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Monitoring Tools of Water Temperature and pH in Fresh Water Fish Pool Based on the Internet of Things (IoT)

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ABSTRACT

One of the fish species that can live in high salinity (euryhaline) is tilapia (Oreochromis niloticus). It is not surprising that tilapia can be found in brackish water, swamps, reservoirs, lakes and rivers. The growth rate of tilapia is influenced by age and water quality as well as the quality and quantity of feed given. The definition of growth is the increase in weight and also the length of the body of living things during a certain period of time. These parameters should be monitored for the survival of the fish. The use of Internet of Things (IoT) can be used as a monitoring and automation system for fish environmental parameters. IoT in this research was chosen because this system can simplify human work. The instruments needed in designing the monitoring system include components that function as the main controller, namely the Node MCU ESP2866 microcontroller, components for detecting water pH levels, namely a pH meter sensor type pH-4502C, and a water temperature measuring component, namely DS18B20. NodeMCU is the main component as a microcontroller as well as a component that connects to Wi-Fi. This system displays the temperature and pH of the water on the LCD and is sent to the android application. The results of the design of the temperature and pH monitoring tool obtained the average error value on temperature readings is 0.88%. The small error value gives the conclusion that the temperature sensor readings in this study are accurate. The pH acidity reading has an average error value of 0.42%. The small error value gives the conclusion that the pH sensor readings in this study are accurate. With the results of sensor value readings and errors, it can be concluded that the tool can be used and can work properly.

1. Introduction

One of the freshwater fish that is favored by the community is tilapia. Tilapia has several advantages, namely easy to breed, high survival rate, relatively fast growth and relatively large size [1]. A wide habitat distribution and wide tolerance to salinity Growth is a process of increasing the length and weight of an organism that can be seen from changes in length and weight in units of time. The quality and quantity of feed affects the growth of tilapia, besides that age and water quality can also affect its growth [2][3].

One of the freshwater fish favored by the public is tilapia. Tilapia has thick flesh, tastes good and the price is affordable. The higher public awareness of healthy and low-fat sources of protein, the need for tilapia continues to increase. Growing tilapia requires a water pH of approximately 6.5-8.5 and a water temperature ranging from 25°C - 30°C [4]. If the temperature is very low it will cause a decrease in the level of immunity in tilapia, while very high temperatures will cause tilapia to be infected by bacteria and viruses. Diseases caused by bacteria can cause over 80% death in a relatively short time [5].

In tilapia cultivation, it is necessary to control several parameters, one of which is water temperature and water pH which affect the development and growth of tilapia. Improper handling of tilapia cultivation can cause fish to experience stress, so that their immune systems decrease and they are susceptible to disease [6]. If the temperature is very low it will cause a decrease in the level of immunity (immunity) in tilapia, while very high temperatures will cause tilapia to be infected by bacteria and viruses [7][8]. While a pH that is not optimal can cause stress in fish, susceptible to disease, and low productivity and growth. In addition, pH is very important in the field of aquaculture because it relates to the ability to grow and reproduce. A good degree of acidity (pH) for tilapia cultivation is around 6.5-8.5. The optimal temperature needed by fish for growth. The optimum temperature for cultivating tilapia is around 25°C-30° [9][10].

2. Method

The system design in this study is divided into two stages, the initial stage is the software design stage and the second stage is the hardware design stage. To obtain optimal results and in accordance with what is desired, the design of this system refers to theories and data sheets that have been obtained from reliable sources. In the early stages of design, namely the stage of designing and manufacturing software such as flowcharts and programs. In the second stage is the design stage such as block diagrams, and also the system design in this study includes the electronic part of the circuit and monitoring media.

2.1. System Design

The system design in this study is divided into two stages, the initial stage is the software design stage and the second stage is the hardware design stage. To obtain optimal results and in accordance with what is desired, the design of this system refers to theories and data sheets that have been obtained from reliable sources. In the early stages of design, namely the stage of designing and manufacturing software such as flowcharts and programs. In the second stage is the design stage such as block diagrams as shown in Fig. 1, and also the system design in this study includes the wiring diagrams consisting of electronic parts of the circuit and monitoring media as shown in Fig. 2.

