DESIGN AND DEVELOPMENT SENSOR BASED ELECTRONICS SYSTEM OF WATER QUALITY DETECTOR

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Date : 1th June 2017

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ABSTRACT

Water is the commonly used in our daily life. However, we as the consumer do not know the condition of water. Either it in good specification or not. Water pollution is easily to occur but it is hard to recover it back if the action taken is late. Besides that, the manpower to monitor the water also cannot monitor the water 24/7. This is because we as the human being surely need a rest. Meanwhile the water to be polluted can be happen at any time. Other than that, the price of the system that already has in market is too expensive. This will make the people only really need to use it only will buy it. In order to make many people will take care of their water is by reducing the cost of the system. In this thesis, is using the Arduino UNO as the microcontroller and Esp8266 as the WiFi module. WiFi module is used to make the data can be send to Thingspeak and can be monitor it everywhere. Besides that, parameter for this project is pH and turbidity level and the scope of the project is for house water tank. By using this components, the cost of the system can be reduced and help more easy to monitoring it.

ABSTRAK

Air adalah satu keperluan dalam kehidupan seharian kita. Walau bagaimanapun, kita sebagai pengguna tidak mengetahui keadaan air. Sama ada ia dalam keadaan baik atau tidak. Pencemaran air adalah mudah untuk berlaku tetapi ia adalah sukar untuk baikpulih semula jika tindakan yang diambil lewat. Selain itu, tenaga kerja untuk memantau air juga tidak boleh memantau air 24/7. Ini kerana kita sebagai manusia pasti perlu berehat. Sementara itu air yang akan tercemar boleh berlaku pada bila-bila masa sahaja. Selain daripada itu, harga sistem yang sudah ada dalam pasaran adalah terlalu mahal. Ini akan menyebabkan rakyat yang hanya benar-benar perlu menggunakan ia hanya akan membelinya. Dalam usaha untuk membuat ramai orang akan menjaga air mereka adalah dengan mengurangkan kos sistem. Dalam tesis ini, menggunakan Arduino UNO sebagai pengawal mikro dan Esp8266 sebagai modul WiFi. modul WiFi digunakan untuk membuat data boleh dihantar ke Thingspeak dan boleh memantau mana-mana. Selain itu, parameter untuk projek ini adalah pH dan tahap kekeruhan dan skop projek ini adalah untuk tangki air rumah. Dengan menggunakan komponen ini, kos sistem boleh dikurangkan dan membantu lebih mudah untuk memantau.

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CHAPTER I

INTRODUCTION

This chapter will discuss the introduction, scope and methodology of this project.

1.1 Introduction

Water is one of the important things in our daily life. Therefore, the quality of water is very important to take care. As we can see water around us, it was polluted and not in good condition. Like what happened in early 2017, at the Selangor has an issue that the water is polluted and some area the water supply has to be stopped for a while to clean it. As the industrial is growing up year by year, our water also exposed to a threat of pollution, especially from the industrial activities.

Basically, it needs the manpower to monitoring the water and it is impossible to manpower to continuously monitor it every second. It is also impossible to monitoring the all the place at one time due to lack of manpower, the cost of equipment and facilities to monitoring it. This will lead to a late action will be taken to the situation. Therefore, it is important to have the monitoring system that lower cost, flexible and reliable. It may help in reducing the reliance on manpower for monitoring the water.

There are several conditions of water that needs to consider such as pH level, chlorine, turbidity, temperature and the other. In this project, it will check the pH level value and the turbidity. The normal range for the pH value is 6.7 until 7.3 meanwhile for the turbidity is 5.

1.2 Problem Statement

The presence of professional tools that can check many types of the condition is good but the price is too expensive. It may burden the people that just want to monitor the water. It also needs the manpower go to the site to test and check water quality.

This project provides an alternative way to monitor the water in the more efficient way. By using a nowadays method which is Internet of Thing (IoT), it will make the monitoring of the water will be more efficient and better. It also can monitor the water every time and does not need manpower go to the site.

It is important to develop the devices that monitoring the water in real-time. This is because it may help the emergency response to take an action if anything happens to the water. Prevent is better than cure. If the pollution is late to take an action, it will make harder to clean it back or to stop it before become worse.

The use of sensor technologies in a right and manner way can help lowering the risk of water pollution and can make the user feel safe and comfort hence improving their healthy quality.

