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Wire Guided Underwater Vehicle (ROV)

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Abstract*: Underwater robotics projects offer an excellent medium for discovery based engineering and science learning. The challenge of building underwater robotic vehicles and manipulators engages and stimulates a very broad spectrum of engineering disciplines and scientific concepts. This paper describes the successful design and implementation wire guided remotely operated underwater vehicles (ROVs) with motorized grabbers. These projects help to expose practical design, foster creative problem solving skills and may aid retention on engineering programs. Ongoing work is described to extend these projects to include computer control and sensory feedback, to develop autonomous underwater vehicles (AUVs). Further, ongoing work is outlined to assess the effectiveness of these modules. These robots are tethered by a series of wires that send signals between the operator and the ROV. All ROVs are equipped with a video camera, propulsion system, and lights. Other equipment is added depending on the specifications required. These include a manipulator arm, water sampler, instruments that measure clarity, light penetration, temperature, and depth.

***Keywords*: Robotics, Manipulators, Grabbers, Propulsion System, Light Penetration.**

1. INTRODUCTION

This paper describes an ongoing effort to develop a set of modules, which will work with fundamental engineering principles through the design, construction, programming, and testing of underwater robotic vehicles using simple materials. These modules emphasize discovery based learning, creative problem solving, collaborative team work and provide hands on exposure to the iterative engineering design process. The paper provides an overview of the proposed module, presents the results of a pilot implementation with which, successfully constructed remotely operated underwater vehicles and discussed methodologies and its effectiveness of such modules might be assessed. A mechanical design project, creating stable vessels at near to neutral buoyancy. It has also investigated underwater propulsion by running a series of experiments to optimize thrust based on gearing and propeller design and to investigate ways of controlling vertical motion in the water. Future work will involve adding a variety of sensors and small microcomputers to the vehicles, eventually programming the machines to respond to sensor stimuli with intelligent motion. The ultimate design challenge will be to develop a vehicle which will perform simple, unaided, autonomous tasks. The use of various different kinds of control systems and programming languages are investigated. One may benefit from starting with simple control systems and accessible graphical programming languages before progressing to more sophisticated controllers and advanced syntactical languages.

1.1. Importance of Fabricating ROV

ROV can improve the following aspects:

- The efficiency and safety of marine operations
- National and homeland security
- Predictions of natural hazards and those effects
- Predictions of climate change
- Public health
- Protection and restoration of healthy ecosystems

• The sustainability of living resources.

The use of projects based on small robotic vehicles is now widespread in the engineering field, however, these are predominantly wheeled, terrestrial vehicles. Such projects often reduced to little more than exercises in applied programming, losing valuable opportunities to present substantial mechanical challenges or to incorporate real interdisciplinary engineering design. In contrast, the underwater environment presents unique design challenges and opportunities. The motion of an underwater vehicle, through a three dimensional space with six degrees of freedom, is more complex. Additional engineering issues include propulsion, drag, buoyancy, and stability. Practical construction problems include how to waterproof electrical components. The challenge of creating a robot which can be sent to explore a hostile and inaccessible environment.

1.2 Situation Focussed

In order to take any research and search operation in depth of the sea, it's difficult to undergo such a process in a day- to-day life. Cost for research studies will be extremely high and also in other felids like rescue and emergency management.

1.3 Effective Solution

Many marine studies are under taken to develop a compact ROV, in the same manner, a compact ROV has been designed and fabricated in all needs of above problem faced felids and it has been considered with cost on the mind, so it is cost effective and which can be used by all people who can able to control it. The use of all efficient and effective components in our ROV has developed its abilities to with stand pressure under the water and stability controls and many more advantages like underwater lighting and power consumptions.

1.4 Work Concept

This ROV can able to rescue the people from the deep holes and marine research studies can be carried out easily in all conditions and cost effective in nature. The main objective is to explore the nature resources under the sea and oceans. The same mechanism is followed on AUV it is similar but only the control system varies from wired to wireless. So, the project can be manufactured according to the work concept of our ROV.

2. DESIGN

The design of our ROV by keeping all sorts of problems and calculation analysis. Moreover, a compact and easily affordable ROV to all people, industrial applications are designed, research and studies. With help of 2D and 3D software, we have designed our ROV.

