UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF AUTONOMOUS UNDERWATER VEHICLE DEPTH CONTROL SYTEM

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

by

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2019

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APPROVAL

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

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ABSTRAK

Laut merangkumi hampir 70% bumi tetapi hanya 5% kita telah menemui laut. Laut sangat penting bagi kita, tanpa laut kita tidak boleh bernafas dan tidak boleh makan ikan atau makhluk laut yang lain. Itulah sebabnya mengapa penerokaan laut penting bagi kita untuk mengekalkan dan mencari penemuan. Walau bagaimanapun, penerokaan laut tidak mudah, persekitarannya sukar terutama tekanan dan memerlukan kenderaan khas untuk melakukan penerokaan dan terdapat beberapa AUV yang tidak dapat selam pada kedalaman yang tertentu akibat gangguan . Oleh itu, projek ini di buat untuk pembangunan kawalan kedalaman Kenderaan Autonomi bawah laut, reka bentuk struktur mekanik, litar elektronik, dan kawalan kenderaan bawah laut. Projek ini juga di buat untuk menganalisis fungsi dan kebolehpercayaan kenderaan bawah laut autonomi (AUV) dalam aspek kawalan kedalaman. Pembangunan itu dilakukan berdasarkan peristiwa pertama, kedua dan ketiga. Pengembangan kawalan kedalaman AUV dianalisis dan ditafsirkan hasilnya menunjukkan bahawa kawalan kedalaman AUV dapat mencapai kedalaman yang dikehendaki. Perkembangan ini dijangka menunjukkan bagaimana kawalan mendalam AUV berfungsi dan boleh beroperasi dalam keadaan baik.

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ABSTRACT

Sea covered almost 70% of the earth but only 5% we have discovered the sea. Sea is very important for us, without sea we cannot breathe and cannot eat the fish or other sea creature. That is why sea exploration is important for us to preserve and for discovery. However, the sea exploration is not easy, the environment is tough especially the pressure and needs a special vehicle to do the exploration and there are some AUV that can't be kept up at the specified depth for quite a while as a result of disturbance. Hence this project was made for the development of an Autonomous Underwater Vehicle depth control, design the mechanical structure, electronic circuit, and control of the underwater vehicle. This project was made also to analyse the functionally and reliability of the autonomous underwater vehicle (AUV) in the aspect of depth control. The development was done based on the first, second and third milestone. The development of AUV depth control was analysed and interpreted which the result shows that the AUV depth control was able to reach the desired depth. This development is expected to show how the AUV depth control to function and can operate in good condition.

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DEDICATION

This report is dedicated to my beloved parents who always give the endless support to keep me moving forward and complete my studying. As my mother would always say, there's nothing comes easy in this life so you have to work hard. Their sacrifice had inspired me to work hard for the things that I aspire to achieve. I cannot find the appropriate words that could describe my appreciation for their support, love and faith in my ability to achieve my dreams.

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ACKNOWLEDGEMENTS

I would love to extend my thankfulness to my supervisor, Mr. Mohd Zaidi Bin Mohd Tumari for his unwavering guidance, constructive comments and never-ending assistance throughout the Development of Autonomous Underwater Vehicle Depth Control which comprised inspiration, supervision and support.

My gratitude also goes to my friend who helped me and offered . I am also indebted to my friends their invaluable contribution in giving ideas especially to Mohamad Syafiq bin Khamaron, Muhammad Fariz bin Fazzuly and Mohd Riduan bin Zakaria.

This project might be impossible to complete without all of your help. Last but not least, thank you to everyone that directly and indirectly involved in helping me finishing this Finale Year Project.

Thank you so much.

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TABLE OF CONTENTS

		PAGE
DECLARATION		**iv**
APPROVAL		**v**
ABSTRAK		**vi**
ABSTRACT		**vii**
DEDICATION		**viii**
ACKNOWLEDGEMENTS		**ix**
TABLE OF CONTENTS		**x**
LIST OF TABLES		**xiii**
LIST OF FIGURES		**xiv**
LIST OF APPENDICES		**xvii**
LIST OF SYMBOLS		**xviii**
LIST OF ABBREVIATIONS		**xix**
CHAPTER 1	**INTRODUCTION**	**20**
1.1	Introduction	20
1.2	Project Background	21
1.3	Problem Statement	22
1.4	Objective	22
1.5	Work scope	23

