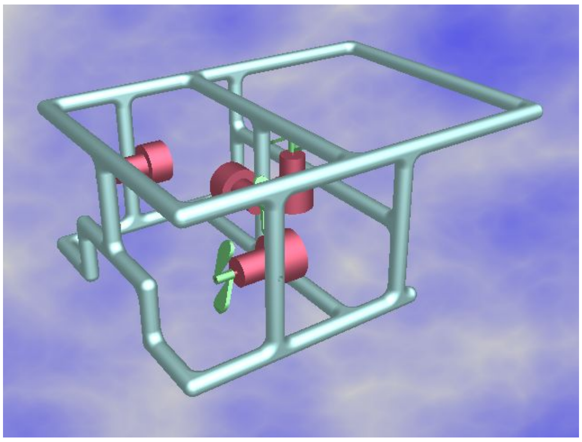
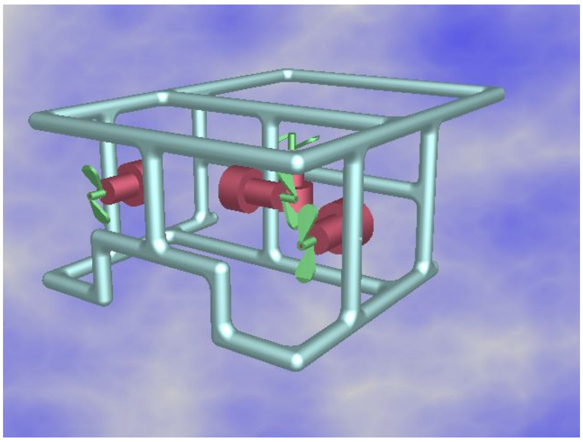
2007 MATE Center/MTS ROV Committee ROV Competition

Technical Report

Wesley 1





The Methodist Church Hong Kong Wesley College

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Instructors:

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Abstracts:

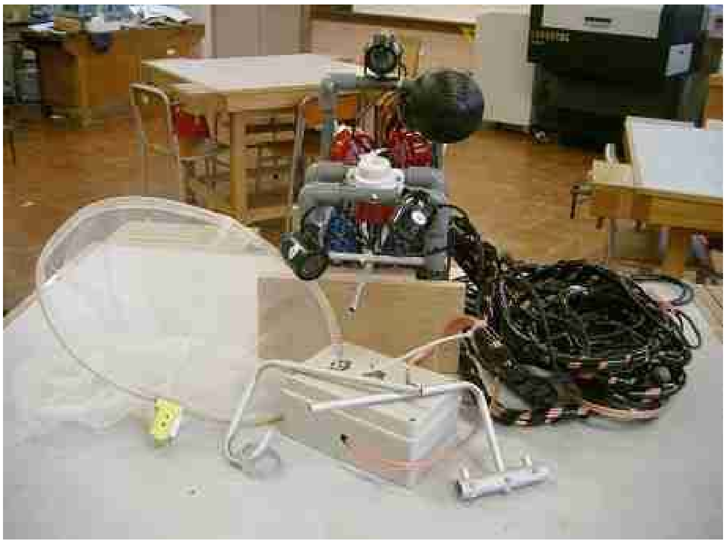
We have designed and built an underwater robot that can operate with four cameras in three different environments: a flume tank, an ice tank and a tow tank. We will finish different tasks in different environments.

We will have mission 1 in the flume tank; we will thread a messenger line through the buoy's anchor ring and return it to the surface. In this scenario, the messenger line serves as the mechanism to thread other, heavier lines through the anchor ring. Eventually a line capable of lifting the anchor and mooring chain will be threaded through the ring, allowing the anchor and chain to be retrieved to the surface.

In mission 2, we will collect ONE jellyfish (an O-ball) from the bottom of the ice tank and return it to the surface. Then, we will collect ONE sample of algae (a ping pong) from under the ice sheet. Finally, we will deploy a PAS with its attached communication cable within a designated area at the bottom of the ice tank.

In mission 3, we will install a gasket in the wellhead in the tow tank. This seal will help to ensure a good connection between the wellhead and the Christmas tree. Once the wellhead's protective cover has been replaced, we will inject corrosion prohibiter (to protect the gasket and the wellhead) into the wellhead using a hot stab. A hot stab is a tool used to transfer fluid to another tool or piece of subsea equipment.

