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DEVELOPMENT OF SELF NAVIGATOR FOR OPEN WATER SWIMMER

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

by

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APPROVAL

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

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ABSTRAK

Pada masa kini, aktiviti berenang sering dilakukan oleh individu apabila mereka mempunyai masa yang terluang. Walau bagaimanapun, aktiviti ini mempunyai sedikit risiko apabila perenang tidak mempunyai peralatan renang yang sesuai. Salah satu cabarannya adalah perenang sukar untuk terus berenang di landasan untuk mencapai destinasi.. Ini disebabkan ketika seseorang itu sedang berenang, ia amat susah untuk menentukan titik destinasi tanpa melakukan teknik berenang yang betul. Keadaan ini menjadi terhad apabila seseorang perenang itu perlu berhenti sebentar untuk menentukan titik destinasi itu semula. Dalam projek ini, Global Positioning System (GPS), Ublox Neo 6-M telah digunakan untuk menentukan arah tuju yang tepat ke destinasi. Di samping itu, ia juga terdiri daripada sensor magnetometer (HMC5883L) yang menyediakan arah tuju semasa perenang itu. Peranti ini akan menavigasi dan membantu perenang dengan menyediakan sudut tajuk yang betul untuk mencapai destinasi. Semua sistem ini dilakukan oleh mikrokontroller Arduino Mega 2560 untuk mengira jarak antara semasa perenang dan titik destinasi. Ia juga digunakan untuk menentukan sudut tajuk yang betul untuk membantu perenang mencapai titik destinasi. Akhirnya, projek ini dibangunkan untuk membantu perenang kurang mahir untuk melatih teknik renang yang betul.

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ABSTRACT

Nowadays, swimming is one of the sports activities that often adopted by individuals in their leisure time. This activity also is a popular exercise because it contributes all around body developer. Besides that, it also commonly used by people with physical disabilities in their therapy session. However, this activity has little risks whenever a swimmer does not have the proper equipment of swimming. One of the challenges is swimmer are difficult to keep swim on track in order to reach the destinations. This is because a slight imbalance body positioning while swimming can change the heading of the swimmer from destination point. Because of that, its cause them a little time to stop swim as the swimmer need to start lift their head in order to correct the heading direction again. This project was developed to assist a beginner swimmer to reach the destination. In this project, Global Positioning System (GPS) sensor, Ublox Neo 6-M had been used to determine the exact heading to the destination. Additionally, it also consists of magnetometer sensor (HMC5883L) which provide the current heading of the swimmer. This device will navigate and assist the swimmer by provides the correct heading angle to reach the destination. All of these systems are performed by Arduino Mega 2560 microcontroller to calculate the distance between swimmer and destination point. It also determines the correct heading angle to assist the swimmer reach the destination point. Finally, this project was developed to help a less-skilled swimmer in order to trained the right swimming technique.

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DEDICATION

First of all, I am grateful to God S.W.T, because with his grace I can complete the study. Also, the completion of this study could not have been possible without the support from my beloved parents who continuously give me dedication, strength, spiritual and financial support whenever I thought of giving up. I would also like to thank all the many helpful individuals in completing this final project. Without them it is very difficult for me to complete this project.

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I use this opportunity to thank all those who support me throughout the year. I am grateful for their ambition guidance, constructive criticism and friendly advice during the project work. I am grateful that they share the true view and illuminate them on some issues related to the project.

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LIST OF SYMBOLS

Lat	-	Latitude
Lon	-	Longitude
R	-	Radius of earth (average radius = 637100m)
D	-	Distance between two points

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LIST OF ABBREVIATIONS

WHO	The World Health Organization (WHO)
FINA	Fédération internationale de natation (International Swimming Federation)
GPS	Global Positioning System
IMU	Inertial Measurement Unit
EKF	Extended Kalman Filter
UKF	Unscented Kalman Filter
AUV	Autonomous Underwater Vehicle
PID	Proportional–integral–derivative controller
ROV	Remotely Operated Vehicle
IDE	Integrated Development Environment

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Nowadays, the navigation system is a transport guidance that people commonly used in their transportation in order to reach the destination. It also becomes the most important system, because its timesaving and also able to navigate the user to reach the destination efficiently. Be that as it may, there are many people used navigation application on mobile that able to estimate the expected time travelling to the destination.

1.2 Background

The development of navigator for open water swimmer system began from ironman triathlon sports observation. The triathlon sports are consisting of swimming, cycling and running. This project only focuses on the swimming part where to navigate the athlete reach the checkpoint faster. In spite of that, this project also focusses on the beginner athlete to train the correct direction to swim. Open water swimming can be challenging even it is short distance. Traditionally in open water swimming sports, the swimmers are rarely tilt their head out of the water while swimming because it takes time for them to stop and observe the destination point again. Swimmers are often travel based on expected distance without support and rely themselves for navigation.

