

DEVELOPMENT OF PROTOTYPE REMOTELY OPERATED  
UNDERWATER VEHICLE

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“Dedicated, in thankful appreciation for support, encouragement and understandings to my beloved parent, Mr. Jamaluddin bin Ibrahim and Mrs. Robitah binti Sembin, my supervisor, Mr. Ahmad Nizam bin Jahari @ Johari, my siblings and all my friends.”

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## ABSTRACT

Nowadays, robots technologies have been developed rapidly in most countries. Robot is a device used to replace humans in doing tasks or work especially in hostile environment. Robotics are always related to automation which defined as the process of following a predetermined sequence of operations with little or no human intervention using specialized equipment and devices that control and perform the particular tasks. Nowadays, the underwater vehicle have become an important tool in underwater activities that can control by using the remote control. As a result Remotely Operated Vehicle has been developed in order to do underwater inspection with little or no human supervision. This development is very important in order to replace human to do tasks in a dangerous environment underwater. This development is very important in order to replace human to do tasks in a dangerous environment underwater. The objective of this project is to develop a Remotely Operated Underwater Vehicle (ROV). This ROV is as prototype that can move underwater and been controlled by a remote that was made using push button. With this prototype, the users can perform intelligence activities only by using the remote control and it is much easier. This report presents the development of ROV from mechanical design, electronic design and software implementation.

## ABSTRAK

Sejak kebelakangan ini, teknologi robotik telah dibangunkan dengan pesatnya di kebanyakan negara. Robot adalah suatu alat yang digunakan untuk menggantikan manusia dalam melakukan tugas atau kerja terutamanya di kawasan merbahaya. Robotik sering dikaitkan dengan automasi yang ditafsirkan sebagai proses atau operasi yang dilakukan tanpa atau sedikit penggunaan tenaga manusia. Ia lebih menggunakan peralatan khas untuk mengawal tugas-tugas tertentu. Pada masa kini, kenderaan bawah air telah menjadi alat penting dalam kegiatan dasar laut di mana ianya dapat dikawal dengan menggunakan alat kawalan jauh. Hasilnya ROV telah dibangunkan untuk menjalankan penerokaan dasar laut sama ada melibatkan manusia atau tidak. Hal ini amat penting untuk menggantikan fungsi manusia melakukan kerja yang amat merbahaya di dasar lautan. Pembangunan ini sangat penting dengan tujuan menggantikan manusia melakukan kerjakerja di persekitaran yang merbahaya di bawah laut. Tujuan projek ini adalah untuk mereka sebuah Kenderaan Bawah Air Kawalan Operasi. Kenderaan ini boleh bergerak di dalam air dan dikawal oleh sebuah alat kawalan jauh yang dibuat menggunakan suis tekan. Pengguna boleh melakukan aktiviti perisikan hanya dengan menggunakan alat kawalan jauh dan ianya lebih mudah. Laporan ini memaparkan pembangunan Kenderaan Dalam Air Kawalan Operasi dari rekaan mekanikalnya, rekaan elektroniknya dan pelaksanaan perisiannya.



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## LIST OF ABBREVIATIONS

PIC	-	Programmable Interface Controller
ROV	-	Remotely Operated Underwater Vehicle
AUV	-	Autonomous Underwater Vehicle
UUV	-	Unmanned Underwater Vehicle
PVC	-	Polyvinyl Chloride
PCB	-	Printed Circuit Board
FPGA	-	Field Programmable Gate Array
PC	-	Personal Computer
DC	-	Direct Current
MCU	-	Microcontroller Unit
EEPROM	-	Electrically Erasable Programmable Read Only Memory



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# CHAPTER I

## INTRODUCTION

### 1.1 Background

Remotely underwater vehicle is a mobile robot designed for aquaculture. Underwater vehicle user can control the vehicle on the ship or boat. Most underwater vehicles are equipped with at least a video camera and lights. Using a remote and camera the operator can moves the vehicle to desired locations to record the data. Underwater vehicle are also widely used by the science community to study the ocean. A number of deep sea animals and plants have been discovered or studied in their natural environment through the use of underwater vehicle.

This project is the hardware Development of Prototype Remotely Operated Underwater Vehicle (ROV). This prototype can be utilized in several application such as survey, search, maintenance and repair in submarine operation. The prototype is linked to the remote by a group of cables that carry electrical signal back and forth between user and the underwater vehicle. PIC is used to control the movement of the vehicle. There are six direction of movement that will be control by using PIC. The movements of this prototype in underwater are limited to forward and backward movement, upward and downward movement and lastly turn right and left.

## 1.2 Problem Statement

Problem statement for this project are:

- a) Nowadays, the underwater vehicle have become an important tool in underwater activities that can control by using the remote control. With this prototype, the users can perform intelligence activities only by using the remote control and it is much easier.
- b) People that are interested in exploring the deep ocean but they don't have the knowledge in swimming can use this prototype to see what was inside the deep ocean. They just need to control the prototype on the boat.
- c) Fisherman difficult to know the locations that have plenty of fish populations. Hence, this prototype will help fisherman to detect where the fish populations live.

