EVOLUTION IN ELECTRICAL AND ELECTRONIC ENGINEERING
e-ISSN: 2756-8458

EEEE

Vol. 5 No. 1 (2024) 54-59
https://publisher.uthm.edu.my/periodicals/index.php/eeee

Water Quality Monitoring System for Catfish Using IoT

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DOI: https://doi.org/10.30880/eeee.2024.05.01.008

Article Info

Received: 12 January 2024
Accepted: 19 February 2024
Available online: 30 April 2024

Keywords

IoT-based system, Water quality, catfish, Blynk,remote monitoring

Abstract

This work introduces a water quality monitoring system that was made for catfish ponds, using the capabilities of the Internet of Things (IoT). The system integrates three essential sensors which are pH sensor, temperature sensor, and ultrasonic sensor to monitor the aquatic environment. The pH sensor continuously measures acidity levels, crucial for maintaining optimal conditions for catfish health. Simultaneously, the temperature sensor captures real-time temperature data, offering insights into the thermal dynamics of the pond. The ultrasonic sensor, strategically placed at the water surface, enables to recording of water level measurement, contributing to the assessment of water volume and environmental variations. The output readings can be seen on the LCD. Other than that, wireless communication channels transmit sensor data to the Blynk IoT platform, establishing a seamless connection for remote monitoring. The Blynk mobile application serves as an intuitive interface, allowing users to visualize real-time data and receive notifications directly on their devices. If the quality of the water in the pond is in bad condition, it will alert the farmer in the Blynk app. For example, if the temperature, pH level, and water level are not in a normal state it will alert the farmer by giving a notification on the app. For temperature, the ideal is between 26 to 32 Celsius, for the pH level the water should be between 5.5 to 7.5, and the ideal water level range for the catfish not to jump out from the water is around 1 foot which equals 30cm to 40cm. This water quality monitoring system represents a significant advancement in aquaculture management, empowering catfish farmers with timely and actionable insights. The study evaluates the system's effectiveness in providing accurate data and notifications through the Blynk app, offering a promising solution for sustainable catfish farming and contributing to broader initiatives addressing water quality challenges in aquaculture.

1. Introduction

Water is a special type of environmental resource that is essential for maintaining the earth's biodiversity. In addition to sustaining human life and behavior, water serves as an ecosystem that helps protect the ecological structure, ecological processes, and local surroundings. Water contamination is one of the more serious environmental issues that have emerged with the economy's rapid growth. This may affect the fish around there [1]. Fish consume toxins such PCBs, PBDEs, dioxins, and chlorinated insecticides in their diet as well as in the

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water and sediments. Fish that live on the bottom are more likely to have high concentrations of these chemicals in polluted regions because these substances settle to the bottom where the fish feed [2].

To make well-informed decisions about managing water quality and reducing pollution water quality monitoring equipment is required for data collecting and real-time monitoring. An IoT ecosystem includes web-enabled smart devices that use embedded systems, such as processors, sensors, and communication tools together to communicate and act on data they gather from their surroundings. IoT devices link to IoT gateways or other edge devices to exchange the sensor data they gather. From there, the data is either transferred to the cloud for analysis or is analyzed locally. These devices occasionally exchange information with other similar devices and take action based on that information. Although individuals may engage with the devices to set them up, give them instructions, or retrieve the data, most of the work is done by the gadgets without human involvement.

2. Methodology

In the proposed system, Nodemcu ESP8266 has been used because the work is IoT-based and this ESP8266 has Wi-Fi functionality which is suitable for this work. For the activation of this entire system, the ESP8266 must be connected to the solar charge controller which will give the supply via a battery that will charge by the solar panel. When the temperature sensor, ultrasonic sensor, and pH sensor run, the data can be seen on the LCD screen. The output can be seen using the mobile application which has been developed. The block diagram of this work is presented in Fig. 1.

