Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF WATER QUALITY MONITORING SYSTEM AT THE OFF-RIVER STORAGE BY USING IOT TECHNOLOGY

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Bachelor of Electrical Engineering Technology with Honours

2022

DEVELOPMENT OF WATER QUALITY MONITORING SYSTEM AT THE OFF RIVER STORAGE BY USING IOT TECHNOLOGY

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A project report submitted
in partial fulfillment of the requirements for the degree of
Bachelor of Electronics Engineering Technology with Honours

Faculty of Electrical and Electronic Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2022

UNIVERSITI TEKNIKAL MALAYSIA MELAKA
FAKULTI TEKNOLOGI KEJUTERAAN ELEKTRIK DAN ELEKTRONIK

BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek : Development of Water Quality Monitoring System at the Off-River Storage by using IOT Technology

Sesi Pengajian : Semester II 2022/2023

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I declare that this project report entitled “Developmement of water quality monitoring system at the off-river storage by using IOT technology” 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.

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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 with Honours.

Signature : 

Supervisor Name : Mr. Mohamad Na'im Bin Mohd Nasir

Date : 27 January 2023

DEDICATION

I acknowledge my sincere dedication, honors and gratitude to both of my parents for their love and encouragement, supports and sacrifices throughout whole my life. Without their sacrifice and encouragement, I cannot possible reach this stage. Special gratitude also dedicated to my brother and also my sisters which always support and advise me in whatever I do in my life. Special thanks to all of lectures especially my supervisor Mr. Mohamad Na'im Bin Mohd Nasir and also my academic advisor, Mr. Ts. Dr. Zikri Abadi Bin Baharudin who had taught and guide me throughout my studies and during this Bachelor Final Year Project 2. I would like to thank all my friends who always been with me throughout this challenging semester and help me along my studies. I hope all of their supports and encourage will help me make this project a success.

ABSTRACT

In this era globalization, technology is one of the best initiatives to improve the quality of water at the off-river storage. There are some problem need to encountered for managing and monitoring water quality for every month at off-river storage. Among these problem is the difficulty to achieve the range of various parameter for suitable raw water supply to entering the treatment plant to process and distribute fresh water to consumers. Therefore, the purpose of this project is to develop and implement smart water quality monitoring at the off-river storage by using IOT system. The objective of this project is to develop smart monitoring water quality system based on microcontroller. The function is to monitor pH level in raw water, ammonia level and the intensity of light using smartphones connect with WIFI network and analyze the performance of the water quality system. This water quality system used an ESP32 board as a microcontroller to control input and output of the system and WIFI module to sending the data from sensors through to the mobile application by using Internet connection. Water quality metrics were tested at several sites along an off-river storage (ORS) and users were able to acquire updated results and undertake data analysis on a regular basis. This project is simple to use and user-friendly because it enhanced the monitoring of water quality at off-river storage.

ABSTRAK

Dalam era globalisasi ini, teknologi merupakan salah satu inisiatif terbaik untuk meningkatkan kualiti air di simpanan luar sungai. Terdapat beberapa masalah yang perlu dihadapi untuk mengurus dan memantau kualiti air bagi setiap bulan di simpanan luar sungai. Antara masalah tersebut ialah kesukaran untuk mencapai julat pelbagai parameter bagi bekalan air mentah yang sesuai untuk memasuki loji rawatan bagi memproses dan mengagihkan air tawar kepada pengguna. Oleh itu, tujuan projek ini adalah untuk membangun dan melaksanakan pemantauan kualiti air pintar di simpanan luar sungai dengan menggunakan sistem IOT. Objektif projek ini adalah untuk membangunkan pemantauan pintar sistem kualiti air berasaskan mikropengawal. Fungsinya adalah untuk memantau tahapph dalam air mentah, paras ammonia dan keamatan cahaya menggunakan telefon pintar yang disambungkan dengan rangkaian WIFI dan menganalisis prestasi sistem kualiti air terhadap industri rawatan air. Sistem kualiti air ini menggunakan papan ESP32 sebagai mikropengawal untuk mengawal input dan output sistem dan modul WIFI sebagai menghantar data dari sensor melalui aplikasi mudah alih dengan menggunakan sambungan Internet. Metrik kualiti air telah diuji di beberapa tapak di sepanjang storan luar sungai (ORS) dan pengguna dapat memperoleh keputusan yang dikemas kini dan menjalankan analisis data secara tetap. Projek ini mudah digunakan dan mesra pengguna kerana ia meningkatkan pemantauan kualiti air di simpanan luar sungai.

ACKNOWLEDGEMENTS

First and foremost, I would like to express my gratitude to my supervisor, Mr. Mohamad Na'im Bin Mohd Nasir for their precious guidance, words of wisdom and patient throughout this project.

