



**REAL-TIME WATER QUALITY MONITORING USING IOT NEAR  
SALTWATER AREA IN SUNGAI MELAKA**



**BACHELOR OF MECHANICAL ENGINEERING TECHNOLOGY  
(BMMV) WITH HONOURS**

**2023**



**Faculty of Mechanical and Manufacturing Engineering  
Technology**



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**Nurul Nadhirah binti Ishak**

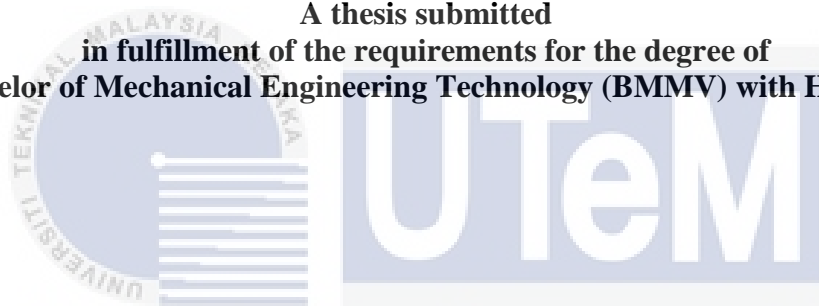
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**NURUL NADHIRAH BINTI ISHAK**

A thesis submitted  
in fulfillment of the requirements for the degree of  
**Bachelor of Mechanical Engineering Technology (BMMV) with Honours**



اونيورسيتي تيكنيكل مليسيا ملاك

**Faculty of Mechanical and Manufacturing Engineering Technology**

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**2023**

## DECLARATION

I declare that this thesis entitled “ Real-Time Water Quality Monitoring Using Iot Near Salt Water Area In Sungai Melaka ” is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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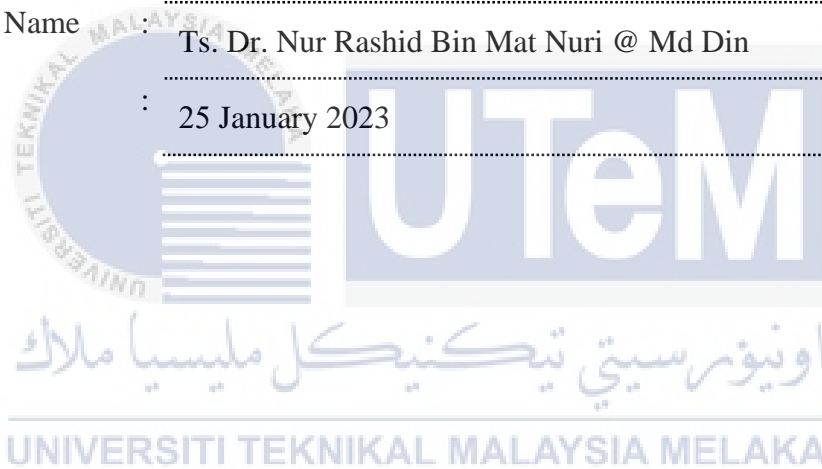
## APPROVAL

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 (BMMV) with Honours.

Signature : 

Supervisor Name : Ts. Dr. Nur Rashid Bin Mat Nuri @ Md Din

Date : 25 January 2023



## DEDICATION

This thesis dedicated to my dearest family especially to my king and queen of heart ,  
Ishak bin Ali and Norhayati binti Abdul Rahman. Not forget to all my friends who give  
endless support throughout this thesis journey. Shout out to my fellow supervisor , Ts. Dr.  
Nur Rashid Bin Mat Nuri @ Md Din for his guidance .



