UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF GRABBER STRUCTURE OF SMALL SCALE ROV FOR EDUCATION PURPOSES

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Mechanical Engineering Technology (Automotive Technology) with Honours

By

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APPROVAL

This report is submitted to the Faculty of Mechanical and Manufacturing Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Mechanical Engineering Technology (Automotive Technology) with Honours. The member of the supervisory is as follow:

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ABSTRAK

Pelbagai corak dan bentuk ROV yang direka secara kreatif dan sesuai digunakan oleh semua komuniti untuk tujuan tertentu. Reka bentuk yang dihasilkan pada setiap bahagian ROV memerlukan penilaian terperinci mengenai keberkesanan fungsi mesin termasuk pegangan atau pencengkam yang berfungsi untuk mengambil atau memegang bahan di bawah air yang disebut sebagai grabber. Pencengkam tersebut boleh melakukan pelbagai tugas seperti penyelamat mangsa lemas, peralatan yang hilang, sampel, serta memegang alat seperti botol pengesan kebocoran, peraturan pengukuran, carabiner talian dan banyak lagi. Mereka direka bentuk menyerupai lengan manusia. Oleh itu, kertas kerja ini menerangkan pengembangan struktur ROV berskala kecil untuk tujuan pendidikan dengan maklumat terperinci setiap bab. Objektif utama kertas kerja ini adalah untuk mengembangkan struktur pencengkam ROV berukuran kecil, membuat pencengkam ROV berskala kecil yang sesuai untuk tujuan pendidikan, dan kemudian mengembangkan pencengkam ROV yang mudah dikendalikan. Reka bentuk akhir pencengkam ROV skala kecil dikembangkan dan dinilai.

ABSTRACT

Various patterns and shapes of ROVs that are creatively designed and suitable for use by all communities for a specific purpose. The design produced on each part of the ROV requires a detail evaluation of the effectiveness of the function of the machine including a handle or rake that serves to pick up or hold a material under water which is called a grabber. The grabber can do various duties such as the recovery of drowning victims, missing equipment, samples, as well as holding instruments such as leak detection bottles, measurement rules, line carabiner and much more. They are designed to resemble a human arm. Thus, this paper describes the development of the grabber structure of small scale ROV for education purpose with detail information of each chapter. The major objectives of this paper were to develop a small size ROVs grabber structure, fabricate a small-scale of ROVs grabber suited for educational purposes, and then develop a grabber of ROV that was easy to manage. The small scale ROV's grabber final design was developed and evaluated.

DEDICATION

My work is devoted to my family and friends. I used to know that any task requires individual work and guidance from all around. Besides this, my family, whose words of support and priests offer me each day a particular feeling of appreciation. This paper also is intended for the ongoing direction, advise, idea, comment and support given to my project's supervisor, Mr. Mohammed Noor Bin Hashim, for my project supervision work. Next, I want to thank my friends who have supported me in the preparation of this project through thick and slim. I also want to thank my family who helped me in my preparation of this project. Last but not least, I also would like to thank you for all my lectures which have supported, encouraged, thought and guided me to complete my project directly or indirectly.

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LIST OF SYMBOLS

D, d	-	Diameter
F	-	Force
1	-	Length
m	-	meter
P	-	Pressure

LIST OF ABBREVIATIONS

ROV	Remotely Operated Vehicle
HOQ	House Of Quality
CNC	Computer Numeric Control
3D	Three Dimension
AMS	Advantage Marine Services (Malaysia)
MBARI	Monterey Bay Aquarium Research Institute
WHOI	Woods Hole Oceanographic Institution
URI/IFE	University of Rhode Island / Institute for Exploration
MCM	Mine Countermeasure
SLS	Selective Laser Sintering

CHAPTER 1

INTRODUCTION

1.1 Introduction

An unoccupied subsea robot linked to a vessel by a network of cables is a remotely operated vehicle (ROV). These cables provide control and control signals from the operator to the ROV that enable the vehicle to be operated remotely. An ROV can contain a video camera, lights, sonar, and joint arm. ROVs (Remotely Operated Vehicles) are widespread in the deep-sea industry. The usage of subsea technology has expanded as the oil sector, as well as other key industries, expands into deeper water. Man-powered diving is inconvenient for maintenance and surveys for safety and practical reasons. The idea is to deploy unmanned, highly agile ROVs that are controlled by a human on board a vessel. The ROV is often outfitted with one or more manipulator/ grabber that allow it to execute simple tasks such as pulling cables, opening valves, and handling various instruments. It is critical that the grabbers be easily movable, extremely precise, and have a rapid reaction since this will save money while also allowing for performance. The ROV is often outfitted with one or more grabbers that allow it to execute simple tasks such as pulling cables, opening valves, and handling various instruments. It is critical that the grabbers be easily movable, highly precise, and have a rapid reaction since this will save money while also allowing for the completion of more challenging jobs. Furthermore, the usage of a decent grabber can help to protect the environment. The joint arm is used to pick tiny things, to cut lines or to connect hooks to bigger ones. The manipulator of a ROV or AUV is the most important component of the system. Underwater operations like as grabbing things and manipulating mechanical parts, or twisting handles to lock or open valves, for example, are impossible to do without a correctly constructed and regulated manipulator. Although numerous ROV applications are employed, some of the most frequent hydrographic applications include item identification and vessel hull inspections (for underwater navigational risks). A ROV is not designed as a replacement for hydrographic inspection but may be a replacement if the divers are not available or the safety of divers is concerned. However, nowadays ROV is utilised for a numbers of analytical applications. In the realm of sea research, they have been very beneficial. They are also utilised in aquaria for educational programmes and for connecting to live on-line research excursions.