I am also indebted to Universiti Teknikal Malaysia Melaka (UTeM) for the financial support through subject coordinator which enables me to accomplish the project. Not forgetting my fellow colleague, Mohamad Saiful Bin Hamzah for the willingness of sharing his thoughts and ideas regarding the project.

My highest appreciation goes to my parents, parents in-law, and family members for their love and prayer during the period of my study. An honourable mention also goes to my siblings for all the motivation and understanding. And to Mashila Binti Amilludin, thanks for her help in guiding me to complete this PSM phase 2. Other than that, thanks to Muhammad Ashraf Bin Mohd Zamani for giving me enthusiasm and motivation that is very meaningful for me to complete this project.

Finally, I would like to thank all the staffs at the FTKEE, 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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LIST OF SYMBOLS

Ω - Ohm

ºC - Degree Celcius

% - Percent

LIST OF ABBREVIATIONS

V	-	Voltage
PPM	-	Parts-Per-Million
NTU	-	Nepheometric turbidity unit
Mg/l	-	Miligram per litre
mg	-	Miligram
l	-	Litre
g	-	Gram
Min	-	Minute
I	-	Ampere

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CHAPTER 1

INTRODUCTION

1.1 Background

In today modern's society, there is a lot of water pollution that occurs in Malaysia which results in adverse effects on the environment and also the society. These may include addedcontaminants like as oil and chemical compounds, as well as ingredients occurring in naturalwater that can still be influenced by human sources such as oxygen, bacteria, and nutrition. Traditionally, sampling methods were used to examine the quality of water in the river. The type of secondary parameters to be monitored, the frequency of sampling, the number of sampling points and the sampling location, all depend on the information in the catchment area such as the type of land use, sources of pollution and so on. However, water quality monitoring system that consists of microcontroller is useful to people, continuous and real time data sending via wireless technology to monitoring station and smartphones[1],[2].

1.2 Problem Statement

The most frequent water quality issue that happen at off river storage due to the manual monitoring is very trivial task and not systematic. Water is the most important source to life in the earth even the plant also need a fresh water to survive. Water safety issue is so important to doing periodic inspection tests to raw water at off river storage (ORS). In this case, it take some high cost in terms of expenses as well as vehicle fare expenses to go to the location. Beside that, the unstability or high content of ammonia, turbidity and pH level content in raw water at off river storage (ORS) before

channeling water using a high-powered water pump to a water treatment plant. Water quality disorders occur as a result changes in the colour of the water that turns yellow to the dark brown colour. The colour changes is the chemical reaction and non-sendimentary soil mixture that occurs in the raw water. Raw water should follow the standards set by the ministry of environment and water before channeling water from the ORS to the water treatment center. Lastly, lack of improvement integration information management system leads problem to monitor water at off-river storage. Examiners are displeased with the quality of water given, according to complaints and reports submitted by relevant of government departments. As a result, a concept in whichequipment, machines, sensors, and devices are linked to the Internet and data is collected and transferred over the network built to track the water quality index is devised. The incorporation of element IR4.0 has a positive influence on civilization and the ecosystems of our planets.

1.3 Project Objective

The main goal of this project are:

a) To simulate the control system circuit of monitoring water quality system.

b) To design and develop monitoring water quality system at the off river storage (ORS) determined by several parameters.

c) To investigate and evaluate the performance of the system at the off river storage (ORS) system.

1.4 Scope of Project

The scope of this project are as follows:

a) ESP32 board is used to read from detector of sensor based on capacitance value.

b) Real time database and alerting notification will be showing in blynk apps.

c) Blynk apps and WIFI network is used to bridge the sensor with blynk server.

d) The size of whole system is another limitation. A smartphone must be located near to Internet connection (WIFI network) in order to transmit the data between ESP32 to smartphone via WIFI network.

e) Cost of the sensor was one of the limitation of our project. Some of precise sensor such as dissolved oxygen sensor and salinity sensor are not affordable. So, all that sensor were not included in our project.

f) The power supply of system use solar panel to powered up the devices.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Off-river storage is one whose filling, storage, and draining behavior is guided by a watercourse that does not pass through the channels, conduits, or overbank floodways that connect the storage to the river. For example, Oxbox Lake is the most abundant off-river storage, although a broad range of layouts, both natural and man-made, may be found[3]. By the water from off-river storage, the water will be channeled through conduits and delivered to water treatment to get fresh water for the consumers. The off-river storage is quite similar to water reservoirs implemented in Malaysia and also other countries. The government of Malaysia proposed off-river storage to ensure that government knows how to face the pollution areas of water reservoirs caused by drought. Extensive use of chemicals in manufacturing, construction and other industries, fertilizers in agriculture, and the direct discharge of polluted water from industry into nearby bodies of water all contribute significantly to global water quality declines and has led to major problems [1], [4], [5].

