BATHYMETRIC STUDY AT MALACCA RIVER (PHASE 2) USING COMPRESSED HIGH-INTENSITY RADIATED PULSE DEVICE

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Faculty of Mechanical and Manufacturing Engineering Technology

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A thesis submitted
in fulfillment of the requirements for the degree of
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DECLARATION

I declare that this project entitled “BATHYMETRIC STUDY AT MALACCA RIVER (PHASE 2) USING COMPRESSED HIGH-INTENSITY RADIATED PULSE DEVICE” is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature :

Name : Muhammad Afiq Bin Mohammad Ariff

Date : 18/1/2023

APPROVAL

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 with Honours.

Signature : Najiyah

Name : Dr. Najiyah Safwa Binti Khashi'ie

Date : 18/1/2023

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DEDICATION

To my beloved parents

Mohammad Ariff Bin A Karim

Rosilah Binti Yaakub

Thank you for all support, sacrifices, patient, and willingness to share with me.

To my honoured supervisor,

Dr. Najiyah Safwa Binti Khashi'ie, and all UTeM lecturers.

Thank you for always giving me a guidance and persistent help to complete this project thesis.

ABSTRACT

Bathymetry is a technique for conducting hydrographic surveys. The approach itself is in the process of evolving. A single rope and a single point check are used in classic bathymetric surveys. Furthermore, unlike newer methods such as employing Light Detection and Ranging (LiDAR) or sonar, it has a significant drawback in that it can only verify a single point at a time. The major goal of this research is to determine the depth of the Malacca River (Jalan Plaza Melaka Sentral) and its riverbed. In this project thesis we will design a clamp as a mount to attach the Deeper CHIRP+ device to the RC Boat (Flytec 2011-5). We will perform a hydrographic survey on the riverbed of the Malacca River by using a Compressed High-Intensity Radiated Pulse (CHIRP) device. We also will analyze the data from the CHIRP+ whether it is helping to conduct a bathymetric study. The method we used for this project thesis are designing the product, fabrication of product, data gathering, data processing, and the 3D model Bathymetric Contour Map. Based on the result obtained, the average depth for Malacca River are 1.70 meters for location 1 and 1.56 meters for location 2, where it is sufficient to assure the boat safely cruises across the river. We conclude that the data gathered in the Deeper software demonstrates the smart sonar device's capabilities. The depth of the Malacca River (Jalan Plaza Melaka Sentral) is also sufficient to ensure that the boat can navigate the river securely. As a result, there is still a big chance of a boat accident. The river depth needs to be monitored by Perbadanan Pembangunan Sungai dan Pantai Melaka. Seafloor mapping is a key tool for regulating underwater resource exploration, extraction, and equipment. Hydrographic surveys can also be used to generate an underwater map that allows us to decide what is and is not safe. Bathymetric surveys also help to ensure that ships can maneuver safely and that human-made structures on the ocean floor are secure.

ABSTRAK

Batimetri ialah teknik untuk menjalankan tinjauan hidrografi. Pendekatan itu sendiri sedang dalam proses berkembang. Tali tunggal dan semakan titik tunggal digunakan dalam tinjauan batimetri klasik. Tambahan pula, tidak seperti kaedah yang lebih baharu seperti menggunakan Pengesanan dan Ranging Cahaya (LiDAR) atau sonar, ia mempunyai kelemahan yang ketara kerana ia hanya boleh mengesahkan satu titik pada satu masa. Matlamat utama penyelidikan ini adalah untuk menentukan kedalaman Sungai Melaka (Jalan Plaza Melaka Sentral) dan dasar sungainya. Dalam tesis projek ini, kami akan mereka bentuk pengapit sebagai pelekap untuk memasang peranti Deeper CHIRP+ pada RC Boat (Flytec 2011-5). Kami akan melakukan tinjauan hidrografi di dasar sungai Sungai Melaka dengan menggunakan alat Compressed High-Intensity Radiated Pulse (CHIRP). Kami juga akan menganalisis data daripada CHIRP+ sama ada ia membantu menjalankan kajian batimetri. Kaedah yang kami gunakan untuk tesis projek ini ialah mereka bentuk produk, fabrikasi produk, pengumpulan data, pemprosesan data, dan Peta Kontur Batimetrik model 3D. Berdasarkan keputusan yang diperolehi, purata kedalaman bagi Sungai Melaka ialah 1.70 meter untuk lokasi 1 dan 1.56 meter untuk lokasi 2, di mana ia adalah mencukupi untuk memastikan bot selamat merentasi sungai. Kami membuat kesimpulan bahawa data yang dikumpul dalam perisian Deeper menunjukkan keupayaan peranti sonar pintar itu. Kedalaman Sungai Melaka (Jalan Plaza Melaka Sentral) juga mencukupi untuk memastikan bot dapat mengharungi sungai dengan selamat. Akibatnya, masih terdapat kemungkinan besar kemalangan bot. Kedalaman sungai perlu dipantau oleh Perbadanan Pembangunan Sungai dan Pantai Melaka. Pemetaan dasar laut ialah alat utama untuk mengawal selia penerokaan sumber bawah air, pengekstrakan dan peralatan. Tinjauan hidrografi juga boleh digunakan untuk menjana peta bawah air yang membolehkan kita memutuskan perkara yang selamat dan tidak selamat. Tinjauan batimetri juga membantu memastikan kapal boleh bergerak dengan selamat dan struktur buatan manusia di dasar laut adalah selamat.

