DEVELOPMENT OF SEABIN WITH WATER QUALITY CONTROLLED BY ANDROID APPLICATION

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ABSTRACT

Water quality can be affected by garbage disposal problems at the sea. It is important to identify water conditions and sources of pollution, to directly recognize the solution for pollution control and to establish strategies to minimize contamination resources. The Seabin will be designed to solve the problem of rubbish that float at the surface of water. It is an automated rubbish bin that collect floating rubbish in water and use a water pump that create a flow of water into the bin, bringing with the floating rubbish. This project used water quality sensor which are included with water temperature and pH sensor that will be able to check the condition of water. In this new era, the world moves forward in using modern technology. Internet of Things (IoT) is a medium for connecting any device which able to on or off switch to the internet. To allow IoT to exchange the data, it must embed with electronics, software and network connectivity allow objects to be sensed or remotely controlled across the existing infrastructure in the network. In this project, IoT technology will be applied to enable monitoring and control the Seabin that located in the surface of water.

Keywords: IoT, pH sensor, temperature sensor, rubbish, water pollution

1. INTRODUCTION

Water is an important part of the earth's environment that is vital to human life and related activities such as fisheries, agriculture, and others. "The global demand for water has been increasing at a rate of about 1% per year over the past decades as a function of population growth, economic development and changing consumption patterns, among other factors, and it will continue to grow significantly over the foreseeable future" (World Water Development Report,2018). Water quality is one of the most important factors in a healthy ecosystem. The issue

had emerged concerning the status of low water quality which can harm human life, marine life, and environment.

According to an article by Ocean Conservancy says that every year, 8 million metric tons of plastics enter our ocean on top of the estimated 150 million metric tons that currently circulate our marine environments. This number will be rising and affect the marine ecosystem where a lot of time is needed to collect the trash that is floating on the surface of the water. Besides that, the effect of water pollution can reduce the economic growth of our country. “Clean water is a key factor for economic growth. Deteriorating water quality is stalling economic growth, worsening health conditions, reducing food production, and exacerbating poverty in many countries” (World Bank,2019). According to the problem, without any action and precaution step, it will keep rising. So, it is important to identify water conditions and sources of pollution, to directly recognize the solution for pollution control and to establish strategies to minimize contamination resources.

According to an article [1], Malaysia is recognized as the 8th country that contributes the most of plastic marine debris to the ocean. At the area of Port Klang, all the waste comes from Klang River with 15.3 million kg of plastic waste, which is the highest record around Peninsular Malaysia. While, at Kuala Selangor, the river that access to the ocean is Selangor River with an output of 1.27 million kg of waste and at Pulau Ketam, Sungai Satu village is the most severely affected place that contribute 9.86 thousand kg of waste. The significance of this project is to raise awareness and educate the public to prevent water pollution. This is because water is an important part of the earth’s environment that is vital to human life and related activities. The development of this project will be reducing the time and energy of the worker to clean the water. The notification and data will be sent directly to the user through an android application that the cleaning process is needed or not at that time. Furthermore, this project is designed to provide a new alternative to a user in terms of android application in the device. This will give a benefit to users that the device is easy to use and monitor.

To live in a sustainable world, all humans have their rights. A water consisting of sea, river and lake is one of the major bodies to play an important role as well as maintaining the green environment. If the quality of water is bad, it will affect the whole ecosystem. This statement supported by [2] where the quality of water is a sensitive topic and it is affected by natural as well as anthropogenic processes. From previous work, research conducted by [3] discussed due to an increase in water pollution in the form to waste debris, Pond Cleaning Robot is developed. It is a device that involves removing the waste debris from the water surface and safely dispose of the water body that can be damaging the life of an aquatic animal. The system used in this device is working on a Bluetooth module to extract wastewater debris, plastics, and garbage from the river. A robot will lift the waste surface debris from the water bodies, and it consists of a belt drive mechanism that lifts the debris from the water. The movement robot is also controlled by an android phone application.

