SMART MONITORING WATER QUALITY DETECTOR

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Special dedicate to my family, supervisor and all my fellow friends in helping me to successfully accomplish this report.

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ABSTRACT

Monitoring pollution level of waters is essential to assess human health risks and ecosystem. This project aims to monitor the pollution level of water following the Water Quality Index (WQI) as a standard practice by Department of Environment (DOE) Malaysia. This project aims to be able in monitoring water parameters based on WQI standard. Two parameters which are pH and turbidity are monitored in IoT platform. The pH parameter is to determine the water whether it is acidic, basic, or neutral while turbidity is to determine the lake total suspended solid. These parameters were taken by pH sensor and turbidity sensor. The sensor is then connected to the microprocessor and transmitted the data to the database by using a Wi-Fi module as a bridge. This project allow user to monitor water quality without the user present at the site. This will give advantage when there is a bad weather occurrence. It is expected that the developed Smart Monitoring Water Quality Detector is potential to monitor water quality with ease.

ABSTRAK

Pemantauan tahap pencemaran air adalah penting untuk menilai risiko kesihatan manusia dan ekosistem. Projek ini bertujuan untuk memantau tahap pencemaran air mengikut Indeks Kualiti Air (IKA) sebagai amalan standard oleh Jabatan Alam Sekitar (JAS) Malaysia. Projek ini bertujuan untuk menjadi parameter pemantauan air berdasarkan standard IKA. Dua parameter iaitu pH dan kekeruhan dipantau melalui platform IOT. Parameter pH adalah untuk menentukan air sama ada ia adalah berasid, berakali, atau neutral manakala kekeruhan adalah untuk menentukan jumlah pepejal terampai tasik. Parameter-parameter ini telah diambil oleh sensor pH dan sensor kekeruhan. Sensor ini kemudiannya disambungkan kepada mikropemproses dan menghantar data kepada pangkalan data dengan menggunakan modul Wi-Fi sebagai jambatan. Projek ini membolehkan pengguna untuk memantau kualiti air tanpa perlu hadir pada tapak. Ini akan memberi kelebihan apabila terdapat cuaca buruk. Ia dijangka bahawa *"Smart Monitoring Water Quality Detector"* berpotensi untuk memantau kualti air dengan mudah.

TABLE OF CONTENTS

II LITERATURE REVIEW

III METHODOLOGY

LIST OF TABLES

LIST OF FIGURES

LIST OF FORMULA

LIST OF ABBREVIATION

WQI	-	Water Quality Index
DOE	-	Department of Environment
IoT	-	Internet of Things
SSID	-	Service Set Identifier
TSS	-	Total Suspended Solid

LIST OF APPENDICES

CHAPTER I

INTRODUCTION

This chapter gives an overall overview of the project which including problem statement, objective, objective, significance of study and scope of project.

1.1 Project overview

According to United States Geological Survey, water covers 2/3 of the land on earth which roughly around 71% of the earth's total surface area is water. This ratio is always in flux due to climate changes and weather. From this number, lakes only occupy about 0.02% of overall water on earth. Some of this are man-made lake and some of it natural lake.

However, it became a question whether the lake is safe and clean to be use as water supply source or recreational purposes. As of water supply source, the water that have been used domestically are most likely to be safe and clean due to the responsible parties such as *Syarikat Air Melaka Berhad* (SAMB) because the water has been treated. The main question, the lake that use as recreational purposes. Recreational lake water makes contact to human directly and can cause water-borne diseases[10] such as Typhoid, Cholera, Paratyphoid Fever, Dysentery, Jaundice, Amoebiasis and Malaria.

Due to this, a water quality monitoring system is becoming an importance to implement at the recreational lake. The system able to monitor the lake whether it safe or not for recreational purposes and inform the responsible parties. Current water quality monitoring system is sufficient yet it is expensive and hard to maintain.

The new water quality monitoring system by using Arduino is simple, inexpensive, and easy to maintain. The system uses internet of things (IoT) to transmit the data and the user able to access the data anytime with a simple internet connection.

1.2 Problem statement

Water is necessary to human and have many uses. It can be used for domestic purposes such as washing clothes, drinking, bath, etc. It can also be used for recreational purposes such sport and open lake activities. Nowadays, there are many outdoor activities involving lakes, whether it is man-made lake or natural lake. With these activities becoming famous and a lot of people took part in these activities, it is becoming a concern whether the lake is safe or not for recreational purposes.

