Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF WATER SURFACE ROBOT FOR WATER MONITORING VIA INTERNET OF THINGS (IOT)

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Bachelor of Electrical Engineering Technology (Industrial Automation & Robotics) with Honours

2021

DEVELOPMENT OF WATER SURFACE ROBOT FOR WATER MONITORING VIA INTERNET OF THINGS (IOT)

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A project report submitted
in partial fulfillment of the requirements for the degree of
Bachelor of Electrical Engineering Technology (Industrial Automation & Robotics) with Honours

Faculty of Electrical and Electronic Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2021

UNIVERSITI TEKNIKAL MALAYSIA MELAKA
FAKULTI TEKNOLOGI KEJUTERAAN ELEKTRIK DAN ELEKTRONIK

BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek : DEVELOPMENT OF WATER SURFACE ROBOT FOR WATER MONITORING VIA INTERNET OF THINGS (IOT)

Sesi Pengajian : 2021/2022

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DECLARATION

I declare that this project report entitled "DEVELOPMENT OF WATER SURFACE ROBOT FOR WATER MONITORING VIA INTERNET OF THINGS (IOT)" 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	:	
Student Name	:	MUHAMMAD NAJMI ASYRAFF BIN AHMAD NAZRI
Date	:	11/01/2022

APPROVAL

I hereby declare that I have checked this project report and in my opinion, this project report is adequate in terms of scope and quality for the award of the degree of Bachelor of Electrical Engineering Technology (Industrial Automation & Robotics) with Honours.

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Supervisor Name : TS. DR. SUZIANA BINTI AHMAD

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DEDICATION

Dedication and appreciation towards my parent, lecturers, friends and my siblings for their encouragement, support, understanding and help in completing this final project.

ABSTRACT

Water is a valuable resource for human. Therefore, water resources must be preserved and taken care of so that they are not contaminated with harmful substances such as chemicals released by factories or from other sources. To conserve water resources, data need to be taken from those water sources either through traditional means by collecting data manually or with current technology in an automatic way. This project is capable of collecting data automatically because it uses various sensors. The sensors used are pH, temperature and turbidity. This project can be controlled using IOT platform. ESP 32 is used as a microcontroller in this project. The hardware consist of MDD10A motor driver, two underwater motor and lithium polymer battery. Finally, to control and retrieve data, coding from Arduino IDE is used.

ABSTRAK

Air merupakan sumber yang berharga buat manusia. Maka dengan itu sumber air perlu dipelihara dan dijaga agar tidak tercemar dengan bahan yang merbahaya seperti bahan kimia yang dilepaskan oleh kilang mahupun dari sumber lain. Untuk memelihara sumber air, kita perlu mengambil data daripada sumber air tersebut sama ada melalui cara tradisional dengan mengumpul data secara manual mahupun dengan teknologi semasa dengan cara automatik. Projek ini mampu mengumpul data secara automatik kerana menggunakan pelbagai penderia. Penderia yang digunakan merupakan pH, suhu dan kekeruhan. Projek ini dapat dikawal menggunakan IOT. ESP 32 digunakan sebagai pengawal mikro di dalam projek ini. Projek ini juga terdiri daripada MDD10A pemandu motor, dua motor bawah air dan juga bateri lithium polimer. Akhir sekali, untuk mengawal dan mendapatkan data, pengkodan daripada Arduino IDE digunakan.

ACKNOWLEDGEMENTS

First and foremost, praise to Allah SWT whose give me an ability and strength for completing my FYP to develop an DEVELOPMENT OF WATER SURFACE ROBOT FOR WATER MONITORING VIA INTERNET OF THINGS (IOT).

I would like to express my gratitude to my supervisor, TS. DR. SUZIANA BINTI AHMAD the precious guidance, words of wisdom and patient throughout this project.

My highest appreciation goes to my parents, and family members for their love and prayer during the period of my study.

Finally, I would like to thank all the staffs at UTEM, fellow colleagues and classmates, the Faculty members, as well as other individuals who are not listed here for being co-operative and helpful.