According to [4] paper, the machine of Efficient Lake Garbage Collector by Using Pedal was designed to clean the lake of water. This system is using the boat which is manpower is needed

to operate the pedal for the forward movement of the boat and conveyer for collecting the garbage. The boat required the power of a human being which is equal to the weight of collected garbage by boat. The boat is running on water due to which it limited to collect a waste which only floating on the water level. Furthermore, clean water is important to our health, communities, and economy. The pollution of water affects our ecosystems which people depend on clean water for their health. From [5] paper stated that abundant dumping of waste into the water could affect the aquatic life in a threatening way. Non-organic waste present in it can result in blockage of water ow and the decaying of organic waste could result in the catastrophic destruction of aquatic life in that area due to difference in oxygen, Chemical Oxygen Demand (COD), and Biological Oxygen Demand (COD) level rise or depletion. In this paper, Aquatic Waste Management System was designed to sense the waste using ultrasonic sensors and programmed to remove the macroscopic waste present in water. This work aims at developing an automatic robot, which can perform various tasks required for the cleaning and maintenance of lakes, ponds, and fisheries.

Based on the related project that has the same motive which is to reduce the pollution in water bodies, the research conducted by [6] developed the machine which is Design and Fabrication of River Cleaning Machine in order use in places where there is waste debris in the water body which are to be removed. The machine is consisting of waterwheel driven conveyer mechanism which collects and remove the wastage, garbage, and plastic wastages from water bodies. In this project, it has stored the energy in the battery and used this energy for river cleaning with the help of a motor and chain drive arrangement. From [7] paper stated that nowadays even though automation plays a very important role in all industrial applications, the proper disposal of sewage from industries and commercials is still a challenging task. A Sewage Cleaning Machine was created to replace the manual work in drainage cleaning by introducing a semi-automated system in an efficient way to control the disposal of wastages and with regular filtration of wastages. According to [8] journal, the Seabin was created by two Australian surfers, Andrew Turton and Pete Ceglinski to help rid the oceans of plastic and pollution. Each Seabin device works independently, floating up and down with the tide, removing wastes from the water 24 hours a day. “Water is sucked in from the surface and passes through a catch bag inside the Seabin, with a submersible water pump capable of displacing 25.000 liters per hour, plugged directly into either a 110V or 220V outlet. The water is then pumped back into the marina leaving litter and debris trapped in the catch bag” (The Seabin Project, 2020).

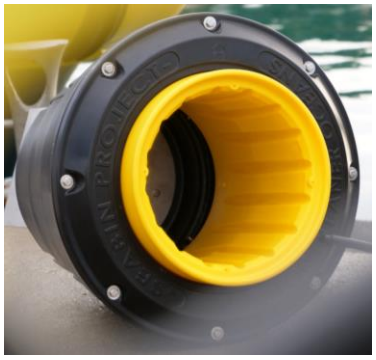


Figure 1: Seabin V5

From [9] paper stated that water pollution is a foremost global problem that needs ongoing evaluation and adaptation of water resource directorial principle at the levels of international down to individual wells. The negligence of the public and administration and the lack of a control system for water quality that causes serious health problems are some of the reasons for this happening. This paper proposes a sensor-based water quality monitoring system. The motive of this monitoring system is to develop a system for continuous monitoring of river water quality at remote places using wireless sensor networks with low power consumption, low-cost, and high detection accuracy. pH, conductivity, turbidity level, etc. are the limits that are analyzed to improve the water quality.

2. ANALYSIS OF THE RESULTS

In this project, the system is using submersible water pump to create a flow of water bringing with the floating rubbish into a Seabin.

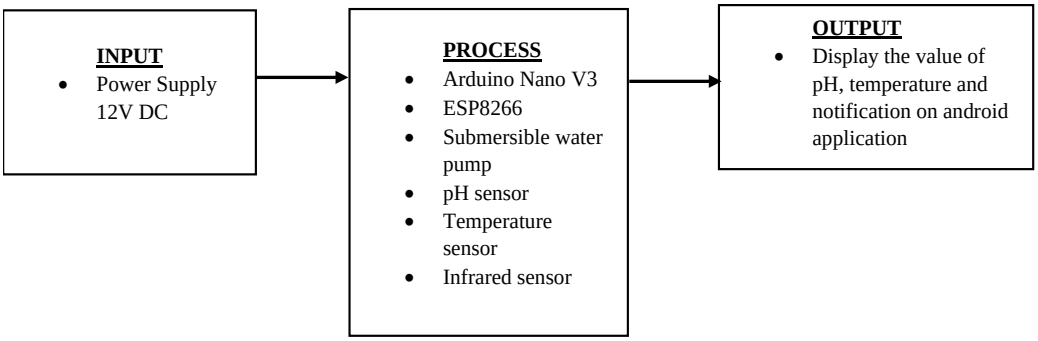


Figure 2: Block Diagram of Seabin

The block diagram above shows the part component of the project system. As an input, a power supply is needed to supply the voltage to the development of Seabin with water quality controlled by android application. The sensors used in this paper is pH sensor, water temperature sensor, and infrared sensor. Those sensors detect and send to the Arduino Nano as a data input for the process. Arduino Nano is connected by using the Internet which is ESP8266 known as a Wi-Fi module.