1.3 Objective of Project

The main objective of this project is to design the prototype of water quality control detector in monitoring the quality of water (pH level and turbidity). Besides that, to apply the IoT app in notifying user so that the user and emergency response

team can know the condition of the water. Last but not least is to investigate the performance of the developed system to send data to the Thingspeak.

1.4 Project Scope

The design of this **water quality control detector in monitoring the quality of water** is divided into two working scope which is software and performance of the system. The first scope includes the program that is used for controlling the input and output of the wireless fidelity (WiFi) module. Arduino integrated development environment (IDE) and ESPFlashdownloadtool software are used for this working scope.

The second scope is the performance of the system. The data that the sensor reading will be display in the LCD display and it also will be sent to the Thingspeak (cloud). By using the ESP8266 as Wi-Fi transmitter to send data to the Thingspeak.

1.5 Research Interest

The interest of this project is about obtaining knowledge in developing an electronic circuit. With the right information, each of the function of the components used in this project can be particulars studied and applied. Other than that, the installation process of the electronic component such as placing the sensor to the right pin and make it function.

The student also can gain a massive experience when completing this project. There is so much progression and step needed to be done in order to achieve a stable and working electronic devices. All knowledge that has been learned from the previous bachelor studies surely would be used for completing this project including the basic.

New ideas or knowledge that cannot be learned in classes is found when student face a problem while emerging the circuit. Troubleshooting process is needed in order

to make sure the devices is fully working. An experiences of developing a full complete electronic device is a very useful experiences and cannot be learnt in a short time, student must face the hard moment before they can gain a whole new valuable experiences.

1.6 Report Guidance

This bachelor project report contains five chapter for explaining about the design and development **Sensor based Electronic System of Water Quality Detector**. This report starts with an introduction, literature studies, methodology, results and discussion, conclusion and suggestion.

Chapter I - Introduction to the project background. Basic explanations are discussed in this chapter. This introduction discussing the background of the project, problem statement and the objective of the project development. It is also discussing the importance of this project.

Chapter II - This chapter comprise the literature studies of the theoretical concept that applied on this project. It also contains the information obtained for completing the project.

Chapter III - The methodology explained is about how the progress of this project is accomplished. The main content discussed in this chapter is a flow chart, circuit operation, hardware, and software configuration.

Chapter IV - Concentrating on the results and discussion of the project. All discussion was done based on the results of the successfully implemented project.

Chapter V - Contain a conclusion regarding this project. After the project is completely been developed, a few suggestions are proposed for improvement of the project in the future.

CHAPTER II

LITERATURE REVIEW

This chapter contains the literature studies of the theoretical concept that applied on this project. It is also containing the information for completing the project.

2.1 Previous Water Quality System Studies and Projects.

This section will discuss the system that has been formed before. This information has been studied prudently in order to enhance the quality and reliability of this project. By analyzing the ideas and recommendation of earlier project, a lot of information is obtained and can be used as a references or guidance for completing this project. By studying the previous works, a proper thing or design is considered in order to make this project become reliable and marketable. In addition to that, there are a little finding from internet and books that extremely contribute to this project.

2.1.1 Water Quality Monitoring System Using Zigbee Based Wireless Sensor Network [1]

This project has been developing by X. Hu, J. Wang, Q. Yu, W. Liu, and J. Qin. This project is used ZigBee in order to transfer the information. The monitoring system is using a number of nodes with an interacting competence for an ad-hoc for continuous monitoring purpose. Temperature, turbidity and pH level is the parameter for this project and monitoring it in real-time at base station in the room. In order to reduce the monitoring system cost in term of facilities and the labor cost. In this paper, wireless sensor network (WSN) is proposed by using the ZigBee and the IEEE 802.15.4 compatible transceiver.

2.1.2 Design and Development of A Portable Low-Cost COTS-based Water Quality Monitoring System [2]

This project has been developing by Sritrusta Sukaridhoto, Rahardhita Widyatra Sudibyo , Widi Sarinastiti, Rizky Dharmawan, Atit Sasono , Ahmad Andika Saputra , and Shiori Sasaki. This project is measure the ORP, pH, dissolved oxygen (DO)., temperature and conductivity. This project consists three main part which is central measurement unit, control unit and communication unit. Central measurement unit is using the Arduino UNO to collect the data from sensor. Meanwhile at the control unit, this project using the Raspberry PI ARM Single-Board-Computer (SBC) version 2.0 and connect to LCD touch screen. Communication unit is using the CDMA Modem which is Smartfren CE682. This project using the 10KmAh battery to this device.

