UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF AUTONOMOUS UNDERWATER VEHICLE (AUV) VISION SYSTEM BY USING RASPBERRY PI CAMERA

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

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I hereby, declared this report entitled Development of Autonomous Underwater Vehicle (AUV) Vision System by Using Raspberry Pi Camera is the results of my own research except as cited in references.

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Date:

APPROVAL

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

Signature: .....

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ABSTRAK

Tujuan utama kenderaan bawah air autonomi menggunakan kamera Raspberry Pi untuk mencipta sebuah platfom untuk mengesan dan menjejak objek di bawah air. Projek ini mempunyai tiga elemen utama dimana ia terdiri daripada pembangunan mekanikal untuk menghasilan badan utama kenderaan bawah laut, manakala pembangunan elektronik untuk menghasilkan penglihatan dan kawalan kenderaan bawah air. Manakala pembangunan reka bentuk mekanikal, penambahan berat diperlukan untuk memberi kestabilan terhadap daya apungan di dalam air. Untuk kawalan pergerakan kehadapan dan kebelakang empat biji DC motor diperlukan dalam bahagian electronic dan dua motor DC digunakan untuk mengawal pergerakan atas dan bawah. Kamera Raspberry Pi telah dipasang di hadapan kenderaan bawah air bertujuaan untuk mengesan dan menjejak objek. Untuk mengawal kelajuan motor DC menggunakan peranti kelajuan electronic (ESC), manakala untuk penghasilan pemperosesan gambar ia menggunakan perisian OpenCV dan untuk membuat kod menggunakan perisian Phyton.

ABSTRACT

The purpose of Autonomous Underwater Vehicle (AUV) Vision System by Using Raspberry Pi camera is to design a platform and to detect and track the object under the water. This project consists 3 main element part which is mechanical part for main body, electronic for circuit and vision for monitor the AUV. For mechanical design AUV suitable additional weight can enable AUV stable buoyancy in the water. For the electronic part four DC motor is used for the moving upward and downward movement while two bilge pumps for forward and backward movement. A raspberry camera is mounted at the front of AUV to detect and track the object in the water. Raspberry Pi B+ used to control the movement and thruster through the Electronic Speed Control (ESC). lastly in software design, OpenCV software used to make the image processing. Beside that to make a coding using the Phyton software.

DEDICATION

To my beloved parents and team member for support, encouragement and understanding and for praying and help me to completing the final project and for successful.

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ALHAMDULLILAH praise to Allah SWT for give me an ability and strength for completing my final year project to Develop of Autonomous underwater Vehicle (AUV) vision System by Using the Raspberry Pi Camera. I wish to express my sincere appreciation to my main project supervisor, En. Mohd Zaidi bin Mohd Tumari, for guidance until finish this project. I would like to express my gratitude to Universiti Teknikal Malaysia Melaka (UTeM) for giving me opportunity to pursue my Electrical Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM).

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LIST OF SYMBOLS

D, d	-	Diameter
F	-	Force
1	-	Length
m	-	Mass
P	-	Pressure
r	-	Radius
V	-	Velocity
z	-	Height
q	-	Angle

LIST OF ABBREVIATIONS

PCA	Principal Component Analysis
ROV	Remotely Operated Underwater Vehicle
AUV	Autonomous Underwater Vehicle
ESC	Electronic Speed Control

CHAPTER 1

INTRODUCTION

1.1 Introduction

In this chapter, it will be representing the introduction about Autonomous Underwater Vehicle AUV. Chapter 1 will cover project background, problem statement, objective, work scopes and conclusion of this project by using Raspberry Pi Camera.

1.2 Project Background

Autonomous Underwater Vehicle (AUV) is commonly known as Unmanned Under Water Vehicle (UUV), that have efficient to travel underwater without a need of direct human operators. Underwater robot is used in many tasks and variety of military application such as assembly, welding, inspection, surveillance, and mapping. In general, most industrial AUV can decrease the time and cost of operation. Generally, AUV have many sensors for measuring oceanic water properties, water prove DC motor and power supply to enable them since it operates manually. For a visual underwater vehicle, it uses a Raspberry Pi Camera to avoid any obstacles in the water.