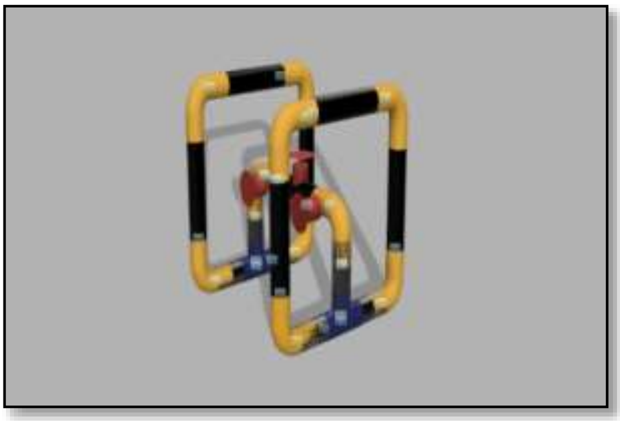

Fig-1: Design Of Remotely Operated Under Water Vehicle

3. CONSTRUCTION

3.1 Frame

Frame is the outer and skeleton part of the ROV, in which all other components are mounted on it, so it should with stand the force created, frame was usually designed by using fibre or high quality polymer glass plastics, in idea of cost reduction we have used PVC pipes as a base source for construction of frame. After several analysis and studies regarding the construction of frame and calculations, the frame has been constructed to the correct dimensions. The frame also encloses some amount of water in it's hallowed space, so two holes are drilled its adjacent frame pipes.

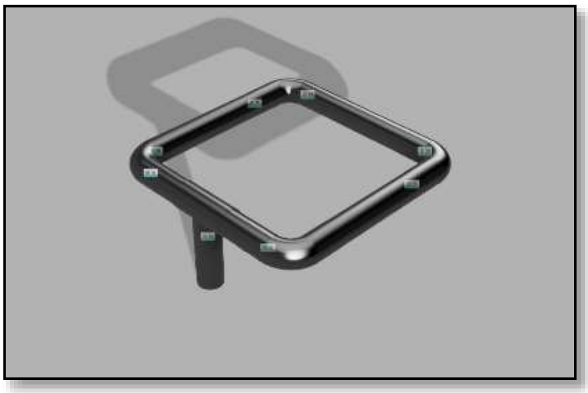

Fig-2: Remotely Operated Under Water Vehicle Frame

3.2 Fittings

3.2.1 Elbow

There are two exact frame at the each side which are facing opposite to each inorder to join the each single pipe pieces are joined in the bending by use of elbow, An elbow is installed between two lengths of pipe (or tubing) to allow a change of direction, usually a 90° or 45° angle; 22.5° elbows are also available. The ends may be machined for butt welding, threaded (usually female), or socketed. When the ends differ in size, it is known as a reducing (or reducer) elbow.A 90º elbow, also known as a "90 bend", "90 ell" or "quarter bend", attaches readily to plastic, copper, cast iron, steel, and lead, and is attached to rubber with stainless-steel clamps. Other available materials include silicone, rubber compounds, galvanized steel, and nylon. It is primarily used to connect hoses to valves, water pumps and deck drains. A 45º elbow, also known as a "45 bend" or "45 ell", is commonly used in water-supply facilities, food, chemical and electronic industrial pipeline networks, air-conditioning pipelines, agriculture and garden production, and solar-energy facility piping.

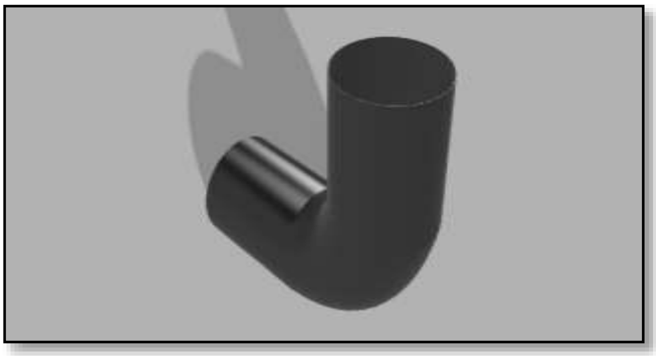

Fig-3 : Elbow

3.2.2 Tee-Joint

A tee, the most common pipe fitting, is used to combine (or divide) fluid flow. It is available with female thread sockets, solvent-weld sockets or opposed solvent-weld sockets and a female-threaded side outlet. Tees can connect pipes of different diameters or change the direction of a pipe run, or both. Available in a variety of materials, sizes and finishes, they may also be used to transport two-fluid mixtures. Tees may be equal or unequal in size of their three connections, with equal tees the most common.The joint used to connect the two opposite frame for using inter linking PVC pipe by using a two tee joint.

