

IoT-based device for real-time water quality monitoring system

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ABSTRACT –Water pollution is one of the environmental issues that threatening many countries including Malaysia. A manual approach which has been commonly used to monitor the water quality consists of some drawbacks. Thus, this paper proposes a device with IoT technologies to measure and monitor the physical and chemical parameters of the water in real-time. The data collected from various sensors are processed by the microcontroller. The wireless network connectivity allows the data to be displayed in textual and graphical formats on the smartphone and stored in a cloud-based platform. The proposed system is portable and more flexible to deploy at remote sites and facilitates the user to act wisely and action can be taken promptly in monitoring and preventing measurement.

1. INTRODUCTION

Water is essential to all living things to survive. However, over the years, the globe faces significant numbers of water pollution which threatening many countries including Malaysia. According to [1], chemical wastes, oil spills, pesticides and fertilizers, and domestic sewage are examples of major sources of water pollution. Polluted water is hazardous and harmful to animals, plants, and human health as water is an important natural resource used for drinking and other developmental purposes [2]. Regular monitoring of water bodies like rivers, lakes, and dams is very important. Commonly, the physical and chemical parameters of the water quality such as pH value, turbidity level, temperature and water level are manually measured and collected on sites, and analysed in the off-site laboratory. This approach wastes too much manpower and other resources. Only limited samples can be collected, and the analysis is time-consuming. Some studies [3-6] suggest system-based methodologies of water quality monitoring. However, these system-based approach lacks of alert capability and data availability to support prompt action, especially in critical situations. Thus, this paper presents an improved IoT-based real-time water quality monitoring system with alert notification and cloud storage capabilities.

The rest of this paper is structured as follows: Section 2 presents the details of the proposed system. Next, Section 3 provides the results and discussion and

finally, the paper ends with a conclusion.

2. METHODOLOGY

The system architecture and complete prototype for the proposed system are depicted in Figure 1 and Figure 2 respectively. A microcontroller (Arduino UNO) acts as a central unit that integrates with four sensors (temperature, pH, turbidity, ultrasonic), a portable battery, and a Wi-Fi module (ESP8266). The pH sensor senses the amount of acidity or alkalinity in the water, whereas the temperature and turbidity sensors measure the temperature and the relative clarity of the water respectively. The ultrasonic sensor is used to measure the water level. In order to support portability, the power source for a microcontroller can be supplied using a portable battery instead of a power source adapter. Furthermore, the network module provides wireless network connectivity to ThingSpeak and Blynk platforms. Data collected by the sensors are displayed continuously in real-time on the smartphone and Internet applications in textual and graphical formats. The data are stored in the cloud platform for future use.