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1.5.1 Mechanical Design 23

1.5.2 Electronic Design 23

1.5.3 Software Design 24

1.6 Conclusion 24

CHAPTER 2 LITERATURE REVIEW 25

2.1 Introduction 25

2.2 Development of Autonomous Underwater Vehicle (AUV) 25

CHAPTER 3 PROJECT METHODOLOGY 50

3.1 Introduction 50

3.2 Methodology Work Flow 51

3.2.1 First Milestone 51

3.2.1.1 Project Description 51

3.2.1.2 Literature Review 52

3.2.2 Second Milestone 52

3.2.3 Third Milestone 53

3.2.3.1 Electronics Design 54

3.2.3.2 Software Design 58

3.2.3.3 Mechanical Design 60

3.2.4 Conclusion 62

CHAPTER 4 RESULT AND DISCUSSION 63

4.1 Introduction 63

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4.2 Hardware Design 63

4.3 Mechanical Design 65

4.4 Software Design 67

4.5 Analysis and Results 70

4.5.1 Analysis of the depth of BMP280 70

4.5.2 The analysis of the AUV to float versus the time 73

4.5.3 This analysis of AUV depth control with the PID controller 74

CHAPTER 5 CONCLUSION AND RECOMMENDATION 79

5.1 Introduction 79

5.2 Conclusion 79

5.3 Future Improvement (Recommendation) 80

REFERENCES 82

APPENDIX 85

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LIST OF TABLES

TABLE	TITLE	PAGE
Table 2.1.	List of devices that used to develop low cost AUV.	27
Table 2.2:	List of devices that used to develop COMET-ROV.	43
Table 3.1:	List of the components.	54
Table 4.1:	BMP280 depth measurement	70
Table 4.2:	AUV desired altitude versus time taken.	73

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LIST OF FIGURES

FIGURE	TITLE	PAGE
Figure 2.1:	AUV's states	27
Figure 2.2:	The inner part of AUV design.	28
Figure 2.3:	The outer part of AUV design.	28
Figure 2.4:	U-CAT UAV.	30
Figure 2.5:	Illustration of U-CAT UAV to actuate the 6 DOF.	31
Figure 2.6:	The six degrees of freedom.	33
Figure 2.7:	The schematic of AUV "CH-2".	34
Figure 2.8:	Principle of VBS module.	35
Figure 2.9:	Depth Plane dynamics.	37
Figure 2.10:	Basic block diagram of fuzzy controller.	37
Figure 2.11:	Flowchart of fuzzy logic control	39
Figure 2.12:	Fuselage design and physical map.	40
Figure 2.13:	The releasing and launching of Raider.	40
Figure 2.14:	The flow diagram of fuzzy control theory.	41
Figure 2.15:	The Algorithm process of PID.	41
Figure 2.16:	Control system structure.	42
Figure 2.17:	The Comet-ROV	44

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Figure 2.18:	Block Diagram of depth control.	45
Figure 2.19:	Flow Chart of the project.	46
Figure 2.20:	The proportional controller.	48
Figure 2.21:	Control board and thruster.	48
Figure 2.22:	ROV develop by UteRG.	49
Figure 3.1:	The methodology work flow	51
Figure 3.2:	Flow chart of the project methodology.	53
Figure 3.3:	ArduinoAtmega2560.	55
Figure 3.4:	T100 Thruster model.	55
Figure 3.5:	Bilge Pump.	55
Figure 3.6:	BMP280 sensor.	57
Figure 3.7:	LiPo battery.	57
Figure 3.8:	ESC FVT LittleBee 30A	58
Figure 3.9:	Closed Loop Control System	59
Figure 3.10 :	The formula of PID.	60
Figure 3.11:	Autonomous Underwater Vehicle (AUV) model.	61
Figure 3.12:	The Drawing of AUV model.	61
Figure 4.1:	The Overview of the Hardware Design Part 1.	64
Figure 4.2:	The Overview of the Hardware Design Part 2.	64
Figure 4.3:	Connection of BMP280 to Arduino and the thruster motor	65
Figure 4.4:	The AUV from the side view	66

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Figure 4.5:	The top view of AUV in the swimming pool	66
Figure 4.6:	The BMP280 that have been wrapped.	67
Figure 4.7:	The Software design of BMP280	68
Figure 4.8:	The Software design of PID	69
Figure 4.9:	The BMP280 graph	71
Figure 4.10:	The BMP280 graph in serial plotter.	71
Figure 4.11:	Conduction the experiment depth of BMP280	72
Figure 4.12:	The graph Depth versus time taken for AUV to float	73
Figure 4.13:	Conducting experiment for depth versus time taken for AUV	74
Figure 4.14:	Ziegler Nichols table.	75
Figure 4.15:	The graph of Ku and Kp of the AUV.	75
Figure 4.16:	Tuning experiment was conduct.	76
Figure 4.17:	The graph of depth control of the AUV after using PID	76
Figure 4.18:	The AUV.	77
Figure 4.19:	The experiment of AUV depth after using depth control in swimming pool.	77

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LIST OF APPENDICES

APPENDIX	TITLE	PAGE
1.	The coding of PID and BMP280	85

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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

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LIST OF ABBREVIATIONS

PCA	Principal Component Analysis
PID	Proportional, integral and derivative
Kp	Proportional gain
Ki	Integral gain
Kd	Derivative gain
ESC	Electronic Speed Control