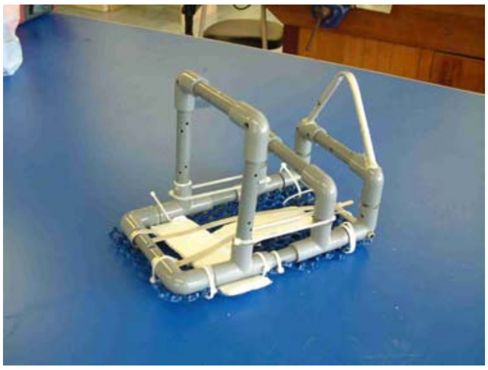
Proposed solution:



Testing and Modifications:

1. Size of ROV

- It is difficult to control the ROV, the ROV is always tilted. So we separate the buoys to stabilize the ROV. We find that it is useful.
- It is difficult to complete the missions. We find that the positions of cameras are very important. So we enlarge the size of ROV.



2. Position and power of Motor

- The positions of motors are also important. It will influence the movement of ROV.
- When we change the positions of motor, the floating power is also affected.
- When we tested the ROV, the wires were too heavy. We have added some foam board to raise them up.
- When we tested the ROV in the sea, the floating power was different. So we have prepared different sizes of buoys and foam board.

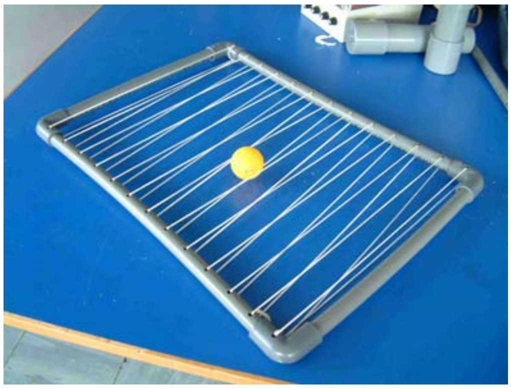
3. Control system

- It is difficult to keep the ROV in different depth, so we use the bi-directional DC motor speed controller.
- When we tested the ROV, we found that ROV would pass through the target easily, so we have added one more motor to drive the ROV horizontally.
- Although we use the night-vision Cameras, it is still very dark under the sea. We add two torches to light up the environment.

4. Troubleshooting

- For mission 1, we used the spring to release the wire. But we find that it was not useful. We change the idea by using the clamp to hold and release the wire.

- For mission 2, we used the fishing net to collect the algae. But we find that it was difficult to use. We change the design.



Final solution:

ROV Specifications:

1. Size: 60 cm (L) x 38 cm (W) x 24 cm (H)
2. ROV: Operated at 12V D.C. and 25 amps. The system must be connected in series to a single fuse.
3. Sensor: Four night-vision Cameras with waterproofed.

Frame

We have chosen PVC as the material for the frame of Wesley 1. It is because of cost effectiveness and the availability of the material. There are different types and configurations of connectors to make our design flexible.

PROPULSION

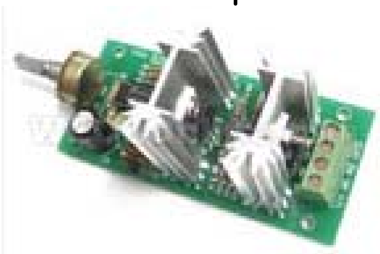
Our propulsion system is comprised of four bilge pumps with plastic 5 cm two-blade propeller. For the left and right motors we have chosen bilge pumps that are rated 1892 litres per hour. Because of our design of the ROV, these two motors are able to create enough thrust to move the ROV forward and backward efficiently.

The other bilge pumps are rated to move 3784 litres per hour and are used for vertical propulsion. These motors, with the aide of the buoyancy system, create enough thrust to move the ROV vertically under different loads required throughout the competition tasks.