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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

CHAPTER 1

INTRODUCTION

1.1 Background

This chapter will cover an overview of the river, its use, and how to preserve. Besides, this report will generally discuss bathymetric analysis, including the project's core concept, the problem statement, objective, scope, and the expected result.

1.2 Project Overview

Since then, the river has been a natural water supply for humans, and it is God's handiwork. As a result, water becomes a crucial component of most species' lives. Most creatures will perish if there is a lack of water. Furthermore, water is essential for people. Water, for example, is required to transport nutrients. Furthermore, it aids in the conversion of food to energy. As a result, water supply has the potential to maintain the quality of human life.

Bathymetry, or underwater depth measurement, will be used throughout this research. Using the data gathered during 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 seafloor relief or terrain in the form of contour lines, as well as selectable depths and surface navigational data.

Bathymetry initially relied solely on depth sounding to determine the depth of the ocean (Gao, 2009). Using a rope or cable over the side of a ship was an older method of bathymetry. This approach, however, is inefficient because it only measures the depth of one place at a time, in addition to ship movements and winds, which cause the rope to drift out of the line and be inaccurate. A bathymetric survey today usually involves the use of an echo sounder mounted on the boat (Kapoor, 1981). The echo sounder transmits a sound signal down to the seafloor, and when it reaches the seafloor's bottom, it returns the signal to the transponder. In bathymetric studies, ecologists use remote sensing Light Detection and Ranging (LIDAR) or Laser Detection and Ranging (LADAR) systems. This is a more advanced version of the echo sounder device. It travels through the water via sound or light speed transmission.

1.3 Problem Statement

The Malacca River, which runs through the heart of the city, is famous for its river cruises. The Malacca River, which flows from the Tampin and Batang Melaka rivers, is around 40 kilometers long. The Malacca River was previously known as the "Venice of the East" by European seamen. Because of the river cruises, the Malacca River has been a major tourist attraction in recent years. The river ride is 45 minutes long and spans 9 kilometers round trip. If the river is effectively maintained, it will become a major tourist attraction in Malacca.

The problem statement that will be mainly focused on here are:

a) For the Malacca River (Jalan Plaza Melaka Sentral), there has been no bathymetry investigation that records the depths and shapes of underwater topography to depict the land below.

b) The shallow river depth locations that could pose a considerable risk of boat accidents are unknown (Fowler and Sørgård, 2000).

1.4 Project Objective

The major goal of this research is to determine the depth of the Malacca River (Jalan Plaza Melaka Sentral) and its riverbed. The project's specific goals are as follows:

a) To design a clamp as a mount to attach the Deeper CHIRP+ device to the RC Boat (Flytec 2011-5)

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

c) To analyze the data from the CHIRP+ whether it is helping to conduct a bathymetric study.

1.5 Project Scope

This project scope was shown below:

a) The accuracy of the CHIRP+ device.

b) Only focusing on the Malacca River (Jalan Plaza Melaka Sentral).

CHAPTER 2

LITERATURE REVIEW

2.1 Background

Based on Figure 2.1, the information gathered for this bathymetric survey from earlier articles or sources will be given in this chapter. The Malacca River will be the focus of this project's literature review.

