Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF WATER SURFACE CLEANING ROBOT AND TRASH MONITORING VIA INTERNET OF THINGS (IOT)

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DEVELOPMENT OF WATER SURFACE CLEANING ROBOT AND TRASH MONITORING VIA INTERNET OF THINGS (IOT)

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DEDICATION

I want to express my gratitude to my loving parents for all that they have done for me. Without their encouragement, I would not have progressed to the Bachelor's Degree level. Their willingness to invest money in my education provided me with the urge to pursue a degree at UTEM.

ABSTRACT

Rivers are essential to both nature and human society in Malaysia. Along rivers, major cities have also grown drastically and flourished. Rivers also used to provide some food and supply the drinking water in our daily life. And though we are not permitted to dump garbage into the trench or river, we can see a lot of trash floating in the channel, river, and sea. Therefore, this causes river pollution and harms the organism. Due to this problem, the Water Surface Cleaning Robot with Trash Monitoring System is proposed to overcome the pollutions problem. The robot can manoeuvre on the water surface and monitor the trash on the water surface by using an ESP32-WiFi camera via IoT. The movement of the robot is done by controlling the thruster by using an RC transmitter. The robot can collect the trash by using the servo motor that is also controlled by the RC transmitter. The ESP32 will be used as the main controller in the system. The motor driver will be used to control the thrusters. Besides, there is a load cell to measure the weight of the trash and an infrared proximity sensor to measure the level of the trash inside the container. Then, the reading of the sensors can be monitored via IoT. Lastly, the efficiency of the system in collecting and monitoring the trash on the water surface will be analysed.

ABSTRAK

Sungai sangat penting bagi alam semula jadi dan manusia di Malaysia. Di sepanjang sungai, bandar-bandar utama juga membangun secara drastik dan berkembang. Sungai juga sebagai sumber makanan dan minuman dalam kehidupan seharian kita. Walaupun kita tidak diizinkan membuang sampah ke parit atau sungai, kita dapat melihat banyak sampah terapung di saluran, sungai, dan laut. Jadi, ini menyebabkan pencemaran sungai dan membahayakan organisma. Oleh kerana masalah ini, Robot Pembersihan Permukaan Air dengan Sistem Pemantauan Sampah diusulkan untuk mengatasinya. Robot boleh melakukan pergerakan di permukaan air dan memantau sampah di permukaan air dengan menggunakan kamera ESP32-WiFi melalui IoT. Pergerakan robot dilakukan dengan mengawal pendorong dengan menggunakan pemancar RC. Robot dapat mengumpulkan sampah dengan menggunakan motor servo yang juga dikendalikan oleh pemancar RC. ESP32 akan digunakan sebagai pengawal utama dalam sistem. Pemacu motor akan digunakan untuk mengawal pendorong. Selain itu, terdapat sel beban untuk mengukur berat sampah dan sensor jarak inframerah untuk mengukur tahap sampah di dalam bekas. Kemudian, pembacaan sensor dapat dipantau melalui IoT. Akhir sekali, kecekapan sistem dalam mengumpul dan memantau sampah di permukaan air akan dianalisis.

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LIST OF SYMBOLS

LIST OF ABBREVIATIONS

DOE	-	Department of Environment
GPS	-	Global Positioning System
IoT	-	Internet of Things
LAN	-	Local Area Network
LiPo	-	Lithium Polymer
MCO	-	Movement Control Order
USB	-	Universal Serial Bus

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CHAPTER 1

INTRODUCTION

1.1 Background

Malaysian authorities have implemented the Movement Control Order (MCO) due to the novel coronavirus (COVID-19) Pandemic. On March 18, 2020, when the number of cases reached 790, implementation started. The Movement Control Order (MCO) is a restrictive practices order implemented under the Prevention and Control of Infectious Diseases Act 1988 and the Police Act 1967. However, the implementation of MCO proved to be a blessing in disguise for the environment. Because of the decrease in social and industrial activity, the rivers are cleaner and more transparent than previously. Humans use rivers for irrigation in agriculture, transportation, electricity generation from hydroelectric dams, and recreational activities. River water contamination is a severe crisis in Malaysia due to urbanisation and modernisation, and it harms the quality of water supplies. The river water quality from 2008 to 2017 chart is shown in Figure 1.0.