Arduino Nano sends a signal to the LCD to display the parameter detected and notification on android application.

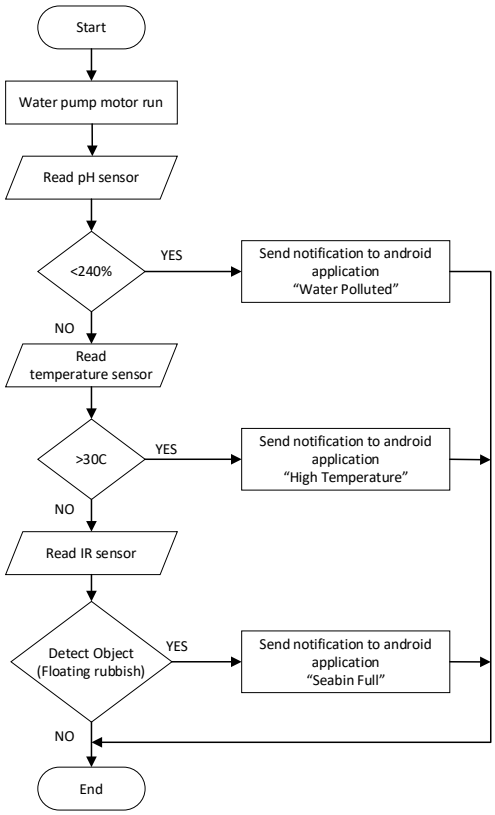


Figure 3: Flowchart of the Seabin Operation

Based on the Figure 3, as soon as the water pump motor is on, the system will read the pH sensor to initialize the value of pH. The data will be sent to the android application as "Water Polluted" if the value is below than 240% for the value of pH. The process continues with reading of temperature sensor. This parameter will measure the value of temperature of water. This sensor will be triggered if the value of temperature is above 30C. The alert notification will be display on android application as "High Temperature". The final process is continue reading of infrared sensor. The infrared sensor will detect any floating rubbish or object within it range of detection. When the infrared detects the object, the data will be sent to android application as "Seabin Full".

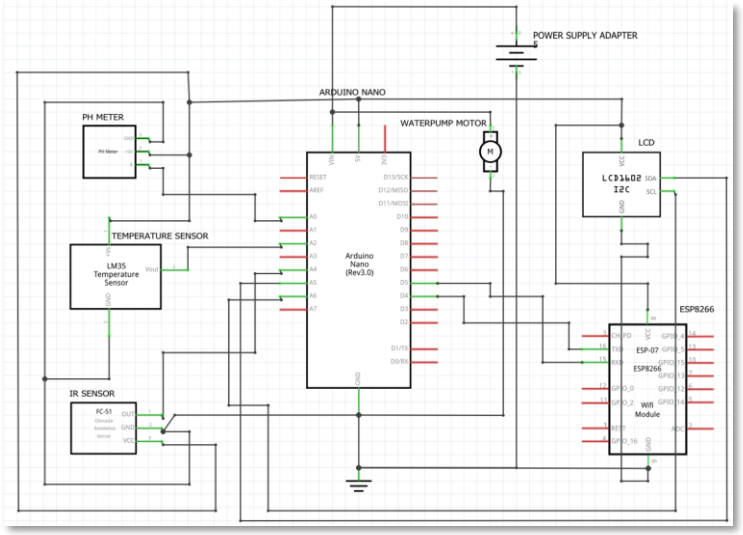


Figure 4: Flowchart of the Seabin Operation

Figure 4 above shows the circuit diagram for Seabin with water quality. The circuit will use a water pump motor to pull the water from the bottom of the Seabin that will create a flow of water. This project will be controlled through the microprocessor which is Arduino Nano to get the data of pH and temperature for water and an infrared sensor for detection of a floating object on the surface of the water. The data that transfer from the Wi-Fi module which is ESP8266 will go through to the android application as an alert notification to the user.

