Chapter 21
IoT-Based Real-Time Water Quality Monitoring in Aquaculture Systems Enhancing Aquatic Species Health

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ABSTRACT

For the health and well-being of aquatic species, it is crucial to monitor and maintain ideal water quality in aquaculture systems. Manual testing and inspection are two traditional water quality monitoring techniques that can be time- and money-consuming. Through the use of sensors and other IoT devices, the IoT offers a possible solution by enabling continuous, real-time monitoring of water quality. Using a variety of sensors, including a turbidity, soil moisture, and gas, we discuss the design and implementation of an IoT-based system for monitoring water quality in aquaculture in this project. The outcomes of our field tests show how well the system works for measuring water quality parameters precisely and sending prompt notifications when variations from normal values are found. Overall, our research indicates that the adoption of IoT technology can enable continuous, real-time monitoring of water quality, which has the potential to substantially enhance the efficiency and sustainability of aquaculture operations.

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1. INTRODUCTION

In order to meet the rising global demand for seafood, aquaculture is a sector of the economy that is expanding quickly. But the success of aquaculture operations significantly rely on the welfare and health of the aquatic species raised, which in turn depends on the water quality in which they are raised. In order to ensure the success and sustainability of these operations, it is important to maintain ideal water quality conditions by ongoing monitoring. Aquaculture systems have traditionally been monitored manually using labor-intensive techniques like water sampling and chemical testing. These methods work, but they take a lot of time, money, and are frequently vulnerable to a person's interpretation of the facts (Devarakonda & Bapat, 2017).

Fortunately, the Internet of Things (IoT) offers a potential remedy to these problems by enabling continuous, real-time monitoring of water quality using sensors and other IoT devices. In this research, we demonstrate a cutting-edge Internet of Things (IoT)-based system made for monitoring aquaculture water quality. A turbidity sensor, a soil moisture sensor, and a gas sensor are just a few of the sensors that the system uses. We use NodeMCU, an open-source, affordable microcontroller platform created exclusively for Internet of Things (IoT) applications, to develop the system. A network of interconnected sensors and other devices that communicate with a central hub make up the system. The system may be remotely monitored and controlled thanks to this hub's data collection, processing, and internet connectivity (Gupta & Tiwari, 2019; Li et al., 2017; Ma et al., 2017; Song & Yang, 2017; Song & Yang, 2018).

The system can quickly spot deviations from normal levels by continuously monitoring key water quality parameters like pH, temperature, dissolved oxygen, and nutrient levels, as well as other elements that may affect the wellbeing of aquatic species, like gas levels and soil moisture (Kamilaris & Prenafeta-Boldú, 2018). These deviations result in prompt alarms that allow for prompt corrective action. This innovative approach raises the productivity and sustainability of aquaculture operations while protecting the well-being of aquatic creatures.

2. LITERATURE SURVEY

A cutting-edge IoT-based smart water quality monitoring system was proposed by Pasika and Gandla (2020). The system uses a number of sensors to measure a number of different characteristics, including turbidity, pH value, water level in the tank, surrounding environment wetness, and water temperature. These sensors are linked to a Microcontroller Unit (MCU), which communicates with a Personal Computer (PC) to process the collected data further. Continuous water quality monitoring is made possible by this economical solution, ensuring optimum management and upkeep. The study conducted by Pasika and Gandla adds significantly to the study of water quality monitoring systems.

Mukta et al. (2019) designed an IoT-based Smart Water Quality Monitoring (SWQM) system in another study. The pH, temperature, turbidity, and electric conductivity are the four main water quality metrics that this system focuses on measuring. Four sensors are combined with an Arduino Uno to accomplish this, and the Arduino Uno collects and transmits data to a desktop application created on the .NET platform. To ascertain if the water sample is consumable or not, the gathered data is compared to reference values using a rapid forest binary classifier. This SWQM model considerably aids in the proper evaluation of water quality thanks to its sophisticated classification capabilities.