2.1.3 A Low Cost Nephelometric Turbidity Sensor for Continual Domestic Water Quality Monitoring System [3]

This system is design by Ahmad Aftas Azman, Mohd Hezri Fazalul Rahiman, Mohd Nasir Taib, Norbaya Hj Sidek, Ilyani Akmar Abu Bakar, Mohd Fozi Ali. The main focus of this project is to check the turbidity level of water quality. This project is using the PIC microcontroller which is PIC 16F777. The PIC will turn on the LED light and measure the brightness of the LED using the LDR. Computer will be the output of the sensor using the USB cable from RS232. It will display the voltage and the turbidity value in NTU. It need to take 0.5 sec before it read the next reading.

2.1.4 Smart Water Quality Monitoring System [4]

A.N.Prasad, K. A. Mamun, F. R. Islam and H. Haqva are the designer of this project. This project is making the oxidation and reduction potential (ORP), conductivity, pH and temperature as their parameter. In order to test the acidity of the water, this project is using the lemon juice adding to tap water. This project is using the analog to digital converter (ADC) for the sensor, microcontroller as the processor and SD storage and GSM module to store and send data to the cloud. The data can be stored into the SD storage or can be transferred using the File Transfer Protocol (FTP) server or cloud server.

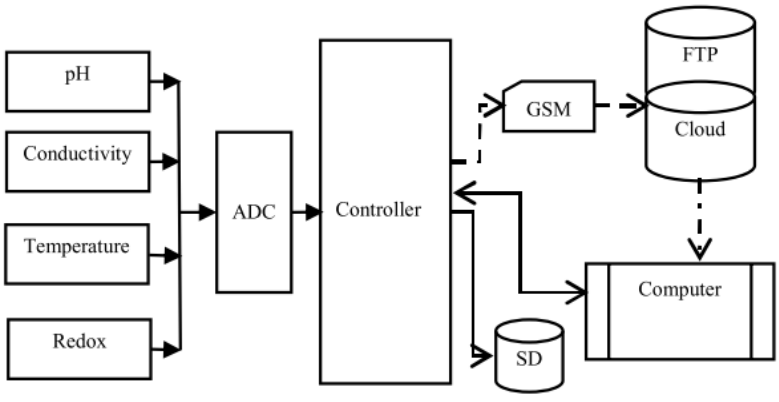


Figure 2.1: Overall block diagram of system operation

2.1.5 Wireless Acquisition System For Water Quality Monitoring [5]

This project has been designed by Vinod Raut and Sushama Shelke from Dept. of E & TC Engg., NBN Sinhgad School of Engineering, Pune, India. This project will check the pH value, turbidity, water level sensor and the temperature of the water and using the peripheral interface controller (PIC) embedded platform. The PIC this project using is PIC 18F4550 and using the ZigBee as the wireless transmission.

2.1.6 Real-Time Wireless Monitoring and Control of Water Systems using Zigbee 802.15.4 [6]

Saima Maqbool and Nidhi Chandra from Department of Computer Science and Engineering, Amity University, Noida, Uttar Pradesh, India have invented the system. This project is using the XBEE Pro series1 as the communication module and 74HC14 Hex Inverting Schmitt Trigger in order to convert the input signal into the value needed.

