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Temperature Monitoring System and pH Control of Catfish Breeding Pond Water Based on NodeMCU 8266 with Telegram Bot Notification

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Abstract. This research presents the design of a temperature monitoring and pH control device for catfish nurseries. The pH range of 6.5 to 8.5 with a temperature of 27℃ to 31℃ is the optimal condition for catfish farming. However, water quality can decrease due to unstable pH conditions and temperature changes. In this case, periodic monitoring is necessary to maintain stable pH and temperature conditions. This tool is constructed to monitor temperature and control water pH using DS18B20 temperature sensors, pH sensors, water pumps, Node MCU 8266, and a telegram application. This device is applied to maintain the stability of the pH of the water; pH control is carried out with a new water replacement method when the pH value is over the normal limit or is in acid and alkaline state. The new water replacement method is carried out by utilizing a water pump for the circulation process. When all components are well integrated into a system, including the whole program, then testing is carried out. Testing on this tool begins with turning on and running the system and observing the system's performance, dipping the temperature sensor and pH sensor probe into the water, and then observing the temperature and pH data displayed on the LCD. Furthermore, if the pH is in an acid or alkaline state, the pump will be active to carry out the process of circulating water replacement. The output of water temperature and pH measurements is displayed on the LCD and with Telegram notifications by sending messages or statuses on Telegram.

1 Introduction

Catfish is one of the Indonesian people's most widely cultivated fishery commodities [1]. The stability of water quality with controlled pH and water temperature is an obstacle for catfish farmers [2]. In this case, farmers must always be vigilant so that water quality is maintained and the results of catfish farming are maximized. The water conditions need to be similar to the original habitat of cultivated aquatic biota [3]. The water environment must be where the fish live if they want them to live normally, such as adjusting to existing parameters [4].

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Water treatment management for catfish cultivation is very necessary to obtain optimal catfish production. Water quality that meets the standards will provide comfortable conditions for catfish. Inadequate water conditions due to poor water treatment cause catfish to be susceptible to disease, easily stressed, have no appetite, and eventually die. The water quality parameters for catfish cultivation include a neutral pH of 6.5 - 8.5, a temperature of 25 - 30°C, a dissolved oxygen content of 5-6 ppm, odorless, free of ammonia, and not foam. Proper and sustainable management of water quality can determine success in catfish cultivation. There are many sources of peat water in the Kalimantan area, a neutral pH value of water is needed in catfish cultivation. Actually, catfish can still adapt to water with a pH of 6-9, but in this condition the growth of catfish will be hampered. A pH value that is too low can cause fish to be lazy to move, excrete excessive mucus and can cause death; if the pH value is too high, it can cause stress to catfish and slow catfish development [5].

One of the parameters for catfish farming is said to be good is the stability of the water pH, with a pH range of 6.5-8.5. Under conditions of pH below neutral, i.e., acidic, fungi or bacteria can easily breed. On the other hand, in the pH range of 6.5-8.5, catfish can live well. In this case, catfish can still live in an alkaline pond water atmosphere. Therefore, if the atmosphere of the water in the pond becomes acidic, the activities carried out are to increase the alkaline conditions in the pond water so that the atmosphere of the pond water becomes neutral [2].

During the study, the condition of the pond water temperature was in the range of 22-30°C. On the morning of the second day of observation, the lowest temperature (22°C) and the highest temperature (30°C) were obtained. Furthermore, observations were made for three days; in the morning, the water temperature range reached 22-25°C, while during the day, it ranged from 27-30°C [7]. Conditions in the pond temperature will be low if it rains. The reason is the decrease in air temperature and the absence of incoming solar radiation [8]. Two factors can affect the survival of fish, namely internal factors such as age and external factors such as predators, disease, and water quality. The inability to survive fish life is usually caused by changes in temperature that are intolerant of fish [9].

