DEVELOPMENT OF POWER MODULE OF SMALL-SCALE ROV FOR EDUCATIONAL PURPOSES

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in fulfillment of the requirements for the degree of
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DECLARATION

I declare that this Choose an item. entitled " Development Of Power Module Of Small-Scale Rov For Educational Purposes " is the result of my own research except as cited in the references. The Choose an item. has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature	:	
Name	:	Mohd Shafiq Nazri Bin Kussim
Date	:	18/1/2022

APPROVAL

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor of Mechanical Engineering Technology (Maintenance Technology) with Honours.

Signature : ....

Supervisor Name : Mohammed Noor Bin Hashim

Date : 18/01/2022

DEDICATION

My project is dedicated to my family and my friends. I used to understand that every task requires self-effort and advice from everyone. In addition, a particular sense of appreciation to my family who offer me every day a word of encouragement and prayers. I'm also dedicating my work to my supervisor who has helped me from start to finish. Last but not least, thanks to the friend who has provided all the information and suggestions for the successful completion of PSM 2. I could not finish the work in a timely and completed way without you guys.

ABSTRACT

Day by day, technology are developing in all countries such as ROV technology in any sector including educational sector, but there are several obstacle in the process to build a ROV, which is the power module system. This paper describes the development of power module of small-scale ROV for education purpose with detail in every chapter. The objective of this paper is to develop a small-scale ROV power module and to fabricate a small-scale ROV suited for educational purpose, which is for high school students for learning. This small-scale ROV power module designed based on engineering design methods such as Morphological chart, conceptual design method and testing. The final dimension of the small-scale ROV power module was 175 mm x 118 mm x 62 mm in size with a thickness of 1-5 mm. Moreover, the small-scale ROV air and water tight container design were chosen because of engineering features, which is needed for buoyancy and safe for all electronic component, also allowing it to dive underwater. The power source enough to supplied to the whole ROV. The SLS machine was utilize to produce and fabricate the entire component of ROV including drilling and threading process. The study expected outcome is the development of a power module for a small-scale ROV for educational purposes, using a nylon plastic material. As a result, specific criteria was applied to select the most appropriate ROV power module for educational purpose including shape, material used, component used for system, fabrication or manufacturing method and dimension.

ABSTRAK

Hari demi hari, teknologi berkembang di semua negara seperti teknologi ROV dalam mana-mana sektor termasuk sektor pendidikan, namun terdapat beberapa halangan dalam proses membina ROV iaitu sistem modul kuasa. Kertas kerja ini menerangkan pembangunan modul kuasa ROV berskala kecil untuk tujuan pendidikan dengan terperinci dalam setiap bab. Objektif kertas kerja ini adalah untuk membangunkan modul kuasa ROV berskala kecil dan menghasilkan ROV berskala kecil yang sesuai untuk tujuan pendidikan, iaitu untuk pembelajaran pelajar sekolah menengah. Modul kuasa ROV berskala kecil ini direka bentuk berdasarkan kaedah reka bentuk kejuruteraan seperti carta Morfologi, kaedah reka bentuk konsep dan ujian. Dimensi akhir modul kuasa ROV berskala kecil ialah bersaiz 175 mm x 118 mm x 62 mm dengan ketebalan 1-5 mm. Selain itu, reka bentuk bekas kedap air dan udara ROV berskala kecil dipilih kerana ciri kejuruteraan, yang diperlukan untuk daya apungan dan selamat untuk semua komponen elektronik, juga membolehkannya menyelam di bawah air. Sumber kuasa yang cukup untuk dibekalkan kepada keseluruhan ROV. Mesin SLS digunakan untuk menghasilkan dan mengarang keseluruhan komponen ROV termasuk proses penggerudian dan benang. Hasil yang dijangkakan kajian ialah pembangunan modul kuasa untuk ROV berskala kecil untuk tujuan pendidikan, menggunakan bahan plastik nilon. Hasilnya, kriteria khusus telah digunakan untuk memilih modul kuasa ROV yang paling sesuai untuk tujuan pendidikan termasuk bentuk, bahan yang digunakan, komponen yang digunakan untuk sistem, kaedah fabrikasi atau pembuatan dan dimensi.

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LIST OF SYMBOLS AND ABBREVIATIONS

D,d	-	Diameter
ROV	-	Remotely Operated Vehicle
DC	-	Direct Current
LiPo	-	Lithium Polymer
RC	-	Radio control
3D	-	Three Dimension
SLS	-	Selective Laser Sintering
ESC	-	Electronic Speed Controller
mAh	-	Mili Ampere per Hour
V	-	Voltage

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Unoccupied underwater robots or Remotely Operated Vehicle (ROV) are controlled by a human that is on a ship or boat, called remotely operated vehicles. They are easy to travel in water and are linked to the ship through the cable system which carries electrical signals between the operator and the ROV itself. A camera and lights are standard on most ROV. To maximize the ROV's capabilities, additional equipment is often added. Sonars, magnetometers, a still camera, a manipulator or cutting arm, water samplers, and instruments that measure water clarity, light penetration, and temperature are examples of external devices. ROV were first designed for industrial uses, such as pipeline checks and offshore platform structure checking. Today, however, ROV are used for a variety of purposes, many of which are analytical. They've proved to be incredibly useful in the field of ocean exploration. They're also used in aquaria for instructional programmes and to connect to live research expeditions through the Internet.