## ABSTRACT

The increasingly rapid development around the city of Melaka has a great impact on the environment. Among the effects that can be seen is water pollution along the Melaka River. This is a bad example because Melaka is a city that is famous as a tourist destination and holds treasures of historical heritage. The Melaka River once experienced a change in color to black and caused the death of a large number of fish. This situation produces an unpleasant smell for the surrounding residents, especially for the tourists who enjoy the scenery along the Melaka river. In order to overcome the problem of water pollution that has occurred, the Hydro Quality System (HydroQS) will monitor water quality through 5 parameters through sensors namely pH, water temperature, dissolved solids, total dissolved solids and turbidity by using Internet of Things (IoT) in the estuary area. Melaka River. As for the casing component, this component consists of 4 parts which are the main body, the float assembly, the solar panel cover and also the camera casing. In addition, HydroQS also has electronic components consisting of an Arduino Uno as a micro controller, a power bank that works as a portable battery that can be used to recharge electronic devices and a solar panel that generates renewable energy from the sun and converts it into electricity to be used to move electrical load. Every component and part of HydroQS is produced using a 3D printing machine SLS Machine Farsoon SS402P. after completing the sintering process, all components will undergo a fitting session to ensure that the parts that have been printed can be installed perfectly. If there are parts that fail during the installation session, those parts need to be reprinted. Before conducting a field study in the study area, HydroQS will perform a pre-test and calibration to measure floatation, leakage and the ability of all sensors to function properly. HydroQS has used polyurethane foam as a material to increase the buoyancy of the HydroQS buoy. This material also acts to hold the shape of the float despite any impact. The design of the float connector is also modified to ensure that no leakage occurs. The HydroQS main body also uses high-performance seals, rubber ring seal gaskets and conventional protective coatings as measures to overcome leakage problems. It is proven that all these preventive measures help to ensure that the main body is free from entering water after soaking. After passing the pre-test, HydroQS will undergo a field study within 24 hours and at hourly intervals and will be calibrated manually to ensure that each component works and takes into account all problems encountered for improvement. All the data that has been collected can be accessed through a device anywhere through an application that has been developed. Through the collection of data that has been recorded by all sensors and comparison with the standards that have been issued by the Malaysian National Water Quality Standard, the water quality of Melaka River is under class IIA .

## ABSTRAK

Pembangunan yang semakin pesat di sekitar bandaraya Melaka memberi impak yang besar kepada alam sekitar . Antara kesan yang boleh dilihat ialah pencemaran air di sepanjang Sungai Melaka . Ini merupakan contoh yang tidak baik kerana Melaka merupakan sebuah bandar yang terkenal sebagai tempat pelancongan dan menyimpan khazanah warisan sejarah.Sungai Melaka pernah mengalami perubahan warna menjadi hitam dan menyebabkan kematian ikan yang sangat banyak . Keadaan ini menghasilkan bau yang tidak menyenangkan kepada penduduk sekeliling terutama bagi para pelancong yang menikmati pemandangan di sepanjang sungai melaka . Bagi mengatasi masalah pencemaran air yang telah berlaku ini , Hydro Quality System (HydroQS) akan memantau kualiti air melalui 5 parameter melalui sensor iaitu pH , suhu air , pepejal terlarut , jumlah pepejal terlarut dan kekeruhan dengan menggunakan Internet Pelbagai Benda (IPB) di kawasan muara Sungai Melaka. Bagi komponen selongsong , komponen ini terdiri daripada 4 bahagian iaitu badan utama , pemasangan pelampung , sarung solar panel dan juga selongsong kamera. Selain itu , HydroQS juga mempunyai komponen elektronik yang terdiri daripada Arduino Uno sebagai pengawal mikro , bank kuasa berfungsi sebagai bateri mudah alih yang boleh digunakan untuk mengecas semula peranti elektronik dan solar panel menjana tenaga boleh diperbaharui daripada matahari dan menukarkannya kepada tenaga elektrik untuk digunakan untuk menggerakkan beban elektrik. Setiap komponen dan bahagian HydroQS dihasilkan menggunakan mesin pencetakan 3D SLS Machine Farsoon SS402P . setelah selesai proses sintering, semua komponen akan menjalani sesi fitting bagi memastikan bahagian yang telah dicetak dapat dipasang dengan sempurna. Sekiranya terdapat bahagian yang gagal dalam proses sesi pemasangan, bahagian tersebut perlu dicetak semula. Sebelum menjalani kajian lapangan di kawasan kajian , HydroQS akan melakukan pra ujian dan kalibrasi untuk mengukur pengapungan, kebocoran dan kebolehan semua sensor berfungsi dengan baik . HydroQS telah menggunakan buih poliuretana sebagai bahan untuk meningkatkan daya apungan pelampung HydroQS . Bahan ini juga bertindak untuk memegang bentuk pelampung walaupun mengalami sebarang hentakan . Reka bentuk penyambung pelampung juga diubahsuai untuk memastikan tiada sebarang kebocoran berlaku . Badan utama HydroQS juga menggunakan pendedap berprestasi tinggi, gasket pendedap gelang getah dan salutan pelindung konvensional sebagai langkah mengatasi masalah kebocoran . Ini terbukti kesemua langkah pencegahan ini membantu untuk memastikan badan utama bebas dari dimasuki air setelah direndam .Setelah melepasi pra ujian , HydroQS akan menjalani kajian lapangan dalam tempoh 24 jam dan sela masa sejam dan akan di kalibrasi secara manual untuk memastikan setiap component berfungsi dan mengambil kira semua masalah yang dihadapi untuk penambahbaikan . Semua data yang telah dikumpul boleh diakses melalui peranti di mana mana sahaja melalui aplikasi yang telah dibangunkan.Melalui pengumpulan data yang telah direkodkan oleh semua sensor dan perbandingan dengan piawaian yang telah dikeluarkan oleh Standard Kualiti Air Negara Malaysia , kualiti air Sungai Melaka di bawah kelas IIA .