The controlling device can be employed regarding the control and monitoring system of the environment. The most widely used component in analog and digital circuits is the transistor. The function of the transistor in the circuit is to amplify the signal. A device that can move a contactor composed of an electronic switch controlled from a circuit using electric power is called a relay [10]. The pH level of water can be detected using a pH sensor. The function of the pH sensor is to detect pH levels in catfish pond water and monitor the pH levels of catfish pond water. Sensors that measure temperature in places that are difficult to reach or wet usually use the DS18B20 sensor [11]. The development of the ESP 8266 with firmware is the NodeMCU which is equipped with a micro usb port and push button. In addition, this study uses Telegram, a free and non-profit-based multiplatform instant messaging service application [12]. Based on

the above explanation, this research presents the design of a temperature monitoring and pH control device for catfish nurseries using NodeMCU 8266 with Telegram Bot Notification.

2   Methods

2.1   Block Diagram

The Block diagram of the device is given in Figure 1.
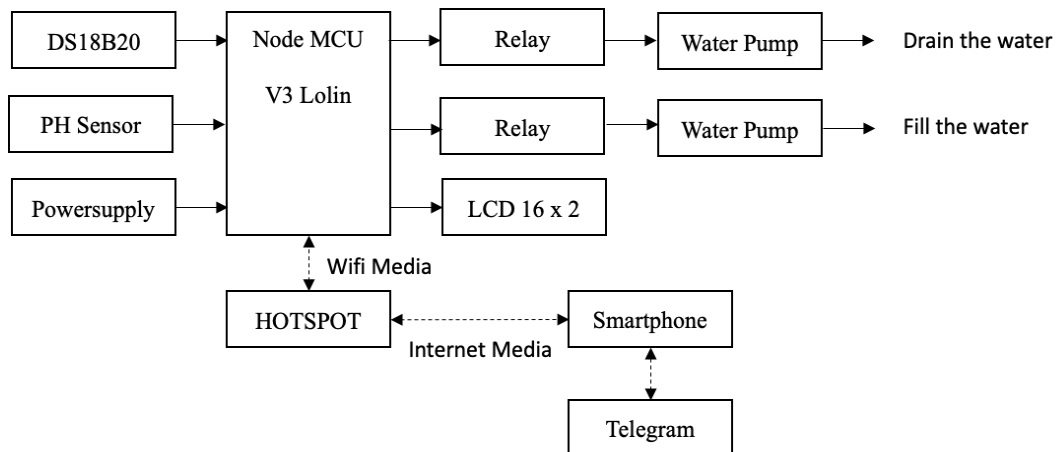