1.2 Background

A remotely operated vehicle, usually known as a ROV, is an underwater vehicle that is unmanageable and is connected to the operator in general. An unbroken vehicle is comparable to a robot fitted with sensors and sampling equipment that collect different kinds of data. It operates like a small underwater, except it doesn't have the people. It works wi-fi or wirelessly, although it's more common. A lot of components make up the very complex ROV. A cable network connects the operator to the remotely operated vehicle to allow the ROV to move properly. ROVs are extremely difficult and have a variety of uses. These may be observed in a wide range of fields from exploration and unexpected excursions to study and sport. Offshore, maritime and Renewable Energy businesses, naval defense, water exploration and rescue have been used to repair, maintain and operate undersea operations (researched-based purpose). The ROV is meant to carry out dangerous or destructive activities utilizing predictive, classified and diagnostic algorithms. Other producers, on the other hand, focus on underwater monitoring and operate for specialized reasons. Furthermore, contemporary technology may be integrated with a remote underwater vehicle to properly monitor and evaluate current temperature, light penetration and water clarity. They are typically used in scientific and exploratory ROVs to learn about the underwater environment. A chemical analyzer will also investigate the specific makeup or composition of the water at various locations and depths. ROVs or under surfaced robots were originally designed to do regular pipeline testing (inside and outside) and to carry out structural testing procedures in diverse offshore locations. Wrecks and old marine water remnants will also be explored with efficient rolling stock. The ROVs meet the demands of a wide array of research missions and aquarium training. The ROV has been engaged in applied training, in maritime organization and usage, and in information, instruments, and strategy research and design as well as in increasing the number of qualified experts working on "important developments in technology" since 1992. ROVs have been used in certain educational endeavors. ROV-based education and activities may be used to promote people's interest in innovation and design expertise. However, no research has been carried out on the effect of the ROV movement or programme, or even the image of innovation and design, on increased study interest. ROVs are also widely employed by scientists to explore the ocean. ROVs have been used to find and study a variety of deep sea creatures and plants in their natural habitat, including the jellyfish Stella medusa Ventana and the eel-like allosaurs. Cutting-edge research is conducted at several public and private oceanographic institutions in the United States, including the Monterey Bay Aquarium Research Institute (MBARI), the Woods Hole Oceanographic Institution (WHOI) (with Nereus), and the University of Rhode Island / Institute for Exploration (URI/IFE). ROVs used in science can in a variety of sizes and forms. Because superb video footage is essential for most deep-sea scientific study, research ROVs are often supplied with high-output lighting systems and broadcast-quality cameras. A scientific ROV will be outfitted with various sample devices and sensors, depending on the research being carried out. Many of these devices are one-of-a-kind, cutting-edge experimental components designed to operate in the harsh environment of the deep ocean. Science ROVs also use commercial ROV technologies, such as hydraulic manipulators and very precise underwater navigation systems. While in military, with 95 percent of the world's trade flowing by sea, the security of our seas, coasts, and inhabitants remains a critical concern for maritime nations. The Deep Trekker Military ROV is assisting EOD crews. Traditionally, EOD teams utilised expert divers to investigate and clear possible underwater minefields. Missions were carried out by a number of assets, from which data was collected, manually analysed, and put together before any further action could be done. As a result, time-consuming processing occurred, placing front-line personnel at danger. Unmanned assets, such as remotely controlled vehicles (ROVs), have been increasingly used for such reasons in recent years. Navies are investing substantially in ROVs to help their EOD crews in difficult situations by conducting Mine Countermeasure (MCM) operations. Until now, these vehicles have mostly been employed to detect, categorise, identify, and locate mines. Military and police personnel who defend our planet rely on powerful technologies to perform their missions as securely and efficiently as feasible. Their equipment include ground robots, aerial drones, and high-tech night-vision gadgets. Deep Trekker is now an alternative for jobs that require underwater examination or inspection.

1.3 Statement of the Purpose

The purpose of the research is to develop the capable grabber of ROV by using mechanical properties such as metal alloys and plastics which is suitable for learning purposes in high school. There are several objectives to achieve the purpose:

1. To develop the concept of an educationally suitable small-scale ROVs grabber module.

2. Fibrate the tiny ROV which is suited for education.

3. ROV easy control and suitable for education purpose.

1.4 Problem Statement

The problem of the design and improvement of the scope of the ROV for training purposes in the grabber construction is lack of design for the grabber due to lack of use. Most ROVs are used only to view underwater conditions where the focus is on the use of cameras and sensors. Therefore, the criteria in the production of the holder or grabber should be studied in depth to meet the suitability of its use. Specific materials are utilised for construction of the underwater manipulators to work in deep seas and to cope with the severe circumstances of the subsea environment. In addition, dependent on the task, the submarine manipulators must comply with the applicable standards for workplace dimensions, lifting capability, wrist torque, etc. Metal alloys such as titanium Ti 6–4, alloys anodized aluminium (5083, 6082 T6, 6061 T6, 7075 T6, A356) as well as plastics are utilised in construction of underwater manipulators and in plastics (Polyethylene). The features of these materials include relatively high strength, resistance to corrosion and excellent processing.

1.5 Project Scope

The scope of this project is to examine all aspects related to the design, structure and construction of the tiny ROV's grabber. The manufacturing process of the ROV's grabber prototype is completed after the investigations, which involves:

1. Easy to manage and educationally acceptable ROV's grabber.
2. Using Selective Laser Sintering (SLS) machine, manufacture ROV body and grabber structure.