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

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## TABLE OF CONTENTS

	<b>PAGE</b>
<b>DECLARATION</b>	
<b>APPROVAL</b>	
<b>DEDICATION</b>	
<b>ABSTRACT</b>	<b>ii</b>
<b>ABSTRAK</b>	<b>iii</b>
<b>ACKNOWLEDGEMENTS</b>	<b>iv</b>
<b>TABLE OF CONTENTS</b>	<b>v</b>
<b>LIST OF TABLES</b>	<b>vii</b>
<b>LIST OF FIGURES</b>	<b>viii</b>
<b>LIST OF SYMBOLS AND ABBREVIATIONS</b>	<b>x</b>
<b>LIST OF APPENDICES</b>	<b>xi</b>
<b>CHAPTER 1 INTRODUCTION</b>	<b>12</b>
1.1 Background	12
1.2 Problem Statement	13
1.3 Research Objective	15
1.4 Scope of Research	15
1.5 Outline of Thesis	16
<b>CHAPTER 2 LITERATURE REVIEW</b>	<b>18</b>
2.1 Introduction	18
2.2 What Is Water Pollution?	18
2.2.1 River Water Pollution in Malaysia	19
2.2.2 River Water Pollution in Melaka River	20
2.3 Past Research Method	21
2.3.1 Traditional method	21
2.3.2 Internet of Things (IoT)	21
2.4 Type of Parameter	22
2.4.1 pH	22
2.4.2 Dissolved Oxygen (DO)	24
2.4.3 Total Dissolved Solid (TDS)	24
2.4.4 Turbidity	25
2.4.5 Temperature	25
2.5 Sensor	26
2.5.1 pH Sensor	26