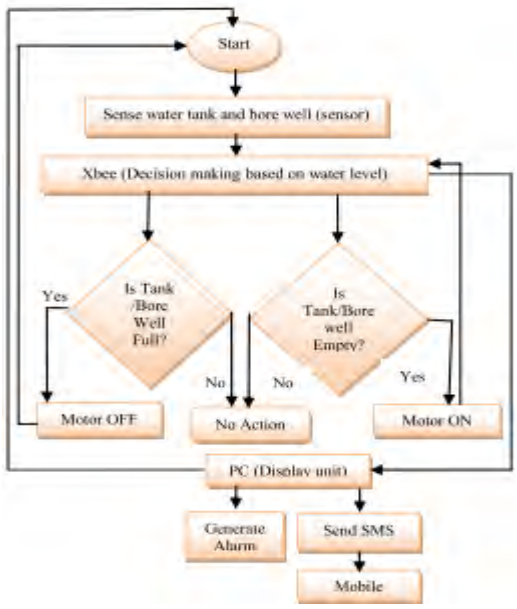


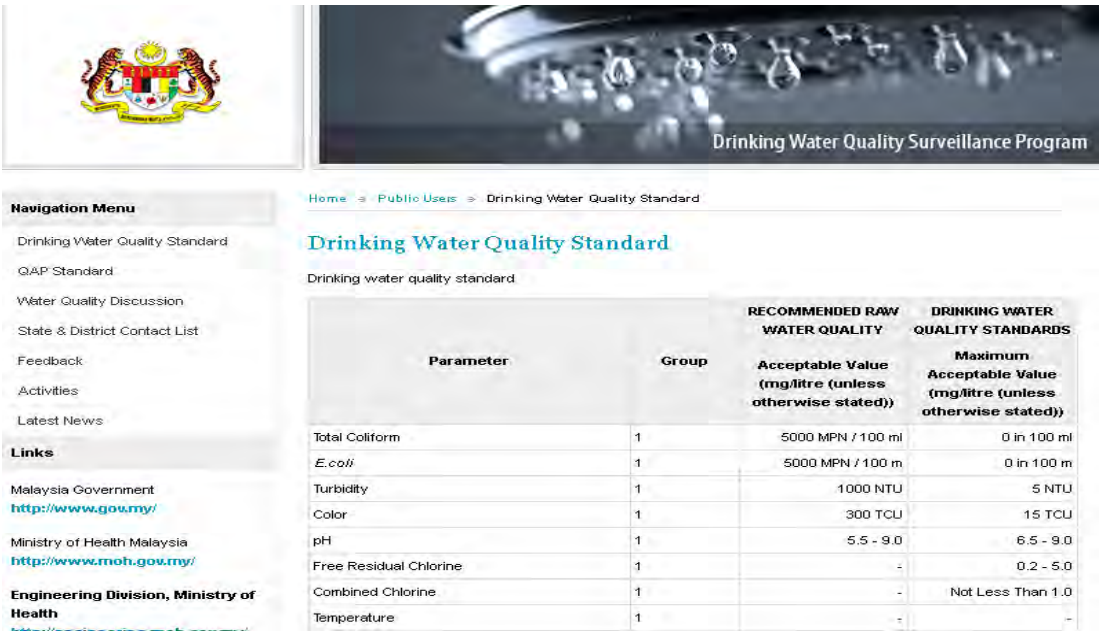
Figure 2.2: Flow chart of the system

2.1.7 Guidelines for Drinking-water Quality Fourth Edition [7]

In this book state three components of water safety plans (WSPs). First is a system assessment to determine whether the drinking-water supply chain as a whole can deliver water that meets the specification. Second is identifying control methods in a drinking-water system that will cooperatively control identified risks. It also must meet the target of the health based. The thirdly is management and communication plans.

2.1.8 Drinking Water Quality Surveillance Programme - Ministry of Health [8]

There are many parameters that have to ensure in order to make sure the quality of the water in good condition. But there are 3 main parameters the most important to check the water. It is pH, turbidity, and chlorine. The range for the drinking water standard pH is 6.5 - 9.0, turbidity is 5 NTU and for the chlorine is not less than 1.0 for combined chlorine.



Parameter	Group	RECOMMENDED RAW WATER QUALITY Acceptable Value (mg/litre (unless otherwise stated))	DRINKING WATER QUALITY STANDARDS Maximum Acceptable Value (mg/litre (unless otherwise stated))
Total Coliform	1	5000 MPN / 100 ml	0 in 100 ml
E.coli	1	5000 MPN / 100 m	0 in 100 m
Turbidity	1	1000 NTU	5 NTU
Color	1	300 TCU	15 TCU
pH	1	5.5 - 9.0	6.5 - 9.0
Free Residual Chlorine	1	-	0.2 - 5.0
Combined Chlorine	1	-	Not Less Than 1.0
Temperature	1	-	-

Figure 2.3: Water specification

2.1.9 Guidelines for Drinking-water Quality - World Health Organization - Google Books [9]

Turbidity, pH, chlorine residuals are the example of a measurable variable that is the parameter of the water quality. The effectiveness of operational monitoring must consider the timely indication of performance, ready to be measured and provide an opportunity for an appropriate response. Limited use for operational monitoring such as indicator bacteria and pathogens is not considered because the time taken to process and analyze water sample does not meet the requirement.

