



## **UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

### **WATER QUALITY SENSOR DEVELOPMENT AND WIRELESS MONITORING USING ARDUINO**

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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## BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

**TAJUK: Water Quality Sensor Development and Wireless Monitoring Using Arduino**

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# APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Electronic Engineering Technology (Telecommunication) with Honours. The member of the supervisory is as follow:

.....

(Project Supervisor: AZIEAN BINTI MOHD AZIZE)

## ABSTRAK

Air merangkumi dua pertiga permukaan bumi dengan lebih daripada 97% hadiah di lautan dan kurang daripada 1% di sungai air tawar dan tasik. Air adalah kediaman penting untuk ikan dan kehidupan laut yang lain. Seperti yang diketahui, kualiti air sangat penting dalam akuakultur, ikan melakukan semua fungsi tubuh mereka di dalam air kerana ikan bergantung sepenuhnya kepada air untuk bernafas, makan dan pertumbuhan, membuang buangan, mengekalkan keseimbangan garam, dan membiak, memahami fizikal dan kimia kualiti air sangat penting bagi akuakultur yang berjaya supaya pemantauan masa nyata dan kajian amaran awal mengenai persekitaran air menjadi bahagian penting akuakultur. Saya, pelajar tahun terakhir Sarjana Muda Teknologi Kejuruteraan Elektronik (Komunikasi Elektronik), telah mengambil projek pembangunan dan Pemantauan Sensor Kualiti Air Menggunakan Arduino sebagai projek akhir tahun saya. Kualiti air adalah yang paling penting dalam kehidupan seharian terutama dalam kehidupan akuakultur. Projek ini adalah untuk menggambarkan parameter kualiti air seperti kekeruhan dan suhu air. Ia akan memantau proses pensampelan dan menganalisis keadaan air. Projek ini memberi tumpuan kepada spesies akuakultur. Rangkaian sensor wayarles pemantauan kualiti air direka untuk membolehkan petani ikan memantau dan mengawal ikan mereka di dalam kolam lebih mudah berbanding sebelum ini. Ia juga untuk petani ikan untuk memahami lebih lanjut tentang parameter kualiti air yang diperlukan untuk ikan mereka. Ia dilengkapi dengan pengesanan amaran awal yang dapat membantu penternak ikan mengawasi kolam mereka. Hasilnya ialah apabila data dihantar dengan menggunakan Modul WiFi dan pengguna akan mendapatkan data mengenai keadaan kolam mereka. Ini dapat meningkatkan produktiviti ikan kerana pengguna sentiasa dapat memantau tahap kualiti air yang sesuai dengan ikan. Kelebihan projek ini juga dapat membantu petani ikan untuk mengawal produktiviti ikan dan peranti mudah digunakan dan mudah.

## **ABSTRACT**

Water covers two-third of the Earth's surface with over 97% presents in the oceans and less than 1% in freshwater streams and lake. Water is an essential habitation for fish and other marine lives. As all known, water quality is very important in aquaculture, fish perform all their bodily functions in water because fish are totally dependent upon water to breathe, feed and growth, excrete wastes, maintain a salt balance, and reproduce, understanding the physical and chemical qualities of water is critical to successful aquaculture so the real-time monitoring and early warning studies on the water environment have been an essential part of aquaculture. I, the final year student of Bachelor of Engineering Technology Electronic (Electronic Communication), have taken up project tittle Water Quality Sensor Development And Monitoring Using Arduino as my final year project. Water quality is the most important in daily life especially in aquaculture life. This project is to describe the water quality parameter such as turbidity and temperature of the water. It will monitor the process of sampling and analyze the water condition. This project is focused on aquaculture species. Water quality monitoring wireless sensor network is designed to allow fish farmers to monitor and control their fish in the pond much more easily than before. It is also for fish farmers to understand more about the water quality parameter that needed for their fish. It is equipped with an early warning detection that can help fish farmers monitoring their pond. The result is when the data are transmitted by using the WiFi Module and user will get the data regarding the condition of their pond. This can enhance the productivity of the fish because user can always monitor the level of water quality that suitable with the fish. The advantages of this project also can help fish farmers to control the productivity of the fish and the device is easy to use and convenient.