Control system:

Bi-direction DC motor speed controller:

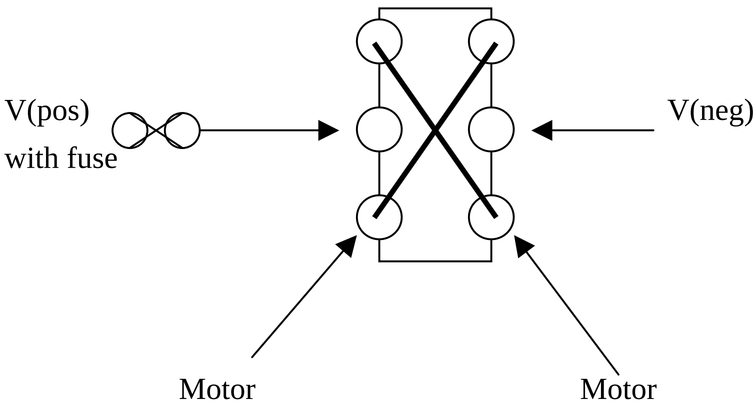
We use the electronic circuit for controlling the speed of motor. Then the ROV can be driven in different depth stability.

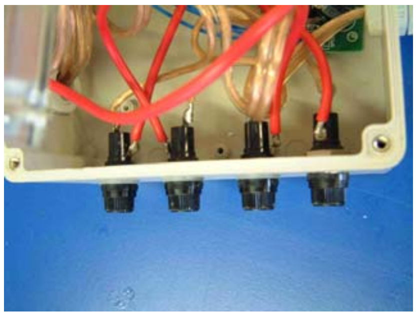


Safety:

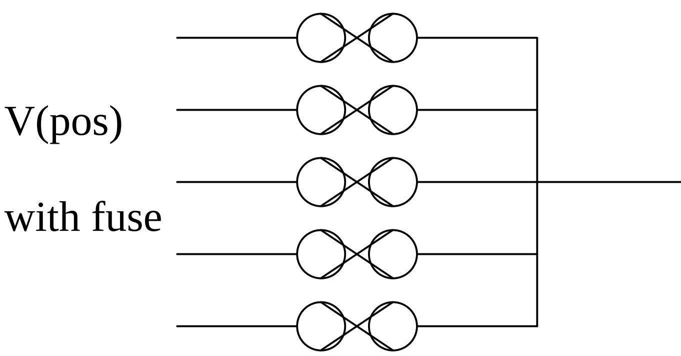
Each circuit includes fuse to prevent current overflow.

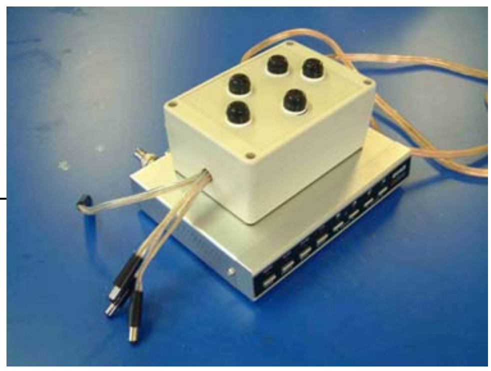
Connection of each switch with fuse:





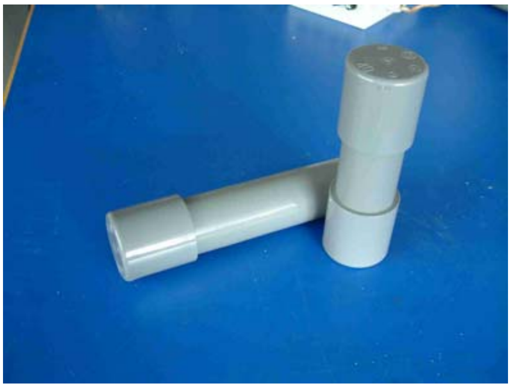
Connection of each camera:





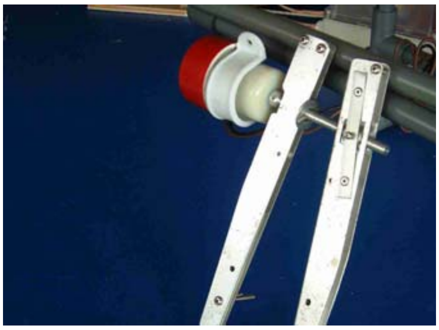
Buoyancy

We prepare different sizes of buoy for balance in different loads required throughout the competition tasks.