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1.3 Problem Statement

Recently, the issue of many people died because of drowning is increasing resulting based on the statistic obtained. As reported by journalist Audrey Dermawan (2017), Annually, there were 700 cases of drowning in the country, 500 from the total involved children between the ages from one to 18. The World Health Organization (WHO) reported that, approximately 40 people drowned every hour worldwide, summing up to 372,000 people a year. Also as reported by Hariati Azizan (2018) "Some of the main causes of drowning are neglecting safety precautions when doing water activities and people's lack of swimming skills or even awareness of their own ability in the water," Nik Zulkifli told Sunday Star. He also told that "It founded that mostly the main factor from this cause were because of lack of navigation skills and fatigue". Figure 1.1 shows the statistic of drowning cases in Malaysia from 2015 to 2018. This statistic shows that in 2017, there are 327 persons died mostly on the river and beaches. However in 2018, it shows that there are 225 drowning cases reported which is more decrease than 2017.

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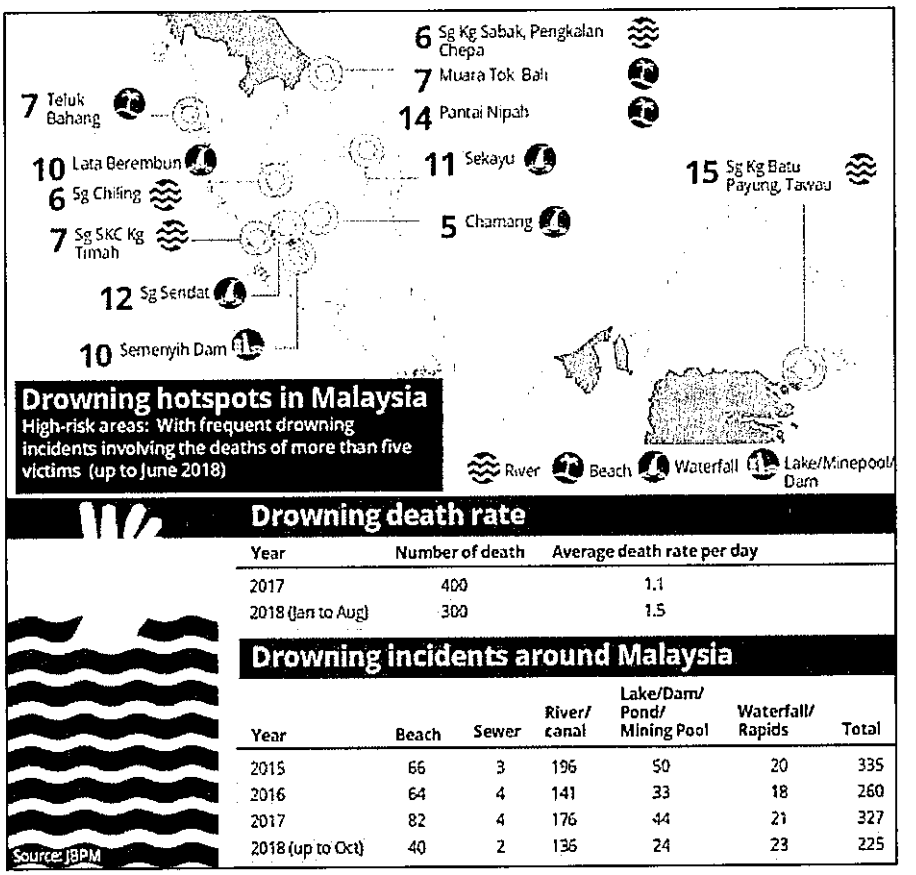

Figure 1.1: The statistic of drowning cases from 2015 to 2018 (Azizan, 2018. Drowning death rising by the year. The Star online, 16 Dec, [online]).

Traditionally, swimming pools are designed for the swimmer so that it easy to them to swim in a straight line. Even though it is wide and provides a dark line on the bottom of the pool to give a reference to the swimmer. The swimming pool only provides a short distance range which only takes 50 meter in length and 2-meter depth (FINA 2013). Unlike open water environment like sea or lake, the swimmer does not have a reference line. Additionally, the swimmer also takes a long period of time to go into the depth of water. In terms of fatigue without a proper device, the swimmer also can be changed the direction which resulting a long time for them to reach the destination.

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1.4 Objective

Based on the problem statements discussed, the objectives of this study are:

i. To develop a self-navigator device for open water swimmer based on heading correction.

ii. To analyze the accuracy in navigation system to reach the destination.

iii. To evaluate the efficiency at the system in providing a correct direction.

1.5 Scope

The scopes of this research are develop based on the objectives that mentioned. This navigation system is built using Global Positioning Sensor (GPS) to determine the coordinate of starting position and destination point. Additionally, the magnetometer sensor is used in order to navigate the heading position lead to the destination. Furthermore, the Bluetooth is used to connect between the device and smartphone to select the destination point. Lastly, Arduino Mega 2560 microcontroller will set as the microcontroller to calculate the travel distance and navigate the swimmer to reach the destination efficiently and precisely.

1.6 Organization

This report is contained by four chapters. Initially, chapter one describing about the issue of drowning cases, objective and scope. Next, chapter two is about the writing literature review of existing methods and comparison of each method based on the previous development. Next, the selection of hardware and methods to be used will be described in chapter three. Lastly, chapter four are basically discuss about the expected result based on the hardware testing.

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