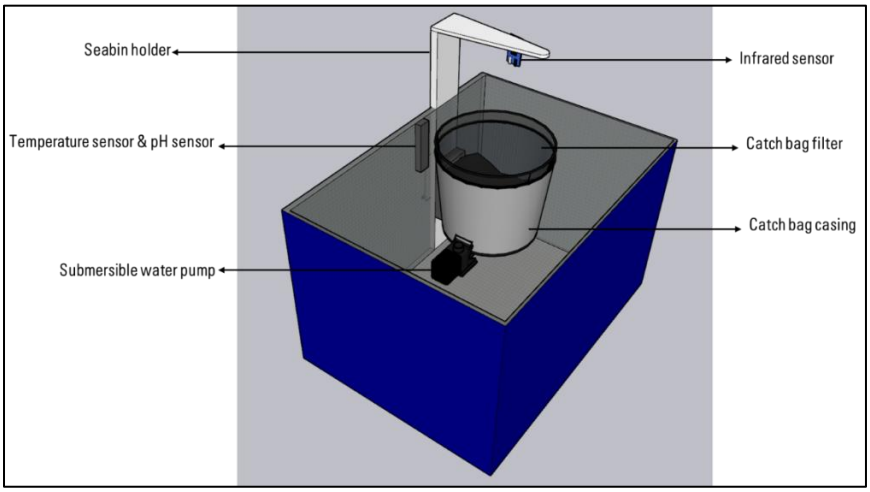


Figure 5: Final Design Prototype

The Figure 5 shows the 3D view design of the prototype. The figure also shows the part of Seabin and component that has been located at the specific place for better reading of data and working process. The dimension of the design prototype is 35cm x 30cm x 20cm (length x width x height).

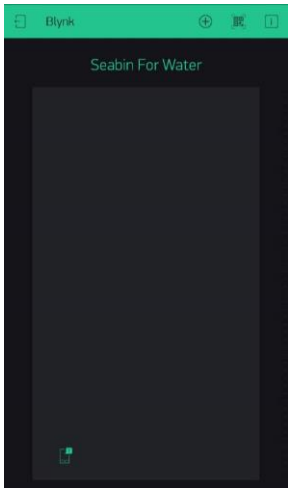
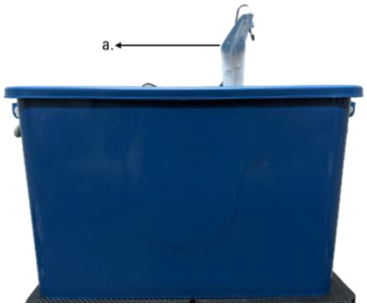
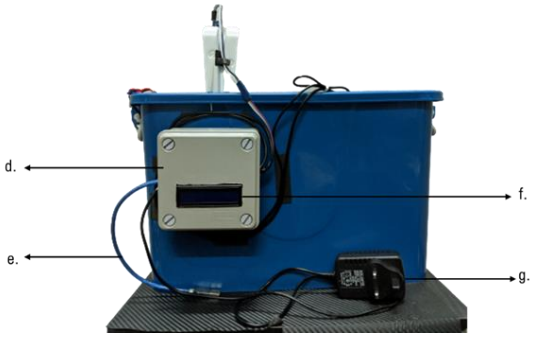


Figure 6: Display of Seabin for Water on Blynk Application

The figure above shows the display of the Blynk application for Seabin. This application will display only alert notification based on the program and command that has been upload. The application is used to receive and transfer data from Wi-Fi module which is ESP8266 that attach on the project. As shown on the figure, the "Seabin for Water" will display three alert notifications which are "Seabin Full", "Water Polluted" and "High Temperature".

The table below shows the complete Seabin with water quality sensor. The product contains of one water pump motor which used to pull and create a flow of water from bottom of the Seabin. The water pump will be located at the bottom of the catch bag Seabin. The main component was placed in the junction box or casing which is ESP8266 that to receive a better coverage signal without any problem or obstacle. The infrared sensor was located on the top and attached with the Seabin holder in order to detect any floating object from above.

Table 1:View of hardware

Front View	**Back View**
	
Side View	**Top View**

a. Seabin holder.

b. Infrared sensor.

c. Catch bag filter.

d. Casing for component.

e. USB cable.

f. LCD.

g. Power supply adapter.