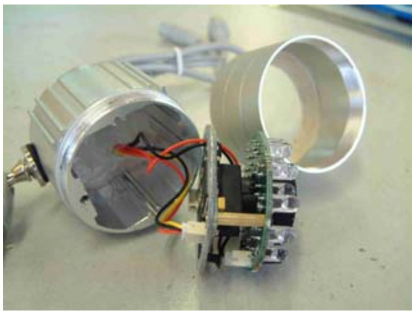
Clamp

A bilge pump is attached to an 8 mm threaded rod. When power is applied to the bilge pump in the forward direction, the arm opens; when power is applied in reverse, the arm closes.



Water-proofed Cameras:

Smear the silicon Sanitary Sealant over each joint to prevent the water from going inside.



Troubleshooting Techniques:

Mission 1: FLUME TANK

Ocean observing in polar seas: The SmartBay Project in Placentia Bay

The mission task involves:

- Transporting the messenger line to the buoy anchor.
- Threading the messenger line through the buoy anchor ring.
- Returning the messenger line to the surface.

Use the clamp to hold the line and transport it to the anchor.

Release the line by opening the clamp.

Use the hook(under the clamp) to take the line back to the surface.

Mission 2: ICE TANK

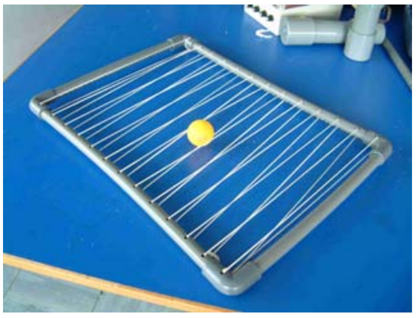
Science & technology under the ice: NOAA's "Hidden Ocean" arctic expedition

The mission task involve:

- Collecting and returning one benthic jellyfish to the surface.
- Collecting and returning one sample of algae to the surface.
- Transporting and deploying the PAS within the designated area.

Use the hook to collect the jellyfish.

Use the net to collect the algae.



Use the clamp to transport the PAS.

Mission 3: OFFSHORE ENGINEERING BASIN

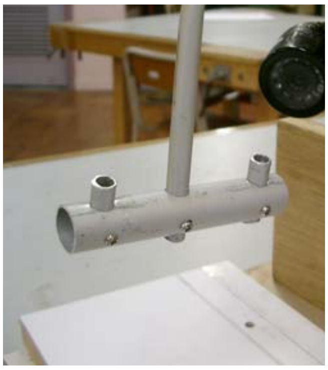
Oil & gas exploration and production in the North Atlantic: Hibernia platform

The mission task involves:

- Transporting the gasket to the wellhead.
- Removing the wellhead's protective cover.
- Installing the gasket into the wellhead.
- Replacing the wellheads' protective cover.
- Transporting the hot stab to the wellhead.
- Inserting the hot stab to the wellhead.
- Removing the hot stab from the port on the wellhead.
- Returning the hot stab to the surface.

Use the clamp to transport the gasket.

Use the hook to remove the wellhead.



Use the clamp to transport, insert and remove the hot stab.

Budget:

ROV		
Material	Quantity	Costs
PVC (dia. 9mm)	8 metres	HK$108
L – Joints	20	HK$40
T – Joints	18	HK$72
PVC(dia. 40cm)	1.5 metres	HK$32
Tube Cover	4	HK$17.2
Glue	1	HK$8
Motors(500GPH)	4	HK$800
Motor(1100GPH)	1	HK$250
Wires	57 metres	HK$399
Wires	15 metres	HK$150
Wires	15 metres	HK$100
Wires	1.5 metres	HK$6
Wires	1.5 metres	HK$8
Waterproof Box	1	HK$77
Fuse and fuse holder	5	HK$17.5
Switch	4	HK$60
Switch cover	1	HK$4.5
DC Motor controller	1	HK$108
Nylon Water Screws	4	HK$36
Waterproof Torch	2	HK$290
Terminal	52	HK$26
Badge	100	HK$25
Spiral Wrappings	1	HK$55
Magnet	1	HK$19
DC Plug	6	HK$12
	Total	HK$1908.2

Tools		
Material	Quantity	Costs
Aluminium Tube	1	HK$20
Screw and nut	20	HK$48
Net	30 Yards	HK$30
Rsfr Tube	2	HK$15
	Total	HK$113

Camera		
Material	Quantity	Costs
Camera	4	HK$1120
Wires for camera	4	HK$240
Silicon cement	2	HK$120
Colour Quad processor	1	HK$300
Box	1	HK$28
Fuse and Fuse holder	5	HK$27.5
	Total	HK$1835.5

Future improvement

For mission 2:
We do not have any working experiences in cold environment. We do not know whether the camera can work or not. The water vapour may be condensed on the glass. Moreover the electronic equipment may be destroyed. So we may need to keep the camera warm.