Current available water quality monitoring system cannot sustain outdoor uses and the testing mostly done by certain period of time or in the lab. This method is sufficient; however, it is time consuming and expensive.

This project is proposed to monitor the pollution level of water following the WQI as a standard practice by DOE Malaysia with rapid speed, cheaper, and able to sustain outdoor uses.

1.3 Objective

The objective of the project is to design and develop pH and turbidity monitoring system for *"Tasik UTeM"* and develop IoT based system for monitoring the water *"Tasik UTeM"*. Finally, it is to analyse the effectiveness of the designed project.

1.4 Scope of work

This project is to design a water quality monitoring system for *"Tasik UTeM"* by monitoring its pH level and water turbidity. This project will use Arduino UNO R3 as a microcontroller for the pH sensor and turbidity sensor. The software for Arduino UNO R3 microcontroller is Arduino IDE which use C++ language. The data will be transmitted through a Wi-Fi shield/module which is involving IoT. User will receive an alert if the quality exceeds the threshold value based on WQI as a standard practice by DOE Malaysia. User also able to inspect the lake with the data transmitted and display a suitable information to the public.

This project are mainly focuses on designing the water quality monitoring system with Arduino compatible hardware and IoT. The whole project is focus on hardware where software is used to interface the sensors to microcontroller and data transmission.

1.5 Significance of work

This project is to monitor water quality for pH and turbidity in real-time by using IoT and display the final result or data for the public to know the current situation of the water.

CHAPTER II

LITERATURE REVIEW

This chapter will highlight the past studies which related with water quality monitoring system and their designated area.

2.1 Hardware

The literature review for hardware of this project is about the other projects that have almost same field of studies with this Smart Monitoring Water Quality Detector. This project will be compared to previous study.

According to the DOE, there are six (6) parameters to be measured to calculate WQI. The six parameters are Ammoniacal Nitrogen, Biochemical Oxygen Demand, Chemical Oxygen Demand, Dissolved Oxygen, pH, and Total Suspended Solid.

DOE Water Quality Index Classification

PARAMETER	UNIT	CLASS				
		I	II	III	IV	V
Ammoniacal Nitrogen	mg/l	< 0.1	0.1 - 0.3	0.3 - 0.9	0.9 - 2.7	> 2.7
Biochemical Oxygen Demand	mg/l	< 1	1 - 3	3 - 6	6 - 12	> 12
Chemical Oxygen Demand	mg/l	< 10	10 - 25	25 - 50	50 - 100	> 100
Dissolved Oxygen	mg/l	> 7	5 - 7	3 - 5	1 - 3	< 1
pH	-	> 7	6 - 7	5 - 6	< 5	> 5
Total Suspenbed Solid	mg/l	< 25	25 - 50	50 - 150	150 - 300	> 300
Water Quality Index (WQI)	-	< 92.7	76.5 - 92.7	51.9 - 76.5	31.0 - 51.9	> 31.0

Water Classes And Uses

CLASS	USES
Class I	Conservation of natural environment. Water Supply I - Practically no treatment necessary. Fishery I - Very sensitive aquatic species.
Class IIA	Water Supply II - Conventional treatment. Fishery II - Sensitive aquatic species.
Class IIB	Recreational use body contact.
Class III	Water Supply III - Extensive treatment required. Fishery III - Common,of economic value and tolerant species;livestock drinking.
Class IV	Irrigation
Class V	None of the above.

Sourse : EQR2006

Figure 2.1: DOE water quality parameters and index including its classes

This project will focus on pH and Total Suspended Solid. The pH will be measured by using pH sensors and the Total Suspended Solid will be measured by using turbidity sensor. These parameters are then studied the relation between other parameters if there is any relation for example a lower pH value indicates a higher ammonia in water.