Figure 1. Block diagram of the device

2.2   Electrical Circuit Design

This circuit has several constituent components installed in the main circuit, namely the NodeMCU 8266 board (Figure 2). This circuit works when the NodeMCU 8266 board is supplied with a voltage of 6 volts from the PSA. Then the NodeMCU board will control the whole system according to the program run on the NodeMCU board. This function is to monitor the temperature and control the PH of the pond water based on the degree of acidity or the PH value of the water, with the method of circulating water replacement, using the DS18B20 temperature sensor and the water PH sensor. The PH sensor functions to detect the PH value of the pond water; the water pump will turn on when the PH sensor detects the PH value of the water below six or in an acidic state and when the PH value of the water is above 8.5 or in an alkaline state. Then the sensor readings will be displayed on the LCD and sent to the telegram application. The DS18B20 temperature sensor will detect the water temperature. The sensor reading data will be processed by the NodeMCU 8266 board, displayed on the LCD, and sent to telegram. The flowchart of the device is given in Figure 3.
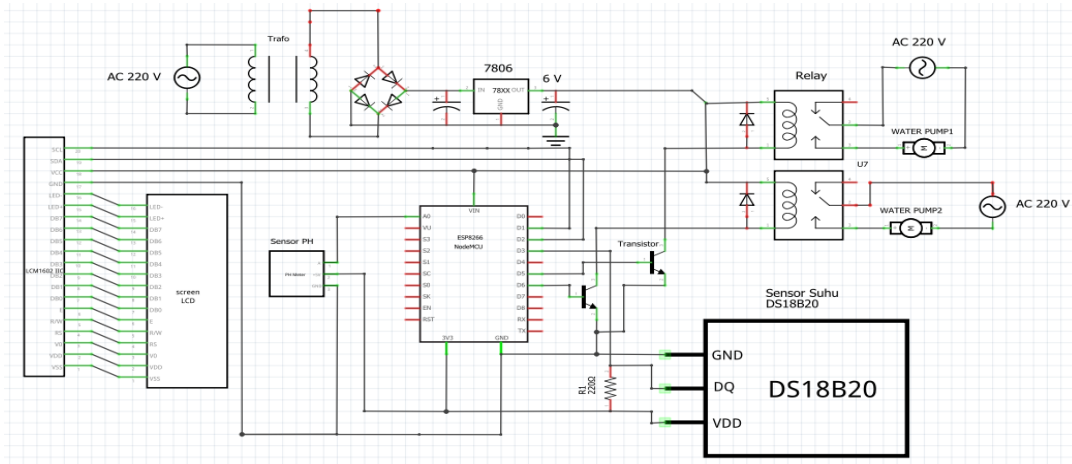
Figure 2. The Electrical Circuit of The Device
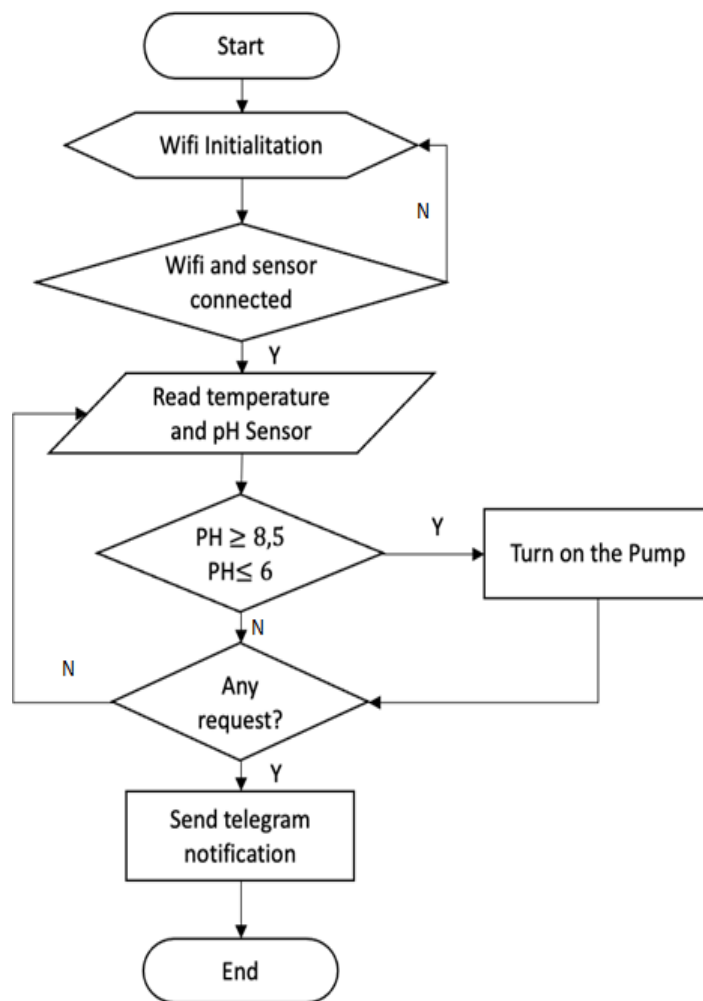

Figure 3. Flowchart

3 Result and Discussion

3.1 Temperature Sensor Testing

In this test, the comparison value of the temperature measurement results between the DS18B20 temperature sensor and a digital thermometer can be seen.

Table 1. Temperature Sensor Test Results

No	Thermometer (℃)	Temperature Sensor DS18B20 (℃)	*Error* percentage (%)
1	33.7	33.0	2.077
2	40.8	39.5	3.186
3	44.5	43.5	2.247
4	48.2	47.0	2.489
5	50.7	49.5	2.366
6	59.6	58.5	1.845
7	63.5	62.5	1.574
8	64.1	63.0	1.716
9	65.1	64.0	1.689
10	71.8	69.0	3.899
Average			2.308

From the test results in Table 1, the percentage error value is not more than 4% and the test results obtained that the DS18B20 temperature sensor is more accurate at working under 71°C, and obtained the average value of 2.308%

3.2   PH Sensor Testing

The pH sensor test is carried out by dipping the sensor probe into a buffer solution whose value is known; the pH of the buffer solution used is 4.01, 6.86, and 9.18, then the comparison value is measured (Table 2).