In this matter, agricultural land use without environmental controls to avoid agrochemical over-application is causing extensive degradation of the soil/water ecosystem as well as the underlying aquifers. The primary issues linked with agriculture include salinization, nitrate and pesticide pollution, and erosion, which results in higher concentrations of suspended particles in rivers and streams and impoundment siltation. Irrigation has increased the amount of land accessible for crop production, but the consequent salinization has caused the degradation of previously rich soils in some locations[6].

In traditionally, Water quality detection is done manually, taking water samples and sending them to a lab for testing, which is time consuming, expensive and labor intensive. Such techniques did not provide real-time data [1]. To upgradein this method, the proposed water quality monitoring consists of a microcontroller and basicsensors that consists of some parameters that need to be focused such as turbidity, pH level, and total dissolved solid in water. In this work, different types and techniques for monitoring water quality at the river have been investigated to an enhanced monitoring system for moreuseful and compactable and also sending the data continuously in real-time.

2.2 Water management system

Around 97% of the world's water is salt water, while just 3% is fresh water. Fresh water is utilized by people for an assortment of purposes. There are four wellsprings of water for human utilization for specific water, surface overflow (streams, ditches, ocean), groundwater, and water from the vanishing system. In Peninsular Malaysia, half of the water assets come from the water out of a sum of 640 billion cubic meters of water created in one year. Of the 3% of freshwater tracked down on the planet, two-thirds of it is as ice, while the rest is groundwater and just a little part of surface water. There are many purposes of water and among them are for use in homes, agribusiness, and industry, and there is additionally water utilized for sporting purposes. Just 1% of the water on earth can be tanked[7]. In Malaysia, clean water likewise supply comes from water that gathers in rivers and streams into dams. Water supply to buyers is through an organizational arrangement of pipelines that convey water from a water treatment plant. In a water supply system, the treated water should go through 9 phases of cleaning before it very well may be distributed to consumers, as displayed in Figure 2.0[8].

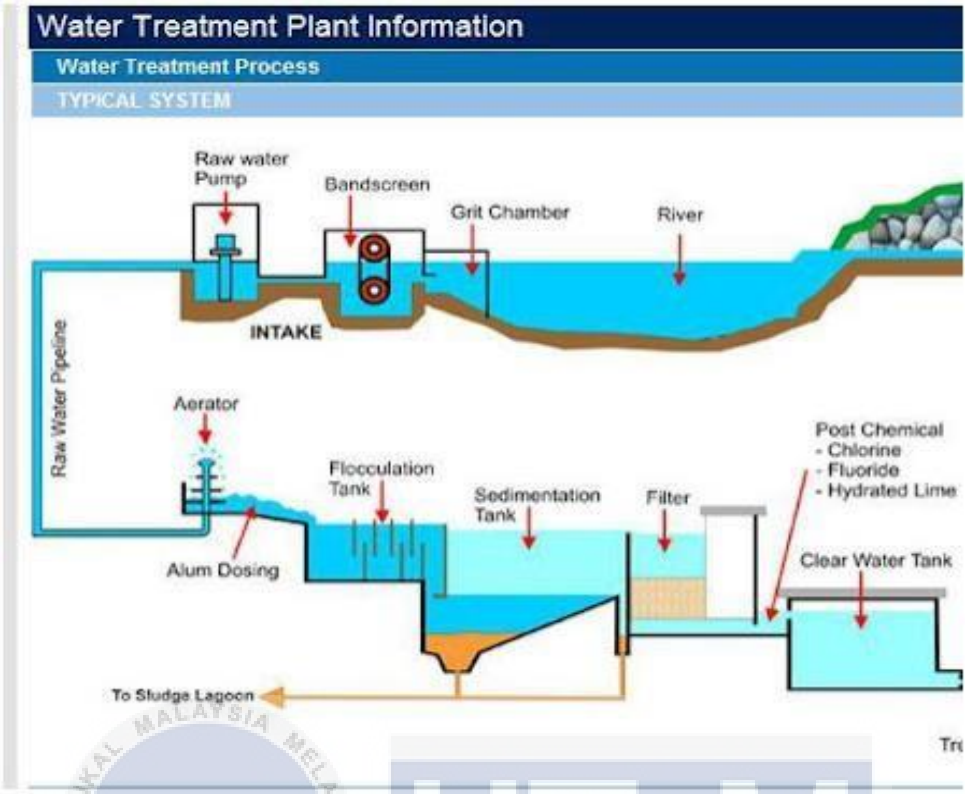

Figure 2.0: The flow of 9 phases water purification process[7].