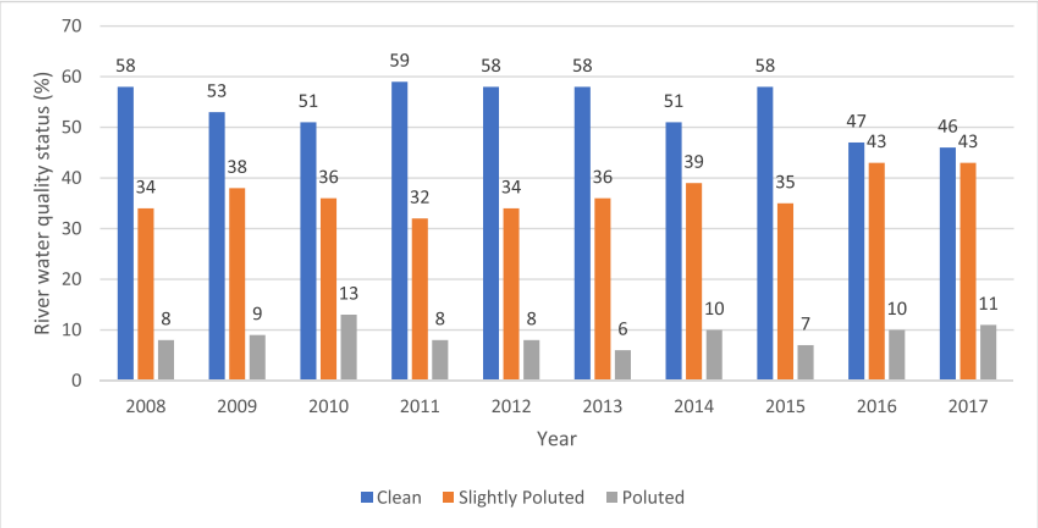

Figure 1.0 River water quality from 2008 to 2017.

Rivers are essential to both nature and human society in Malaysia. Along rivers, major cities have also grown drastically and flourished. Rivers also used to provide some food and supply the drinking water in our daily life. Besides that, the rivers also act as a source of tourist attraction, for example, the Melaka River. During the MCO time, the Melaka River became the talk of the town due to its cleaner, fresher water. Previously, the water of the Melaka River was muddy and had a brown-like hue. The lack of activity in the area and along the Melaka River during the MCO caused this situation. Malaysia has 356 small and short rivers and 117 main rivers. Regrettably, they are becoming more contaminated. The Department of Environment (DOE) tracked 186 rivers (or 39%) that were lightly polluted and 244 rivers (or 52%) that were clean. The most polluted rivers are those found in city areas. It is made up of high-polluting substances originating from various sources, including wastewater treatment plants, industries, and industrial enterprises. As a result, a remotely controlled water surface cleaning robot with a monitoring system for river cleaning will help to minimise the amount of trash or wastewater plants in the river. By controlling the cleaning robot to track and collect the garbage, the trash or waste product can be reduced or cleaned. Besides, to have real-time vision, the robot incorporates a monitoring camera, which helps the user see the surrounding area and more accurately capture waste from a distance. This surface vehicle contributes to the reduction of ecosystem imbalance, human health problems, and emissions.

1.2 Problem Statement

Nowadays, there are still issues related to river and sea pollution in the era of technologies due to human's irresponsible attitude. And though we are not allowed to dump garbage into the trench or water, we can see a lot of trash floating in the trench, river, and sea. When we dump waste into the water, it causes the river to become polluted and smelly, which is a serious concern. It may also harm the organism living in the river. However, the cleaning process needs human intervention to clean up the trash manually, which the solution is not efficient. It becomes more difficult if the floating trash is hard to reach and locate by humans since the trash is pushed away from the shoreline. Rivers are also important sources of food and drinking water for humans. As a result, we must reduce waste and garbage in the river. Thus, the water surface cleaning robot with trash monitoring is developed to tackle the problem in the river, which is a remotely controlled surface robot to gather waste that floats on the river. Furthermore, the water surface cleaning robot can make the cleaner's job easier when removing trash from the river.

1.3 Project Objective

a) To design and develop the water surface cleaning robot and trash monitoring system using a microcontroller based on IoT.

b) To analyze the weight and level of the trash using a monitoring system via IoT.

c) To construct the robot movements and trash collector mechanism using a controller based on an RC transmitter.

d) To evaluate the cleaning robot system in collecting and monitoring the trash by testing the robot system on the water surface.