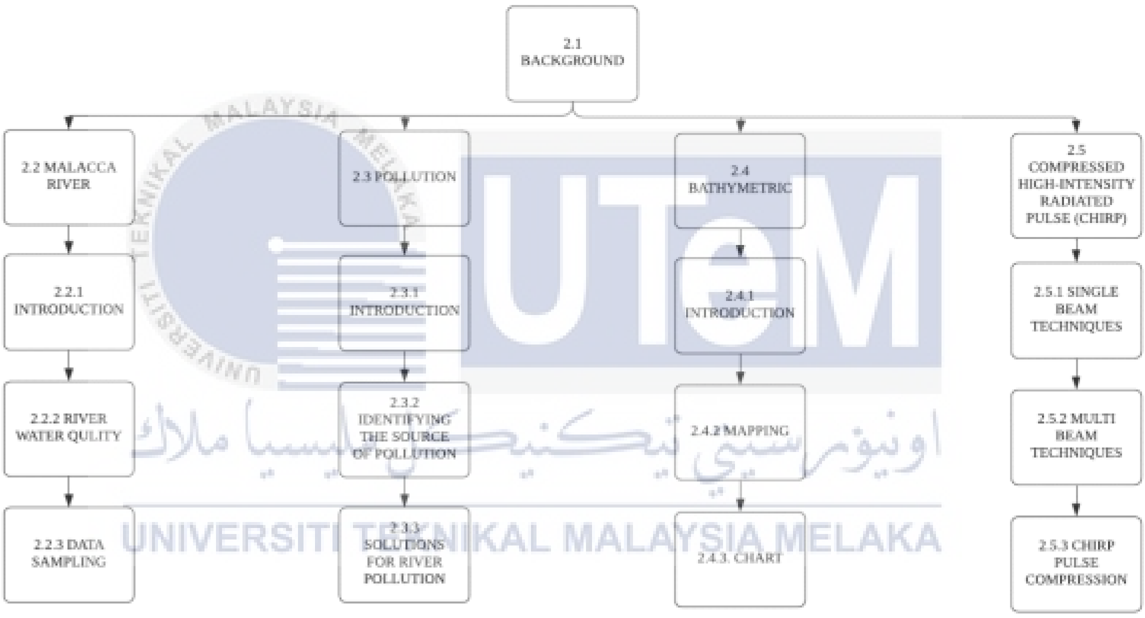

Figure 2.1 Flowchart of Literature Review

2.2 Malacca River

2.2.1 Introduction

Malacca is Peninsular Malaysia's southernmost state. Alor Gajah, Jasin, and Malacca Central are the three districts that make up Malacca. The Malacca River is defined by the watershed's 13 subbasins, according to (A. K. Hua, 2017).

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.

2.2.2 River Water Quality

Land Use Land Cover (LULC) alterations in the Malacca River's water quality detection have already been researched by the researcher (A. K. Hua, 2017). As shown in Figure 2.2, the study determined the river water quality at nine distinct sample stations; they indicated that the data on river water quality was collected from the Malaysian Department of Environment (DOE) (A. K. Hua, 2017).

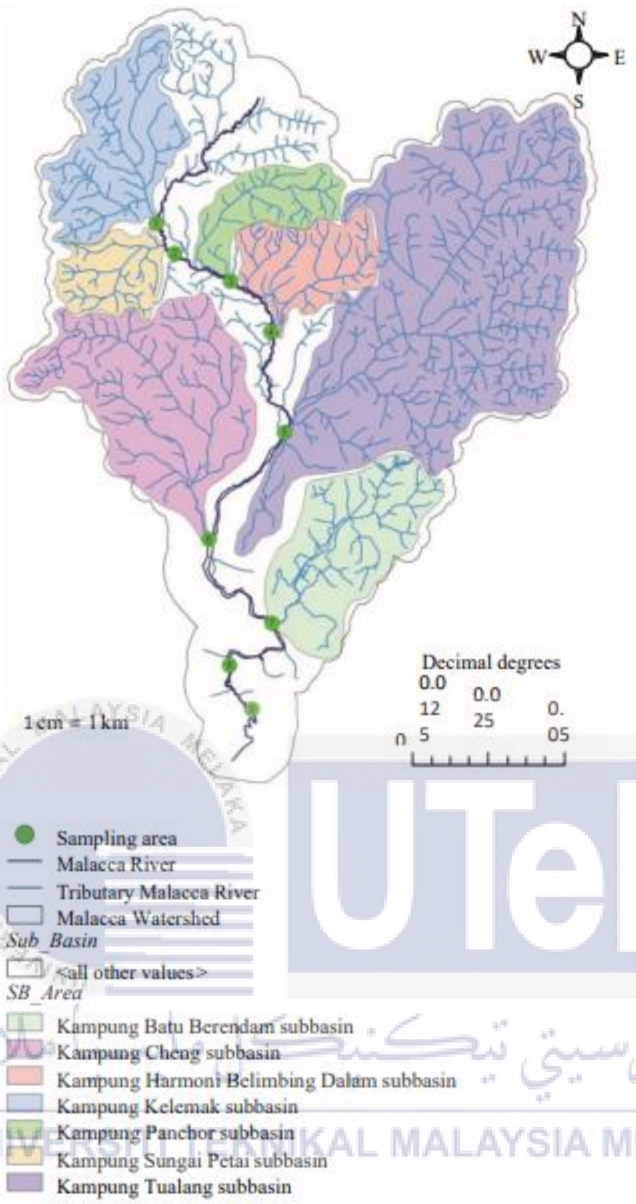

Figure 2. 2 Sampling station and subbasins (A. K. Hua, 2017).

pH, temperature, electrical conductivity (EC), salinity, turbidity, and total suspended particles are used to evaluate river water quality (TSS). They also measured dissolved solids (DS), dissolved oxygen (DO), biological oxygen demand (BOD), chemical oxygen demand (COD), and ammoniacal nitrogen (NH3N), as well as trace elements, in river water (i.e., mercury, lead, and zinc). Table 1 shows the sampling data that led to this result. The study reveals a relationship between LULC and river water quality.

