Faculty of Electrical and Electronics Engineering Technology

DEVELOPMENT OF WATER QUALITY MONITORING SYSTEM USING ARDUINO FOR SMART CITY

IDZHAM RIZAL BIN JAMSARI

Bachelor of Electronics Engineering Technology (Telecommunications) with Honours

2022

DEVELOPMENT OF WATER QUALITY MONITORING SYSTEM USING ARDUINO FOR SMART CITY

IDZHAM RIZAL BIN JAMSARI

A project report submitted
in partial fulfilment of the requirements for the degree of
Bachelor of Electronics Engineering Technology (Telecommunications) with Honours

Faculty of Electrical and Electronic Engineering Technology
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2022

UNIVERSITI TEKNIKAL MALAYSIA MELAKA
FAKULTI TEKNOLOGI KEJURUTERAAN ELEKTRIK DAN ELEKTRONIK

BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek : DEVELOPMENT OF WATER QUALITY MONITORING SYSTEM USING ARDUINO FOR SMART CITY

Sesi Pengajian : 1 – 2022/2023

Saya IDZHAM RIZAL BIN JASMSARI mengaku membenarkan laporan Projek Sarjana Muda ini disimpan di Perpustakaan dengan syarat-syarat kegunaan seperti berikut:

1. Laporan adalah hakmilik Universiti Teknikal Malaysia Melaka.
2. Perpustakaan dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan laporan ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. Sila tandakan (✓):

☐	**SULIT***	(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972)
☐		(Mengandungi maklumat terhad yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)
☑	**TIDAK TERHAD**	

Disahkan oleh:

(TANDATANGAN PENULIS)
Alamat Tetap: NO 30, JALAN ISORA 5,
NILAI IMPIAN,
71800 NILAI,
NEGERI SEMBILAN

Tarikh: 20 Februari 2023

(COP DAN TANDATANGAN PENYELIA)
ELIYANA BINTI RUSLAN
Pensyarah
Jabatan Teknologi Kejuruteraan Elektronik & Komputer
Fakulti Teknologi Kejuruteraan Elektrik & Elektronik
Universiti Teknikal Malaysia Melaka

Tarikh: 24 Februari 2023

*CATATAN: Jika laporan ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali tempoh laporan ini perlu dikelaskan sebagai SULIT atau TERHAD.

DECLARATION

I declare that this project entitled "DEVELOPMENT OF WATER QUALITY MONITORING SYSTEM USING ARDUINO FOR SMART CITY" 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 : IDZHAM RIZAL BIN JAMSARI

Date : 26/1/2023

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 Electronics Engineering Technology (Telecommunications) with Honours.

Signature	:	
Supervisor Name	:	TS. ELIYANA BINTI RUSLAN
Date	:	26/1/2023

DEDICATION

To my beloved mother, Norizan Binti Kamin, and my father, Jamsari Bin Maarof,
Thank you for supporting me when I continue my studies
for bachelor`s degree in UTeM.

To my brother, Asyraf Abdul Wafi Bin Jamsari and Rashydan Rafi Bin Jamsari,
Thank you for providing your creativity expertise and suggestion
for completing this project.

To my sister, Diyanna Athirah Binti Jamsari and Liyana Atikah Binti Jamsari,
Thank you for your emotional support.

ABSTRACT

This project is designed to automatically monitor and alarm the user to information and data on the water quality. This Water Quality Monitoring System is suitable to be placed on a water-cooling tower in a manufacturing building. Normally, user need to go and take the data of the quality of water manually by using a sensor and draft it on a paper which is really inadequate. This Water Quality Monitoring System is equipped with pH sensor and TDS sensor to detect the quality of the water monitored. The system design of this project is the data and information that are obtained from the sensors is transmitted through a wireless Wi-Fi network. Then a real-time measurement automatic checks the data format, differentiate the data and display it. It will also set up water quality alarm threshold to automatically give a warning notification when it reaches certain threshold value. The main purposes of the project are to detect and analyse a system that can monitor the quality of water by using a laptop or mobile phone anywhere. This project is made to analyse, maintain and improve the quality of water. It is expected this project is able to make it easy for user to get the information of the quality of water anytime. Overall, we concluded that this project is targeted to bring improvement in society.

