UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Real-Time Water Quality Monitoring Implementing the Concept of IoT

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electronics Engineering Technology (Telecommunications) with Honours.

by

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APPROVAL

This report is submitted to the Faculty of Electrical & Electronic Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfillment of the requirements for the degree of Bachelor of Electronic Engineering Technology (Telecommunications) with Honours. The member of the supervisory is as follow:

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ABSTRAK

Projek ini dijalankan untuk mengukur kualiti menggunakan sensor dan mikrokontroler. Sumber air sangat penting untuk makhluk hidup, dan air yang bersih adalah sangat penting kerana terdapat pencemaran dunia moden ke dalam air dalam pelbagai bentuk. Projek ini memberi tumpuan terhadap bagaimana kita dapat mengukur dan menganalisis kualiti air.

Projek ini mengutamakan tujuan untuk mengukur pH, Kekeruhan dan Suhu air. Ketiga-tiga faktor ini dipertimbangkan kerana pH menentukan sama ada air menjadi berasid atau alkali, Kekeruhan membantu menentukan jumlah zarah pepejal, dimana nilai-nilai ini berbeza dengan perubahan suhu.

Keperluan mengekalkan kualiti air adalah penting kerana air digunakan oleh makhluk hidup seperti manusia mahupun haiwan untuk perlbagai kegunaan. Tidak kira untuk manusia, tumbuh-tumbuhan atau hidupan marin, air yang diselenggarakan dengan baik adalah penting untuk kelestarian yang sepatutnya. Ujian pertama dilakukan dengan mengambil data setiap sensor secara berasingan. Selepas selesai menghasilkan analisis sensor, litar digabungkan untuk memproses semua sensor dalam mikrokontroler yang sama. Data dipaparkan di dalam monitor bersiri dan kemudiannya di perisian Arduino. Arduino menunjukkan graf setiap voltan yang diambil dari sensor. Akhir sekali, nilai semua sensor dipaparkan secara jelas dalam Aplikasi Blynk pada telefon bimbit menggunakan konsep IoT melalui ESP8266 sebagai modul wi-fi.

ABSTRACT

This project is carried out for the measurement of water quality using sensors and microcontroller. Water is indispensable for the living beings, and clean water is critical because of the modern world pollutions into the water in different forms. This project focuses on how we can measure and analyse the quality of water.

This project focuses on measuring pH, Turbidity and Temperature of water. These three factors are considered because pH determines either the water be acidic or basic, Turbidity helps to determine the amount of solid particle, whereas these values may slightly differ with the change in temperature.

The need for maintaining the quality of water is essential since the water is used or consumed by living beings in many different ways. Whether it is for a human being or aquatic plants or fishes, the properly maintained water is crucial for the proper sustainability. The measurement was first carried out by taking each sensor separately. After the completions of analysing sensors result, the circuit was combined to work all sensors together in the same microcontroller. The data was presented in serial monitor and then to the Arduino software. Arduino shows the graph of each voltage retrieved from the sensors. Finally, the value of all the sensors was presented clearly in the Blynk Application on a mobile phone using the concept of IoT via ESP8266 as wi-fi module.

DEDICATION

To my beloved mother and father

Supervisor EN. MOHD ANUAR BIN ADIP

&

Dear friends

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First of all, I would like to express my appreciation and gratitude to the ALLAH SWT for giving me such blessing to finish this project. Although I had been through tough time on finishing this project and have me the strength to overcome it and finished it.

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LIST OF ABREVIATIONS

AC	Alternate Current
ADC	Analog To Digital Converter
BOD	Biological Oxygen Demand
BNC	Bayonet Neill–Concelman
DC	Direct Current
DO	Dissolved Oxygen
GSM	Global System for Mobile communications
IoT	Internet of Things
ISFET	Ion Selective Field Effect Transistor
LCD	Liquid Crystal Display
LED	Light Emitting Diode
NTC	Negative Temperature Coefficient
NTU	Nephelometric Turbidity Units
PTC	Positive Temperature Coefficient
SMS	Short Message Service
USB	Universal Serial Bus
UTeM	Universiti Teknikal Malaysia Melaka
WHO	World Health Organisation

CHAPTER 1

INTRODUCTION

1.1 Background of Project

I developed a project to monitor water quality using multiple parameter in real-time and based on IoT concept. This project can decrease or safe to say eliminate conventional procedure of monitoring quality where people need to gather samples by doing it manually and transfer it to the lab to be analysed. The step to obtain the result is time-consuming, not conservative and also wastage of man power, thus it needed new technology and method need to be developed to solve this problem. The system that I designed for this water quality monitoring analysed the water in real-time using multiple parameter through several sensors to analyse the water quality.