## **DEDICATIONS**

This thesis is dedicated to:

My beloved family,

For raising me from a boy to a man,

My Supervisors,

My Lectures,

My Housemate,

And all my friends,

Thank you for the nice support and powerful encouragement.

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Alhamdulillah, thank you Allah because of His blessing, I finally complete and finish my final year project successfully.

During the process to complete my project objective, I do a lot of research either by using internet, reading past year thesis, reference books and journal. With the guidance and support from people around me, I finally complete the project due to the time given. Here, I want to give credit to those who helped me to achieve what I had achieved in my final year project.

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# LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

RFID	-	Radio Frequency Identification Detection
PIAM	-	General Insurance Association of Malaysia
GSM	-	Global System for Mobile Communication
RO	-	Read Only
WORM	-	Write Once Read Many
HCI	-	Host Controller Interface
GSMA	-	GSM Association
MIM	-	Man In Middle
TDMA	-	Time Division Multiple Access
MS	-	Mobile Station
BSS	-	Base-Station Subsystem
BTS	-	Base Transceiver station
MSC	-	Mobile Service Switching Center
NSS	-	Network and Switching Subsystem
GPRS	-	General Packet Radio Service
PWM	-	Pulse Width Modulation
IDE	-	Integrated Development Environment
AT	-	ATTENTION
LCD	-	Liquid Crystal Display
EGSM	-	Extended Global System for Mobile Communication
DCS	-	Distributed Control System
SRAM	-	Static Random-Access Memory

# CHAPTER 1

## INTRODUCTION

In chapter 1 is about the introduction of idea their project. It is cover on the overview of the project, detailing the objectives, the problem statement, scope and outcome of the project.

### 1.1. Introduction

Water covers two-third of the Earth's surface with over 97% presents in the oceans and less than 1% in freshwater streams and lake. Water is an essential habitation for fish and other marine lives. As all known, water quality is very important in aquaculture, fish perform all their bodily functions in water because fish are totally dependent upon water to breathe, feed and growth, excrete wastes, maintain a salt balance, and reproduce, understanding the physical and chemical qualities of water is critical to successful aquaculture so the real-time monitoring and early warning studies on the water environment have been an essential part of aquaculture. At present, most domestic water quality monitoring are still using manual methods. The detection process involved in sampling, sample transportation and preservation, laboratory data measured .This is a complex but associated system. Any error of the steps will affect the results of the final data. Water is the important source for our life and also for aquaculture species such as fish or other marine lives.

The project was designed is Water Quality Sensor Development and Wireless Monitoring Using Arduino that is a system that consists a Arduino UNO, ESP8266 WiFi Module and sensors parameters. This system was integrated together to measure



the turbidity and temperature in water. This project are focused in aquaculture species that are for fish ponds. It was designed to ease and saves times for the water analysis. In addition this project is a lower cost and easy to handle.

## **1.2. Problem Statement**

A major challenge for aquaculture is to produce more food, fee and fiber to meet growing global demand. It also generates effects external to market, both positive and negative. The problem is water are very important natural which needs a constant quality monitoring for ensuring it safe to use. Before this, the water quality analysis has been carried out manually where in the water samples are collected and taken to the laboratories for analysis. Because of that the data cannot be display in real time data. The fish farmer will not know if there were anything happened to the water because before this there were only check water quality for the fish farm in the time given.

## **1.3. Project Objective**

The objectives of this development are:

- To study the application of wireless monitoring using Arduino.
- To monitor the required parameter of water quality in aquaculture.
- To develop the transmission of water quality information over wireless technology.