Table 2. The pH Sensor Test Results

No	pH meter	pH sensor	*Error* Percentage
1	4.79	4.74	1.04%
2	6.79	6.41	5.59%
3	8.69	8.55	1.61%
Average			2.74%

After conducting three test parameters using a pH buffer, the result is very close to the standard pH meter with a percentage error of 2.74 %.

3.3   Pond Temperature and pH Test Results

The overall testing was carried out for three days starting in the morning at 8.00 WIB, then at noon at 14.00 WIB and then at night at 20.00 WIB (Table 3, Table 4, and Table 5).

Table 3. The results of testing the temperature and pH of the pond on the first day

No	Time	Temperature (℃)	pH
1	Morning (8.00 WIB)	26.50	8.36
2	Afternoon (14.00 WIB)	31.50	7.32
3	Evening (20.00 WIB)	30.00	8.26

Table 4. The results of testing the temperature and pH of the pond on the second day

No	Time	Temperature (°C)	pH
1	Morning (8.00 WIB)	26.50	8.26
2	Afternoon (14.00 WIB)	31.50	6.78
3	Evening (20.00 WIB)	30.00	8.10

Table 5. Test results for the third day of pond temperature and pH

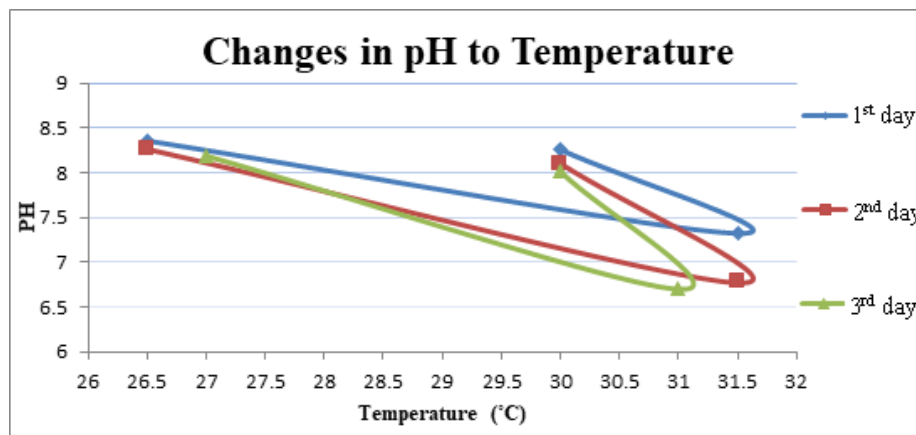| N0	Time	Temperature (°C)	pH
1	Morning (8.00 WIB)	27.00	8.19
2	Afternoon (14.00 WIB)	31.00	6.70
3	Evening (20.00 WIB)	30.00	8.01

Figure 6. Graph of changes in pH of pond water with a temperature

Figure 6 shows that on the first day where at a temperature of 26.50°C, the pH value of 8.36 was obtained, then the water temperature increased so that it reached a temperature of 31.50°C. After that, the pH of the pond water decreased so that the pH value was obtained at 7.32; then the pond water temperature decreased again so that a temperature of 30.00°C was obtained, and the pH value of the water increased so that a pH value of 8.26 was obtained. Then on the second day shown in the graph, starting at a temperature of 26.50°C, a pH value of 8.26 was obtained. Then, at a temperature of 31.50°C, the pH of the water decreased so that the pH value was 6.78. Then, at a temperature of 30.00°C, the pH value increased to 8.10. On the second day, shown in the graph, the pH value decreased from the first day at the same temperature. Then on the third day shown in the graph, starting at a temperature of 27.00°C, the pH value of 8.19 was obtained, then the water temperature increased so that the temperature of 31.00°C. Next, the pH of the water decreased so that a pH value of 6.70 was obtained. Finally, at a temperature of 30.00°C, the pH of the water has increased so that a pH value of 8.01 is obtained.