IV. RESULTS

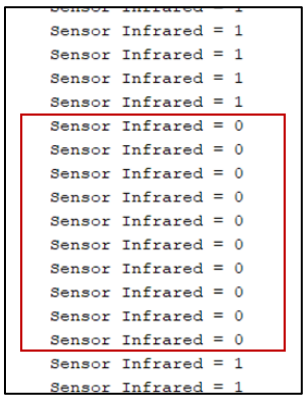


Figure 7: Data of Infrared sensor

Based on the Infrared sensor's data of 0 as shown in the figure above, the ray sent by the IR Transmitter is reflected from a surface that has been identified and falls on the IR Receiver. This

is because there is no surface or object ahead, a result of 1 indicates that the light sent is not reflected. For this project, the result of 0 shows that the sensor was detect a floating object or rubbish in the Seabin. The data will transfer to the Blynk application as the alert notification to the user.

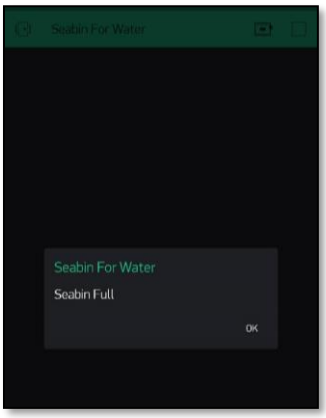


Figure 8: Display on Blynk Application

As shown in the figure above, the alert notification will be sent to the user as “Seabin Full”. So, the user will notify and collect the rubbish in the Seabin immediately. The maximum load for this Seabin is 1200 grams with the maximum flow rate of the water pump which is 350 gallons per hour. The result can be summarized that the maximum range for the Seabin to detect floating rubbish is 2cm from the sensor. The time taken for the Seabin to send the notification to Blynk application is below than 1 second based on the quality of internet connection of the user.

Table 2 below show the classification of pH level based on the testing was conducted. The reading of pH was collected from the four different value of pH which are 4.01, 6.86, 7.00 and 9.18.

Table 2: Reading of pH level

pH Level	pH Reading (%)
4.01	448 - 460
6.86	317 - 320
7	310 - 316
9.18	225 - 240

The significance of this project based on the water quality sensor is to collect the data from the four different type of pH value and to measure the temperature of water for fulfil the criteria of the water quality. The Table 2 show the summary of the result that can be conclude from the reading taken.

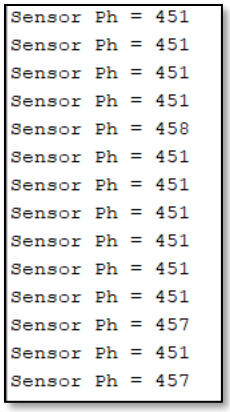


Figure 9: Data for pH 4.01

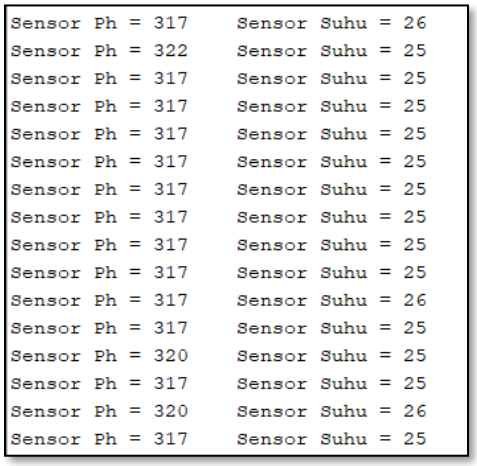


Figure 10: Data for pH 6.86

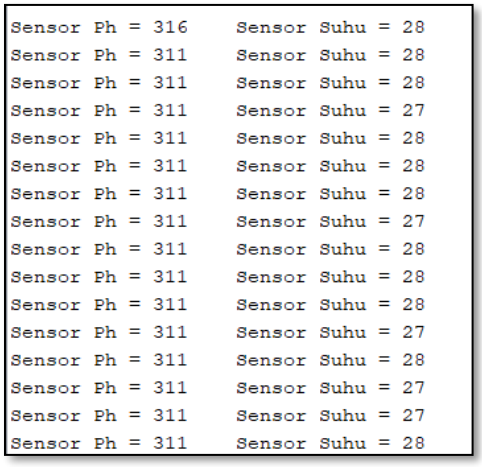


Figure 11: Data for pH 7.00

Figure 9 shows the data that has been collected from the reading of pH 4.01 in serial monitor of Arduino IDE software. The range of reading for pH 4.01 is between 448% and 460%. In general,

the pH 4.01 is acidic. This is because water that produces more free hydrogen ions is acidic, whereas water that has more free hydroxyl ions is alkaline.