2.5.2	Dissolved Oxygen (DO) Sensor	27
2.5.3	Total Dissolved Solid (TDS) Sensor	28
2.5.4	Turbidity Sensor	28
2.5.5	Temperature Sensor	29
2.6	Water Quality Monitoring	30
2.6.1	Water Quality Index	30
<b>CHAPTER 3 METHODOLOGY</b>		<b>32</b>
3.1	Introduction	32
3.2	Research Method	32
3.2.1	Research Area	32
3.2.2	Flow Chart	33
3.3	Hydro Quality System (HydroQS)	34
3.3.1	Casing components	34
3.3.2	Sensor components	35
3.3.3	Electronic components	41
3.4	SLS Machine Farsoon SS402P	43
3.4.1	Sintering Process	44
3.4.2	Assemble of casings, sensors, and electronic components	45
3.5	HydroQS Structure Design	47
<b>CHAPTER 4 RESULTS AND DISCUSSION</b>		<b>50</b>
4.1	Introduction	50
4.2	Pre-testing device	50
4.2.1	Float Test	50
4.2.2	Leak Test	52
4.3	Sensor Calibration	56
4.4	Field Test	58
4.5	Data Analysis	59
4.6	Result Comparison with NWQS	63
<b>CHAPTER 5 CONCLUSION AND RECOMMENDATIONS</b>		<b>64</b>
5.1	Conclusion	64
5.2	Recommendations	64
5.3	Limitations	64
<b>REFERENCES</b>		<b>65</b>
<b>APPENDICES</b>		<b>68</b>

## LIST OF TABLES

TABLE	TITLE	PAGE
Table 2.1	Impact of pH level on aquaculture	23
Table 2.2	NWQS Class Definitions	31
Table 2.3	Excerpt of the NWQS for Malaysia	31
Table 3.1	pH sensor specifications	36
Table 3.2	Dissolved Oxygen Sensor Specifications	37
Table 3.3	Total Dissolved Solid (TDS) Sensor Specifications	38
Table 3.4	Turbidity Sensor Specifications	39
Table 3.5	Temperature Sensor Specifications	40
Table 3.6	Power bank	42
Table 4.1	Comparison of buoy design	51
Table 4.2	Comparison in the main body of HydroQS when the leak test is carried out	55
Table 4.3	Display result on Home Assistant	56
Table 4.4	Percentage of error	57
Table 4.5	Data collected in 24 hours	62
Table 4.6	Data Analysis	62
Table 4.7	Comparison with NWQS	63

## LIST OF FIGURES

FIGURE	TITLE	PAGE
Figure 1.1	Melaka River in blackish colour. (ALI, 2022)	14
Figure 1.2	Fish floating and dead in Melaka River. (Ikan mati di Sungai Melaka akibat kekurangan oksigen dalam air, 2022)	15
Figure 2.1	Polluted River in Malaysia	19
Figure 2.2	Fish floating and dead in Melaka River. (Ikan mati di Sungai Melaka akibat kekurangan oksigen dalam air, 2022)	19
Figure 2.3	Condition of Kelantan River	20
Figure 2.4	Malacca River	21
Figure 2.5	The pH scale	23
Figure 2.6	A set of water samples showing increasing turbidity (left to right), as well as changes in colour.	25
Figure 2.7	pH sensor	27
Figure 2.8	Dissolved Oxygen (DO) Sensor	27
Figure 2.9	Total Dissolved Solid (TDS) Sensor	28
Figure 2.10	Turbidity sensor	29
Figure 2.11	Temperature sensor	29
Figure 3.1	Flow Chart	33
Figure 3.2	Design of HydroQS	34
Figure 3.3	Main body	35
Figure 3.4	The buoyancy part	35
Figure 3.5	Analog pH Sensor	37