The water quality monitoring characterized as an assembling of data at one area and at standard intervals just to obtain data that used to portray the conditions. The purpose of this real-time monitoring system of water quality including quantification of the parameters (chemical properties, physicals and microbial) to distinguish the variations in parameters and give prior alert identification of risk or danger. Other than that, this project gives online result of information assembled and recommend appropriate procedures to be taken.

The objectives of the project are binary. The first one is to give a complete study of recent project accomplished for this such related project in several aspects (system of communication used, applications and sensors utilizing,). The other objective is, to build a not complex and economical technology system for monitor water quality operated by a microcontroller that has a built-in Wireless module to observe the characteristic of water (conductivity, pH and turbidity). The project also has alarm function to notify the user if there is difference or something on the parameter.

1.2 Problem Statement

The quality of water is influe nced by source of pollutions, including discharging of domestic sewage, discharging of chemical from factories, and agricultural run-off. Other than that, water pollution caused by flood and drought happens due to less of awareness among people. People need to be involved in keeping the quality of water in a good shape by taking care at aspect such as storage and disposal, environment sanitation and hygiene.

To ensure the source of water is safe to use may be a hard obstacle for everyone due to the huge amount of pollutants, which are most of them caused by human. Nowadays as we can see, natural source has been exploited too much by greedy human, the industrialization is currently on fast pace have led to pollution and badly affected our waterways. We as human should practice on how to take care our water and plays critical role in ensuring the quality of water.

Bad water quality can cause infection even death and hinders a social and economic progression. Approximately 9 million individuals dies each year cause by waterborne illness globally WHO (Water Health Organization) [1]. Farmers that utilized

pesticide is one of the factors that can affected the waterways due the fertilizer or pesticide is absorbed into the soil by rains to rivers. Chemical discharged from factories is also streamed into waterways. All these pollutions can cause a contamination in the food chains, that can affect organism and environment. Chemical disposed by factories can also be main factors that affecting our waterways as most of the factories utilized water from waterways to activate their machine or to cool down the machine. Thus, when there is change in water temperature such it temperature rises, the level of dissolved oxygen is decrease and can bring imbalance of marine life. The issues stated above is the reason why we need to monitor water quality regularly.

1.3 Objectives

1. To design real-time system that monitor quality of water system using the concept of IoT.
2. To develop a user friendly and low-cost equipment in monitoring the quality of water.
3. To investigate the water quality parameters effect to water quality.

1.4 Scope of Work

The scope of this paper is to build a system to monitor water quality device in real-time that can be observed directly utilizing the concept of IoT. Nowadays, Remote Sensing and Internet of Things (IoT) methods utilized in various segment of experiment or research for examining, gathering and monitoring information from distance.

The project was proposed to display the plan and progress of an economical system for real-time quality monitoring based on IoT concept. The device built with multiple sensors that are utilized to compute the parameter of the water such as

conductivity, turbidity, pH and dissolved oxygen. By deploying the system, an individual can evaluate the water quality from any water body anytime and anywhere globally.

Multiple sensors are installed in this device to check the quality of water parameter. The sensors are set up in the water. These sensors convert the raw data into quantifiable electrical quantity, that used as a data-input to microcontrollers via wi-fi communication system. The foundation of microcontrollers is to analyse the information from the parameter sensor, execute it and transfer the information to a user via suitable communication technology. Application are used to monitor the parameter as application must have data/information management function, data/information analysis and warning system if there is change in parameters.

