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Internet of Things (IoT) Based Aquaculture Monitoring System

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Abstract. Aquaculture is one of the fastest growing manufacturing businesses in many parts of the world as the demand for fish and processed fish feed is increasing day by day. Aquaculture is also known as aquaculture, breeding, rearing, collecting fish, seaweed, seaweed and many other organisms. It is also defined as a breeding species that thrives in an aquatic environment under controlled conditions. This study is developing an aquaculture system that can remotely monitor water acidity, temperature, and turbidity levels using the Internet of Things (IoT). Sensors are installed in this system to receive data. Results obtained with all systems developed, the success rate for acid-base monitoring is 97.66%. The success rate for water temperature monitoring is 94.92%. For cloudy water, use a range of numbers from 1 to 50, where 1-9 is clear water, 10-24 is slightly cloudy, 25-49 is fairly cloudy, and more than 50 is very cloudy.

Keywords. Aquaculture, IoT, Andoid

1 Introduction

Indonesia is one of the fourth most populous countries in the world after China, India and the United States. The wealth of natural resources, namely fish in the Indonesian seas, is quite large, this will continue to be used for the benefit of society, namely for the consumption needs of the community, which are considered far from ideal. The Department of Maritime Affairs and Fisheries has a target fish consumption rate (AKI) in 2024 which is 62.05 kg per capita per year. In 2021, the national MMR was recorded at 55.37 kg per capita in 2021. This number increased by 1.48 percent compared to the previous year and amounted to 54.56 kg/capita.

Rapid population growth poses a challenge to the community's food needs. 100 hectares per year of agricultural land in Indonesia is used as non-agricultural land. The need for land use is used for sustainable urban development. Urban agriculture which means meeting food needs in urban areas, while limited land in urban areas is still a problem for city residents, the availability of very minimal food is a threat to survival. The wealth of natural resources, namely fish in the Indonesian seas is quite abundant, this will continue to be used for the benefit of the community, namely for the consumption needs of the community which are considered less than ideal.

Aquaculture is one of the fastest growing industries in many parts of the world as the demand for fish and processed fish feed is increasing day by day. [1]. Aquaculture is also known as aquaculture, breeding, rearing, collecting fish, seaweed, seaweed and many other organisms. It is also defined as a breeding species that thrives in an aquatic environment under controlled conditions [2][3]. At present, the aquaculture system has been upgraded to an intelligent aquaculture system using IoT, artificial intelligence, data analysis, etc. to improve productivity and efficiency [4][5][6].

Aquaculture maintenance and management requires water quality monitoring and water quality forecasting (WQP). In aquaculture, water quality is the most influential and decisive factor affecting production and product quality. The most important water quality parameters in aquaculture are pH, dissolved oxygen (DO) and temperature [4].

Fish farming requires regular maintenance to stay safe and increase yields. This service/maintenance can be supported by IoT. Technology has a significant impact, both directly and indirectly, on everyday human life. Considering the limited use of current technologies, especially the IoT in aquaculture, this study will improve IoT-based technology, namely fisheries management support technology. This device monitors pond water quality based on temperature, oxygen content, pH value and turbidity level, which fish farmers can view remotely.

The main problem often encountered when aquaculture production fails is poor water quality. Therefore, water quality management during maintenance is a must. A few water quality parameters that are commonly measured and affect shrimp growth are dissolved oxygen (DO), temperature, and pH. Measurements are made in real time and online, so the owner does not need to be in the pond/pond. The owner only needs to see the

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data from the smartphone/tablet. Real-time measurements require sensors that can be integrated with a microcontroller.

1.1 Aquaculture

Aquaculture is the cultivation of aquatic organisms, including fish, shellfish, crustaceans, and aquatic plants. Aquaculture is the fastest growing animal feed sector in the world [7][8]. It is worth noting that aquaculture currently provides about 49% of all fish consumed by humans worldwide and is projected to account for more than half of global fish consumption by 2030 [9].