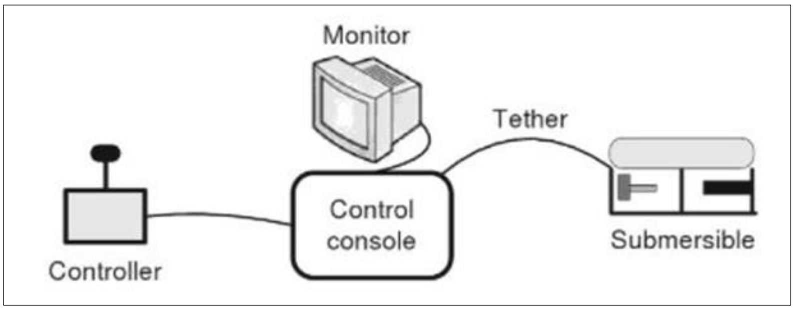

Figure 1.1 Basic ROV system components *(The ROV Manual, 2017)*

1.2 Background

Remotely operated vehicle (ROV) is a tethered robot, often employed for underwater operations. ROV operation is performed through a remote location control box, for example on onshore or on the floating vessel. This is the basic components of Remotely Operated Vehicle consist of; -

i. System of Controlling and Navigation
ii. Thrusters (Propulsion)
iii. Light
iv. Camera
v. Body structure
vi. Service module
vii. Power module
viii. Manipulator or cutting arm

Although the ROV industry has been developing internationally for some time, there are still just a few ROV manufacturers and suppliers in Malaysia. Instead of supporting the oil and gas industry, ROV capabilities can be applied to a wide range of uses, including search and rescue, education, ocean mining, fishing, and shipwreck investigation.

1.3 Problem Statement

The purpose of this project is to design a small scale ROV that suitable for high school students for their learning purpose. To be specific, the part was the power module of the small-scale ROV. The material selection should be considered to make sure the cost of making the ROV is low so that the school is able to afford it. The maneuverability of the ROV should be simple and easy for student to operate it underwater.

1.4 Main Objective

The purpose of this project is to design a small-scale of ROV that suitable for high school students for learning process. There are several objectives to achieve the purpose:

1. To design the concept of a small-scale power module of ROV that suitable for education purpose.
2. To fabricate the small-scale of ROV that suitable for education purpose
3. To investigate power needed for small-scale ROV

1.5 Project Scope

The scope of this project is to understudy all the matters involve with the designing, structuring and building the small-scale ROV. After the studies has complete, the fabricating process of the ROV prototype will be done, where the process involve are:

- Design a small-scale power module with dimension of 175 mm X 118 mm X 62 mm in size, with a thickness of 1-5 mm
- The plan ideas of this fabrication are small-scale, waterproof and light-weight below 3 kg for whole ROV
- The power required to power the whole ROV is supplied by a single pack of Lithium Polymer (LiPo) batteries.
- The ROV easy to control and suitable for education purpose

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter provides a study of the literature on the historical context, general structure, manufacturing process and components of the ROV itself. The historical context are briefly explained on this chapter. Also, on this chapter, the power system of the ROV are also mentioned. Lastly, the manufacturing process such as 3D printing are explained briefly in this chapter.

2.2 History of ROV

The Royal Navy recovered trial torpedoes using a remotely operated submersible in the 1950s. The US Navy financed experiments into what was then known as a "Cable-Controlled Underwater Recovery Vehicle" in the 1960s (CURV). The Navy was able to conduct deep-sea rescue operations and retrieve objects from the ocean floor by CURV. When human divers were unable to manage most of the contemporary offshore construction in the 1980s, remotely operated vehicles (ROVs) became essential. Many old shipwrecks, including RMS Titanic, Bismarck, Yorktown and SS Central America, have already been found using underwater ROVs. However, a lot of work has to be done already! The depth at which most ROVs operate is more than half of the world's seas more than 3000 metres. There is always a lot to uncover in the water. ROVs are mostly used in the oil and gas industry, but they are also used in scientific testing, military uses, and underwater rescue operations for aircraft that have crashed and sunken ships. As technology improves, the ROV will perhaps one day in the near future be capable of exploring the deepest depths of the ocean.