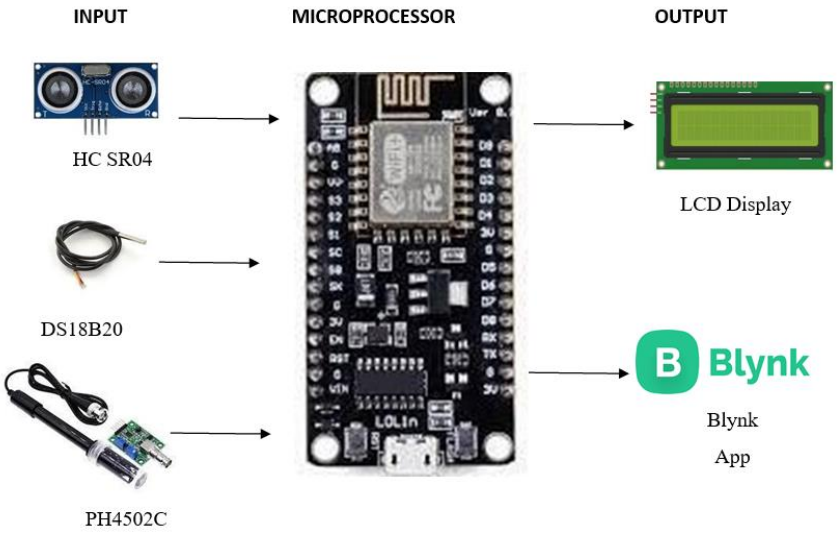

Fig. 1 *The block diagram of the system*

Fig. 2 shows an overview of the program flowchart of the system. Firstly, the sensors will detect the water sensors. After that, ESP8266 will process the data given by the sensor. Then, the readings will be sent to the Blynk application. If the water quality is in bad condition such as the temperature is below 26 Celsius or exceeds 32 Celsius, the pH value below 5.5 or exceeds 7.5 and the water range gets below 30cm the Blynk app will send an alert notification to the person in charge.

