WATER QUALITY MONITORING SYSTEM WITH IOT

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Thanks to ALLAH S.W.T and his Prophet Muhammad S.A.W.

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ABSTRACT

This project proposed an improved method to provide an early detection system at Semangar water treatment plant as many pollution cases occurred within the past years had left many housing area without water supply for days. The solution is based on the idea of developing an alert system, and also a real time database that can store data ammonia, turbidity and pH. The approach has several notable merits, namely cost efficient, not changing the existing system as it only act as an additional feature and higher safety. The idea is proven based on two subsystems. First the early detection system is based on notification through a mobile application. It provides user with notification every time the ammonia reading is above 2 parts per million threshold. Second, The real time database saves the ammonia parameter reading data every 10 seconds in Google Spreadsheet. The current reading of the chemicals can also be viewed using a web server which can then be connected through a mobile application. Database application is not only by Google Spreadsheet but also using Firebase application which can also be viewed through the mobile application. The method proposed in this project can be used for any water treatment plant in Malaysia that's requires data to be stored and view at any given time.

ABSTRAK

Projek ini mencadangkan penambahbaikan kaedah untuk menyediakan sistem pengesanan awal pada loji rawatan air Semangar kerana banyak kes pencemaran yang berlaku dalam tahun-tahun yang lalu telah menyebabkan banyak kawasan perumahan tanpa bekalan air selama beberapa hari. Penyelesaian ini didasarkan pada idea untuk membangunkan sistem amaran, dan juga pangkalan data masa nyata yang boleh menyimpan data ammonia, kekeruhan dan pH. Pendekatan ini mempunyai beberapa merit yang jelas, iaitu kos yang efisien, tidak mengubah sistem yang sedia ada kerana ia hanya bertindak sebagai ciri tambahan dan keselamatan yang lebih tinggi. Idea ini terbukti berdasarkan dua subsistem. Pertama sistem pengesanan awal didasarkan kepada pemberitahuan melalui aplikasi mudah alih. Ia memberikan pengguna pemberitahuan setiap kali bacaan ammonia melebihi 2 bahagian per juta ambang. Kedua, pangkalan data masa nyata menyimpan data bacaan parameter ammonia setiap 10 saat dalam Google Spreadsheet. Bacaan bahan kimia semasa juga boleh dilihat menggunakan pelayan web yang kemudiannya boleh dihubungkan melalui aplikasi mudah alih. Aplikasi pangkalan data bukan sahaja oleh Google Spreadsheet tetapi juga menggunakan aplikasi Firebase yang juga dapat dilihat melalui aplikasi mudah alih. Kaedah yang dicadangkan dalam projek ini boleh digunakan untuk mana-mana loji rawatan air di Malaysia yang memerlukan data yang akan disimpan dan dilihat pada bila-bila masa.

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LIST OF ABBREVIATIONS

IoT	-	Internet of Things
WQI	-	Water Quality Index
ML	-	Machine Learning
IFTTT	-	If This Then That
ESP32	-	Espressif 32 bit architecture
RMSE	-	Root Mean Square Error
MLP	-	Multilayer Perceptron
GB	-	Gigabytes
MB	-	Megabyte
ROM	-	Read Only Memory
PWM	-	Pulse Width Modulation
CRUD	-	Create Read Update Delete
BLE	-	Bluetooth Low Energy
LED	-	Light Emitting Diode

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CHAPTER 1

INTRODUCTION

1.1 Background of study

The purpose of this project is to translate the information given from the sensor reading towards the internet for cloud computing and classify the data based on capacitance reading from ammonia. Water is an essential natural resources for all human kind. But rapid development projects and human activities has caused contamination to the water resources. In today's technology, the method used to test the water quality is to have operators perform the duty of collecting a sample of the water resources a few times per day and conduct the testing for the sample in a lab. This process is tedious and time consuming as it does not monitor the water resources continuously but only at certain time frame of the day. Furthermore, this can cause problems if a contamination were to occur during the time when testing was not being conducted. Internet of Things (IoT) technologies provide a solution to this as it can monitor the water quality at all times and bring about data which can be used for analysis purposes in real time on the cloud. This system can provide an early warning system for which if a contamination were to occur [1].

1.2 Motivation of Study

Water is an essential part of life. Contaminated water is also the leading cause of death, higher than any act of violence including war. In Malaysia, water treatment plants supply the water supply to the residential and industrial areas. If the water treatment plants were to be closed, the said areas will not have any water. The water treatment plants will be closed due to polluted water from the river. Valves controls the flow of water connecting the water treatment plant and the said areas. If the valve is closed before the contaminated water reach the water tank then said areas would still have water. What this project do to solve this problem is to create an early monitoring system with cloud computing in order to prevent the valves from being closed too late.

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1.3 Problem Statement

The main problem with the IoT is the storage system. A typical IoT device can accumulate thousands of data, thus a large storage systems needed. Notification on how to use push is also a topic of discussion. When to alert user based on the water status is also a problem that needs to be solved.

Current practices implemented at the water treatment plant is also an issue when doing this project. The way things work now with respect to checking the water source status whether it is high in ammonia content or not is that technicians check the site every 2 hours. If the water is deemed high in ammonia, there would be no real treatment to it, the plant would need to stop operation and allow the water to naturally lower its ammonia content.

The water treatment plants purpose was only to get the chemical compound reading of the water and sent it to Bakal Setia Air Johor (BAKAJ), for BAKAJ is the one that decides what the next step is going to be taken. Stopping the plant operation requires BAKAJ approval even if the technician confirms the water is polluted. BAKAJ action is not immediate when they receive information knowing that the water is polluted. They would wait around a few hours to half a day to really confirm the water is polluted then only they would instruct the water treatment plant to stop operation. With the time wasted, polluted water would already be in the residential water supply tank thus would prevent people from getting their water. This project needs to close this gap to prevent this situation from ever happening again.

1.4 Research Objectives

The objective of this project can be divided into three main objectives that are:

i. To implement real time cloud computing database function onto the existing device to allow for backlogging capability.
ii. To implement an alerting system for when the water condition is declared polluted based on ammonia level from the sensor.
iii. To compare between Firebase and IFTTT middleware based on their features.

1.5 Research Scope

The scopes of this project are:

i. ESP32 is used to read from micro-fludic sensor based on capacitance value.

ii. Middleware IFTTT with WiFi protocol is used to bridge the sensor and cloud communication.
iii. Real time database and alerting notification can be viewed through mobile phones.
iv. Experiment is done in a lab environment with controlled (100 mililitre syringe) amount of water test samples.
v. Apple development program was used as the mobile platform.

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1.6 Thesis Outline

This thesis consists of five chapters. Chapter 1 introduces the motivation of the study, problem statement, objective of this project, scope of project and the overall thesis outline.

Chapter 2 focuses on literature reviews related to this project based on journals and other references. An introduction on IoT and databases was explained based on their applications towards data storage and monitoring features.

Chapter 3 mainly discussed the methodology of the project. The method to connect to If This Then That (IFTTT) server then use the notification feature and Google Spreadsheet database. Web server used to connect to the IOS application for Firebase was also discussed and explained.

Chapter 4 presents the results of the project. The discussion focused on the difference in features provided by the IFTTT and Firebase. The result of the project is based largely on the finished application and the features ability in fulfilling the objectives of this project.

Chapter 5 concludes the project as a whole. The recommendation for future works was also suggested in this.

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