Figure 10 above shows the data that has been collected from the reading of pH 6.86. The range of reading is between 317% and 320%. The pH of water indicates how acidic or alkaline it is. The pH scale ranges from 0 to 14, with 7 being neutral. Based on the result for this pH level, the acidity is indicated by a pH of less than 7.

Figure 11 shows the data from the reading of pH 7.00. The range of reading for this pH level is between 310% and 316%. The pH 7.00 is known as neutral or pure water. So, a water with a pH below 7.00 is considered acidic and with a pH above 7.00 is considered alkaline.

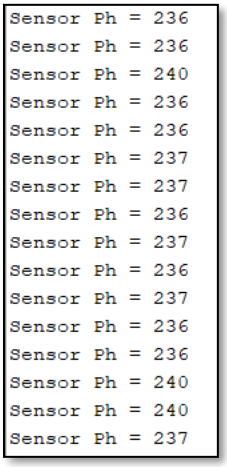


Figure 12: Data for pH 9.18

Based on the data that has been completely collected for pH 9.18, the range of reading is between 225% and 240%. This reading for pH 9.18 is below than 240% which is polluted for seawater. This is because the normal pH value for seawater is between pH 8.00 and pH 8.20. For millions of years, the pH of seawater has stayed constant. The average pH of the ocean surface before the industrial era was around 8.20. Today the pH of seawater about 8.10 (Brewer and Barry, 2021).

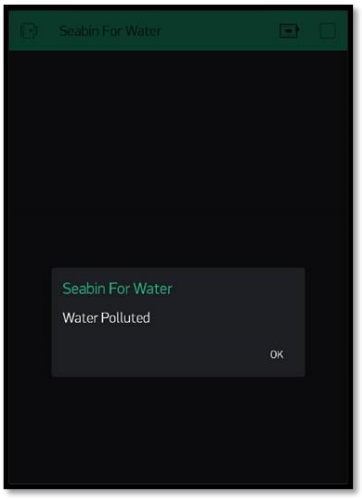


Figure 13: Display on Blynk Application

As shown in the Figure 13 above, the alert notification will be sent to the user as “Water Polluted” when the reading of pH is below than 240%. So, the user will notify and ready to take the precaution step to avoid from using the polluted water.

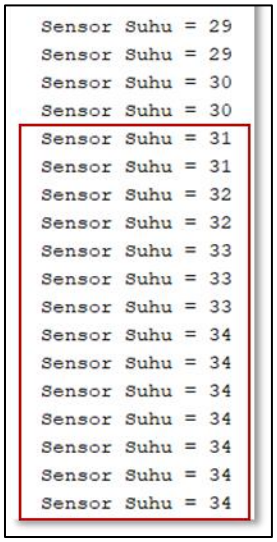


Figure 14: Data of temperature sensor

The testing was conducted using water that has a temperature above 30˚C. The normal temperature for seawater is below 30˚C. This is because high temperature of seawater will affect the aquatic organisms and affect their metabolism and reproduction. The Figure 42 shows that the reading change from 29˚C to 31˚C above. Also, temperature rises in the sea have an impact on marine animals and ecosystems. Coral bleaching and the loss of reproductive habitats for marine fish and mammals are both caused by rising temperatures (Ocean warming, 2021).

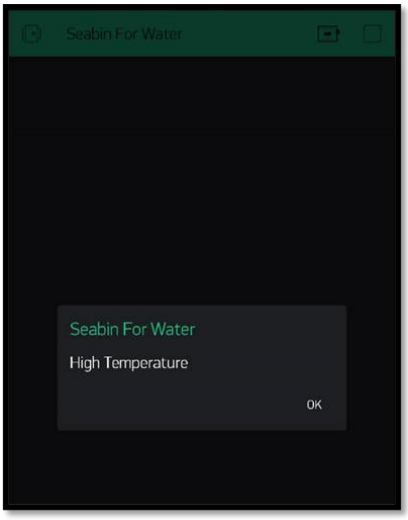


Figure 15: Display on Blynk Application

As shown in the Figure 43, the alert notification will be sent to the user as “High Temperature” when the reading of temperature above 30˚C. So, the user will notify and ready to take the safety precaution step that can help the marine ecosystems.

