BATHYMETRIC STUDY AT MALACCA RIVER (TAMAN RUMPUN BAHAGIA) USING COMPRESSED HIGH-INTENSITY RADIATED PULSE DEVICE

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JAN 2023

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A thesis submitted in fulfilment of the requirements for the degree of Bachelor of Mechanical and Manufacturing Engineering Technology (BMMV) with Honours

Faculty of Mechanical and Manufacturing Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Jan 2023

DECLARATION

I declare that this Choose an item. Entitled "Bathymetric Study At Malacca River Using Compressed High-Intensity Radiated Pulse" 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.

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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 (Automotive Technology) with Honours.

Signature : ....

Supervisor Name : *Najiyah Safwa Binti Khashi'ie*

Date : 11st Jan 2023

DEDICATION

Every difficult task necessitates both self-effort and the guidance of experts, especially those close to our hearts. First and foremost, I dedicate my endeavour to my dear and loving father and mother. A heartfelt thank you to my parents for their unwavering support and for being a pillar of strength during my ordeal. In addition, I would like to express my greatest appreciation to my supervisor and co-supervisor for constantly guiding and advising me.

Thank you.

ABSTRACT

Bathymetry is a technique used to conduct hydrographic survey or measurement of the depth of water in oceans, rivers, or lakes. Generally, classic bathymetric surveys use a single rope and a single point check and unlike other methods such as employing Light Detection and Ranging (LiDAR) or sonar, it has a drawback which is the capability to only verify a single spot at a time. The aim of this study was to investigate the use of sonar to determine the characteristics of the riverbed of the Malacca River. To obtain the desired data and results, a sonar device model which uses Compressed High-Intensity Radiated Pulse (CHIRP) technology is attached to a boat to properly map the riverbed characteristics and terrain of the river by moving around the river in a specific pattern to achieve the best results. An application is used to monitor the readings of the CHIRP+ sonar using built-in Wi-Fi connection installed within the device. This allows updated reading during the scanning process of the river. The results show the data of the underwater map that shows various characteristics in terms of depth, terrain, erosion, and sediment of the river. The data shown is significant as they can be used to study the river shallowness, potential flooding, aquatic systems, or any further research of the river in the future..

ABSTRAK

Batimetri ialah teknik yang digunakan untuk menjalankan tinjauan hidrografi atau pengukuran kedalaman air di lautan, sungai, atau tasik.Secara amnya, tinjauan batimetri klasik menggunakan tali tunggal dan pemeriksaan titik tunggal dan tidak seperti kaedah lain seperti menggunakan Light Pengesanan dan Ranging (LiDAR) atau sonar, ia mempunyai kelemahan iaitu keupayaan untuk hanya mengesahkan satu titik pada satu masa. Tujuan kajian ini adalah untuk menyiasat penggunaan sonar bagi menentukan ciri-ciri dasar sungai Sungai Melaka. Untuk mendapatkan data dan keputusan yang dikehendaki, model peranti sonar yang menggunakan teknologi Compressed High-Intensity Radiated Pulse (CHIRP) adalah dilekatkan pada bot untuk memetakan ciri dasar sungai dan rupa bumi sungai dengan betul dengan bergerak di sekitar sungai dalam corak tertentu untuk mencapai hasil yang terbaik. Aplikasi digunakan untuk memantau bacaan sonar CHIRP+ menggunakan sambungan Wi-Fi terbina dalam dipasang dalam peranti. Ini membolehkan bacaan dikemas kini semasa proses pengimbasan sungai. Keputusan menunjukkan data daripada peta bawah air yang menunjukkan pelbagai ciri dari segi kedalaman, rupa bumi, hakisan, dan mendapan sungai. Data yang ditunjukkan ialah penting kerana ia boleh digunakan untuk mengkaji kedalaman sungai, potensi banjir, sistem akuatik, atau sebarang penyelidikan lanjut mengenai sungai itu.pada masa hadapan.

ACKNOWLEDGEMENTS

In the Name of Allah, the Most Gracious, the Most Merciful

Above all, I want to thank and praise Allah the Almighty, my Creator and Sustainer, for everything that has been given to me since I began my studies. I would like to thank Universiti Teknikal Malaysia, Melaka (UTeM) for providing me with a good research platform. Thank you to the Malacca Department of Irrigation and Drainage for assisting me in locating the survey area for my analysis. Also, special thanks to Malaysian Ministry of Higher Education (MOHE) for the financial assistance.