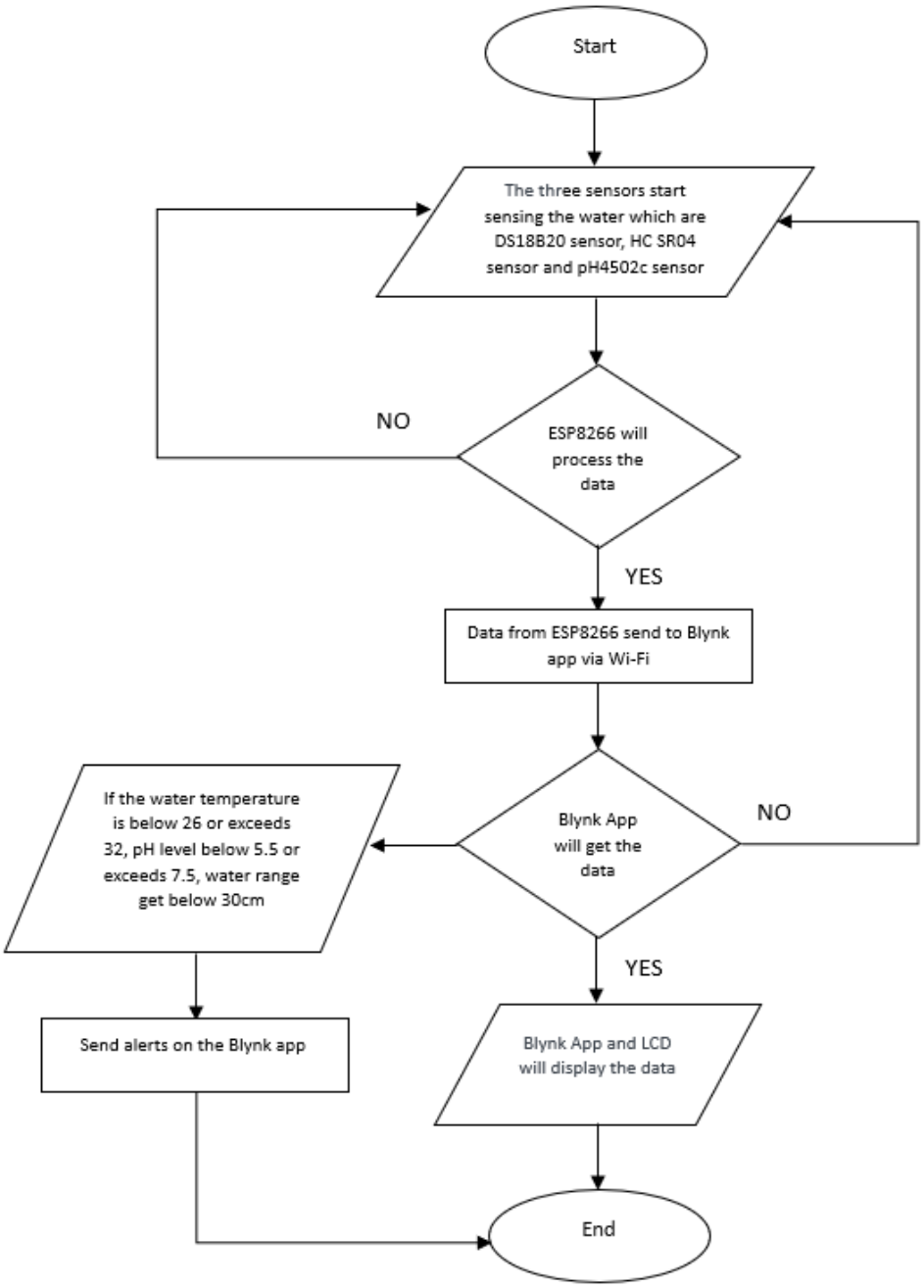

Fig. 2 *Flow chart diagram for the system*

3. Results and Analysis

As per Fig. 3(a), the outer part of the model consists of a solar panel, temperature sensor, pH probe, and LCD. As in Fig. 3(b), the inner part of the system consists of a 12V battery, solar charge controller, ultrasonic sensor, breadboard, ESP 8266, and pH4502c module, and in Fig. 3(b) the Nodemcu ESP 8266 is connected to the 5V power supply which will be given by 12V battery. A Nodemcu ESP8266 V3 has been used to place the Nodemcu ESP8266 microcontroller.

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Fig. 3(a): *Front view of the model*

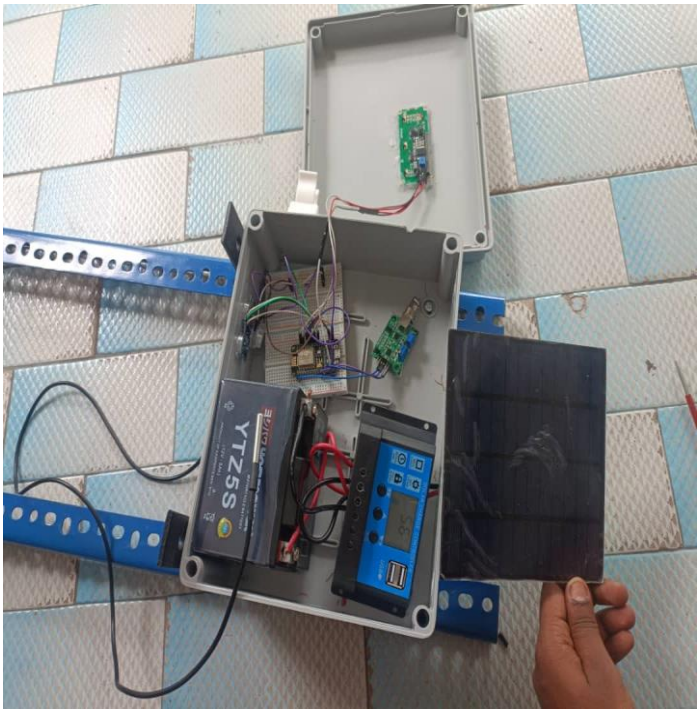

Fig. 3(b) *Inner part of the model*

3.1 Study Area

As in Fig. 4(a), this work tested outdoors and the monitoring device was placed at a catfish fish farming known as Fishlegs Farm which is located at Jalan Parit Jalil, Batu Pahat. The farm has 3 ponds which contain from baby catfish to bigger ones. There are around 3000 fish there so that makes it an ideal place to conduct tests for the system. Fig. 4(b), shows how the system has been set up in the pond.

Fig. 4(a) *Field test at Fishlegs Farm*

Fig. 4(b) *System setup in the pond*

3.2 Analysis

As for the analysis, we can know if the water is in bad condition by checking the quality of the water. The ideal temperature is between 26 to 32 Celsius, for the pH level the water should be between 5.5 to 7.5 and the ideal water level range for the catfish that didn't jump out from the water is around 1 foot which equals 30cm to 40cm. If the readings of the water are not as stated above then it will give an alert to the user in the Blynk application. First of all, place the monitoring system in the pond. Put the DS18B20 sensor which is the temperature sensor and the pH4502c sensor which is the pH sensor to check the pH level and temperature level of the water. The HC-SR04 ultrasonic sensor has been installed at the bottom of the casing so that it will check the water level of the pond. After the sensor starts sensing the water quality and the water level it will show the readings on the LCD so that the user can see the qualities of the water. The LCD will not show any warnings if the water is in bad quality. The warnings have all been shown in the Blynk App. The reader can see the values on the LCD and using the Blynk app which will be more convenient to the user. Fig. 5(a) and Fig. 5(b) show the readings on the LCD. Fig. 6(a) shows the application interface created using the Blynk App. It is a simple Android app that shows the results of each sensor that is shown on the LCD. The purpose of this Android app is to monitor or access the sensors' data anytime in any place easily. Fig. 6(b) shows the alert notifications that the user receives if the water quality of the pond is out of the ideal range.