1.2 Internet of Things (IoT)

The IoT is used in many applications such as environmental monitoring, animal tracking, industrial management, precision agriculture, and so on. Thanks to the application of the concept of the Internet of Things in the fisheries sector, a large amount of data has been collected using connected sensors and systems that can be controlled and triggered automatically. This optimizes productivity. Farmers can manage their time away from important tasks. In addition, accurate information from the Internet of Things increases the productivity of fisheries, especially in risky and complex routine operations [10][11].
Basic IoT in agriculture is a simple system that allows farmers to control pumps or control soil moisture or temperature with a smart device. Whereas precision farming – aquaculture focuses on optimizing and improving agricultural processes to achieve maximum productivity and minimum costs. Therefore, more sensors and smarter systems are needed to meet these expectations. Many related new technologies are also applied, such as B. Low power long distance wireless communication to cover a wide field and support multiple sensors [10][12].

1.3 Internet of Things (IoT)

Ubidots is a cloud platform for IoT applications. It provides a simple and secure way to send and receive various sensor data to and from IoT devices via a global cloud network in real time. Ubidots provides a powerful platform for hobbyists, innovators, and professionals to prototype and scale IoT projects for manufacturing. Ubidots has many advantages and features, such as [13], [14]:

a. Useful for collecting, visualizing, analyzing and managing data.
b. Ubidot's GUI is simple and easy to use.
c. Ubidots offers users and operators access to the application wherever there is an internet connection.
d. The data stored in it is secure and protected and only users with permission can access this data [15].

1.4 Android

A smartphone is a technology product that most people own. According to field observations, almost everyone in the world has a smartphone. Therefore, Android-based smartphones have good potential if they are used as media tools to make it easier to find out a lot of information [16].

1.5 Sensor

1.5.1 *PH Meter Sensor*

Requires an Arduino Analog pH Sensor (SEN0161) as shown in Figure 1. Used to measure the pH of water. Specially designed for the Arduino series, the PH sensor features easy communication and built-in functions. The BNC connector is required to connect the sensor to the Arduino. This PH sensor has a range of 0-14. It has an accuracy of ±0.1PH at standard temperatures of 25-30°C and operating temperatures of 0-60°C. Water can only be supplied to certain parts of the sensor. The reliability of the pH sensor lasts for half a year with clean water and for a month if the water is very cloudy.

Fig. 1. PH Meter Sensor

1.5.2 *Temperature Sensor*

The proposed system also uses a temperature sensor DS182B0. We used an Arduino DS18B20, the waterproof temperature sensor shown in fig. 2. Operates within ±0.5°C, -10°C to +100°C.

Fig. 2. Temperature Sensor

1.5.3 **Turbidity Sensor**

Turbidity sensor to measure the degree of turbidity or opacity, the Arduino gravity turbidity sensor detects water quality. The sensor uses light transmission and scatter rate measurements to distinguish between particles dissolved in the water, which differ in water by total suspended solids (TSS) (see Figure 3). The turbidity monitor sends a laser beam into the water for analysis. Then each suspended particle will scatter light. The amount of reflected light is used to determine the density of particles in water.