4   Conclusion

This work has successfully produced water temperature monitoring and pH control systems using pH sensors, DS18B20 temperature sensors, and water pumps. This device has several outputs: an LCD to display temperature and pH data, a pump for circulating water replacement, and Telegram notifications. Remote monitoring systems using internet media can be realized with the NodeMCU microcontroller and the Telegram application as a place to store and transmit data by the circuit. The system controls the pH with the circulation method of water replacement, based on the pH value of the pond water; if the pH of the pond is in an acidic state or pH < 6.5 and the pH of the pond are in an alkaline state, namely pH > 8.5, the pump will be active to carry out the circulation process. From the tests conducted on catfish ponds, it is known that changes in temperature in pond water affect changes in the degree of acidity or pH value of the pond water; the higher the temperature of the pond water, the lower the pH value, and also in catfish ponds, the pH value of the pond water decreases significantly every day.

REFERENCES

[1] A. Bimantara, "Uji Proximat Daging Ikan Lele yang Dibudidayakan dengan Perbedaan Manajemen Kualitas Air dan Pakan," *Jurnal Ilmiah Perikanan dan Kelautan*, vol. 10, no. 1, pp. 40-45, 2018.

[2] Hermansyah, E. Derdian and F. T. Pontia W, "Rancang Bangun Pengendali Ph Air Untuk Pembudidayaan Ikan Lele Berbasis Mikrokontroler Atmega16," *Jurnal Teknik Elektro Universitas Tanjungpura*, vol. 2, no. 1, pp. 1-13, 2017.

[3] S. Mulyani, Hadijah and B. Hitijahubessy, Potensi Pengembangan Budidaya Ikan Kerapu Perairan Teluk Ambai Provinsi Papua, Makassar: Pusaka Almaida, 2021.

[4] M. Radhiyufa, "Dinamika Fosfat dan Klorofil dengan Penebaran Ikan Nila (*Oreochromis niloticus*) pada Kolam Budidaya Ikan Lele (*Clarias gariepinus*) Sistem Heterotrofik," Undergraduate thesis, Universitas Islam Negeri Syarif Hidayatullah, Jakarta, 2011.

[5] Suhendra, Syahrizal I, 2017. *Teknisi pengelolaan air untuk budidaya ikan lele* dikolam terpal. Stain Pontianak Press. Pontianak.

[6] Muarif, "Karakteristik Suhu Perairan di Kolam Budidaya Perikanan," *Jurnal Mina Sains*, vol.2, no. 2, pp. 96-101, 2016.

[7] R. Parker, Aquaculture Science 3rd Edition, US: Cengage Learning, 2011.

[8] C. E. Boyd and F. Lichtkoppler, Water Quality Management in Pond Fish Culture, Alabama: Auburn University, 1979.

[9] P. Suwarno and T. S. Widodo, "Simulasi Sistem Pembayaran Retribusi Gerbang Parkir Menggunakan Mikrokontroler AT89S51. *Jurnal Teknik Elektro*, vol. 1, no. 1, pp. 22-32, 2009.

[10] I. Y. Basri and D. Irfan, Komponen Elektronika, Padang: Sukabina Press, 2018.

[11] B. Ariwibowo, "Rancang Bangun Sistem Pengatur Sirkulasi Air Berdasarkan pH dan Temperatur Air pada Kolam Ikan Gurami Berbasis Arduino," Undergraduate thesis, Institut Teknologi Sepuluh Nopember, Surabaya, 2017.

[12] J. Fahana, R. Umar and F. Ridho, "Pemanfaatan Telegram Sebagai Notifikasi Jerangan untuk Keperluan Forensik Jaringan," *QUERY: Jurnal Sistem Informasi*, vol. 1, no. 2, pp. 6-14, 2017.