Mrs. Najiyah Safwa of the Faculty of Engineering Technology at Universiti Teknikal Malaysia Melaka (UTeM) is my primary supervisor, and I am grateful for all her assistance, advice, and inspiration. Her unswerving patience in mentoring and imparting invaluable knowledge will be remembered forever. And all, to my co-supervisor, Mr. Shikh Ismail, Universiti Teknikal Malaysia Melaka (UTeM) who constantly supported my execution plan for this project. My special thanks go to Dr. Munir for all the help and support I received from him.

Finally, Thank you from the bottom of my heart to my PA, Mohd. Arizam bin Abdul Wahap, for his words of encouragement and advises during my research. I would also like to thank my beloved sister for her endless support, love, and guidance to complete this project. Lastly, thank you to all the individual(s) who had provided me the assistance, support, and inspiration to embark on my study.

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LIST OF SYMBOLS AND ABBREVIATIONS

™	-	Trademark
CHIRP+	-	Compressed High-Intensity Radiated Pulse
LiDAR	-	Light Detection and Ranging
LADAR	-	Laser Detection and Ranging
3D	-	Three Dimensional
SLS	-	Selective Laser Sintering
2D	-	Two Dimensional
m	-	Meter
mm	-	Milimeter
GPS	-	Global Positioning Sensor

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CHAPTER 1

INTRODUCTION

1.1 Background

This chapter provides an overview of the river, its use, and ways to protect it. In addition, this report will include bathymetric analysis in general, covering the project's fundamental idea, problem description, purpose, scope, and predicted outcome.

1.2 Project Overview

River water is a kind of surface water and a component of the water cycle. It can be utilised for domestic purposes, irrigation, industrial processing, or energy generation. In humans, water is essential. Water, for example, is required to give nutrients. Several variables influence the quality and amount of water transported in the river. As a result, water supply has the capacity to ensure that human life quality is maintained.

Bathymetry, or underwater depth measurement, will be used throughout this research. Using the data gathered throughout the investigation, this analysis aids in the creation of an underwater map. A bathymetry chart, on the other hand, is used to aid in the protection of surface and subsurface navigation. It usually shows seabed relief or terrain in the form of contour lines, as well as selectable depths and surface navigational data.

Bathymetry is the measure of the depth of water in oceans, seas, and lakes. Maps of these depths are referred to as bathymetric maps. They are important tools for navigation, fishing, and scientific studies. A weighted rope was lowered over the edge of a drifting vessel in the first approach, which was primitive but successful. The length of the line was measured after the weight had reached the bottom. The process was enhanced over time by employing a tiny wire, which substantially improved the sounding accuracy. The Mariana Trench was discovered in 1875, while the Mid-Atlantic Ridge and Challenger Deep were discovered in 1877, thanks to these basic procedures. Modern lake mapping techniques combine the most advanced echo sounding and global positioning system technologies. Thousands of precise soundings may be collected on even the tiniest of lakes or ponds thanks to technology advancements. A software programme is used to process the data and build the final map. In bathymetric research, ecologists utilise remote sensing Light Detection and Ranging (LIDAR) or Laser Detection and Ranging (LADAR) systems. This is a more sophisticated mechanism than the echo sounder. It travels across the water using sound or light transmission speeds.

1.3 Problem Statement

The Malacca River, which runs through the heart of the city, is famous for its river cruises. The Malacca River is around 40 kilometres long and originates from the Tampin and Batang Melaka rivers. The Malacca River was formerly dubbed the "Venice of the East" by European seamen. Because of the river cruise, the Malacca River has been a major tourist destination in recent years. The river ride takes 45 minutes and covers 9 kilometres. If the river is effectively maintained, it will become a major attraction in Malacca.

The major focus of this paper will be on the following problem statement:

a) There has never been bathymetry research to record the depths and forms of underwater topography to depict the region beneath the Malacca River.

b) The shallow river depth areas that may pose major flash flood threats

c) Due to the CHIRP device location, data retrieval via a remote control boat does not yield precise data.

1.4 Project Objective

The main objective of this project is to estimate the depth and the riverbed of the Malacca River. In detail, the project objectives are as follows:

a) To perform a hydrographic survey on the riverbed of the Malacca River (Taman Rumpun Bahagia) by using a Compressed High-Intensity Radiated Pulse (CHIRP) device.

b) To analyse the depth of the Melaka River (Taman Rumpun Bahagia) as well as the causes of its shallowness

1.5 Project Scope

This project scope was shown below:

a) The CHIRP+ device's accuracy when scanning a 200-meter section of the Malacca River (Taman Rumpun Bahagia) at 675 kHz (a cone angle of 7°).

b) The research was limited to the Taman Rumpun Bahagia district of Melaka.

