Smart Water Turbidity Level Measurement System with Wireless Data Transmission Based on Arduino Hardware Platform

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Abstract

The Internet of Things (IoT) has been called the next Industrial Revolution or the next evolution of the Internet. It will impact how businesses, governments and consumers interact with the physical world through Internet-connected sensors, cameras, handheld devices, smartphones and other smart IoT devices. Due to pollutions, water quality needs to be monitored frequently. Therefore, a smart water turbidity level measurement system with wireless data transmission based on Arduino hardware platform is developed. The developed system is used as a tool for water monitoring by collecting data from the turbidity level sensor. In addition, the collected data is sent to Mobile Apps using the two ways of wireless connection which Bluetooth and Wi-Fi. The range of high or low-level parameters was identified from the sensor. Hence, this project could solve the current problems in water pollution and has a high potential to be commercialized for application in environmental monitoring.

Keywords: Water Pollution, Turbidity, IOT, Wi-Fi, Mobile Apps

1. Introduction

Water is most indispensable for living life, and the quality of water is the essential part we should take care of all the time before consuming. Because of modern technology, water is polluted in a different form. European Communities said that about 20% of the water source at the European Union is completely polluted [1]. As a result, it is necessary to be careful about the cleanliness of the water. An estimation has been made whereas 7.5 litres of water per person either for drinking, food or personal hygiene [2]. Since, living things and beings health are mostly dependent on the water, which is why quality check of water in every process is becoming essential, and it should be taken care of.

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Moreover, once all the water is processed, it will flow into every single home to be either drinking water or else. Unfortunately, about 20% of people are not taking a proper way of drinking water [3]. Plus, drinking water sources should be taken seriously, because it may contain a variety of contamination that may increase the risk mostly on children whereas easily being infected. Few microorganisms might be the reason being infected organic chemicals, inorganic chemicals and many more [4]. It is also stated by the World Health Organization(WHO) about four billion cases of diarrhoea each year due to lack of water cleanliness [5]. The natural river is used for many important requirements for lives. Unfortunately, human activities may affect the river in many ways. In such, Industrial Activities keep disposing of waste material without being treat or filter since the early stage of the Industrial Revolution [6]. From reviews that have taken from a certain article, it is clearly can be said that current condition of water pollution is getting even worst whereas can see this project would be perfect to overcome or at least lessen the current condition of water pollution.

2. Methodology

As a purpose of this project, to monitor a water turbidity level turbidity with different parameters based on a few sensors. Furthermore, the displaying monitors can be seen in via two different platforms which are via Bluetooth and Wi-Fi. However, the overall system for this project works is shown in the form of a block diagram as in Figure 1.

