UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF REMOTELY OPERATED UNDERWATER VEHICLE (ROV) CONTROLLED BY BLUETOOTH MODULE

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electrical Engineering Technology (Industrial Automation & Robotics) with Honours.

by

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APPROVAL

This report is submitted to the Faculty of Electrical and Electronic Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Electrical Engineering Technology (Industrial Automation & Robotics) with Honours. The member of the supervisory is as follow:

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ABSTRAK

Kenderaan Dalam Air (ROV) yang dikendalikan dari jauh berstruktur dengan beberapa motor kalis air dan beberapa komponen elektronik yang boleh menyelam ke dalam air juga sebagai robot yang boleh dikendalikan oleh manusia menggunakan pengawal khas. ROV adalah robot yang sepenuhnya membantu manusia menyelam lebih daripada 30 meter dari permukaan. ROV ini diprogramkan oleh pengaturcaraan asas untuk membantu sistem berkomunikasi dan mendapatkan data dari peranti lain. Apabila menyelam, manusia tidak dapat menahan tekanan tinggi. Ketahanan badan manusia kurang berbanding dengan robot bawah air di dalam air. Oleh itu, Kenderaan Underwater Underwater (ROV) yang dikendalikan secara jauh sedang dibangunkan untuk membantu manusia menjalankan tugas di bawah air. Objektif projek ini adalah untuk membangun pangkalan kenderaan bawah laut jauh dari elektronik, mekanikal dan perisian untuk ROV dan mengawal pergerakan ROV dengan aplikasi mudah alih melalui sambungan Bluetooth. Terdapat tiga bahagian utama untuk membangunkan ROV ini iaitu reka bentuk perisian, reka bentuk elektronik dan reka bentuk mekanikal. Reka bentuk perisian adalah Arduino IDE, SolidWorks dan MIT App Inventor 2. Sementara itu, dalam perkakasan elektronik dan mekanikal menggunakan Arduino Mega 2560 sebagai pengawal utama. Oleh itu, ROV boleh mengawal dengan menggunakan Aplikasi Android. ROV yang dikawal oleh modul Bluetooth diperlukan untuk menjalankan projek ROV. Di akhir projek ini, ROV dapat dikawal ke hadapan, ke belakang, ke kanan dan kiri, naik ke permukaan air dan turun ke dasar tanpa sebarang halangan.

ABSTRACT

A Remotely Operated Underwater Vehicle (ROV) is a structure with several waterproofs motor and some electronic component that can dive into the water also viewed as a robot that can be control by human using special controller. ROV is a fully remotely robot which can help people to dive more than 30 meters from the surface. This ROV was programmed by basic programming to help system communicate and get the data from others device. When dive, humans cannot withstand high pressure. The endurance of human body is less compared to underwater robot in deep water. Therefore, Remotely Operated Underwater Vehicle (ROV) is develop to help human doing task underwater. The objective for this project is to develop remotely underwater vehicle based on electronic, mechanical and software for ROV and control the movement of ROV with mobile application via Bluetooth connection. There are three main part to develop this ROV which are software design, electronic design and mechanical design. Software design provides Arduino IDE, SolidWorks and MIT App Inventor 2. Meanwhile, in electronic and mechanical hardware using Arduino Mega 2560 as a main controller. As a result, the ROV can control by using Android Apps. The development of ROV controlled by Bluetooth module has been required in improving the ROV project. By end this project, The ROV able to move forward, backward, right, left, up and down without any obstacles.

DEDICATION

This report is dedicated to my respective parents Khamaron Bin Hj Yasir and Fatimah Binti Hj Peranto, who always support me to never give up and give me hope for me to complete this project completed successfully. Secondly, this report is dedicated to my project supervisor, Mohd Zaidi Bin Mohd Tumari, for been the one who play important rule and always give me help for any unresolved problem. Lastly, the others friends, who always help me on the hardware and circuit design and implementation part. Without their support this project would not have been made possible.

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LIST OF SYMBOLS

D, d	-	Diameter
F	-	Force
g	-	Gravity = 9.81 m/s
I	-	Moment of inertia
1	-	Length
m	-	Mass
N	-	Rotational velocity
P	-	Pressure
Q	-	Volumetric flow-rate
r	-	Radius
T	-	Torque
Re	-	Reynold number
V	-	Velocity
w	-	Angular velocity
x	-	Displacement
z	-	Height
q	-	Angle

LIST OF ABBREVIATIONS

ROV	Remotely Operated Underwater Vehicle

CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter provides a production to this project. Specifically, it starts with the general information and background about a remotely operated underwater vehicle, project overview, problem statement of this project, description of prototype, objective, scope and it will also cover the thesis outline of the development of the remotely operated underwater vehicle (ROV) controlled using Bluetooth module.

1.2 Project Background

A Remotely Operated Underwater Vehicle (ROV) is a structure with several waterproofs motor and some electronic component that can dive into the water. A ROV also viewed as a robot that can be control by human using special controller. ROV will follow each instruction from human to move another place. A ROV is a fully remotely robot which can help people to dive more than 30 meters from the surface of water. This ROV was programmed by basic programming to help system communicate and get the data from other device. In this ROV, only use six instructions such as forward, reverse, left, right, upward, and downward. In the industry, ROV already develop in early 1950's known as Cutlet. Royal Navy used Cutlet to recover practice torpedoes and mines. Figure 1.1 shows the Royal Navy ROV (*Cutlet*) first used in 1950's retrieve practice torpedoes and mines.