1.6 Thesis Organization

The first section of this chapter is an introduction. The project overview, which is about bathymetric or underwater depth measurement that will be employed in this project, is discussed in this chapter. Observation, checklists, and questionnaires are used to identify problems. This is followed by the study's objectives and scope, which narrows down the scope of the research. In chapter 2, discuss the fundamental ideas underlying the study issue as well as past studies from journals, books, and the internet. Chapter 3 explains how the project was carried out and how the data was collected. Following the collection of data, it will be analysed and discussed in Chapter 4. The conclusion in the last chapter was formed based on result of the simulation, and offer recommendations for improvement to this project.

CHAPTER 2

LITERATURE REVIEW

2.1 Malacca River

2.1.1 Introduction

Melaka is a historically significant state. Melaka lies on Peninsular Malaysia's west coast, bordering the states of Johor and Negeri Sembilan. From the mouth of the Melaka Straits to Kg. Gadek, the Melaka River is 40.0 kilometres long (intersection of Sg. Batang Tampin with Sg. Batang Melaka). The Melaka River is fed by numerous significant tributaries, including Sg. Putat, Sg. Cheng, Sg. Durian Tunggal, and Sg. Alor Gajah.

Alor Gajah, Jasin, and Malacca Central are the three districts that make up Malacca. Malacca has one reservoir despite having just three districts. Between Alor Gajah and Malacca Central, the Durian Tunggal Reservoir is a 20-kilometer-square reservoir. It provides drinking water to Malacca's population. Public services such as transportation, housing, lodging, drainage, and water supply expand as a community's population grows, resulting in economic development and political change. Cultural and social links, on the other hand, were enhanced, which benefitted the environment, notably the water quality of the Malacca River.

Rivers are essential to both human society and the wider ecosystem, and pollution of those rivers may have a wide range of negative consequences on plant, animal, and human life. The riverine ecosystem both collects and transmits pollution, accumulating organic and inorganic pollutants in ways that harm flora, animals, and human health while. also transferring them to the sea. Aside from the environmental impact, one that should not be overlooked is the economic impact - rivers are a way of life and a source of income for many people, providing income through fishing and aquaculture, and a polluted river will have depleted stocks of fish, crustaceans, and other aquatic life on which some economies rely.

2.1.2 Weather and Rain

The climate in Melaka is consistently hot and humid, with varying levels of precipitation depending on the season. Melaka, one of the driest states in Malaysia, gets slightly under 2,000 millimetres of annual precipitation, whilst the majority of Peninsular Malaysia receives over 2,500 mm. Melaka does not have a dry season, since the average monthly precipitation is more than 100 mm. Melaka is classed as a tropical rainforest climate according to the Koppen climate classification system.