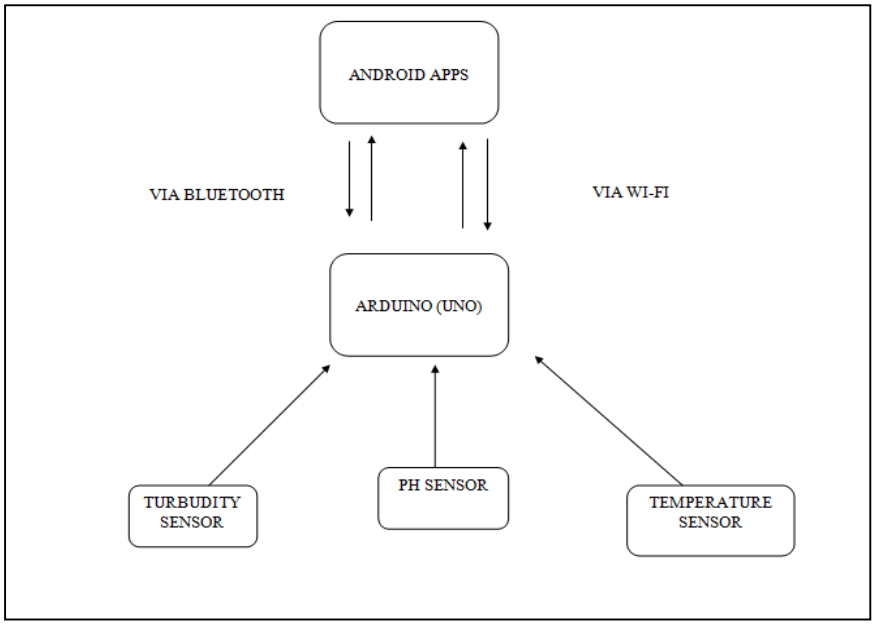

Figure 1: Block Diagram of Water Turbidity Monitor System

In this system, as seen in Figure 1, it starts with the turbidity sensor, pH sensor, and temperature sensor obtain data from a water sample whereas all data consist of different parameter. Once all the data gained from the sample, all sensors sent data into Arduino as it works as a data collection platform. For the last part, all data were sent into two different paths as mention before via Bluetooth and Wi-Fi. Android App is using the same concepts which monitor the water turbidity level as well as warning alarm whenever the level reaches a certain dangerous

level.

Figure 2: List of components used

i. Turbidity Sensor

Turbidity can be defined as a particle that can be found in the water, which the higher the turbidity the lesser the visibility of water. That is why the turbidity can be so called as the important property of water. The level of turbidity can be measured in Nephelometric Turbidity Unit (NTU). Different type of water will show the different value of NTU, for example mostly river with a clear green colour which is low in turbidity comes with about less than 10 NTU. Unfortunately, the level of turbidity might be changed or increase due to flood when the water mixed up with any other particles.

ii. Water Proof Temperature sensor

The Water Proof temperature sensor or so-called DS18B20 is used for temperature measurement of the water for this project. Without realizing it, the temperature actually may affect the quality of water as well as pH level. On the other hand, this sensor is completely waterproof whereas suitable for this project to be playing around different types of water.

iii. pH Sensor

For the last sensor used, which is a pH sensor (SKU: SEN0161). With this sensor, we can detect any kind of water either it is acidic or base type. It also can be said that pH actually measures the hydrogen ion concentration [H+].

iv. Bluetooth Module: HC-06

This model of Bluetooth module act as wireless serial communication which also known as class 2 Slave Bluetooth Module. Whenever sending a data, it will be sent exactly the data received at the receiver that been connected with the module.

v. Wi-Fi Shield (ESP8266 ESP-12E)

Wi-Fi Shield or ESP8266 ESP-12E is a built-in Wi-Fi module for Arduino Uno. The Wi-Fi Shield offers a quicker, easier and more effective way in getting Wi-Fi access for Arduino. From Wi-Fi Shield, the Arduino can achieve Wi-Fi communication via UART by sending the AT command.

vi. Apps Inventor 2

App Inventor is an open source application designer provided by Google. This software allows beginner who tends to design an application where operates on an Android operating system (OS).

3. Results & Discussions

From Table 1 below it can be said that the accuracy and efficiency of the turbidity sensor are quite satisfying. It is because from the table, within 30 minutes the difference between the highest and lowest point for each level are not quite far and relevant as shown. Only after a minute, the sensor reading consistency might change depends on the limits of the sensors.

Table 1. Data analysis of voltage and turbidity reading

Turbidity Level	Highest Turbidity, H_{NTU}, NTU	Highest Turbidity, H_{NTU}, NTU	Turbidity Difference, D_{NTU}, NTU	Highest Voltage, H_{VOLT}, Volt	Lowest Voltage, H_{VOLT}, Volt	Voltage Differece, D_{VOLT}, Volt
Low	4	0	4	5.00	4.98	0.02
Medium	81	68	13	3.66	3.61	0.05
High	248	242	6	0.24	0.17	0.07

At the same time, from the table above, it can be said that those water samples can be classified into three different classes and levels where it depends on the range of turbidity level. For instance, the low turbidity levels range within 0 to 4 NTU. On the other hand, the differences between those ranges only 4 NTU. For voltage relationship, it can be said that the lowest reading would be only 4.98 V whenever the turbidity level reaches 4 NTU and got only 0.02 V of differences between the higher and lower reading.

Next, the medium level of turbidity been placed with a range from 81 until 68 NTU. With that, the difference between the ranges is only 13 NTU. While the difference for voltage reading was only 0.05 V. For the last level, a range of 246 to 242 NTU would be for the high level of turbidity. On the other hand, all of those level been proven where the reading was displayed on mobile apps as shown in Figure 3.