2.2.1 ROV in Malaysia

There are several historical founded in Malaysia but only one are very useful for the research. In July 2006, an international conference titled Underwater System Technology: Theory and Applications was held at Universiti Sains Malaysia (USM) with the aim of improving underwater system technology in Malaysia (USYS06). According to Universiti Sains Malaysia's Assoc. Prof. Dr. Mohd Rizal Arshad,

"*This conference has provided a platform to researchers, scientists, engineers, academicians, as well as industrial professionals from all over the world to present their research result and development activities on underwater system technology and applications. USYS06 was organized by the School of Electrical and Electronic Engineering, Universiti Sains Malaysia, and co-organized by the Ministry of Science, Technology and Innovation (MOSTI), Malaysia and the Science and Technology Research Institute for Defense (STRIDE), Malaysia. Society for Underwater Technology (SUT) and University of Southampton was the co-supporter of the conference." (Hic Su Dracones)*

Malaysia's undersea development, particularly the usage and development of remotely operated vehicles (ROV), is still in its early phases when compared with other countries. But nowadays a lot of company are offering services on ROV. Especially on oil and gas industries such as Nadi Marines Sdn. Bhd, Borneo Subsea Services (Malaysia), TWI Malaysia and many more. Subsea Explore Services (M) Sdn Bhd has created out a place for itself as the main local producer of underwater remotely operated vehicles (ROVs) since 2014. Firm co-founder and managing director Hazali Mansor established the company, which handles subsea projects for Petroliam Nasional Bhd (Petronas). Hazali said that during the company's early days in 2005, with a RM100 000 investment, a plan was created to propel the company towards being a ROV manufacturer. A 2,000 sq ft light industrial facility in Glenmarie, Shah Alam, surrounded by workshops, was used to house the design work for the ROV project, which was code-named "SSV 1." The project was completed in December 2007. According to Hazali, financial institutions have found it difficult to build a case for such complex projects since ROVs are a relatively new idea, and they were unable to establish the project's profitability at the time of application. In addition, despite the fact that they successfully tested the "SSV 1" at West Wharf, Kuantan Port Consortium, Kemaman, Terengganu in 2009, they were unable to enter the domestic market due to the presence of long-established international players in Malaysia, such as Oceaneering International (USA), Subsea 7 (Norway), TMT (Australia), Caldive (USA), Racal (UK), Sonsub (Italy), and others, including Oceane In spite of the difficulties, they were awarded a contract in 2009 for the Caspian Sea Rig Support project for an Iranian oil and gas company, during which SSV 1 was able to dive as far as 1,000 metres below the surface of the sea. Petronas had had enough, and in 2012 the company was given a long-term contract for pipeline survey and inspection operations using remotely operated vehicles (ROVs). ExxonMobil Exploration and Production Malaysia Inc has awarded them an underwater inspection and maintenance project, which they are currently working on (ExxonMobil Malaysia).

Figure 2.1 SSV 1 Project Subsea

Figure 2.2 Subsea Explore Services (M) Sdn Bhd project *(SubseaROV, 2019)*

The ROV's main purpose is to assist the oil and gas industry with pipeline and platform construction, drilling, inspection, and maintenance, survey and for technical reporting. Aside from that, ROVs are used for underwater discovery and search and rescue missions. The Subsea Explore Services (M) Sdn Bhd offers a wide range of ROV classes and roles, as seen in Figure 2.3.

Figure 2.3 Remotely Operated Vehicle Classes and Functions

As shown in this research, the requirement for ROVs may be broadened to cover a wider variety of applications and scopes than previously considered. Aside from the oil and gas sectors, a tiny and basic ROV system may be utilised for river, lake, and undersea exploration for educational reasons, as well as for scientific research. In the fishing business, fishermen may easily utilise a remotely operated vehicle (ROV) system to observe the concentration of fish in a certain region of the sea and identify the optimum fishing site, allowing them to increase their daily harvest by as much as 50%. A remotely operated vehicle (ROV) will offer underwater CCTV surveillance video for individuals working in the maritime and security industries. Remotely operated vehicles (ROVs) will also be beneficial in marine research and exploration, since they will be able to monitor and capture the underwater living environment, and they will also assist divers in the identification of shipwrecks.

2.2.2 ROV in 3D printing and Laser Cutting

Building a ROV has many ways but for a nowadays technologies are wide of the numbers. Such as 3D printing for ROV. Known as the Fifish V6, it is the world's first omni-directional handheld underwater commercial ROV with an integrated 4K UHD camera. Qysea Technology, a leading ROV manufacturer, released the Fifish V6 in April 2019 with 3D-printed protective covers for its smart vector thrusters, a first in the ROV industry. In addition to a maximum dive depth of 100 metres and a diving duration of 4.5 hours, the Fifish V6 has an operating temperature range of -10 to 60 degrees Celsius and provides reliable results. Because of a sophisticated underwater camera and virtual reality technology, it offers users with an accessible and extremely immersive underwater world for scooting, recording, and inspection purposes. The design and development of the thruster protective cover for version 6 of the Fifish series faced several challenges when manufactured using