Table 2.2 The changes of LULC based from 2005 to 2015 (A. K. Hua, 2017).

	Total area and percentage						Magnitude change			
Class name	2005		2009		2015		2001-2009		2009-2015	
	km^2	%	km^2	%	km^2	%	km^2	%	km^2	%
Built-up area	196	29.3	245	36.6	337	50.3	+49	+7.3	+92	+13.7
Vegetation	271	40.4	202	30.1	221	33	-69	-10.3	+19	+2.9
Water	138	20.6	97	14.5	30	4.5	-41	-6.1	-67	-10
Open space	65	9.7	126	18.8	82	12.2	+61	+9.1	-44	-6.6
Total	670	100	670	100	670	100	0	0	0	0

As seen in Table 1, there are a few different land use classes. Furthermore, as indicated in Table 2, the percentage of LULC fluctuates over time (A. K. Hua, 2017).

Table 2. 1 Classification of LULC.

Class name	Description
Vegetation	Including all agricultural and forest lands.
Built-up area	All residential, commercial, industrial, and transportation area.
Water	All water bodies (rivers and lakes).

Open space	All land areas that exposed soil and barren area influenced by a human.

To check that classifications are correct, the Kappa test is employed. All elements of the uncertainty matrix can be accounted for using the Kappa Test. Using predefined producer and user-assigned ratings, this test was used to assess the calculation's accuracy which can be

expressed as follows.:

$$K = \frac{P(A) - P(E)}{1 - P(E)}$$

Where:

$$A = \frac{(F-1)}{I} \times 100$$

where A is a percentage of changes, F is first data, and I is reference data.

Each of the four specified categories should earn a minimum of 50 points to enhance the number of accurate analyses. Therefore, based on kappa coefficients of 0.87, 0.85, and 0.90, the average classification accuracy in 2001, 2009, and 2015 was 89.51 percent, 88.49 percent, and 92.21 percent, respectively. The built-up area was 196 kilometers square (29.3%), agricultural was 271 kilometers square (40.4%), water was 138 kilometers square (20.6%), and open space was 65 kilometers square, according to 2001 statistics (9.7 percent). Only the built-up area and open space expanded by roughly 49 km2 (7.3%) and 61 km2 (9.1%), respectively, in 2009, to equal 245 km2 (36.6%) and 126 km2, respectively (18.8 percent). Agriculture and water, on the other hand, were reduced by about 10% and 6%, respectively, resulting in total areas of 202 km2 and 97 km2, respectively. Finally, the built-up area rose by around 13.7 percent, reaching 337 km2. While rural land has grown by 2.9 percent to a total of 221 km2. Despite this, open space areas have reduced by 44 km2, or 12.2%, totaling 82 km2, while water coverage has dropped by 10%, or 67 km2. As a result, a total of 30 km2 of new land is generated (14.5 percent). The river water quality has degraded as a result of rising LULC. This problem was caused by several circumstances.

2.2.3 Data Sampling

Following that, eigenvalues discovered seven PCs that are more significant than a single PC that accounts for 69 percent of variances, as seen in Table 3. Positive dissolved solids, electrical conductivity, and salinity loadings, all of which are related to agricultural operations and contribute to nonpoint source emissions via surface runoff, account for 15.3% of the major component (PC) 1. Pesticides used on oil palm and rubber plantations, as well as livestock husbandry methods by some inhabitants, contribute to the salt contamination of the Malacca River. PC 2 is responsible for a total difference in turbidity and gross suspended material loadings of 10.3%. Human activities such as dredging, water diversions, and channelization could pollute the Malacca River, making it unstable. On the other side, increased land clearing for urban growth and surface runoff contribute to the erosion of road edges in suburban areas near rivers (A. K. Hua, 2017).

Following that, PC 3 showed positive BOD and COD loading, indicating anthropogenic sources, with a high possibility of contamination emanating from sewage treatment plants as point sources. With a 10% overall variance in PC 4 loadings, positive zinc and iron loadings were identified. Zinc pollution arises as a result of the extensive usage of zinc-coated metallic roofing in both urban and rural settings. When subjected to acid rain or smog, it can be mobilized into the atmosphere and rivers. Iron contamination is caused by agricultural operations in most rural areas, but it is caused by industrial