1.5 Expected Outcome

The expected outcome of this project to design a device that can assist in monitor the water quality in simpler and quick way. Other than that, this project employs statistical analysis to examine regularly used environmental monitoring networks, developing modern technique where suitable, so that the design and implementation of future networks can be made as effective and cost efficient as possible**.**

1.6 Significance of Project

The significance of this project can be seen below:

- Decrease the energy consumed where individual no need to gather and test samples to check the quality of water before transfers it to the lab.
- Time and cost can be save.
- New technology can be implemented.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Quality of water can be refers to physical, radiological, natural and chemical properties of water [2]. It is step to determine the characteristic of water to the reference of standard of organism or human requirement or reason [3]. Various parameters are used to define the standard of water quality universally and also related to safety of contact, health of environment and drinking water.

2.2 Standards

Standardization, organizations have already made conclusion scientifically and politically on the how water will be utilized [4]. Natural water bodies change according to the environment. Researches work to characterize enactment with the aim to kept the waterway is clean and good quality for any use. Most of the water surface in the world are neither clean or toxic. Other than that, quality of water in fact a complex subject due to water basically a complicated medium that link up to the ecosystem of the environment. Commercial events and industrial is one of the critical factors of contamination of water.

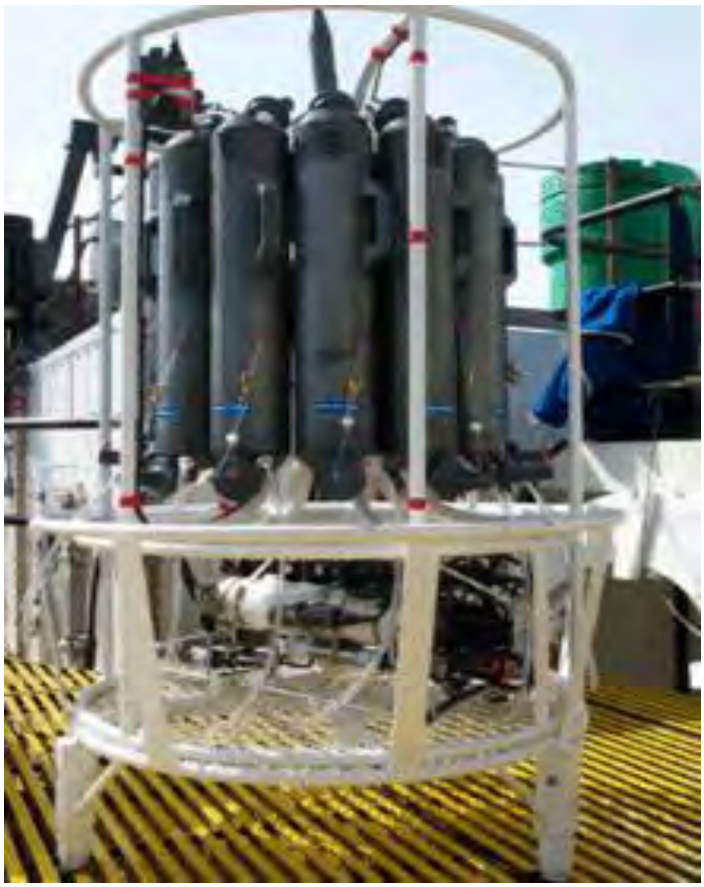

Figure 1: Rosette Sample that utilized to gather samples of water in ocean

2.3 Categories

There are a few categories for the water quality. The quality of water can be decide by how it used.

2.3.1 Human Consumption

Pollutant that contain in crude water including microbes such as bacteria, protozoa and algae; inorganic pollutant (metal and salt); herbicides and pesticides; pollutant caused by radioactive. Quality of water rest on the local environment and geographical and human uses (pollutant from factories, water use as a heat sink and dispersal of sewage.

At modern and exposed to modernisation region in the world, purification of water technology utilized at public system of water to eliminate pollutant in the water before it

spread to other areas. Consumption and uses of water directly from lake or river that does not undergo any treatment in not quality and may expose to pollutant that can affect health.

2.3.2 Domestic and Industrial Use

Domestic and industrial may dispose sewage and pollutant that contain dissolved mineral that affect the fittingness of water. For example, presence of magnesium ion and calcium ion that may react with soap can resulting the soft carbonate and sulphate that deposited in boilers [5]. Several factories disposal can contaminate the quality of water in receiving water bodies [6].