## 1.3 Project Objectives

The objectives of this project are:

- a) To study and understand the underwater vehicle behavior an aspect of controlling.
- b) To design and develop the prototype of remotely operated underwater vehicle.
- c) To design and develop the vehicle controller by using PIC.

## **1.4 Scope of the Project**

Firstly, this project focuses on the hardware development which is the ROV mechanical design attached with the combination of the bilge pump. Besides that, the electronics circuit will be designed and the microcontroller will control the overall system of the ROV. Then, the software development will be implemented which consists of ROV flow chart and programming source code.

## **1.5 Project Outline**

This thesis comprises of five chapters. The first chapter briefly discusses the overviews about the project such as introduction, objectives, problem statements and scope of this project.

Chapter II describes about the research and information about the project. Every facts and information, which found through by any references had been selected. This literature review has been explained about the experienced project of the underwater vehicle.

Chapter III will discuss about the methodology that have been used in this project. The project must be understand first and make the research about previous project. The other method that have been used are design mechanical part, develop the software, design the electronic circuit, troubleshooting the project and lastly the project have been presented. This chapter also consists about the project design in mechanical, electronic and software.

Chapter IV, describe about the result and discussion. The result is presented more to ROV body result and movement meanwhile discussion presented more to the problem that occur along this project session and that problem.

Finally, Chapter V tells about conclusion and recommendation. The conclusion describes about the task that have been done during this project. The recommendation is added to give an opinion and also an improvement on how the future works should have done.

## **CHAPTER II**

### **LITERATURE REVIEW**

This chapter will explain about the literature review which is related to this ROV project. Information about the ROV has been studied from different resources to perform this project.

#### **2.1 Underwater Vehicle Project**

This section will discuss about the previous underwater vehicle project that have been developed by the previous researcher.

##### **2.1.1 Depth Control and Stability Analysis of an Underwater Remotely Operated Vehicle (ROV)**

According to N.H.Tehrani, et. al 2010, [7] ROV or Remotely Operated Underwater Vehicle is a robot, which can play an important role in marine industries especially construction of offshore gas and oil facilities.

This robot (DENA) consists of a main mechanical structure holding several thrusters, cameras and some equipment such as manipulator Arm and sampling units with proper electronic modules to control these units .

### 2.1.1.1 Mechanics

“DENA” has major mechanical units, which play important role in performing different missions. The unit is a well-designed mechanical Structure which helps the ROV to be stable with a good maneuvering ability and a safe and reliable place for all electrical and control units inside the ROV.

#### a) Structure

The ROV is designed Close-Frame which means that there is Hull in designing and different parts of the robot such as thrusters, electrical boards, cameras and manipulator are waterproofed and mounted on different places in a aluminum structure called frame. These waterproofed units are connected together by means of special connectors (called Wet Connectors) and sealed Hoses.

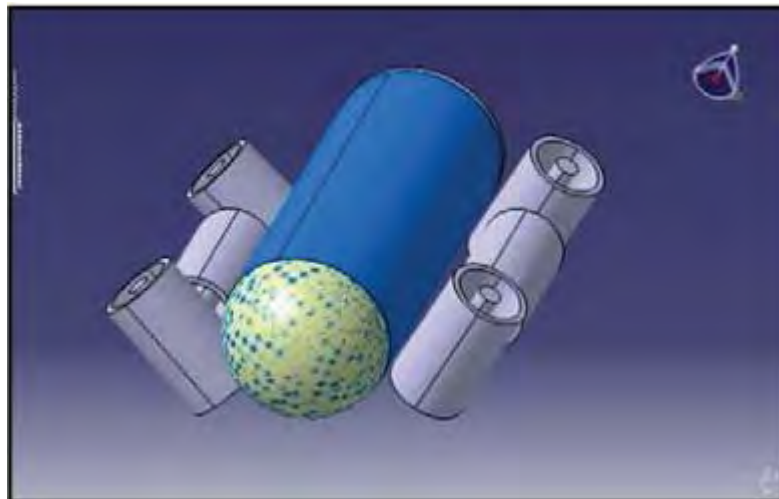


Figure 2.1: ROV Thruster Configuration

b) Maneuver

In order to have different maneuvers, DENA has five thrusters mounted on the Aluminum Frame. There are two vertical thrusters which help the robot to change depth while two horizontal sides perform in-plane maneuvers such as going forward, backward and of course turning to the left and right. As a need to have lateral movement, two extra horizontal thrusters are re placed at front and back of the ROV. DENA has the maximum speed of “1 m/s” and can handle different tasks in depth no more than 15 meters.

c) Thrusters

Nowadays, industrial ROVs utilize high power, high efficiency underwater thrusters, which are very expensive for an educational, propose ROV so the thrusters for DENA are designed by use of low-cost, low power 24V DC motors. Each thruster consists of a DC motor which is mounted in a Teflon waterproofed Cylinder and sealed by a metal cap at the end.

A stuffing- box is placed on the other side to waterproof the motor shaft as shown in figure 2.2. ROV has two vertical thrusters, two horizontal thrusters located on left and right and two additional motors placed for lateral moves.



Figure 2.2: Motor Housing