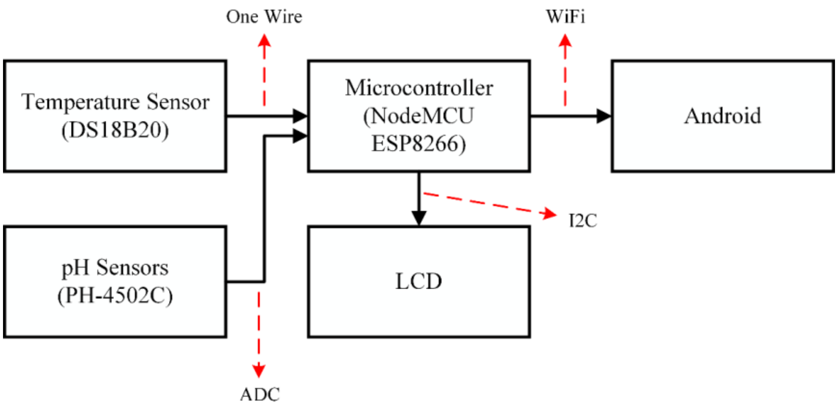

Fig. 1. Diagram block

Diagram block in Fig. 1 Designing a fish pond monitoring model which uses the NodeMCU microcontroller as a system controller and sends data to Blynk. This system uses a ph-4502C sensor and a DS18B20 temperature sensor as input [11][12], by detecting pH and water temperature. NodeMCU ESP2866 processes data from input temperature and pH sensors [13], the processed data will be output in the form of a screen display on a 16x2 LCD and also sent to a smartphone via the Blynk application [14].

The connection between the temperature sensor and NodeMCU uses the OneWire data line. The pH sensor with NodeMCU uses the ADC data line. Then, on the LCD with NodeMCU using the I2C data line. The process of sending data between NodeMCU and Smartphone using Wi-fi [15][16].

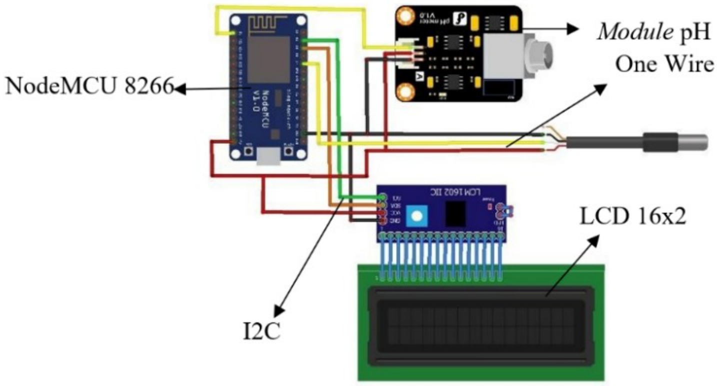

Fig. 2. Wiring diagram

The wiring diagram in Fig. 2 shows the line connection design of each device. By using NodeMCU as a microcontroller, ph and ds18b20 sensors as devices to read voltage and temperature values and an LCD module to display reading data [17][18][19]. From this series, a hardware device is designed that can work in accordance with the objectives of the planned system.

2.2. Algorithm

This research aims to build an IoT monitoring system for pH and water temperature. In Fig. 3, the Flowchart is a part that displays the stages or ongoing work processes in the system as a whole. In addition, the flowchart also describes the sequence of each procedure in the system to describe in detail the procedures of the program process. In this study, the connection between the temperature sensor and NodeMCU uses the OneWire data line. The pH sensor with NodeMCU uses the ADC data line. Then, on the LCD with NodeMCU using the I2C data line. The process of sending data between NodeMCU and Smartphone using Wi-fi.

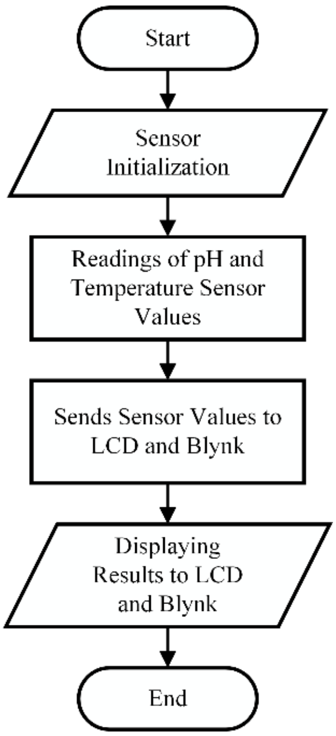

Fig. 3. Flowchart

2.3. Blynk

Blynk is a software company that provides infrastructure for IoT. Blynk has pioneered a no-code approach to IoT app creation and is gaining global popularity for its mobile app editor. Today businesses of all sizes, from new startups to large enterprises use the Blynk software platform to build and manage connected IoT products. Blynk was chosen for this project because of its ease and flexibility of access [20].

3. Results and Discussion

Fig. 4 shows the results of the hardware design used for the final test of the system being built. Fig. 4 hardware design. By using NodeMCU, temperature sensor, pH sensor, and lcd module.

Fig. 4. Hardware design: the whole system for testing

System testing is carried out in two (2) stages, the first is testing the accuracy of the water temperature sensor, and pH. The second is testing the software system built using the Blynk platform.

3.1. Water Temperature Sensor Testing

This test was carried out to find out how the ds18b20 sensor works and to find out whether the sensor can read the water temperature properly. In this test, an experiment was carried out by comparing using standard measuring instruments with research tools. The results of the ds18b20 sensor test can be seen in Table 1.