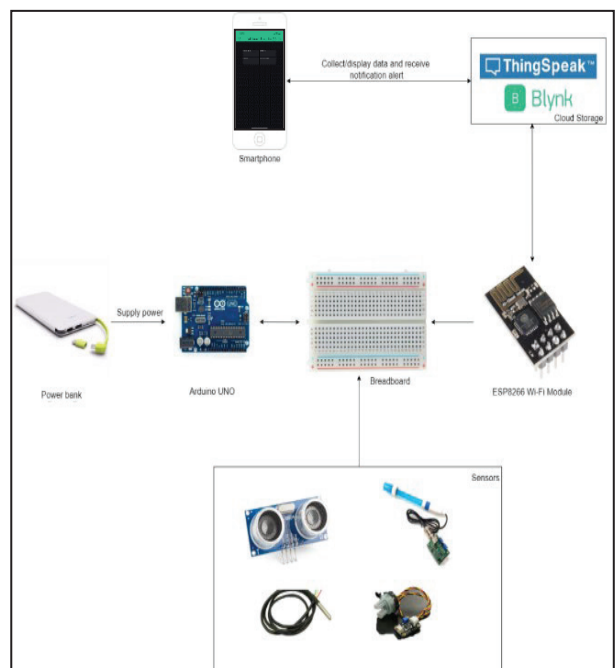


Figure 1 System architecture of the proposed system

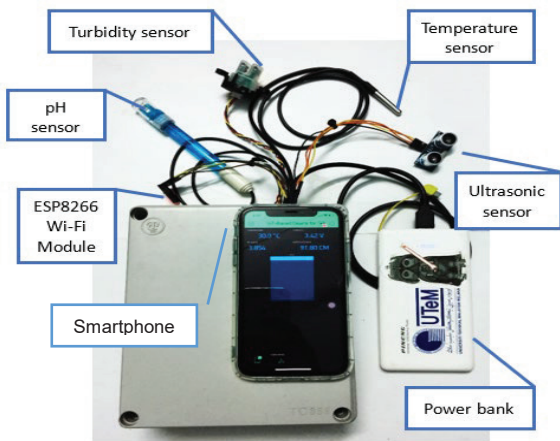


Figure 2 Complete prototype of the system

3. RESULT AND DISCUSSION

Accuracy tests for each sensors were conducted to ensure the functionality of the proposed system. Each sensor requires different sets of the test subject to correspond with the type of the sensor. The test subjects for the pH and turbidity sensors were a water-based solutions with different amounts of alkalinity and acidity and with soil concentration respectively. Regular plain water with different temperatures was used for the temperature sensor. The results from the automatic measurement using sensors were compared with manual measurements using suitable test kits and a measuring tape. Table 1 tabulates the results from the accuracy test. Moreover, Figure 3 and Figure 4 illustrate the examples of Blynk and ThinkSpeak interfaces for system outputs.

Table 1 The results of the accuracy test

pH Sensor			Turbidity Sensor			Temperature Sensor			Ultrasonic Sensor	
Solution	Test	Actual	Solution	Test	Actual	Solution	Test	Actual	Test	Actual
Plain Water	7.22	7.3	Water + soil	0.17	-	Hot Water	56.7	57.2	50	50
Vinegar	1.73	2	Plain Water	3.47	-	Room Water	26.0	26.5	20	20
Soapy water	8.90	8				Cold Water	13.3	14.0	10	10

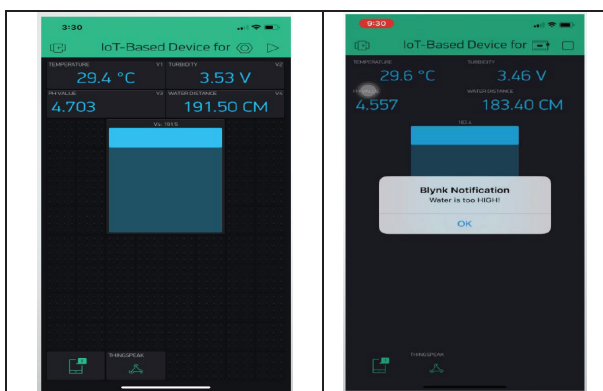


Figure 3 Example of Blynk interfaces

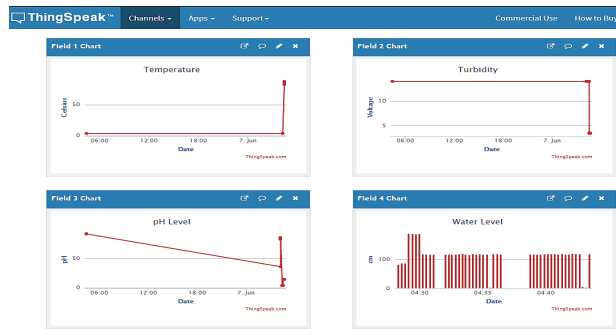


Figure 4 Example of ThingSpeak interface

4. CONCLUSION

The proposed system successfully measures and monitors the intended physical and chemical parameters which are water level, temperature, turbidity and pH value by displaying textual and graphical sensors' data using an online data visualization platform on the smartphone and Internet applications. The data is stored in the cloud platform which can be retrieved anytime. The alert is generated under certain circumstances pre-set in the system. The study produces a portable and flexible system for deployment in remote sites and facilitates the authority to improve water quality monitoring methods with reducing time and energy. The work can be extended in the future by implementing more sensors for comprehensive water quality analysis.

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