Fig- 4: Tee-Joint

3.3 Thruster
An underwater thruster is a configuration of marine propellers and hydraulic or electric motor built into, or mounted to an Underwater Robot as a propulsion device. These give the robot movement and maneuverability against sea water resistance. The main difference between underwater thrusters and marine thrusters is the ability to work under heavy water pressure, sometime up to full ocean depth. Underwater thrusters can be divided in two main groups, hydraulic thrusters and electric thrusters. Electric thrusters are mainly used on battery operated underwater robots such as AUVs, submarines and electric ROVs. Hydraulic thrusters are mainly used on work class hydraulic ROVs. Hydraulic thruster technology is older than the electrical one, they are more rugged and their weight to thrust ratio is higher than electric thrusters, but maintenance and piping issues cause some dissatisfaction with users. electric thrusters are becoming more popular in newly designed products. Weight to thrust ratios are higher for hydraulic thrusters than for electric thrusters, but after taking into account the required hydraulic components including valves, hydraulic power units, pipes joints, etc.

Fig-5: Thruster

3.4 Control Unit
The control unit consists of two parts,which are namely power part and the control part.In which each part will be having a separate function inorder to control over the vechile ,first power part consists of three switches that will be giving the power to the motor when they are in the closed path and the other part is control part which will be also having the same number of switches which are used to control the direction but these switches differrent from normal switches these control part switches are two way switches, mainly inoder to control the direction of the vechile ,we all know that the motor running direction will be depends on the power terminals and the direction of the current flows ,so the direction of the current will be used to control the direction of the vehicle.

3.5 Battery
We have used a 9volt battery to power up the vechile and there are three batteries for each and individual thruster , so that it won't affact the speed and torque of individual thrusters.

Fig-6: Battery

4. WORKING

The power from the battery unit is supplied to the three motors via control unit, for each motor individual power are supplied. For forwarding motion, the two forward motors are power in such a way that both will be rotating in the same direction and the same motors are given reverse current by using the control unit, while they are giving are reverse current they will be rotating in the same reverse direction are maintained. Here comes the major difficult in order to control the right and left direction, so indoor to control the left direction the right side motor power supply will be disconnected, so ROV will be easily turned towards the left. At the same time for the right turn, the motor at the left side will be disconnected from the power unit by means of the control unit. Then for the up and down motion, with the vertical axis reference, the motor is controlled by the control unit. For the downward motion a direction of current will be passed to the motor and for the opposite that's for upward motion the motor will be powered with the opposite direction current, so that the control will be fully achieved by the person who is using the ROV and these are the working operation of the remotely operated vehicle.

6. ADVANTAGES

- No time constraints. Depth range limited by length of umbilical but most models can access depths likely to be encountered in UK coastal waters
- Able to cover wide areas (relative to capacity of human divers)
- Mobility allows close-up examination of sea bed
- Give much information on sea bed topography and burrow types present
- Deployment areas less restricted than towed video. Can be used over mixed substrata or in areas with submarine obstructions
- Some models able to collect benthic samples
- Allows repeated monitoring of fixed study site.

7. DISADVANTAGES

- Equipment needs a hard boat to operate. May be unable to access very shallow waters or enclosed inlets.
- Equipment in ROV very expensive
- Precise quantification of sea bed features difficult due to changes in the field of view.
- Effectiveness can be limited by water turbidity (the ROV motors themselves may disturb the bottom sediments).
- Provide only limited information on smaller sediment fauna.
- A sampling of sea floor features is non-random.

8. APPLICATION

ROV is mainly used in:

- ➢ Military
- ➢ Commerical and
- ➢ Scientific needs

The other uses of the underwater vehicle are:

- ✓ It is mainly used for recovery purpose
- ✓ It plays a vital role in aquaculture
- ✓ Search, detection, and reconnaissance
- ✓ Underwater communications
- ✓ Sub-sea surveillance
- ✓ Self-defense of ships, subs, and harbors
- ✓ Engineering tasks; mine removal, construction port clearance/survey
- ✓ The Oil and Gas Industry is the biggest users
- ✓ Mining
- ✓ Work class ROVs are used to maintain wellheads and equipment
- ✓ Most search and recovery work is undertaken to locate and recover bodies, downed aircraft, sunken boats, valuable equipment, stolen property, or evidence of criminal activitiy.

CONCLUSION

Approximately360,000,000 km^2 (140,000,000 sq mi) saline water are covered and is customarily divided into several principal oceans and smaller seas, with the ocean covering approximately 71% of Earth's surface and 90% of the Earth's biosphere. The ocean contains 97% of Earth's water, and oceanographers have stated that less than 5% of the World Ocean has been explored.The total volume is approximately 1.35 billion cubic kilometers (320 million cu mi) with an average depth of nearly 3,700 meters (12,100 ft).The are many types of research and studies are under taken , and also many mining industries are in depends on the ROV for the extraction of ores from the sea bed , so this developed rov could befor the many areas.Although our ROV could not be used in more depth area like sea, oceans. We would help in the small areas of researches and studies.

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