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CHAPTER 1

INTRODUCTION

1.1 Background

Water is an essential need for human life and the availability of good quality or clean water is important so that water-based disease can be prevent. During Movement Control Order (MCO) that have been implement by authorities due to pandemic outbreak (COVID-19), the water quality at river in Malaysia has been improved. It is because of the decrease in industrial sector activity. The water quality in the river improved significantly as reported by media. The river that has been report is Gombak river, Klang river, Way river, Kemunsing river, Melaka river and Kim Kim river. Before MCO, the river mention is cloudy and some of them appear blackish. As example, river around urban area such as Selangor that are contaminate always appear cloudy if not blackish. It happen because the waste from industrial and human as well. Melaka river can be seen cleaner and greener during MCO due to decrease in tourist activity such as Melaka River Cruise.

Due to concern on our river and water source, this project can be use to monitor the water quality by using sensors such as pH sensor, turbidity sensor and temperature sensor. The data collect from the sensor then can be monitor through Internet of Things (IOT). This project using IOT equipped with sensor to measure the water quality from the water environment.

1.2 Problem Statement

Nowadays even in modern era, issue related to water pollution still exist. All of this happen because of human attitude such as selfish and greedy. The waste from factory directly dumped into the river is a great example because it happen again and again in our beloved country, Malaysia. At some area, it is hard to get sample from the river. So this project will be handy because it can be used to maneuver on water surface and at the same time it will collect data from the river. Some researcher might need data to be collect in the middle of the river, it will be difficult without a boat so this project can be use in that situation.

1.3 Project Objective

The main purpose of this project is to develop the unmanned water surface robot that can be control and monitor through internet of things (IOT). Specifically, the objectives are as follows:

a. To develop the water surface robot system for water quality monitoring using microcontroller based on Internet of Things (IOT).

b. To analyze the PH, turbidity and temperature of the water using sensors via IOT.

c. To construct the robot movements by controlling the thrusters via IOT.

d. To evaluate the water surface robot system by testing in different water quality.

1.4 Scope of Project

This project involved the development of a water surface robot. The robot can maneuver on the water surface and monitor the PH, turbidity and temperature of the water via IOT. To complete the task, pH sensor is use to monitor pH level, turbidity sensor is use to monitor turbidity level and temperature sensor is use to monitor temperature of the water. The movement of the robot is done by controlling the thruster through IOT platform. ESP32 will be used as the main controller and motor driver will be used to control the thrusters. To evaluate the water surface robot system, the sensors are dip in different water sample. For temperature sensor, the test are conduct by dipping the sensor in water sample with different temperature. For pH sensor, the test include vinegar, lime, drinking water, soap, pH4 and pH7 solution. for turbidity sensor, it is tested by dipping in water sample from muddy water, lake, soap, rain water and drinking water.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In today's modern society, the technology has evolved more and more. The evolved technology can be use in various place let it be around us and as far as space and as deep as sea. The various technology has taken people to space and deep sea, it all happen because technology has evolved. By using technology also we can connect with people around the globe with the help of internet and smartphone or laptop. So, by the help of technology people can research and develop interesting project. Also, by the help of technology, this project which is water surface robot is possible to complete and working as we need. To complete this project, ten research has been made to identify how other researcher build their robot or project.

2.2 Previous related paper

Many related research paper have been done in order to complete this project. The first research paper in the list is the project that are researched and build by student from Indonesia (Wibowo *et al.*, 2018). In this project, Arduino mega and wireless telemetry has been used. It work by gathering data using wireless sensor network along Field Programmable Gate Array (FPGA) and ZigBee. The hardware consist of GPS sensor (NEO-M8), pH sensor, turbidity sensor, temperature sensor, dissolve oxygen sensor (DO) and motor pump. In future development, the coordinate of the location might be needed so the GPS sensor is used for that purpose. Temperature sensor will collect temperature data of water in location chosen. The temperature sensor code DS18B20 is a digital thermometer measures the temperature of Celsius 9-bit to 12-bit. Turbidity sensor (analog) is used to provide data on water density. This sensor related to the ability of sunlight that able to penetrate water. As example, sunlight cannot penetrate cloudy water. For some ecosystems, this sunlight is critical. The acidity level of a water can be measured using a PH sensor. This level of acidity is also linked to the ecosystem. The dissolved oxygen sensor (DO) is used to calculated important variable in water quality analysis. Aquatic organisms will have difficulty breathing if there is a lack of dissolved oxygen in the water. Motor pump is used to control direction of the vehicle. Figure 2.1 and 2.2 show block diagram system and ASV.