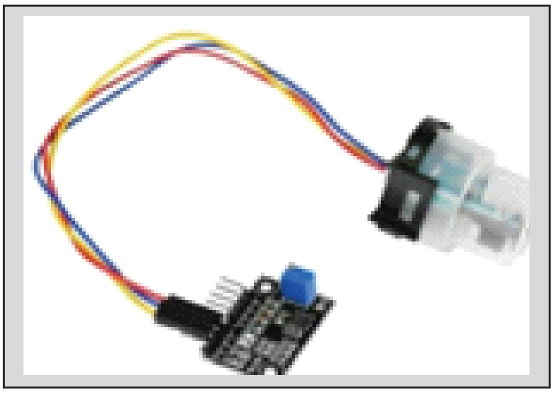

Fig. 3. Turbidity Sensor

2 Research Methodology

2.1 Block Diagram

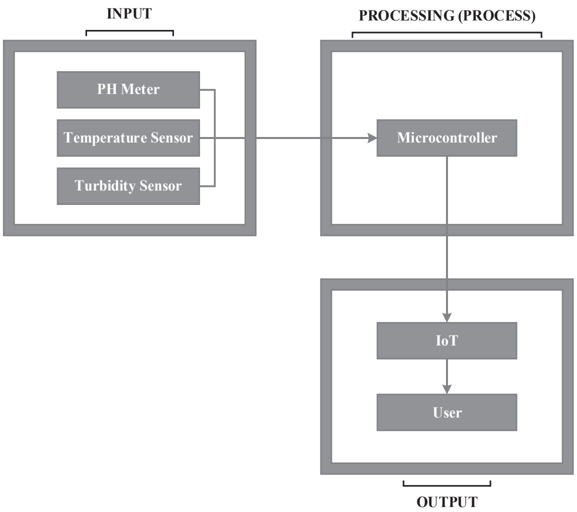

Fig. 4. System Block Diagram

There are several inputs in this system in the form of sensors, namely the PH meter sensor to measure the PH level in water, the temperature sensor to determine the temperature in the water, the last turbidity sensor to determine the degree of turbidity of the water is processed from the input to the Node MCU microcontroller, after which the microprocessor processes the data according to the given parameters. Once the data is collected, it is loaded into the database for verification by the created user application.

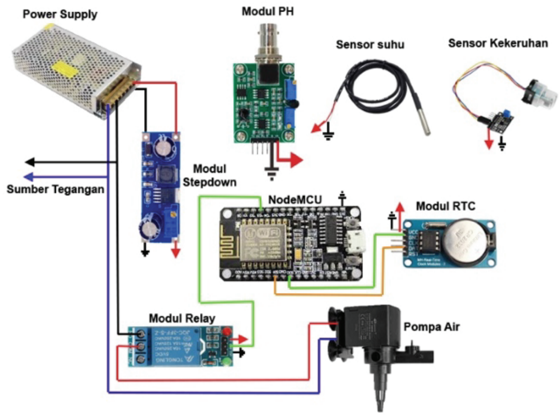

Fig. 5. System Component Design

According to the drawing, the system design consists of several system components, including a microcontroller, sensors, pumps, connected in one block.

3 Results and Discussion

3.1 Working System

This study used 20 tilapia fish of medium length and starting weight of 5cm/7g. In this study, we will monitor the quality of the water, which is the environment for the fish whose PH levels will be monitored with a PH sensor and the temperature will be monitored by installing a sensor temperature, and the turbidity of the water will be monitored by a turbidity sensor. All sensor processing data is sent to the server and stored in the server database, which can later be monitored over the Internet and Android networks.

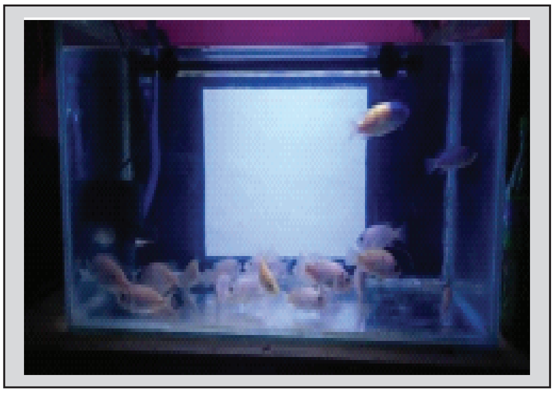

Fig. 6. Aquaculture

3.2 Sensor Success Percentage

3.2.1 *PH Sensor*

This test is performed by immersing the probe of the pH meter probe into water at different levels. This test is used to calibrate the pH sensor and determine the acidity of an aquarium or water tank. The sensor readings are then compared with a digital pH meter.