Table 1. DS18B20 sensor testing

No	Tool Made (°C)	Standard Gauge (°C)	Data Sent	Error Value
1	26.38	26.2	Sent	0.68
2	26.44	26.2	Sent	0.91
3	26.44	26.2	Sent	0.91
4	26.44	26.2	Sent	0.91
5	26.44	26.2	Sent	0.91
6	26.44	26.2	Sent	0.91
7	26.44	26.2	Sent	0.91
8	26.44	26.2	Sent	0.91
9	26.44	26.2	Sent	0.91
10	26.44	26.2	Sent	0.91
Error Average Value (%)				0.88

Table 1 shows the results of testing the water temperature values which have been compared using standard measuring instruments to obtain accuracy from the ds18b20 sensor.

3.2. pH Sensor Testing

This test is carried out to find out how the pH sensor works and whether the sensor can read the pH of the water properly. In this test, an experiment was carried out by comparing using standard measuring instruments with research tools. The results of testing the pH sensor can be seen in Table 2.

Table 2. pH Sensor testing

No	4502C pH sensor	Digital pH Meter Sensors	Data Sent	Error Value
1	8.11	8.1	Sent	0.12
2	8.16	8.1	Sent	0.74
3	8.11	8.1	Sent	0.12
4	8.14	8.1	Sent	0.49
5	8.14	8.1	Sent	0.49
6	8.14	8.1	Sent	0.49
7	8.14	8.1	Sent	0.49
8	8.11	8.1	Sent	0.12
9	8.11	8.1	Sent	0.12
10	8.19	8.1	Sent	1.09
Error Average Value (%)				0.42

In Table 2. There are results of testing the pH value of the water which has been compared using a standard measuring instrument to obtain the accuracy of the pH sensor.

3.3. Software Testing

This test was conducted to find out how the connectivity between the microcontroller and Blynk works properly. The results displayed are the temperature and pH values of the water using Blynk IoT, from the graphical experiment using Blynk the results are in accordance with Tables 1 and 2. In this experiment a graph of water temperature and pH was produced, a graphic sample of the results of this test can be seen in Fig. 5.

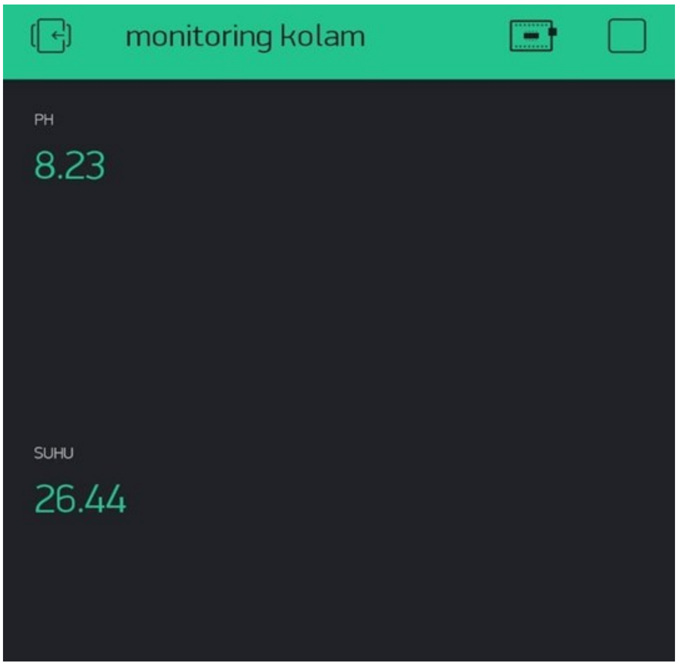

Fig. 5. Display on the Blynk application

4. Conclusion

The results of the research that has been carried out create a system that works well according to its function and can be used by subjects and personal in monitoring water in fish ponds. The test results of the 4502C pH meter sensor for 10 hours in tilapia ponds have good reading results and the suitability of the information data provided is in accordance with the output of the LCD monitoring system for temperature and water pH in tilapia ponds that have been designed and the results of a comparison between the 4502C pH meter sensor with a digital sensor pH tester meter on the market has an average error percentage of 0.42%, this shows that the accuracy of the sensor used is quite good. The test results on the DS18B20 type temperature sensor which has been carried out for 10 hours by looking at changes in temperature values every 1 hour show good test results and the changed values do not have too much difference in value according to standard values in general the fish pond water temperature is of good quality as well as sending data information automatically which has been carried out has resulted in a fast data sending process although sometimes it has delays caused by an unstable internet network. In the comparison test between the DS18B20 type temperature sensor and the waterproof digital temperature sensor on the market, the results of a comparison of the temperature readings are quite good with an average error value of 0.88%.

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