## **1.4. Project Scope**

The scope of this project are to study the basic of microcontroller and also study the code use to detect the water quality parameter. This work focuses on the use

of multiple sensors to monitor and control the water quality parameters of turbidity and temperature in fish ponds in real-time. Wireless sensor network technology have led to the development of low cost, low power, multifunctional sensor. The scope of this project consists of hardware and software. The basic idea is to monitor software and the main part of the hardware is the Arduino and sensor parameter. There are three parameters for this project can be classified as:

Firstly is water quality parameters, there are including turbidity, temperature and pH water level. The main focuses for this project are on dissolved turbidity and temperature. All these parameters are crucial to freshwater organism to survive. If one of these parameters is overloaded or not sufficient, the chance for freshwater organism to die is high. So, the understanding for all parameter is needed for this project.

Secondly is the application of wireless network of their project. Wireless network is commonly used as a medium transmission data. This is very important to the device for receive and transmit the data to user. This project are used ESP8266 WiFi Module as a medium transmit data to user and receive data from Arduino UNO.

Lastly is a Microcontroller. That is low-cost for project development and very popular in education. It allows developer to create a coding to perform a desired task. The most popular microcontroller board such as Arduino Uno, Raspberry Pi and NodeMCU ESP8266. Arduino uses the C and C++ language programming. The function of microcontroller in this project is to detect the water quality parameters and create the early warning detection for the fish farmers.

## 1.5. Thesis Structure

The first chapter introduces brief idea of the project. It focused on the overview of the project, detailing the objectives, the problem statement, scope and outcome of the project.

Projects background is discussed in second chapter. The method concept, theory, and some characteristic of component of hardware that used in this project is discussed in this chapter. This chapter also contain a definition of term used in this project also discusses the concept of the research and how it related to the theory.

In chapter 3, this section is methodology chapter. Methodology chapter is a schedule or steps that need to be complete, detailed reports of studies done to achieve aim objective. This chapter explains the procedure taken to complete the project. It is consist the detail development of this project.

The chapter four is about the result and discussion that we obtain based on the methodology that we used. All the simulations, data collection and analysis obtained were discussed in detail. The results were compared with the outlined objectives in order to state some hypothesis and conclusion.

The last chapter is about the conclusion and future work. In this section, we will conclude what we have done and followed by some recommendation on how to improve the performance of the system based on the desired results.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1. Introduction**

This chapter will discuss about finding and analysis of previous project that related with water quality monitoring using star network wireless sensor network. All the detail is taken from various resources such as journal, thesis, book and valid websites. Water quality monitoring using star network wireless sensor network is similar with water quality monitoring system using remote sensing. Remote Sensing technology have been widely used to monitor the water quality with high-frequency, large-scale, multi-spectral characteristics. The idea to create with water quality sensor development monitoring using Arduino is because water are needs constant quality monitoring for ensuring its water safe use. Before this, the system maybe a problem to who are responsible to record data error by manually. Based on J. Barron [1] ,they have done research of a water quality system, there are few disadvantage by manually collect data and the risk of physical injury to sampling technicians. Even in good weather, technicians can encounter steep banks, rocks, snakes and poison ivy. Therefore, with water quality monitoring using star network wireless sensor network is a project that monitoring pH level and turbidity of water at fish porn. This project is to monitoring water quality system that propose based on wireless sensor network which it helps in continuous and remote monitoring of the water quality data. This project is focused on aquaculture species.

Water quality monitoring wireless sensor network is designed to allow fish farmers to monitor and control their fish in the pond much more easily than before. It is also for fish farmers to understand more about the water quality parameter that

needed for their fish. It is equipped with an early warning detection that can help fish farmers monitoring their pond. The result is when the data are transmitted by using the WiFi Module and user will get the data regarding the condition of their pond. This can enhance the productivity of the fish because user can always monitor the level of water quality that suitable with the fish. The advantages of this project also can help fish farmers to control the productivity of the fish and the device is easy to use and convenient.

## **2.2. Background History**

For a long time, industry has been searching for develop hardware and software with using wireless sensor network that able to monitor a water quality. There are also can reduce the cost of operating system in water quality control and this project also become the modern technology are used in fish ponds. Water quality monitoring using star network wireless sensor network is the best achievement in this search for water quality monitoring system.