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CHAPTER 1

INTRODUCTION

1.1 Introduction

The sea is the soul of Earth, covering in excess of 70 percent of the planet's surface, driving climate, directing temperature, and eventually supporting every single living creature. Hence, by making uncovering, searching for things that mystery can be done by exploring the sea. However, sea exploration is not that easy to achieve the goal of finding something new. With the intense condition and encompassing, the sea exploration should be finished with deliberate, exact perceptions and documentation of organic, synthetic, physical, land, and archeological parts of the sea. With technology and engineering innovations, the challenges of exploring the sea will make it easier and also can improve the technology due to the challenges. This development of Autonomous Underwater Vehicle (AUV) depth control system can overcome the challenges of deep sea exploration.

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1.2 Project Background

Regardless of the way that the sea assumes a part used in everything from the air strain we inhale to day-by-day climate and atmosphere designs, but we did not know anything about our sea. Even though we are relying more and more on these areas for food, energy, and other resources but most of our knowledge of the sea lies in shallower waters and deeper waters remain a mystery. Information from sea exploration is important to everyone. New source for medical drugs, food, energy resources, and other products can be revealed by unlocking the mysteries of deep-sea exploration. Besides that, it also can help us understand how we are affecting and being affected by changes in Earth's climate and atmosphere information and also can help predict earthquakes and tsunamis.

Did you know that you could thank the sea for making Earth a hospitable place to live? The greater part of the oxygen in the environment, that we depend on to breath, initially originated from the exercises of photosynthetic creatures in the sea. We may think of photosynthesis as the life process of land plants, algae and a variety of other microscopic organisms called phytoplankton had been using photosynthesis long before terrestrial plants appeared. These organisms that reduce carbon dioxide and produce oxygen are generally known as primary producers, a term indicative of their role in creating the necessary environment for more complex life to flourish. Regular phytoplankton sprouts still record for over a large portion of the photosynthesis and resulting climatic oxygen creation on Earth.

Therefore, with the sea exploration, we can learn many new things and new facts. However, the sea is not a friendly environment because the current and pressure will be a challenge for sea exploration. To solve this problem, the development of

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Autonomous Underwater Vehicle (AUV) using depth control is a need to do this exploration. The AUV is using depth control as the main operation because to overcome those challenges, we need an automatic control especially depth as we know that the deeper the sea the higher the pressure and also the current will be much more trouble for the exploration. Hence with this depth control, the stability of AUV to maintain at the specified depth becomes easier.

.

1.3 Problem Statement

The problems with the sea exploration are the waves and current that disturbs the underwater vehicle to do the exploration. In the underwater vehicle industries, the thruster is an essential part of controlling the direction, depth, and speed of the AUV. In any case, there are some AUV that can't be kept up at the specified depth for quite a while as a result of disturbance. Therefore, the development of Autonomous Underwater Vehicle (AUV) depth control is essential to solve this problem.

1.4 Objective

1. To develop an Autonomous Underwater Vehicle (AUV) using depth control system.
2. To design the mechanical structure, electronic circuit, and control of the underwater vehicle
3. To analyse the functionally and reliability of the autonomous underwater vehicle (AUV) in the aspect of depth control.

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1.5 Work scope

In this project, the aim of the design is based on three designs, which are mechanical design, electronic design, and software design.

1.5.1 Mechanical Design

- The body structure is design to submerge in the water and the structure is almost like a submarine. All the electronic devices will be inside of the autonomous underwater vehicle (AUV) body and thrusters to the left and right of the autonomous underwater vehicle (AUV).
- Four thrusters of T100 Blue Robotic is used for z-y axis movement and two DIY thrusters that have been made from Bilge Pump with 1100 GPH power is used for x-axis movement.

1.5.2 Electronic Design

- One Arduino Mega is used as a controller for the system and also connected to thrusters. This Arduino Mega also will control the thrusters with using the PID control.
- One barometric pressure sensor, which is BMP280, will be used. The barometric pressure sensor is used to sense the depth of the AUV because water pressure increases with depth where the water up above weighs down on the water below.

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1.5.3 Software Design

- The Arduino Integrated Development Environment (IDE) software is used to program, code editor, build automation and to debug.
- The Solid Works Software is used to design the body structure of the autonomous underwater vehicle (AUV).

1.6 Conclusion

This chapter is to introduce about the project, which is the development of Autonomous Underwater Vehicle (AUV) using depth control. Sea exploration isn't that simple to accomplish the objective of discovering something new. With technology and engineering innovations, the challenges of exploring the sea will make it easier and also can improve the technology due to the challenges. This development of Autonomous Underwater Vehicle (AUV) using depth control can overcome the challenges of deep-sea exploration. This chapter also discussed the objectives and work scope of this project.

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