1.4 Scope of Project

This project involved the development of a water surface cleaning robot. The scope of this project are as follows:

a) The robot can maneuver on the water surface and monitor the trash on the water surface using an ESP32-Wifi camera via IoT.

b) The thruster will control the movement of the robot by using an RC transmitter. The motor driver will be used to manage the thrusters.

c) The robot can collect the trash by using a net. The servo motor does the collecting trash mechanism.

d) There will be a load cell to measure the weight of the trash and an ultrasonic sensor to measure the level of the trash inside the container. The reading of the sensors will be monitored via IoT.

e) The project's main controller will be an ESP32 module.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter will discuss the studies from previous research related to the river cleaning robot. The topic to be reviewed is the robot's application and method and comparing the various types of design. Besides, this chapter also examines previous study limitations and collects ideas to decide which is the best method for developing a water surface cleaning robot.

2.2 Review on River Cleaning Robot

A robot is an automated machine capable of performing complex tasks rapidly and accurately with little to no user intervention. Besides that, it is a machine that can be operated automatically or controlled manually using a remote control. In addition, the engineering field of design, development and operation of robots is robotics.

Many previous related projects have been done recently. Based on Mohammed *et al.*, (2020) research paper, a River Cleaning Robot development has been done experimentally and simulated to obtain a wide range of waste, including gliding litters, rubbish, logs, and tyres. It would increase the desire and need for a river cleaning machine to clean and solve current problems and pollution from rivers, channels and lakes. This robot can work without human intervention or manually controlled through a remote control linked through wireless devices. In this paper, for the mechanical design, the main robot body has a shape like tube design. This design is considered to allow robots to float on the water. Propellers are attached to two DC motors using a belt to operate with an upward and

backward switch. Next, to store the collected waste, a trashcan is used to place the trash after it has been delivered by the conveyor and guided by the front slab. The front slab is used to guide and load waste into the conveyor so that the waste can be moved to trash cans. Moreover, the ultrasonic sensor will be used to monitor the level of the trash in the trash can. The propeller rotates on the axle shaft, allowing the robot to travel correctly. Then, at the back of the robot's body, a solar cell is used to extend the battery's life. At the same place, under the solar cell, there is the robot's main control consists of batteries, a microcontroller and cables for connecting the DC motor. After studying this research, this project's limitation is that the battery cannot hold longer without the solar cell after studying this research. This is because the conveyor mechanism is continuously running, which consumes more power usage. Figure 2.0 shows the proposed final design of the robot.

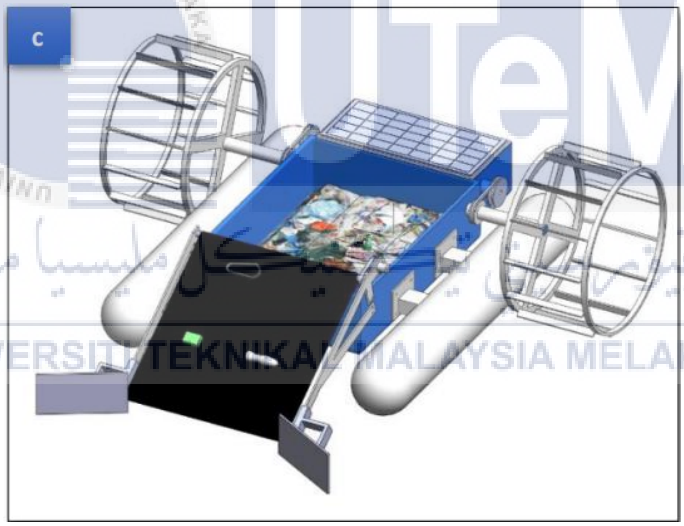

Figure 2.0 The final design of River Cleaning Robot

Ruangpayoongsak, Sumroengrit and Leanglum, (2017) have presented the Floating Waste Scooper Robot (FWSR) with two separate waste scooper prototypes, which also the robot's structure, mechanisms and control is clarified. For example, the waste collection is investigated by enabling only one or both scoopers or adjusting conveyor belt speeds and driving speeds of the robot. The FWSR is intended to replace work-cleaning waste on city drains, lakes, ponds or pools. The robot comprises two propellers that fix the front bumper,