Fig. 5(a) *The output for temperature level*

Fig. 5(b) *The output for water level and pH level*

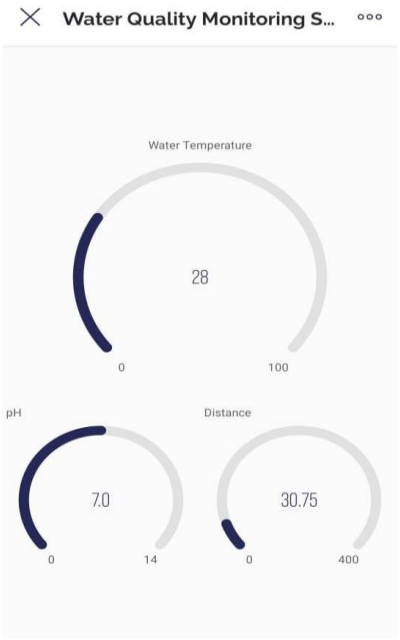

Fig. 6(a) *The Blynk interface*

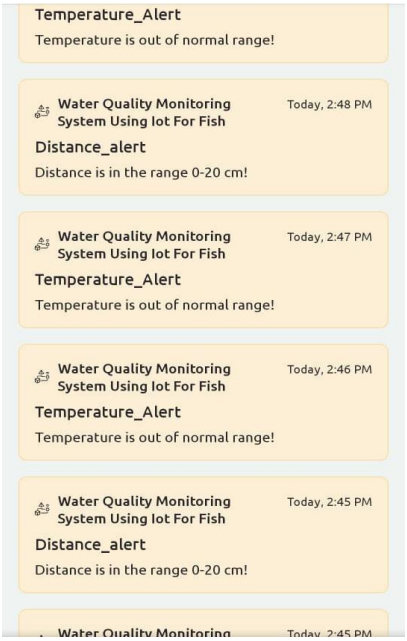

Fig. 6(b) *The notification alerts*

4. Conclusion

In conclusion, the water quality monitoring device designed for catfish ponds serves as a critical solution to address the escalating environmental challenge of water contamination. With water being a vital resource for sustaining biodiversity and ecological processes, it is imperative to safeguard its quality, especially in areas such as catfish ponds where aquatic life is directly impacted. The objectives, namely the design of a water quality monitoring device, the development of a monitoring system utilizing the Blynk IoT platform, and the evaluation of the prototype's efficacy and accessibility, collectively contribute to advancing environmental monitoring practices [3]. Water contamination, fueled by rapid economic growth, poses a significant threat to aquatic life, particularly fish that are susceptible to ingesting harmful toxins present in their diet and surroundings. The integration of IoT technology into the monitoring system allows for frequent observation of water quality, enabling real-time data collection and analysis. This not only aids in making informed decisions about managing water quality but also facilitates the timely implementation of measures to reduce pollution. The efficacy of the prototype lies in its ability to provide valuable data for assessing water quality parameters. The utilization of the Blynk IoT platform enhances accessibility, allowing users to remotely monitor and manage the water quality of catfish ponds [4]. The seamless integration of smart devices, sensors, and communication tools creates an efficient IoT ecosystem that operates autonomously, requiring minimal human intervention. Ultimately, the successful implementation of this water quality monitoring system holds great promise for environmental conservation, sustainable resource management, and the well-being of aquatic ecosystems. As we strive for a harmonious coexistence with our environment, project like these exemplify the potential of technology to address pressing environmental concerns and contribute to the greater goal of ensuring a healthier planet for future generations.

Some recommendations can be made for future work. Those recommendations are to study integrating machine learning techniques to evaluate past data and improve the system's predicting abilities for more precise qualities check and prompt notifications. Other than that, to set up Wi-Fi access points nearby so that data can be measured and notifications can be sent to mobile devices quickly and effectively. Finally, attach a camera which is used to monitor real-time the project place.

Acknowledgement

The authors would like to thank the Faculty of Electrical and Electronic Engineering, Universiti Tun Hussein Onn Malaysia for its support.

Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

The author attests to having sole responsibility for the following: planning and designing the study, data collection, analysis and interpretation of the outcomes, and paper writing.

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