1.3 Problem Statement

Deep underwater exploration is one of dangerous task due to limited of human capabilities. If human can discover the underwater, many discoveries could get and learned with it. So, the underwater vehicle has been designed to overcome that problem. Unmanned Underwater Vehicle had developed for many reasons in order to content the needs of people. Most Autonomous Underwater Vehicle is use as a mapping, oceans survey, environment monitoring, resource exploitation, maritime search and rescue. This underwater vehicle also has high cost technology and hard to handle especially for vision system. Besides that, image sensor that being produce is large amount of data that will overload the processor which give the main problem for the robot. The image processing is capture by the raspberry pi camera and implement the control logic. By taking a step further than this, Raspberry Pi Camera is applying to underwater vehicles which means to perform a task of oceans environment monitoring easily. Since use a Raspberry Pi camera, it is easy to use and a low-cost.

1.4 Objectives

The purposes of this project contain of three vital aims that are:

a) To design a platform Autonomous Underwater Vehicle (AUV) Vision System by using a Raspberry Pi Camera.

b) To develop vision system, mechanical system, and electronics system for AUV.

c) To implement the Raspberry Pi Camera to detect and track the object underwater.

1.5 Scope

To develop Autonomous Underwater Vehicles Vision System the main purpose is to visualize AUV by using the Raspberry Pi Camera. For control the AUV there are three main categories involve, mechanical design, electronic design and control design.

1. **Mechanical Design**

   To develop AUV, the centre of the robot has a cylindrical shape have design to protect the all-electronic component that control the AUV. There are four motor used to control movement upward and downward and two of them used to control the forward, reverse, left and right movement. Besides that, all mechanical parts such as camera mounting, main frame and motor holder are design by using the Solidworks software to implement for this project.

2. Electronic Design

In this portion Raspberry Pi Camera is used for controlling the AUV to track and trace the object in the water. For control the speed of the thruster it is using the Electronic Speed Control (ESC). Besides that, six thruster motor T200 to control the movement the AUV in upward, downward, forward, reverse, turn right and turn left. Lastly to stabilize the AUV in the water by using a BerryIMU.

3. Software Design

Using the Phyton software is use in order to develop a program and make the coding to develop Autonomous Underwater Vehicle. Next, this section also requirement a Raspbian software which is used to configure the Raspberry Pi Camera that connect directly to the Raspberry Pi 3B+. For detect and tracking object in the water OpenCV are used to perform real time image processing.

1.6 Conclusion

In this chapter start introduction Autonomous Underwater Vehicle to introduce where the AUV used as vital tool especially for seafloor mapping and monitoring to replace human to reduce harmful during collect data. For future development an AUV especially for technology long endurance, extreme depth, and response capabilities are needed relevant for new technology. Besides that, this chapter also discuss the objective to develop this project. Objective focusing at vision by using Raspberry Pi Camera and Raspberry Pi 3B+ as controller to capture and record movement for AUV. For work scope cover for development mechanical design, electronic design and software design for develop AUV.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Today, technology development for Autonomous Underwater Vehicle (AUV) is a popular mobile vehicle which it will able to move in the water without operator or human control. The goal for making this AUV is by making a research for all single aspect in the water such as military needed, mapping and commercial it is because AUV fully control to move in automatically, and it required sight system to guide the AUV moving toward point and target in the water. This chapter will discuss about the design and concept based on the latest research and article on the AUV.

2.2 Previous Research

Beatriz Arruda Asfora (2015), Embedded Computer Vision System Applied to a Four-Legged Line Follower Robot by using Arduino platform as microcontroller and pixy camera as vision to move the robot by detecting line follower via colour combination using Otsu's method. For a robot commonly used camera as a sensor for emulating human vision by interpreting human vision 3D and 2D image through Computer Vision Address techniques. Using this technique, robot can control to get data and control robot path therefore robot will intelligently to connect perception to action.