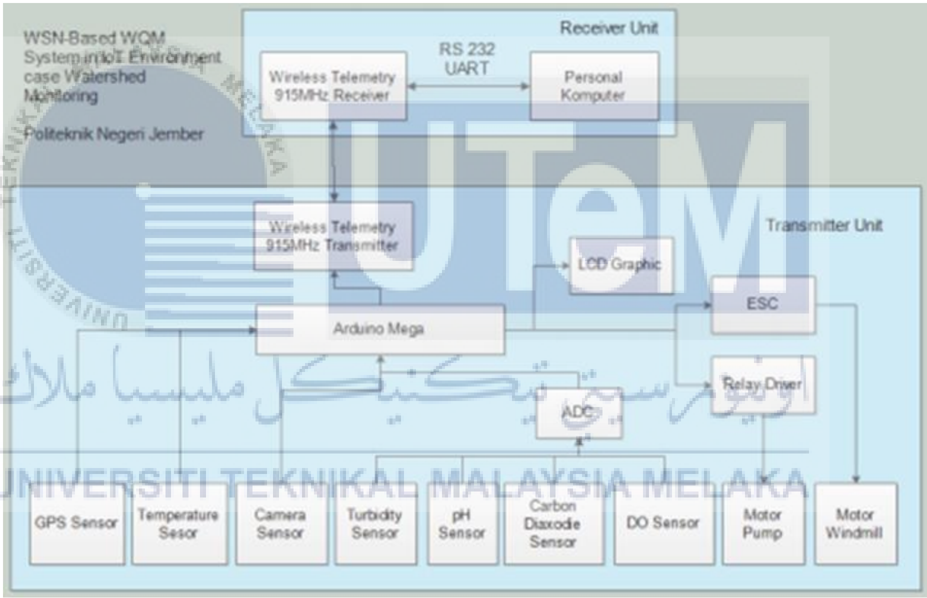

Figure 2.1 Block diagram system

Figure 2.2 Low-cost Autonomous Surface Vehicle (ASV)

Next research in the list is the researcher from Indonesia that point the pollution of the Citarum watershed in Indonesia (Lestari *et al.*, 2019). They have design IoT-based river water quality monitoring system using Low-Power Wide Area Networks (LPWAN) and Long Range (LoRa) mesh notification using mesh network topology a medium to long distance transmission. This project require MQTT broker to acquire data. The hardware design consist of microcontroller and sensor. The sensor used in this project included temperature sensor, pH sensor, metal concentration (Pb and Fe) sensor and turbidity sensor while the microcontroller used in this project is Arduino. Figure 2.3 and 2.4 show hardware component diagram and overall system block diagram.