Figure 1.1 Royal Navy ROV (*Cutlet*)

In 1960's, U.S. Navy develop first ROV that has capability to perform deep-sea rescue operation and find object from the ocean floor such as nuclear bomb. The ROV they called as Cable-Controlled Underwater Recovery Vehicle (CURV). Technology of ROV growing faster in 1980's. At that time so much of the new offshore development exceeded the reach of human divers. Today, ROV can do various tasks for example many company used technology of ROV to do inspection of subsea structure, pipelines, and platforms. Not only that, submersible ROV is one of the robot used to find many historic shipwreck including the RMS Titanic.

The standard structure of ROV uses large flotation packs that provide the necessary buoyancy to do tasks. Aluminum chassis one of the material to make the ROV durable. The component arrangement needs to be accurate to ensure the ROV balance. By placing the heavy component at the bottom and light component on the top, overall system has large space between the center of buoyancy and center of gravity. This preparation provides stability and stiffness of ROV when dive deep water. The thruster placed between center of buoyancy and center of gravity make the ROV easy to

control and also maintain the attitude of the robot when diving. Thruster must be configuring to make sure the rotations for each motor are same.

Nowadays, most of Remotely Operated Underwater Vehicle (ROV) is develop in small scale, lighter, faster, move smoothly and easy to control without any communication loss. It is because today, too many devices can be used to ensure ROV quality is better than before. Figure 1.2 shows the latest ROV from Blue Robotics Company.

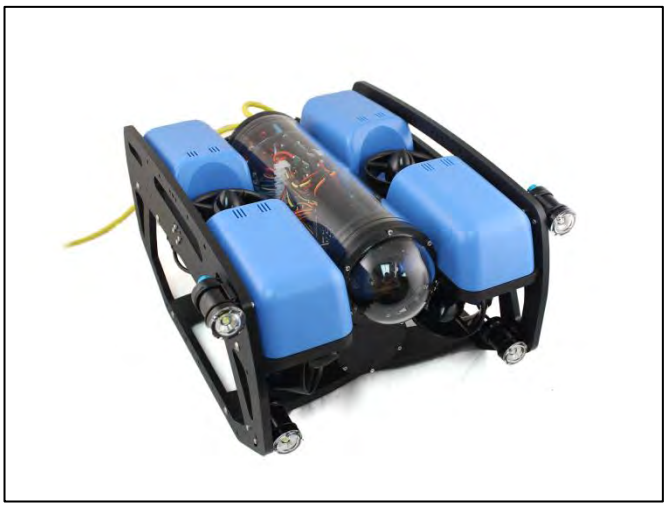

Figure 1.2 BlueROV2

1.3 Problem Statement

Humans have limited ability when in the water. Either in terms of vision or pressure in the water. When dive, humans cannot withstand pressure more than 30 meters from the surface of the water. The endurance of human body is less compared to underwater robot in deep water. Therefore, Remotely Operated Underwater Vehicle (ROV) is develop to help human doing task underwater.

1.4 Objective Research

There are two main objectives in this project which are:

i. To develop remotely underwater vehicle based on electronic, mechanical and software for ROV.

ii. To control the movement of ROV with mobile application via Bluetooth connection.

iii. To stabilize ROV buoyancy when exposed to water waves.

1.5 Scope of Research

In this project, the working scope that is a guidelines that ensures that the project accomplished to objective that provides an easy way to finish the project. This project will involve in mechanical design, electronic design, and software design of remotely operated underwater vehicle (ROV).

i. Mechanical design

- To develop a neutrally buoyancy by using passive ballast at the center of the body that consist of a 6 inches PVC pipe. The ROV structure design using Solidworks software.

ii. Electronic design

- For the electronic path, the main microcontroller is Arduino Mega 2560 that provides many input output. Bluetooth module HC-05 used for communication device between ROV and smartphone.

iii. Software design

- The software which is used for this project is Arduino IDE for create, erase, compile and upload programming. For the android application, MIT app inventor used to create graphical user interface.

1.6 Thesis Outline

The structure and layout of the thesis are as follow:

Chapter 1 – Introduction: This chapter briefly explains about the introductions which cover the objectives, scopes of the project and problem statements.

Chapter 2 – Literature Review: This chapter describes what Remotely Operated underwater Vehicle (ROV) controlled by Bluetooth Module. It also consist of the information which will be the parameter for the developing this project.

Chapter 3 – Methodology: This chapter will review about the methodology of this project, which describes details about the method used for developing this project.

Chapter 4 – Expectation Result: this chapter will consider about the expectation the robot movement in water.

Chapter 5 – Conclusion and Recommendations: this chapter will conclude about the entire project and future expectations that can be done for the future project improvement.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter is a review about the journal and article of the related information to the development of remotely operated underwater (ROV) controlled by Bluetooth module. Furthermore, it contains the description of product or prototype that has been developed by certain party, especially student, as a guide and reference of create the robot. It is focused on design, component, material, programming and sensor of the robot.

2.2 Remotely Operated Underwater Vehicle

ROV is an underwater robot controlled using android applications. Basically, the ROV is just a robot that follows every command conveyed through the Bluetooth module. Next, ROV is used to see the scenery with a depth of over 30 meters from the surface of the water. Most ROVs connects to control system using copper wire or fiber optic cable. Using wires, the probability of interrupting communication is less if comparing with wireless communication. However, the use of long cables requires huge funding to produce them. ROV technology has grown since nearly 70 years ago. Most ROVs also have one or more cameras. The sensors used will generate signal and each signal is very accurate allowing the ROV to be easy to control. Human operator sits in a