Figure 3.6 Analog Dissolved Oxygen Sensor	38
Figure 3.7 Analog TDS Sensor	39
Figure 3.8 Analog Turbidity Sensor For Arduino	40
Figure 3.9 Waterproof DS18B20 Digital Temperature Sensor for Arduino	40
Figure 3.10 Arduino Uno	41
Figure 3.11 Pineng PN-899 30,000mah Power Bank	42
Figure 3.12 Solar panel	43
Figure 3.13 Farsoon SS402P Selective Laser Sintering (SLS) machine	44
Figure 3.14 Sintering post process flow using Farsoon SS402P machine	45
Figure 3.15 Fitting session	46
Figure 3.16 Assembly part	46
Figure 3.17 Assembly using binder material	47
Figure 3.18 Main body	47
Figure 4.1 Polyurethane Foam inserted into the PVC pipe	52
Figure 4.2 Floating test at laboratory	52
Figure 4.3 High Performance Sealant	53
Figure 4.4 Rubber O Ring Seal Gasket	54
Figure 4.5 Conventional Protective Coating	54
Figure 4.6 Take sample of saltwater at Malacca River	58
Figure 4.7 Recorded graph for Dissolved Oxygen	59
Figure 4.8 Recorded graph for pH	60
Figure 4.9 Recorded graph for Total Dissolved Solid	60
Figure 4.10 Recorded graph for Turbidity	61
Figure 4.11 Recorded graph for Temperature	61

## LIST OF SYMBOLS AND ABBREVIATIONS

HydroQS	-	Hydro Quality System
DO	-	Dissolved Oxygen
TDS	-	Total Dissolved Solid
IoT	-	Internet of Thing
TMDL	-	Total Maximum Daily Load
DOE	-	Department of Environment
NTU	-	Nephelometric Turbidity unit
mg/L	-	milligrams per liter
WQI	-	Water Quality Index
NWQS	-	National Water Quality Standards
PPSPM	-	Perbadanan Pembangunan Sungai dan Pantai Melaka
Wi-Fi	-	Wireless Fidelity
AM	-	Additive Manufacturing
CAM	-	Computer-Aided Manufacturing
SLS	-	Selective laser sintering
ppm	-	parts per million

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## LIST OF APPENDICES

APPENDIX	TITLE	PAGE
APPENDIX A	NATIONAL WATER QUALITY STANDARDS FOR MALAYSIA & WATER CLASSES AND USES	68
APPENDIX B	GANTT CHART	69





## CHAPTER 1

### INTRODUCTION

#### 1.1 Background

Melaka is a state located in the southern part of Malaysia which has always been the focus of tourists from around the world because it is a historic city recognized by UNESCO on 07 July 2008. The rapid development in the state of Melaka has contributed many advantages and disadvantages to the locals. Among the effects that can be seen are the advantages through wider employment opportunities, business development, investment and more. However, a development can also bring adverse effects to the State of Melaka which will cause environmental pollution. This can be evidenced by the uncontrolled pollution of the Melaka River. This large-scale activity in the Melaka River has resulted in water pollution and river water quality issues.

Rivers are one of the elements of nature that need to be preserved so that its function in the life of creatures remains awake and lasting. It also plays a major role in assimilating urban wastewater as well as in industry and agriculture. The river irrigation system can be affected if the waste disposal is direct or indirect. River pollution is not only caused by waste disposal but also caused by industrial pollutants released recklessly by nearby factories, accidental oil spills, deforestation, urbanization, vigorous agriculture.

Unfortunately, this modernization can have a negative impact on Melaka because it will affect the environment for example is water pollution. This will lead to pollution and impacts on aquatic animals, disrupt the landscape and the production of foul odors, and disrupt human

relationships and the environment. Up to this point, river pollution has continued, and there has been no improvement in terms of positive outcomes (Afroz & Rahman, 2017).

The responsibility in protecting the environment from various types of damage and pollution must be borne by every community to ensure the sustainability of the earth. Water is also no exception in experiencing deck pollution due to activities such as water transportation, fishing, entertainment, dumping of garbage into rivers and many more. This scenario not only poses a risk to aquatic life and water quality, but it also has an influence on human health and the environment. Along with the country's rapid economic development, there are various human activities that, whether purposefully or unintentionally that can contribute to water contamination.

