and view different ocean habitats from a safe distance. VideoRay provides a range of equipment for every budget and purpose, from fishermen to educators--as well as search and rescue teams. With its lightweight and unmanned capabilities, VideoRay ROVs are ideal for salvaging missions and underwater investigations.

**BUDGET/EXPENSE**

Throughout the process of designing and building the ROV, the overall cost of the project was continually on the forefront. From the decision to use recycled materials from last year's ROV, to requesting donations and discounts from the local businesses, finances played a significant role in the final design. This reflects many of the real-life challenges faced by ROV manufacturers.

The overall budget for this year's ROV project is broken down into three sections:

A. Funds from businesses/organizations

B. Donated Materials

C. Expenditures

**A. FUNDING**

**Funds**

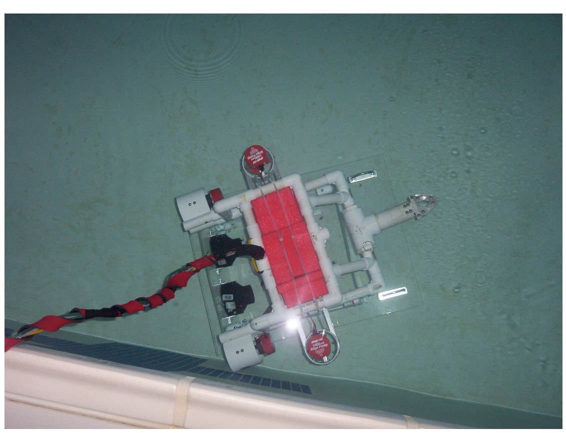
| Date | Account/Supplier | | Amount($) |
|---|---|---|---|
| 10/21/2005 | Carl Perkins Grant | | 453.13 |
| 11/18/2005 | Jenson Communication | | 500 |
| 2/1/2006 | Rochester Trust Fund | | 75 |
| 2/15/2006 | Physical Science Dept | | 150 |
| 4/28/2006 | Physical Science Dept | | 350.88 |
| 5/30/2006 | Physical Science Dept | | 175.14 |
| | | TOTAL | 1704.15 |

**B. DONATED MATERIALS**

**Donated Materials**

| Date | Item | Supplier | QTY |
|---|---|---|---|
| 2/3/2006 | Wire 152 m 18 Gauge | Joe Arnold | 1 |
| 2/3/2006 | Wire 152 m 16 Gauge | Joe Arnold | 1 |
| 2/10/2006 | Electric Motor | Michalsky | 2 |
| 2/10/2006 | Stainless Steel Screws | Michalsky | 25 |

CCC ROV test run 5-15-2006



## C. EXPENDITURES

**Expenditures**

| Date | Item | Supplier | Qty | Price($) | Total($) |
|---|---|---|---|---|---|
| 10/2/2005 | Demo Tank | Englund Marine * | 1 | 120 | 120 |
| 10/2/2005 | Tool Kit | Englund Marine * | 1 | 40 | 40 |
| 10/5/2005 | Electronic Switches | Astoria Electronic | 12 | 2.99 | 35.88 |
| 10/14/2005 | Wire | Englund Marine * | 1 | 64 | 64 |
| 10/14/2005 | Plastic Pipe | Astoria Builders Supply | 2 | 6 | 12 |
| 10/14/2005 | Plastic Fittings | Astoria Builders Supply | 50 | 0.56 | 28 |
| 10/14/2005 | Motors | Englund Marine * | 5 | 26 | 130 |
| 10/14/2005 | Variety Of Propellers | A-Train Hobby | 15 | 1.75 | 26.25 |
| 11/4/2005 | Posters | CCC Copy Center | 35 | 0.22 | 7.84 |
| 2/1/2006 | Vantec Speed Control | Vantec | 1 | 75 | 75 |
| 2/15/2006 | Vantec Speed Control | Vantec | 2 | 75 | 150 |
| 2/15/2006 | Acs Servo Control | Vantec | 1 | 35 | 35 |
| 2/16/2006 | Prop Shaft | Englund Marine * | 4 | 6 | 24 |
| 2/22/2006 | 10.16 cm Pvc Pipe | Astoria Builders Supply | 1 | 15 | 15 |
| 2/22/2006 | 7.62 cm Pvc Pipe | Astoria Builders Supply | 1 | 7 | 7 |
| 2/22/2006 | Corner Fittings | Astoria Builders Supply | 15 | 1 | 15 |
| 2/22/2006 | Misc Pvc Fittings | Astoria Builders Supply | 1 | 15 | 15 |
| 2/22/2006 | 7.62 cm Pvc End Caps | Astoria Builders Supply | 4 | 3 | 12 |
| 4/10/2006 | Gasket Sealant | Astoria Builders Supply | 2 | 5 | 10 |
| 4/11/2006 | Wire Fittings | Astoria Builders Supply | 2 | 5 | 10 |
| 4/12/2006 | Planetary Gearbox | Astoria Builders Supply | 2 | 19.95 | 39.9 |
| 4/13/2006 | Plexiglas Sheeting 76 cm X 50.8 cm | Astoria Builders Supply | 1 | 5.99 | 5.99 |
| 4/14/2006 | Plexiglas Sheeting 50.8 cmX60.9 cm | Astoria Builders Supply | 1 | 6.99 | 6.99 |
| 4/15/2006 | Angle Aluminum 1.9 cm X 1.9 cm X 2.4 m | Astoria Builders Supply | 1 | 5 | 5 |
| 5/3/2006 | CCD Camera B&W | Palm Video | 3 | 58.38 | 175.14 |
| 5/5/2006 | Airfare | Travelocity | 3 | 351.01 | 1053.03 |
| 5/25/2006 | Airfare | Yahoo Travel | 1 | 556.02 | 556.02 |
| | | | | TOTAL | 2674.04 |