2.2 Arduino UNO Overview [10]

This project is using the Arduino UNO which is contain microcontroller ATmega328. It consists of 14 digital input/output pins and 6 analog input. 6pins out of 14 digital pins can be used as PWM outputs. The Arduino UNO has three main part which is USB Bridge, Power and Microcontroller. Three memory type of ATmega328 are flash memory, SRAM memory and EEPROM memory. Flash memory is 32KB and nonvolatile memory. SRAM and EEPROM memory both are volatile memory but SRAM is 2KB and EEPROM is 1KB. In order to power up the Arduino UNO, can be using the USB or a DC jack which only 5v.

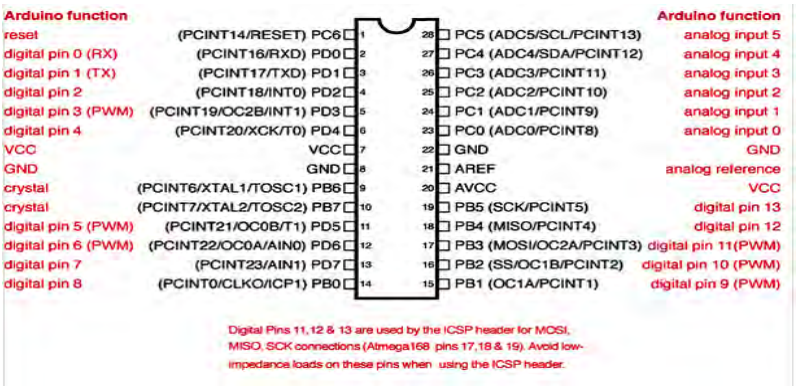


Figure 2.4: ATmega pin mapping

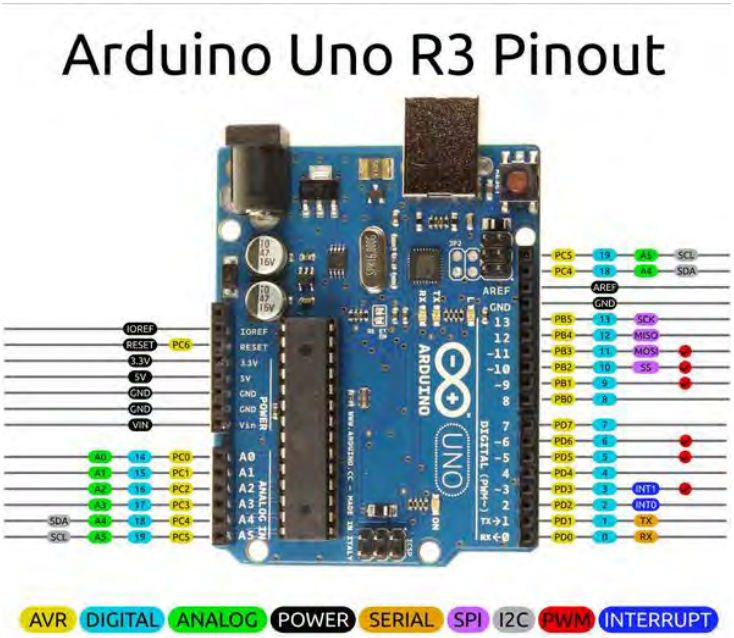


Figure 2.5: Arduino UNO R3 pinout

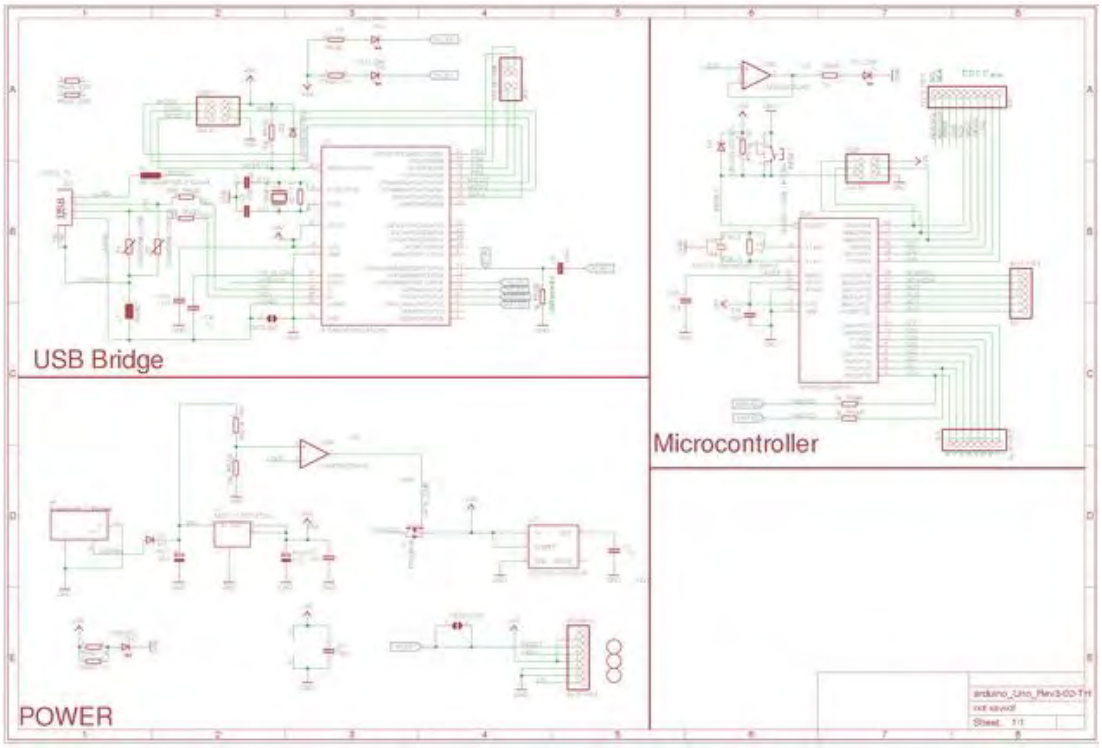


Figure 2.6: 3 main part of Arduino UNO

2.3 ESP8266-01 Overview [11]

This project is using the ESP8266-01 as the WiFi Module. It contained SOC that integrated TCP/IP protocol stack. Therefore, it can give command to microcontroller access to the WiFi network. Esp8266 can be as a client, server and client and server. ESP8266 have been flash and has the AT command set firmware that enable it to communicate with Arduino. It need only 3.3V to power-up it.