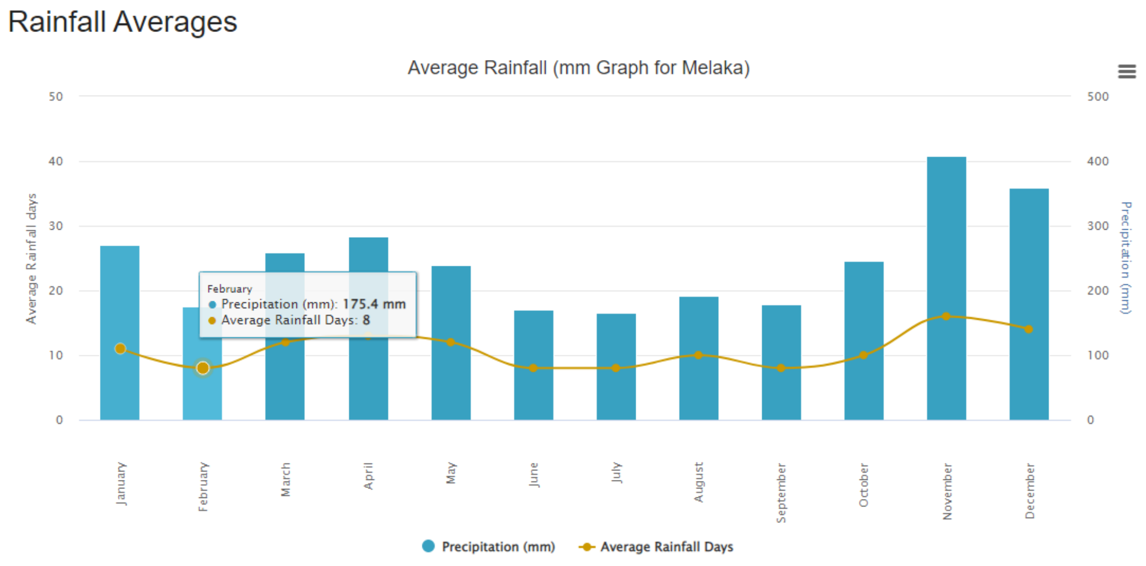

Figure 2.1-1: Average rainfall in Melacca

Melaka has experienced monsoonal flood and flash flood periodically, although the occurrence is categorized as medium type disaster. However, in 2006 the state had to face its worse flood disaster to date, which saw 13,000 people evacuated and damages were estimated at approximately RM54 million. Flooding typically occurs in low-lying areas along the river system and coastal areas. The situation is aggravated further during high tide, as the Melaka River is a tidal river. Flash floods on the other hand occurs when heavy rainfall occurs in a very short period, which strains the capacity of the drainage system to handle the huge volume of runoff.

There are two primary categories of precipitation that might result in flooding: (i) rainfall with a moderate intensity that lasts for an extended period of time and covers a large region; and (ii) rainfall with a high intensity that lasts for only a short time and is concentrated in a specific location. According to flood data, there is also a seasonal pattern of flood occurrences across the nation. Floods mostly impact the east coast and southern parts of Peninsular Malaysia, as well as Sabah and Sarawak in East Malaysia, from December to January, when the Northeast Monsoon is in effect. Flooding happens as a consequence of widespread, sustained heavy rain, which causes a huge concentration of runoff to surpass the capacity of streams and rivers.

During the Northeast Monsoon, significant portions of land are often flooded due to the heavy downpours. On the other hand, flooding in Peninsular Malaysia's west coast is mostly a problem from September to November, when convectional thunderstorm activity is at its peak. Such storms produce brief bursts of very heavy rainfall that severely tax drainage systems and result in localised flash floods. (Department of Irrigation and Drainage, 2016)

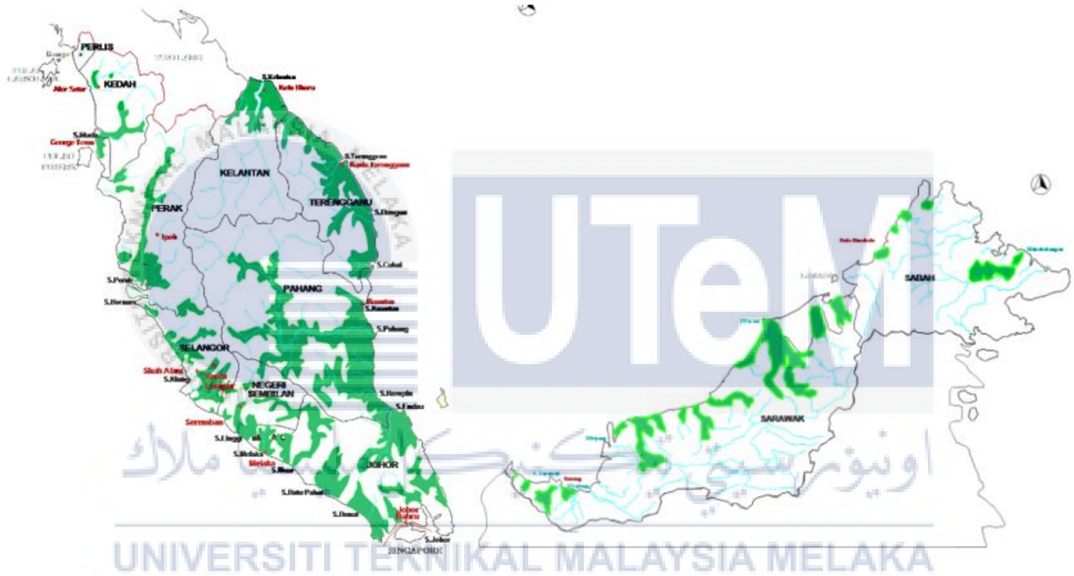

Figure 2.1-2: Flood prone area in Malaysia

2.1.3 Sedimentation and Erosion

The process of erosion starts when soil and rock particles get detached from the surface of the ground by either water or wind. Following their separation from one another, soil particles are carried away by the wind or the water. Climate, soil type, slope length, slope steepness, and the amount of vegetation covering a slope are all factors that influence erosion rates. The risk of soil erosion rises whenever the ground is turned over or otherwise disturbed. Eroded soil particles are often transported by water into streams, which may cause a variety of difficulties due to sedimentation and the presence of suspended solids. It is possible to lessen the damage done to streams by first stopping soil erosion and then halting the movement of soil particles that have been disconnected from the surrounding area.