* 30% Discount

## ACKNOWLEDGEMENTS

We would like to thank the following patrons and businesses:

- Clatsop Community College Physical Science Department
    - Our faculty advisor's wisdom and guidance was a light in the darkest moments of this project.
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- Joe Arnold
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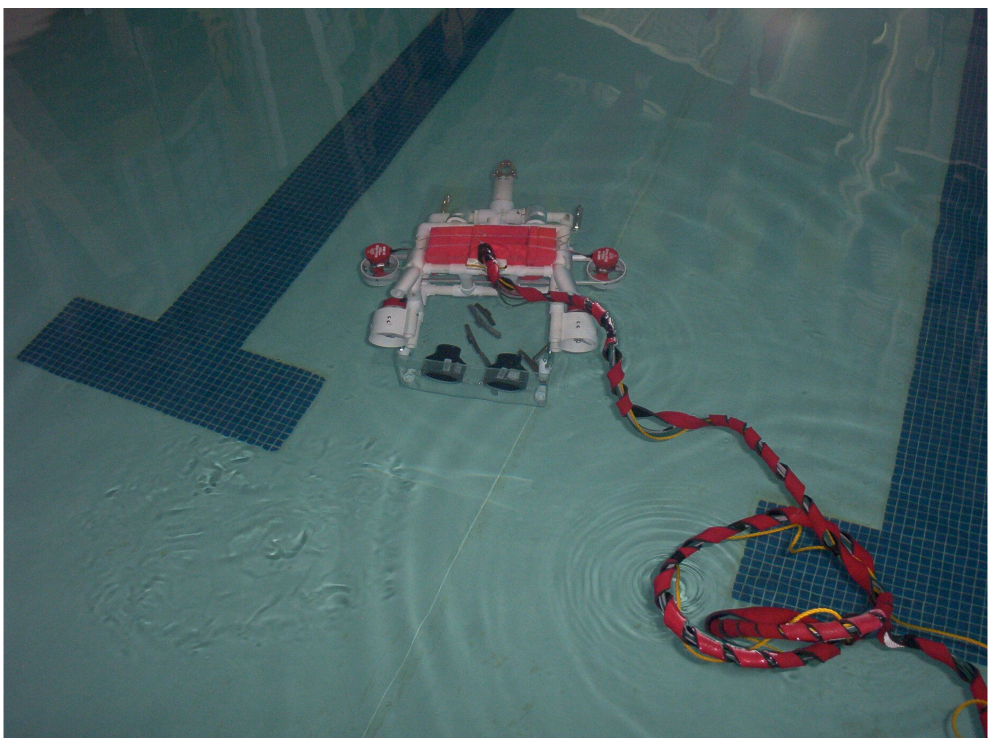
- Englund Marine and Industrial Supply
    - For providing parts at discounted prices.
- City of Astoria Aquatic Center
    - For allowing the use of their facility.
- Our illustrious technical report writing task force
    - And their visionary leader, Dr. Julie Brown, PhD.

Buoyancy Test 5-25-2006