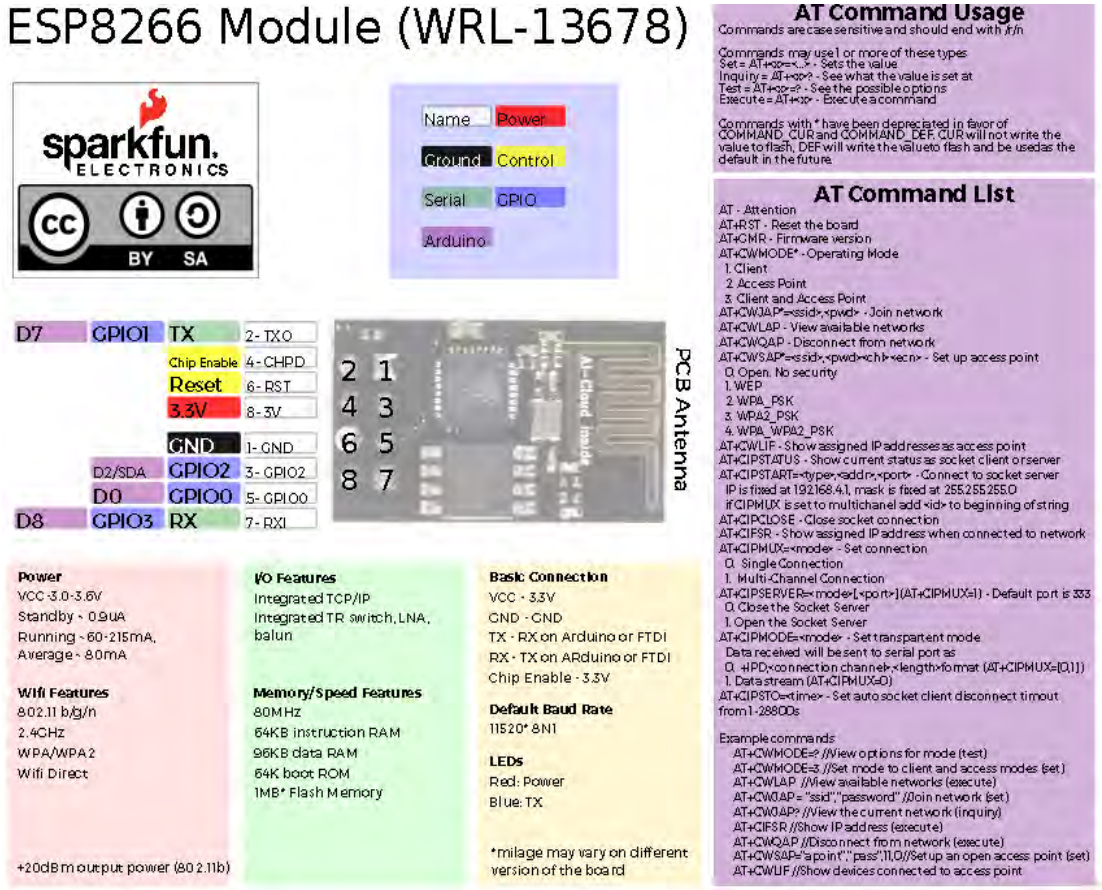


Figure 2.7: ESP8266 graphical datasheet

2.4 pH Sensor Overview [12]

pH meter that has been use in this project is SEN0161. This pH sensor is convenient, practical connection and feature and built-in simple. It can be easily

connected to the Arduino UNO analog pin, 5V and ground. It consists of LED as power indicator, BNC connector and PH2.0 sensor interface. It can measure from 0 until 14 pH value. It only need 5V output power to function it.

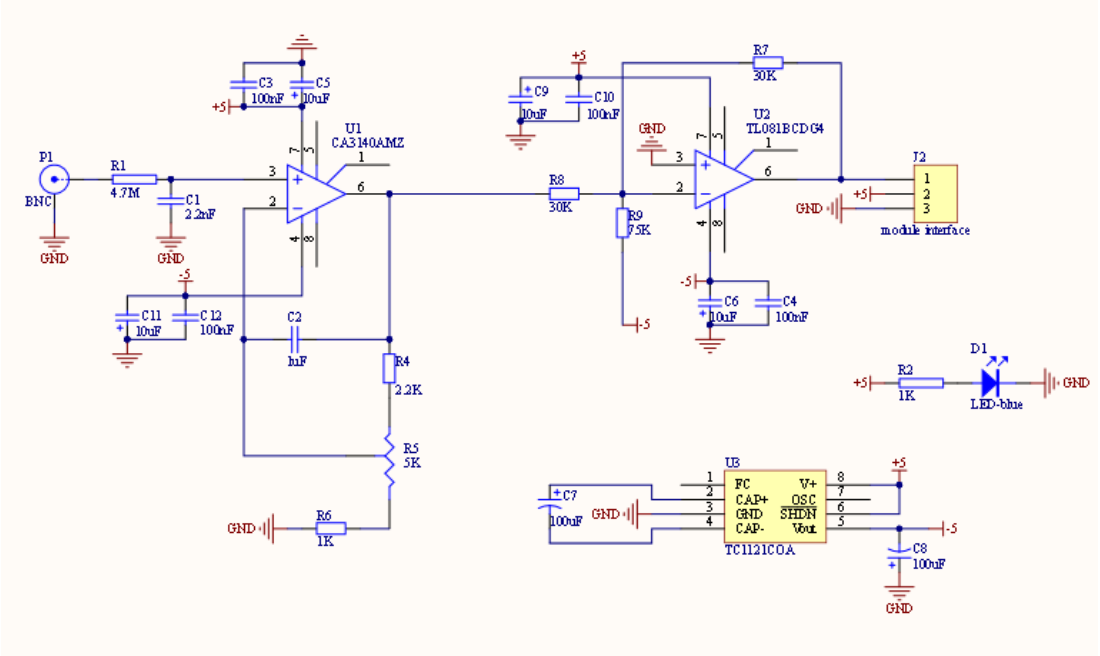


Figure 2.8: Schematic diagram of pH sensor

2.5 Turbidity Sensor Overview [13]

Turbidity sensor SEN0189 is using in this project. Suspended particles in water is detected by measuring the light transmittance and scattering rate, which changes with the amount of total suspended solids (TTS). When the TTS is increasing, the level of liquid turbidity also will increase. This sensor has 2 output mode, analog and digital output. It need 5V for it to be operate and can be operate 5-90 degree Celsius of temperature. The top of the sensor is not waterproof.