Description of a historical aspect of human life at the poles

What is IPY?

The International Polar Year is a large scientific programme focused on the Arctic and the Antarctic from March 2007 to March 2009.

IPY, organized through the International Council for Science (ICSU) and the World Meteorological Organization (WMO), is actually the fourth polar year, following those in 1882-3, 1932-3, and 1957-8. In order to have full and equal coverage of both the Arctic and the Antarctic, IPY 2007-8 covers two full annual cycles from March 2007 to March 2009 and will involve over 200 projects, with thousands of

scientists from over 60 nations examining a wide range of physical, biological and social research topics.

Life and work at the pole:

The South Pole is at an elevation of 9,450 feet above sea level and about 9,000 feet of this is ice. Average monthly temperatures range from minus 18 degrees Fahrenheit in January, the middle of summer, and minus 76 degrees F. in winter, in July.

The ice the Pole station sits on is moving about 30 feet a year, which means the station is slowly moving away from the actual Pole. Each New Year's Day scientists from the U.S. Geological Survey determine the actual position of the pole and put in a marker on top of a metal pole. Behind this is a sign noting the arrival of the first humans to arrive at the pole. Markers from previous years stretch away behind the sign. There is also a ceremonial pole, which is a glass ball on a pole surrounded by the flags of the nations that have signed the Antarctic treaty.

The Station is named after Roald Amundsen, the explorer who first reached the Pole in 1911 with four other Norwegians, and the British explorer Robert Falcon Scott, who reached the South Pole with four companions about a month later in January 1912. Amundsen and his party made it back, but Scott and his men died on the return trip.

The Pole interests scientists for several reasons. The clear, dry air allows infrared and microwave telescopes to detect radiation that does not make it through the atmosphere elsewhere on Earth. The National Oceanic and Atmospheric Administration's Clean Air Facility at the Pole monitors "the cleanest air in the world" to track natural and human-caused changes in gases such as carbon dioxide in the air. Instrument-equipped balloons launched at the South Pole supply key measurements of the amount of ozone in the stratosphere over Antarctica.

A polar home

The South Pole

Earth's cleanest air

Measuring Antarctic ozone

Reference(websites):

http://www.ipy.org/

http://www.us-ipy.go

http://www.usatoday.com/news/science/cold-science/life-work/south-pole-life.htm

http://home.kimo.com.tw/dna90219/1.htm

Reflections on the experience

It is a rare opportunity for us to learn how to build an underwater robot without any experience. It is really hard (especially for three girls). We went to the workshop in the City University of Hong Kong and learnt how to build the robot. At the beginning, we didn't have any confidence to finish it and even did not know how it worked. But it is very lucky that the teacher and the students in the City University of Hong Kong gave us a hand on it so that we could finish it at last. We found interest in building an underwater robot and decided to work on it that day.

While we were preparing for the competition, we faced many problems on building the robots. We discussed for many times on building this robot, such as the shape of the robot, the tools that we used in different tasks, how to control the floating power…Also, as we do not have a swimming pool in our school, we couldn't practise controlling the robot in water. We could just put the robot in a 1.5 m X 1.5 m pool to test it. We found it hard to control the robot.

Besides, we have heavy academic work in secondary six. We need to think about how to manage our time between building this robot and doing our schoolwork. Also, we need to communicate well with our parents as this competition is being held during examination. Fortunately, we did it well! We have learnt about team spirit and communicating with others to express our ideas during this competition.

Acknowledgements

We would like to thank the Electronic Department of City University of Hong Kong and the teachers of The MCHK Wesley College who give us much useful advice.

We thank you for the following sponsors who support our costs.

香港城市大學
City University of Hong Kong

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