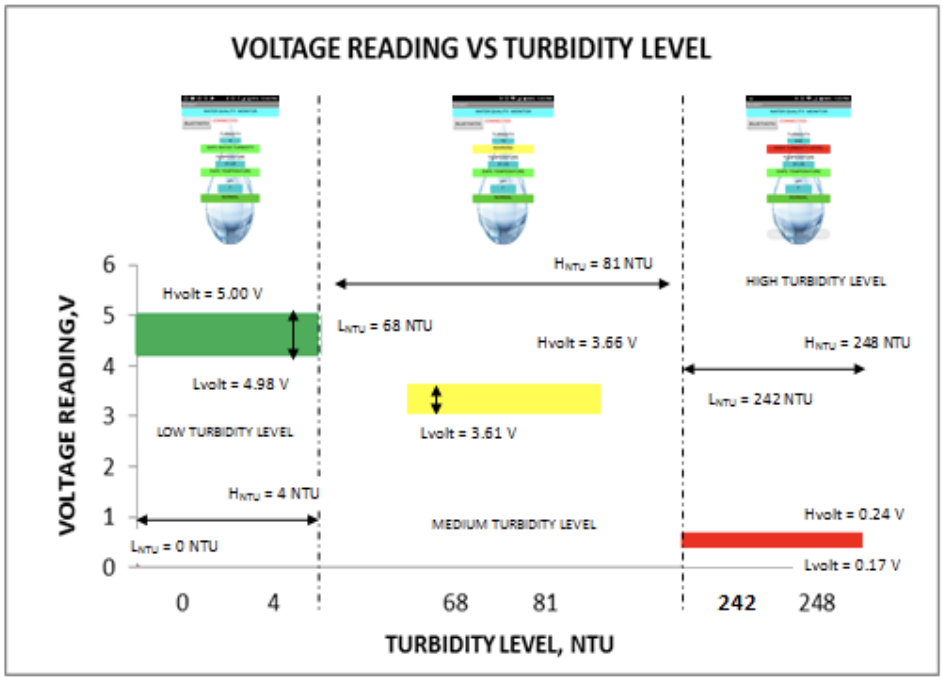

Figure 3: Data analysis of voltage and turbidity reading

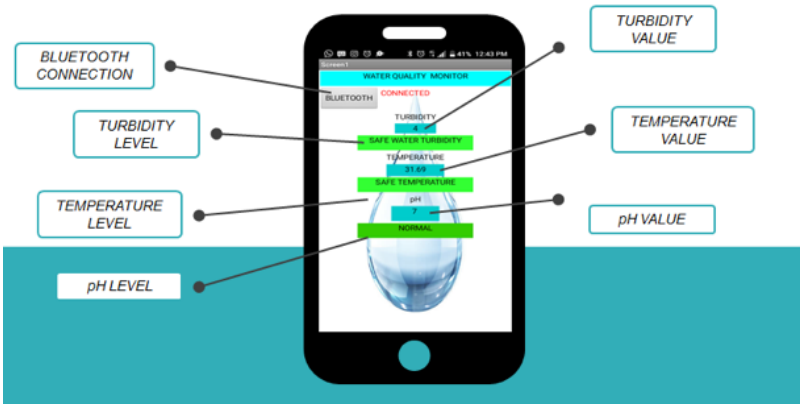

Figure 4: Mobile Apps User interface

In Figure 4, all the necessary component been placed perfectly to complete the app. Firstly on top of the app, it shows the header of the apps which "TURBIDITY LEVEL MONITOR". While below it, a button was placed shows "BLUETOOTH". In order to pair the mobile phone with Bluetooth Module, the user needs to press the button and it will show list devices need to be connected. Once the mobile phone connected with the Bluetooth Module, the status of Bluetooth connection will change into "CONNECTED". The next component which the plain component, it will represent the turbidity level display reading from the turbidity sensors. For the button "VOICE" functions, once pressed, the voice will speak the current reading display on the Turbidity Level Display. The last component will display the current condition based on the turbidity level such "DANGEROUS LEVEL", "WARNING", AND "SAFE TURBIDITY LEVEL".

3. Conclusion

The mobile apps designed seems to work perfectly as a monitoring and warning system by using wireless data transmission. The mobile apps used not only monitor the sensor reading used which turbidity, pH and temperature but also the condition for each sensor either it is dangerous or safe to be used. Besides, the mobile apps give notification and warning in three different ways which text message, voice alarm and monitor on phone screen. Overall, it can be concluded that the implementation of the sensors was successful.

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