## **2.3. Monitoring System**

Water quality monitoring is a process of sampling and analyzing the water condition and characteristics. The complexity of water quality as a subject is reflected in the many types of measurements of water quality indicators. The most accurate measurements of water quality are made on-site, because water exists in equilibrium with its surroundings. Measurements commonly made on-site and in direct contact with the water source in question include temperature, pH, dissolve oxygen, conductivity, and oxygen reduction potential (ORP), turbidity, and Secchi disk depth. There is some equipment to collect the sample of the water. One of it is a Rosette sampler. A rosette sampler is focused on using to collect water samples in deep water.

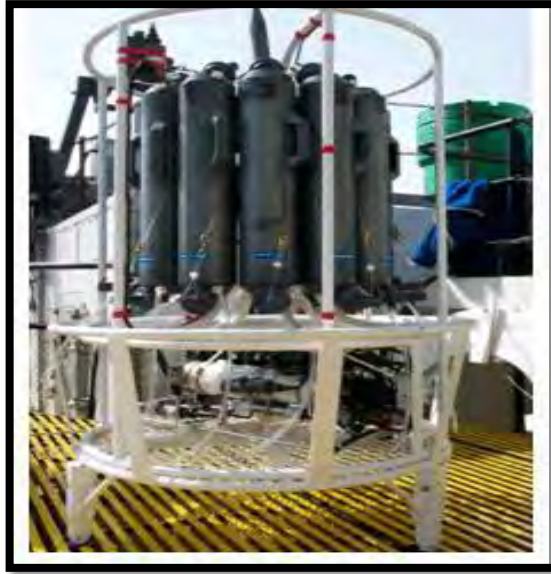


Figure 2.1: A Rosette Sampler [2]

#### **2.4. Type of water quality monitoring system**

Water quality monitoring and notification system using GSM. The water quality is interns of monitoring the level of water, the temperature of the water and its surrounding, the turbidity of the water (how clean the water is) as well as the PH levels of the Water. So this system monitors all of these aspect and finally when all check have been completed, its sends the information or data as an SMS to notify the authorized personnel.