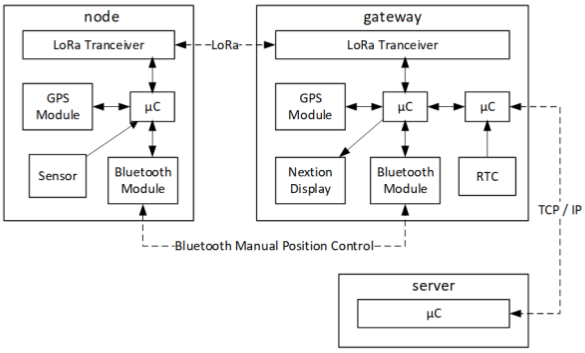

Figure 2.3 Hardware component diagram

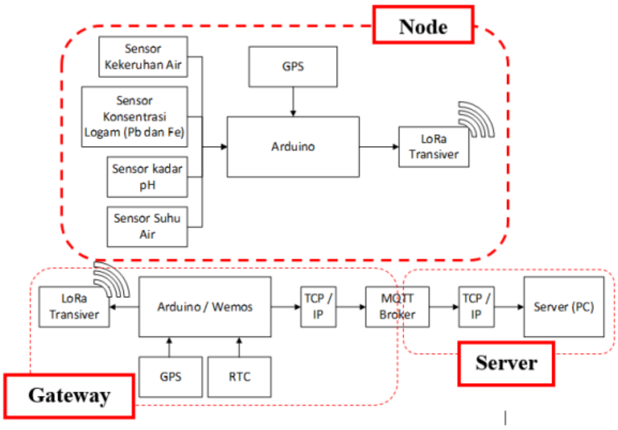

Figure 2.4 Overall system block diagram

The third research in the list is from a university in Thailand and their aim is to make an autonomous platform for replacement of human works in high-risk areas (Siyang and Kerdcharoen, 2016). This researcher team used RC boat and low cost acrylic sheets to creating the robot. By using RC, they able to use the robot to maneuver in water surface. This robot using sensor to record data from the watershed or river. The sensor that are used include oxidation reduction potential (ORP), pH sensor, electrical conductivity (EC), dissolved oxygen (DO) and temperature sensor. The Arduino Mega 2560 are used as microcontroller in this project. This project also makes use of a telemetry module to connect with Ardupilot in order to obtain sensor data about the robot, an XBee module to collect data about water properties, and a radio transmitter to manually control the robot. Figure 2.5, 2.6 and 2.7 show general idea, flow chart of USV and final project.

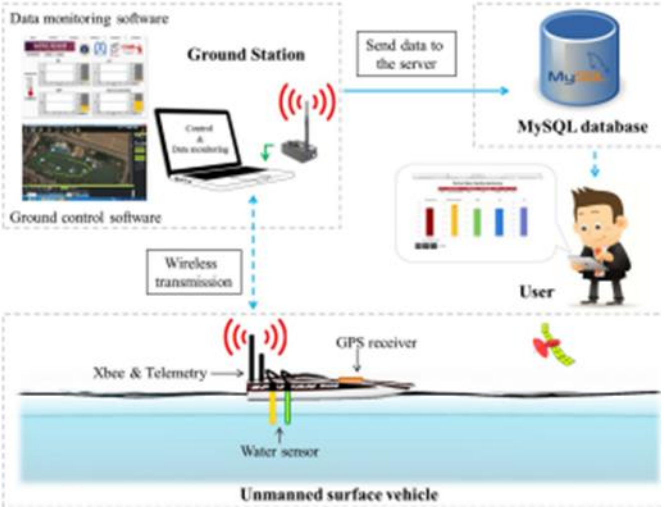

Figure 2.5 General idea of this project

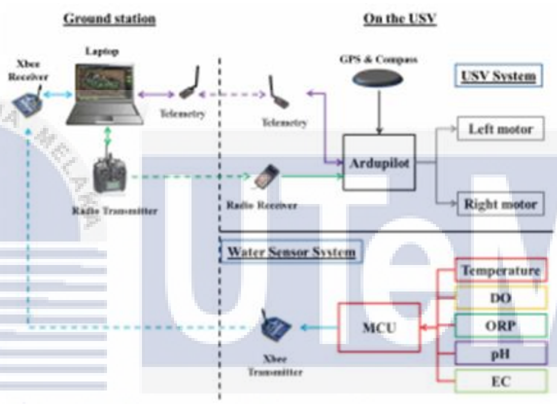

Figure 2.6 Flow chart of USV

Figure 2.7 Unmanned Surface

Further in the list is a research by a university from Indonesia (Adhipramana, Mardiati and Mulyana, 2020). The robot system use Arduino uno then the robot will be controlled by using remote control that has a frequency of 2.4GHz. The output is a DC motor