ABSTRAK

Projek ini direka bentuk untuk memantau dan menggera pengguna secara automatik kepada maklumat dan data tentang kualiti air. Sistem Pemantauan Kualiti Air ini sesuai diletakkan di menara penyejuk air di bangunan pembuatan. Biasanya, pengguna perlu pergi dan mengambil data kualiti air secara manual dengan menggunakan penderia dan drafkannya di atas kertas yang benar-benar tidak relevan. Sistem Pemantauan Kualiti Air ini dilengkapi dengan sensor pH dan sensor TDS untuk mengesan kualiti air yang dipantau. Reka bentuk sistem projek ini adalah data dan maklumat yang diperoleh daripada penderia dihantar melalui rangkaian Wi-Fi tanpa wayar. Kemudian pengukuran masa nyata automatik menyemak format data, membezakan data dan memaparkannya. Ia juga akan menetapkan ambang penggera kualiti air untuk memberikan pemberitahuan amaran secara automatik apabila ia mencapai nilai ambang tertentu. Tujuan utama projek adalah untuk mengesan dan menganalisis sistem yang boleh memantau kualiti air dengan menggunakan komputer riba atau telefon bimbit di mana-mana sahaja. Projek ini dibuat untuk menganalisis, mengekalkan dan meningkatkan kualiti air. Projek ini diharapkan dapat memudahkan pengguna mendapatkan maklumat kualiti air pada bila-bila masa. Secara keseluruhan, kami membuat kesimpulan bahawa projek ini disasarkan untuk membawa peningkatan dalam masyarakat.

ACKNOWLEDGEMENTS

To complete this project, many people had helped and motivate me to finish it without a problem. I have received a lot of support from every each of them.

First and foremost, I would like to express my gratitude to my supervisor, TS. ELIYANA BINTI RUSLAN for her precious guidance, words of wisdom and patient getting me through this project until the end.

I am also very grateful with my fellow colleague and housemates for the willingness of assisting me and giving me extra ideas regarding this project. They are persistent to share their knowledge, information, and experience with me.

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

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

GSM	-	Global System Mobile Communication
GUI	-	Graphic User Interface
IDE	-	Integrated Development Environment
IoT	-	Internet of Thing
pH	-	Potential hydrogen
TDS	-	Total dissolved solids
UI	-	User Interface
Wi-Fi	-	Wireless Fidelity
GPS	-	Global Positioning System
LCD	-	Liquid-crystal display
GPRS	-	General Packet Radio Service
TDMA	-	Time Division Multiple Access
TCP/IP	-	Transmission Control Protocol/Internet Protocol

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

This chapter will discuss about the background of the project, problem statement, objective, scope of the project and the project outline.

1.1 Research Background

Our water quality monitoring is not like ordinary set. It has function to make the user easy to get the data of the water quality on a specific region. There are many types of sensors that is used to get the data for the quality of water. For example, we use temperature sensor, Ph sensor, Turbidity sensor and TDS sensor. For example, if the user wants to check the data of the quality of the water on a specific region, the user just needs to use a laptop or smart phone to get the details. Users can also check on the desired region for the details. This way, the user does not have to waste time to actually go to the specific region to get the data. When the user detects the data is not on a suitable condition, the user can just go to the specific area to maintain the quality of the water. Therefore, with this system, it makes it easy to find the specific region where the water quality is not in a good condition.

1.2 Problem Statement

Standard method of detecting the quality of water is not that practical to use and user friendly as u always need to go to the specific site and test the water quality manually. Users need to hustle on every region to get the details of the water on the area, which is not convenient as the process of checking the quality of the water does not require a lot time, but it takes a lot of time getting to the specific region each time because some water-cooling system is on top of a building. In addition, a regular water monitoring system does not have GPS where we can track the location of the data we took during the procedure. Regarding to the situation, an innovation idea must be done to ease the user to have this kind of problem for the next generation. Therefore, this project is suggested to over the problem by having a sensor that can connect to a Wi-Fi which can give the user a real time data of the quality of the water.

1.3 Project Objective

In the objectives, there are consists of the ways of the project should be achieved the goals in monitoring quality of water system. The main purposes of the project are to detect and analyze a system that can monitor the quality of water by using a laptop or mobile phone anywhere. Below objectives will be conveyed the goals of this project all about such as:

i. To develop a quality monitoring system using Arduino.

ii. To ensure the water is safe for domestic use by measure pH value and total dissolved solids parameter

iii. To analyze the system in terms of its functionality.