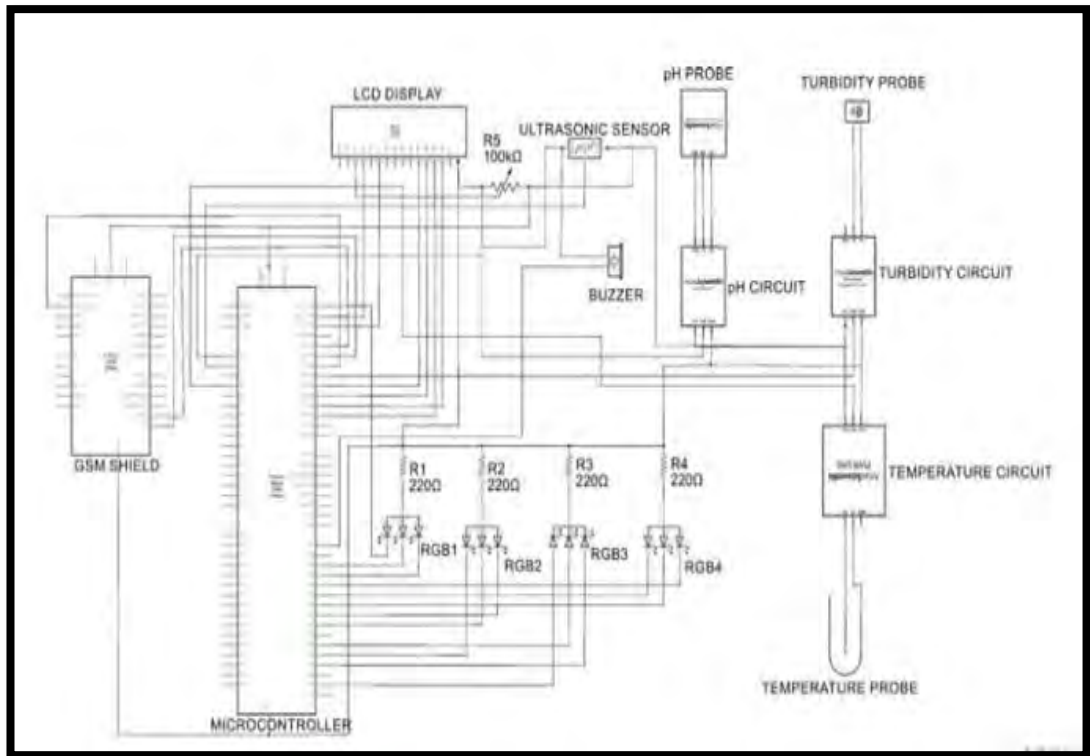


Figure 2.2 : Schematic diagram of water quality monitoring and notification system using GSM.

The second type of water quality monitoring is water quality monitoring system using wireless sensor network. The parameter involved in the water quality monitoring such as the pH level, turbidity and temperature is measured in real time by the sensor that send the data to the base station or control/monitoring room. As the monitoring is intended to be carried out in a remote area with limited access, signal or data from the sensor unit will then be transmitted wirelessly to the base monitoring station. The application of wireless sensor network (WSN) for a water quality monitoring is composed of a number of sensor nodes. [3]

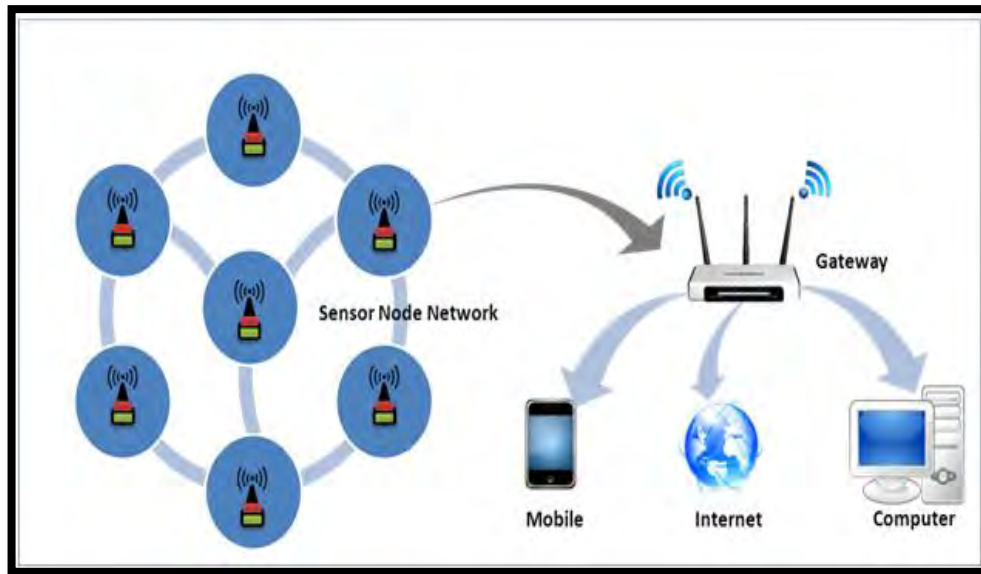


Figure 2.3 : Water Quality Monitoring System Using Wireless Sensor Network(WSN)

## 2.5. Water quality management for aquaculture.

Nowadays, Water quality is the most important factor affecting fish health and performance in aquaculture production systems. Good water quality refers to what the fish wants and to understand the water quality requirements of the fish under culture very well. Fish live and are totally dependent on the water they live in for all their needs. Different fish species have different and specific range of water quality aspects temperature, pH, oxygen concentration, salinity and hardness within which they can survive, grow and reproduce. Within these tolerance limits, each species has its own optimum range, that is, the range within which it performs best. It is therefore very important for fish producers to ensure that the physical and chemical conditions of the water remain, as much as possible, within the optimum range of the fish under culture all the time. Outside these optimum ranges, fish will exhibit poor growth, erratic behavior and disease symptoms or parasite infestations. Under extreme cases, or where the poor conditions remain for prolonged periods of time, fish mortality may occur.