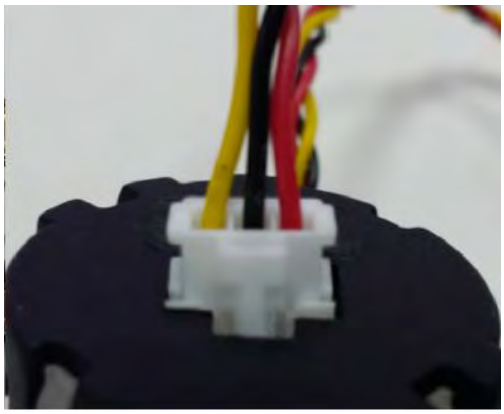


Figure 2.9: Top of the sensor

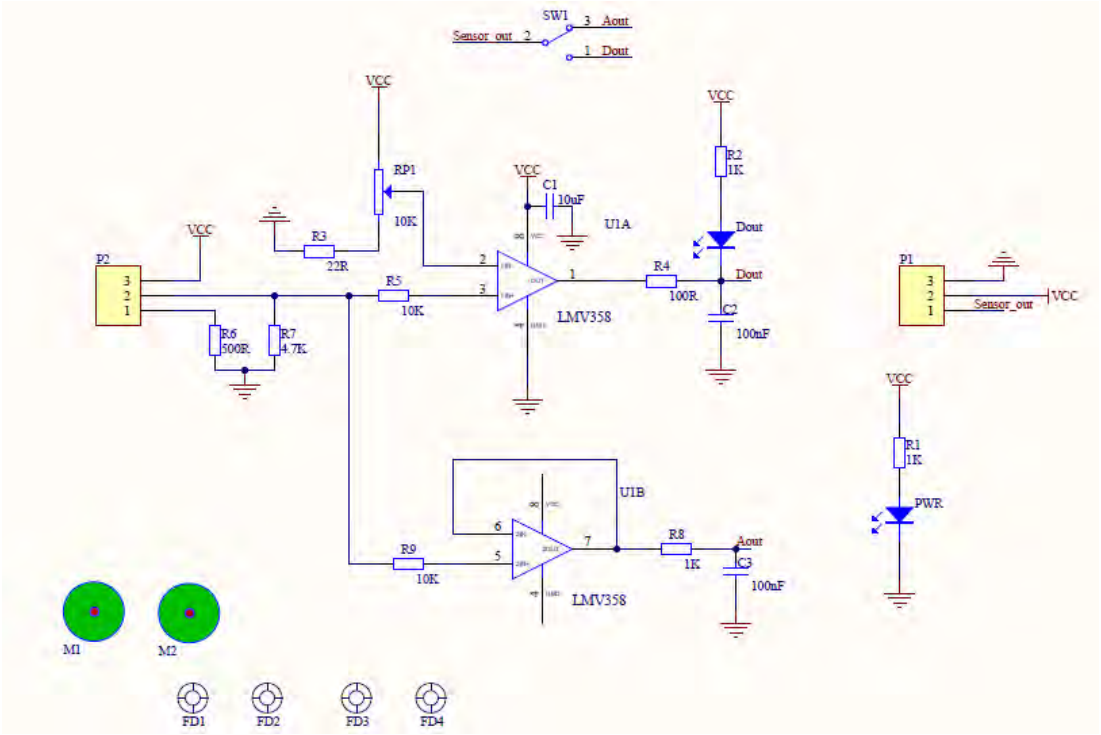


Figure 2.10: Schematic diagram of the sensor

2.6 LCD2004 I2C Overview [14]

This project is using keyestudio 2004 I2C Module LCD as the display of the reading. It can consist of 20 character by 4 line. The background of the LCD is blue and the backlight is white. It helps in reducing the pin input output usage by 5. It also