1.4 Scope of Project

Several scopes must be identified in order to achieve the objective of this project. It will be there a limiting rule or circumstance in every product or project. The limitation of this project is the range of the coverage of the WIFI that we used to share the information of quality of water. There will be a limit of range for it to connect to the product. Furthermore, the connection will be not stable if there is an interference occur during the process of data changing and might be slow. This project will be using an Arduino and a WIFI module as the processing system. The data can be monitored to a laptop or a mobile phone when the product is placed in the desired location. The project will focus on the study of the ability of the system to monitor the quality of water as followed the stated project scopes.

1.5 Summary of Chapter

As a summary of the project, the reason that we need to discuss about such as the objective, problem statement and project scope is because it is the first step of our progression of our project, and it is to present our project to our supervisor that we can continue to the next step.

1.6 Thesis Organization

The introduction to this project is the first chapter of this thesis. This chapter contains the project background, problem statement, objectives, and project scope. This chapter assists the reader in comprehending why this project was created.

The literature review will be the next chapter. The related research conducted by the other researcher will be examined and analyzed one by one in this chapter. The research will be compared and reviewed to determine the benefits and drawbacks of each project.

The methodology, which is the method and technique used in this project, is discussed in Chapter 3. In addition, the schematic diagram, preliminary results, Gantt chart is included.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

For this chapter, this project is able to be determine and developed by having some researched done by previous researcher`s projects, we can apply the knowledges, methods and techniques from it into this project. By comparing and evaluate other`s people projects, we can easily detect and foresight the problems or issues that had occur on their projects. This way, similar issue will not be repeated in our project. Other than that, reviewing other people`s literature will be able to give us the chance to compare, contrast, synthesize and analyse different people`s works. So, in this chapter, some related IoT projects literature will be collected and reviewed.

2.1.1 Water quality monitoring system based on Internet of Things

The system introduced in [1] has three-layer operations which consist of sensing, control and network transport layer. The sensing layer primarily receives water quality data from pH sensors, turbidity sensors, and temperature sensors, and then sends it to the microcontroller unit via the amplifier circuit, which uses the STM32 embedded microcontroller as its core. For further processing, the module will convert the analogue signal to a digital signal. In addition, with a dynamic connection, the LCD panel is utilised to display data in real time. An alarm mechanism is also included in the system to alert customers to changes in water quality metrics. The STM32F103 core controller is used in the control layer. The processor module controls the reading, receiving, processing, and transmission of sensor data as well as coordinating the routine activity of each module. The WIFI module is primarily used by the network transmission layer to deliver data processed by the controller to the cloud remote management centre via the internal communication function. This system features a real-time water quality monitoring system, statistics of water quality data, and abnormal warnings to mobile phones thanks to these three levels.

2.1.2 Application of GPRS Technology in Water Quality Monitoring System

An application of GPRS technology in this project referred in [2] basically a system that automatically collects the water quality information with multiple water quality parameters that consist of dissolved oxygen, electric conduction, temperature, pH, ORP, turbidity, Salinity, TDS, nitrate, ammonia nitrogen, Chlorine, etc. It captures information in real time. The processed data is packaged by the integrated microprocessor into a TCP/IP data package. The data package is sent through wireless GPRS network to the data processing and monitoring centre. The system's architecture hinges on how the monitoring centre can connect to the GPRS network. A reasonable method of connecting can improve security, increase data transmission speed, and have a significant impact on the system's overall performance. The system takes data from the water quality station first, then connects to a LAN network and a multi-computer connection to exchange the information. The data is then checked for format, differentiated, and displayed by a real-time measuring system. It also compares data from the past to provide statistical data and a curve graph. It will also set up a water quality alert threshold that will automatically sound and illuminate an alarm when a specified threshold value is reached.

2.1.3 Design of Water Quality Monitoring System

This project referred in [3] uses an Arduino MCU with a Bluetooth module to monitor the quality of water to get the information to a smart phone. A pH sensor, turbidity sensor, conductivity sensor, and temperature sensor are all included. As with other programmes, this project aims to achieve real-time monitoring and judgement of water quality parameters. After Arduino processing, all of the sensors are utilised to gather water quality measurements, which are then communicated to a smart phone for monitoring through Bluetooth. This project can gather water quality parameters in a timely and precise manner, and the system functions smoothly, making it suitable for usage at home or in other situations where water quality monitoring is required. In comparison to the other projects described, it is quite easy and convenient to use.