2.3.3 Quality of Water of Environment

Quality of water of environment is also known as quality of water of ambient connected with sea, river and lake. Benchmark of quality of water very important because of various ecological conditions, geographical and the activity of human surround it. Pollutants and large densities of microbes could portray risk affecting health for non-drinking activities as example factories uses, fishing, rafting, and swimming. This circumstance can affect flora and fauna that live in the environment as habitat.

Public desired to return the water bodies back to “untouched state” or as in before industrialization time. Most of laws related to environment concentrate on “emphasis” of uses of water bodies. For some country, this “emphasis” permit for water pollution but as long as it is not harmful to selected uses. It would be a challenge to bring the environment

back to “untouched state”, so some of environmentalist tries to maintain the ecosystem in healthy state.

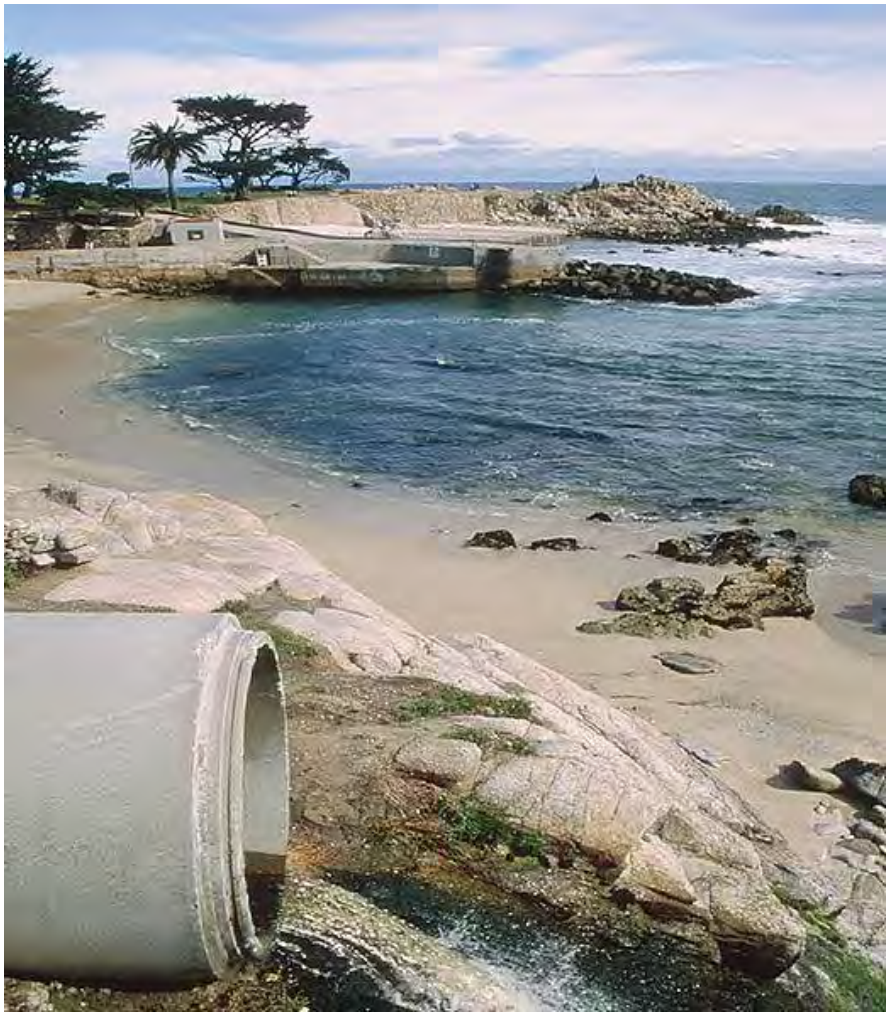

Figure 2: Runoff discharging to coast

2.4 Measurement and Sampling

The complicated of quality of water as a subject is mirrored in identification water quality. Most precise measurement of quality of water are made on site due to existence of water in balance with the environment. The measurement process usually made by direct contact to the source of water using various parameter such as dissolved oxygen, pH value, temperature, and turbidity.