As a result of this issue, the new Hydro Quality System (HydroQS) system was designed and developed to monitor and evaluate river water quality implementing a new development river monitoring system. This system measures river water quality in terms of pH level, Total Dissolved Solids (TDS), Dissolved Oxygen (DO), turbidity, temperature of the surrounding environment. All five sensors that will be used are based on Arduino and can be linked and monitored through the application or online using the device. There are many studies that have been conducted previously on the water quality of the Melaka River by various parties. Nevertheless, all studies conducted were only monitored over a short period of time. The results of the study could not be continued in the future because there is no regular maintenance and observation.

## **1.2 Problem Statement**

Water is an essential element in human life to be used in daily use, meeting the needs of industry as well as ecosystems. The water component can consist in terms of liquids, solids, and gases (moisture). Clean and safe water sources are the main features that are emphasized so that there are no side effects to humans and other living things. Among the sources of natural

water are rivers, seas, lakes. Rivers play a role in bringing out municipal and industrial wastewater from agricultural areas. However, the river system often suffers from water pollution problems because of uncontrolled human activities. The Melaka River is also not excluded in the list of rivers in Malaysia that also receive the effects of water pollution.

A few of the main sources of water contamination is the state of Melaka's modernization. This is obvious through the improvements in water quality that have occurred because of the modernization efforts that are currently being conducted out without of any limitations or obstructions. As seen in Figure 1.1, the river water becomes more polluted, blackish, and releases an unpleasant stench. The Melaka River is a popular tourist destination, thus this scenario quite terrible to present to tourists.



Figure 1.1 Melaka River in blackish colour. (ALI, 2022)

An additional, industrial growth, growing population as well as uncontrolled land use produce large amounts of silt in rivers also lead to water pollution. Such activities cause soil erosion to water. As a result, there is an increase in material mixing, higher turbidity levels, and issues with river sedimentation. Environmental and ecological systems may be harmed because of the pollution that is being created, as well as human health. The presence of dead fish was one of the many conflict issues brought about by this environmental situation. Due to the low levels of dissolved oxygen in the Melaka River, several examples of hundreds of wild marine and

freshwater fish floating and dead in the river have been recorded due to the river. These examples are illustrated in Figure 1.2.



Figure 1.2 Fish floating and dead in Melaka River. (Ikan mati di Sungai Melaka akibat kekurangan oksigen dalam air, 2022)

### 1.3 Research Objective

In order to accomplish the overall objective of the study paper, which is to monitor the water quality in the Melaka River, the following more particular objectives have been emphasized throughout the thesis:

- a) To pre-test the HydroQS body and sensor calibration
- b) To monitor the of saltwater quality at Melaka River.
- c) To analyze the data collection results according to the measured parameters and compare to NWQS standard.

### 1.4 Scope of Research

The scope of this research are as follows:

- a) This study is to focus on monitoring the sample water quality of the Melaka River in terms of parameters such as pH, turbidity, temperature, total dissolved solids, and dissolved oxygen.
- b) This study will be implemented using low-cost devices integrated with the Internet of Things (IoT) to facilitate remote monitoring the parameters by users.

- c) This study aims to observe changes in sample water quality in the Malacca River within a specified period of time.
- d) This study covers near saltwater area in the estuary of the Melaka River.
- e) This study aims to monitor water pollution that occurs in the Melaka River and control the deterioration of water quality.

## 1.5 Outline of Thesis

The following are the five chapters that represent this thesis:

### 1. First Chapter: Introduction

This chapter provides an overview of river water contamination in the Melaka River. This chapter also focuses on the issue statement that functions as a contributing element to water pollution in the Melaka River. In the objectives and scope of study, this will be presented in detail and precisely. The following chapters contain literature reviews and previous study findings

### 2. Second Chapter: Literature Review

The findings of previous studies on river water quality monitoring, particularly in terms of physical characteristics, will be summarized in the literature review. The methodology' concepts, fundamental methods, and techniques will be discussed.