2.2.1 The phases of water treatment process

Treated water has undergone a process of purification from contaminants for human use, including drinking, industrial processes, medicine, and many other benefits. All water treatment processes aim to remove the impurities present in the water or lower the concentration of any pollutants to make the water suitable for the desired end-use [7], [9]. The source of this treated water may be raw water or water that can get from river and off-river storage (ORS), as shown in Figure 2.1, humans have used that. Water that humans have used is known as wastewater or sewage. In half of the countries like Singapore, wastewater is treated and recycled so that it can be used for drinking through a program known as NEWater. In Malaysia, due to sufficient water resources, it may not have reached the level in Singapore. The materials released during this treatment process are such as solids, bacteria, algae, viruses, fungi, and certain mineral substances such as iron and manganese.

The process of treating water can be done in various ways and it is divided into mechanical, physical, biological, and chemical methods [7]. Other countries, such as the United States, have also introduced the Safe Water System for water quality intervention, utilizing simple, affordable, and resilient technology appropriate for the developing world. The goal is to make water safe by disinfecting it and storing it safely at the point of use [10]. The phases of water treatment were discussed in this chapter.

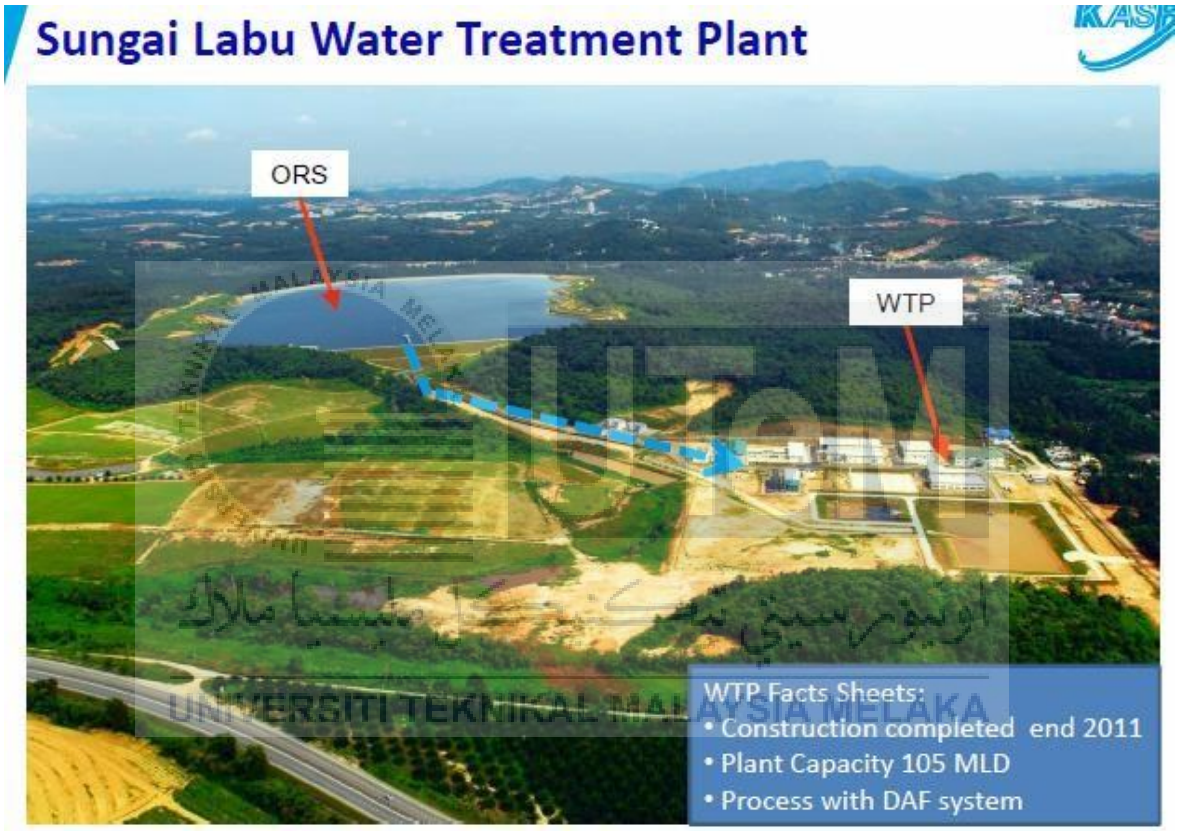

Figure 2.1: Water treatment plant[11].

2.2.1.1 Filtering

Wood fragments, leaves, aquatic plants, and floating foreign matter will be separated through a screening process. After this filtration process, the denser suspended material will be removed by allowing water to flow through the chamber, which will deposit this material at the base, as shown in Figure 2.2. Remove large items from the influent to prevent damage