Table 3: Result Summary

pH Level	**pH Reading (240% - 460% is accepted)**	**Temperature (˚C) (below <30˚C is accepted)**	**Result**
pH 4.01	448	26	The temperature below 30˚C is normal and the range between 448% and 460% is more acidic.
pH 6.86	320	25	pH lower than 7 has an Acidic water but the temperature of 25˚C is accepted.
pH 7.00	310	28	The range between 310% and 316% is neutral for water and the temperature is normal.
pH 9.18	225	27	Below than 240% is considered as polluted for the seawater but the temperature is normal.

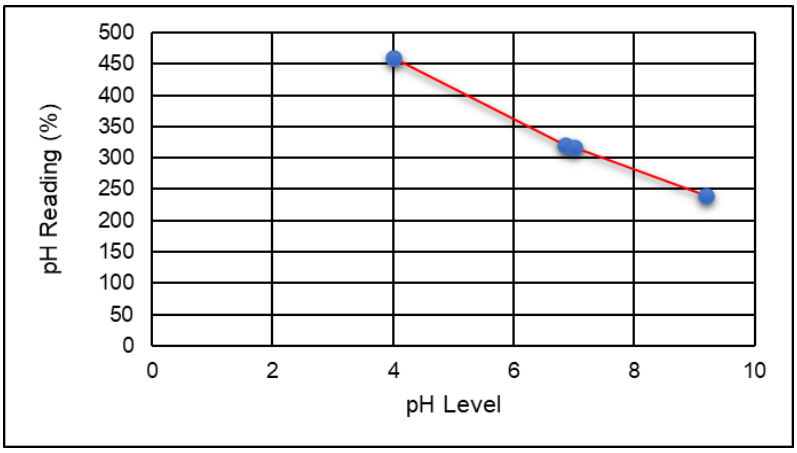


Figure 16: Graph pH level vs pH reading

Based on the Figure 45, the result can be summarized when the level of pH is increases, the pH reading (%) will decrease. It means that the lower the pH reading (%), the water will be alkaline and polluted for seawater.

3 CONCLUSIONS

In this project, the objective is to develop the Seabin, equipped with water temperature and pH sensor by using an android application and to examine the water quality performance of Seabin through an android application. By reviewing the previous and existing project that similar to this development, the Internet of Things (IoT) is more fitting and had been preferred as medium communication between devices for the system.

The Seabin was developed with the water quality sensor which is a temperature sensor and pH sensor that can help to solve the water pollution in Malaysia and to raise awareness and educate the public to prevent water pollution. The system also works effectively and gives alert notification for excess temperature and pH value and when the Seabin is full. The notification will be sent to the user through an android application which is the Blynk Application. The data that receive through this application will be stored and can be read by log in Blynk Application.

This project study is successfully handled to be achieved both objectives of this project development. The data were collected and observe from three different types of sensors. The collected pH level samples from four different pH levels have been identified as the percentage of the pH of water. Furthermore, an infrared sensor is required as an important component that able to detect the presence of the object or floating rubbish when the Seabin is full. The reading of the temperature of the water that suitable for the aquatics and marine ecosystem also shown in the result.

From the result, it can conclude that the development of this project will be reducing the time and energy of the worker or user to clean the water. The notification and data will be sent directly to the user through an android application that the cleaning process is needed. In addition, this project was designed to give a new alternative to a user in terms of android applications in the device. This will give a benefit to users that the device is easy to use and monitor.

4 RECOMMENDATION

While conducting this project, several weaknesses had been detected during the process of development. The water pump had difficulties pulling the water from the bottom of the Seabin. In the project testing, the water pump succeeded to create a flow of water bringing with floating

rubbish into the Seabin area. There are several recommendations for future works about this project as follows:

i. The 750 GPH of the submersible water pump can be applied to get a huge flow of water and directly pull the floating rubbish into the Seabin.
ii. The Seabin can be improve by applying other parameters to calculate Water Quality Index (WQI) such as Turbidity, Dissolved Oxygen and Biochemical Oxygen Demand (BOD).
iii. To obtain an excellent reading and result for future study, the testing need to conduct more frequently.

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