### 3. Third Chapter: Methodology

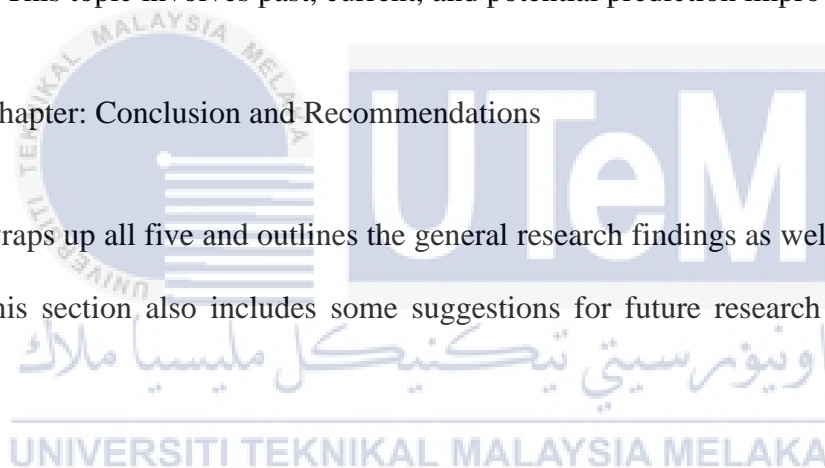
The methodology section will explain the research methodology that includes primary and secondary data collection. The collection and analysis of data for river water quality is presented along saltwater area

### 4. Forth Chapter: Results and Discussion

This chapter describes the study's main findings. This begins with a discussion and analysis of the Malacca River's water quality evaluation. The findings parameter is then obtained across the study area. This topic involves past, current, and potential prediction improvements.

### 5. Fifth Chapter: Conclusion and Recommendations

This chapter wraps up all five and outlines the general research findings as well as the study's conclusion. This section also includes some suggestions for future research that might be improved.



## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 Introduction

This chapter includes background research and a literature review throughout the whole project, utilizing articles, book reviews, and journals as sources. This chapter will concentrate on water pollution challenges, as well as the materials that will be utilized for HydroQS housing utilizing an SLS 3D printing machine and water quality monitoring product. This section will explain in more detail, and it will be easier to understand the whole project with the help of literature review and make project related assessment.

#### 2.2 What Is Water Pollution?

Water is one of the most important natural resources that has been bestowed on human beings. However, rivers are not exempt from pollution. Rivers can be classified into three groups based on the level of pollution, namely low, medium, and high. The rapid growth of civilization and countless human activities have accelerated pollution and the deterioration of water supply (Pujar et al., 2020). Apart from that, the cause of freshwater shortage is the pollution of water resources caused by wastewater discharge and garbage disposal into it as well as natural causes such as acid rain as example shown in Figure 2.1. (Vasudevan & Baskaran, 2021). Water pollution also occurs when organic and inorganic compounds, as well as biological compounds, accumulate to hazardous amounts and contaminate water (Manisalidis et al., 2020).



Figure 2.1 Polluted River in Malaysia

### 2.2.1 River Water Pollution in Malaysia

The issue of river pollution in Malaysia is no longer a small issue. It needs to be curbed and addressed from an early stage so as not to get worse and affect the ecosystem. Figure 2.2 shows some of the rivers in Malaysia that have experienced water pollution. Heavy metals are released into the aquatic environment because of a variety of human-induced activities such as chemical manufacture, mining, municipal effluents, and other human-induced activities. Chemical industry, urban effluents, and other industrial pollution along of the Perak River have all led to the heavy metal contamination of this water supply (Salam and colleagues,2019)



Figure 2.2 Fish floating and dead in Melaka River. (Ikan mati di Sungai Melaka akibat kekurangan oksigen dalam air, 2022)

The Kelantan River in Figure 2.3 is vital to the local people's and government's economies since it is used extensively for residential purposes, agriculture, harvesting, and industry. According to geographical analysis, the state of Kelantan had an increase in land use changes,