2.1.1 Microcontroller

Based on *Towards a Real-Time Embedded System for Water Monitoring Installed in a Robotic Sailboat,* the microcontroller for the system is a Raspberry Pi (RPi) model B. This model has 256 Mb of RAM memory and a 700 MHz processor and its architecture allows the development of several, different embedded system projects through the GPIO pins (there are 26 pins in this version). This makes less demanding the collaboration with other equipment. The Raspberry Pi (RPi) is a very low-cost computer, with the compact size, which supports Unix platforms. The Raspberry Pi (RPi) has support to the SPI communication through pins: SCLK (pin 23), MISO (pin 21), MOSE (pin 19), and SS (pin 24). In the proposed engineering, the RPi is the ace of the SPI correspondence convention and gets sensor information from the information securing module, processes them and sends them to the communication module [1].

Figure 2.2: A picture of Raspberry Pi (RPi) model B

According to *Design of Low-cost Autonomous Water Quality Monitoring System,* the aim of the project is to develop a low-cost wireless water quality monitoring system that aids in continuous measurements of water conditions. The project developed a prototype sensor as one component of the Autonomous Live Animal Response Monitor (ALARM). The system measured are temperature, light intensity, pH, electrical conductivity (EC), total dissolved solids (TDS), salinity (SAL), dissolved oxygen (DO) and oxidation reduction potential (ORP) as the parameters [6].

These parameters give bits of knowledge into the ebb and flow status changing water conditions and help with recognizing contamination sources. Arduino Mega 2560 was used as the sensor node to acquire and process sensor data. Arduino Mega 2560 was chosen because it is an open-source product, inexpensive, and provides sufficient analog/digital pins for this application. It operates at 5V using Atmel's ATmega2560 micro-controller with a clock speed of 16MHz. It has a flash memory of 256 kB and Static Random Access Memory (SRAM) of 8 kB. Out of all Arduino boards, Mega dominates in terms of processing, memory and number of available interconnections. It has 16 analog pins and 4 serial ports. One of the serial port is connected internally to Universal Serial Bus (USB) port. In this project, they used 3 analog pins and all 4 serial ports for application [6].

The difference for the Smart Monitoring Water Quality Detector is that, this project will use Arduino UNO R3 as a microcontroller for the sensor and Wi-Fi

shield/module. Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins, which 6 can be used as PWM outputs, 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It has a flash memory of 32 kB and Static Random Access Memory (SRAM) of 2 kB. It contains everything needed to support the microcontroller. Just simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or a power bank or battery to get it started. Arduino UNO R3 also commonly use due to its cheap price and user friendly because of the Arduino IDE open-source for its software program. Eventhough Arduino Mega 2560 is superior than Arduino UNO R3, the Arduino Uno is sufficient to support this project and it is much cheaper than Arduino Mega 2560.

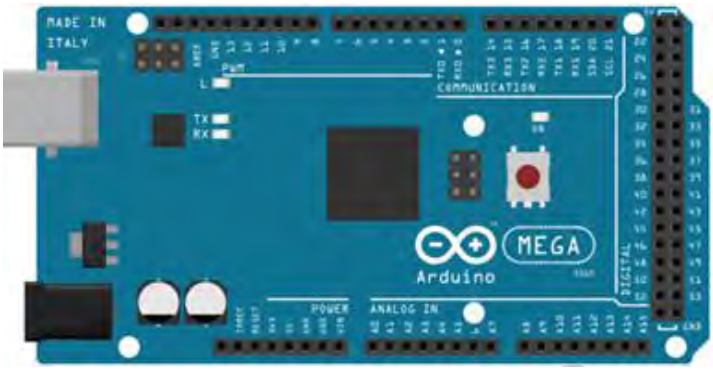

Figure 2.3: Arduino Mega 2560 layout

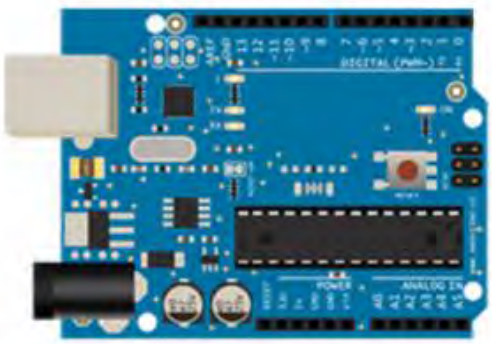

Figure 2.4: Arduino UNO R3 layout

There is also a second option other than the Arduino UNO R3 which is WeMos D1 R2. This microprocessor board is an Arduino base microprocessor board which have almost same layout with the Arduino UNO. However, there is a significant difference between WeMos D1 and Arduino UNO which is the number