2.1.4 The Water Quality Online Monitoring System Based on Wireless Sensor Network.

According to [4] it uses a ZigBee receiver and an embedded microprocessor (STM8) to run the system for this project. It includes five modules which consist of information acquisition module, coordinator module, the host computer module, GSM module and mobile terminal module. The information acquisition module, the coordinator module, the host computer module, the GSM module, and the mobile terminal module are among the five modules. A sensor and a microprocessor are included in the data collection module. Several ZigBee acquisition nodes make up the information acquisition module. Each node is equipped with sensors that capture and transmit environmental data including temperature, pH, and dissolved oxygen. A ZigBee receiver and an integrated microcontroller make up the coordination module. The ZigBee receiver receives the environment parameter data and sends it to the host computer via serial port for processing. The data processed by the host computer may be sent to the mobile terminal via the GSM module. The water quality parameter data transmitted back from the scene is received by the mobile terminal module through a brief message. It is designed to address the issues around online water quality monitoring. Users may watch the water parameters being monitored in real time via WSN, which is displayed on the host computer, and the gathered data can be delivered to the staff's mobile phone via SMS over GSM. This project is low-cost, has a robust system, and is efficient since the data obtained can be delivered to the staff's mobile phone whenever they wish to monitor the water quality.

2.1.5 Smart Water Monitoring System for Real-Time water quality and usage monitoring.

Water monitoring system presented in [5] consists of two parts which is Smart Water Quantity meter and Smart Water Quality meter. The goal of the Smart Water Quantity Meter is to guarantee water conservation by measuring the quantity of water utilised by a household and informing the customer and the authorities. A three-slab billing system creates a fee based on the amount of food consumed. The Smart Water Quality metre measures five qualitative factors of water, including pH, temperature, turbidity, dissolved oxygen, and conductivity, to determine the quality of portable water delivered to the customer. The method guarantees that any potential health risks or concerns are avoided as a result of sewage or agricultural discharge into the portable water. These data will be sent in real-time on the cloud through an online

monitoring system. Any infractions of the consumption restriction or water quality are quickly communicated to the consumer and the authorities through SMS and a system-generated alarm signal. The system is controlled by a Raspberry Pi and an Arduino Uno. This initiative allows each home to get rapid remote access to water quality and quantity data.

2.1.6 Wireless Sensor Network for Monitoring of Water Quality for pond Tilapia

Based on [6], this research present wireless sensor networks for monitoring of water in a Tilapia Pond. Using a Raspberry Pi controller and the NodeMCU module Wi-Fi to receive and collect signals from peripheral sensors such as a water level, dissolved oxygen, temperature, and pH sensor for a tilapia pond, and sending the sensor wireless signals to the central control unit for processing, database, and display of water quality through online auto monitoring. The results revealed that [6] can keep the information and readily identify the condition of the water quality well as normal, cautious, and abnormalities, which can be seen online.

2.2 Journal Comparison for Relevant Previous Research

Table 2.1 shows the comparison for 5 different research related to this proposed project for us to improvise and adapt the inadequacy for this project after we finish analysed it thoroughly.

Among the six of this research, all of it have different type of module is used to run their projects. Some of uses Wi-fi module, some of it uses Bluetooth module, GPRS and GSM. It is common to use ESP8266 WIFI module if convenient as it is cheap and easy to setup for a wireless connection method, but the downside is that WIFI spread, and detection range is still limited to only around 100 meters. As for the GPRS network system, it is good because it adopts grouping data exchange and provides user connection in the form of mobile. It has same frequency slot, bandwidth, retransmission structure, wireless modulation, frequency-hopping and data frame of TDMA as GSM but the drawback is, it has a fee that can be based on the usage or on have a monthly plan. The GPRS network system is actually better if compared to other because it is more convenient. It has no extra network needed, only application to be user

of the public mobile communication network. It also has a coverage of the public communication network which is huge and expandable. Other than that, the user can be online and check the any information and data without limitation if the user pays a monthly fee. Lastly, it also has a high transmission speed. Thus, wireless communication network making use of the public mobile communication network is low-cost, extendible, non-constraint, low-error and stable system with advancement and standards. GPRS is especially suitable for low data rate with high usage frequency communication like transformation of the data relevant to water quality.

Also, some of this research doesn't include their projects to have a mobile platform/GUI to monitor the data. Data monitoring should be made more direct, easy, convenient, and quick. Even if monitoring data on a computer is useful, in an age when virtually everyone owns a smartphone, a mobile platform that allows users to monitor their data through a mobile application is preferable as the users can monitor their data anytime and anywhere.