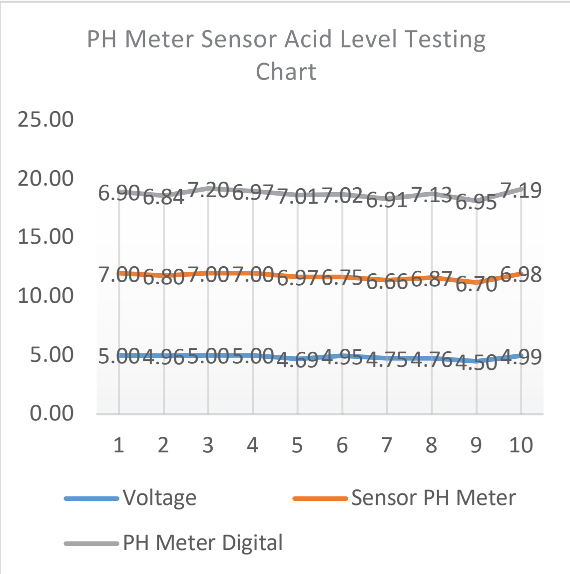

Fig. 7. PH Meter Sensor Acid Level Testing Chart

In the table results, the results of the calibration of the PH sensor are obtained with average success 97.66%.

3.2.2 *Temperature Sensor*

This test is performed by immersing the probe of the temperature sensor in water at different degrees. This test is used to calibrate the temperature sensor and determine the water temperature. The sensor readings are then compared with a digital temperature meter.

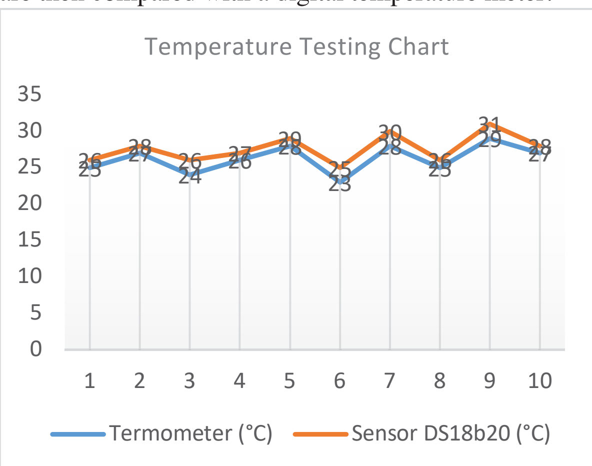

Fig. 8. Temperature Testing Chart

In the table results, the results of the temperature sensor calibration are obtained with an average success of 94.92%.

3.2.3 *Turbidity Sensor*

This test is performed by immersing the turbidity sensor probe in water. This test aims to calibrate the turbidity sensor and determine the level of turbidity in the water.

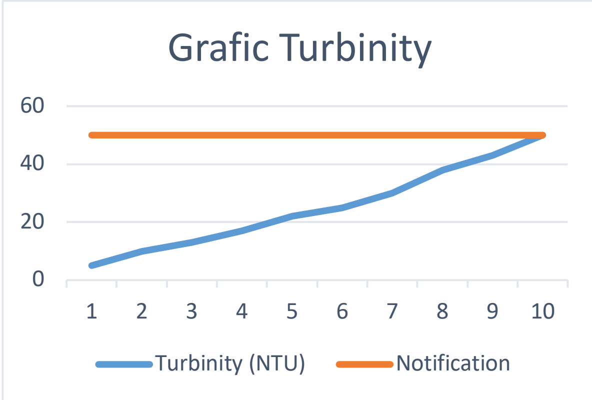

Fig. 9. Turbinity Chart

In the table results, the results obtained for 10 times of data collection always increase. Notifications will be informed if the waste is in the number equal to 50 or above 50, where the water is very cloudy and it is time to drain, because it will affect the growth process of tilapia.

4 Conclusion

Of all systems designed, the percentage of success for monitoring acid-base levels is 97.66%. The percentage of success for monitoring water temperature is 94.92%. For the level of turbidity in water, use a number range from 1-50, where 1-9 is clear, 10-24 is slightly cloudy, 25-49 is quite cloudy and above 50 is very cloudy.

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