Water Quality Monitoring System in Guorami Fish Cultivation Based on Microcontroller

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ABSTRACT
The growth of gourami is not only influenced by food but also by the quality of water as its habitat. Water suitable for use as a habitat for gourami is freshwater. Therefore, goramy farmers need to maintain water quality for the survival of gourami. Water quality is influenced by several parameters including temperature, pH, and water turbidity. The standard temperature of gourami ranges from 24 ° C to 30 °C, pH is 4 to 11, water turbidity remains bright at 20 cm or more. The method used is to create a water quality monitoring system using a temperature sensor, pH sensor, and water turbidity sensor based on ESP32. The temperature sensor testing can work at a temperature of 20 ° C to 50 ° C, testing the pH sensor ranges from pH 4 to 9.18, and testing the turbidity sensor at a viewing distance of 0.1, 10, and 20. The water quality monitoring system developed has been validated and has been work well.

Keywords: *WQMS, Gourami, ESP32*

1. INTRODUCTION

Water is very important for the life of living things, not only humans, but even other living things also need water as one of the main roles in their life. About 70% of the earth's surface is covered with water, but the amount of freshwater is suitable for human consumption and fish habitats in general [1]. Gourami fish is one of the leading commodities in freshwater fish cultivation [2]. Gourami farmers need to maintain the quality of their water to help the process of good cultivation. This means that gourami farmers need technology capable of detecting real-time water quality [3] for the survival of cultivated fish. In the process of cultivating carp, they often encounter problems, one of which is slow fish growth and is often exposed to death and smallpox, causing death. The water used must have a standard of quality and quantity following the life of carp. Many parameters affect water quality, but there are four of the most important in fish farming, namely temperature, pH, dissolved oxygen (DO), and water turbidity. Carp will not grow optimally if the temperature is below 24 °C and above 30 °C [4]. The lethal pH of carp is less than 4 and more than 11 [5]. The optimal DO content for carp is 4-9 mg / 1 [6]. Water turbidity is not suitable for goramy cultivation if the brightness is less than 20 cm and disturbs the respiration of the fish besides it also damages the eyes of the fish [4].

Technological advances cannot be counted anymore. Big companies have developed a system that can help people work and even daily activities. In electronics and computer technology, one of them is a microcontroller. The progress of the microcontroller is very helpful; this is because of the technology that allows controlling with program commands. [1] succeeded in creating a real-time water quality monitoring system, the resulting meter can work without much human intervention. Real-time monitoring can be accessed directly. In his research, [7] also mentioned the same thing. The resulting monitoring system can operate as an automatic water monitoring system on the water surface and can be monitored in real-time.

Consider the problems that often occur in the cultivation process. So this study offers a water quality monitoring system to prevent these problems experienced by fish farming farmers, especially carp. Because the output from the sensor for the three parameters is an analog signal output, it is converted to digital by the ESP32 using the Analog to Digital Converter (ADC).

2. METHOD

This study proposes a water quality monitoring system model in Figure 1. below

The tool used to take pond water samples has several sensors and actuator components. The 4 sensors used are an analog pH sensor which functions to read the pH value of water, a digital temperature sensor that reads the water temperature, an analog turbidity sensor that detects water turbidity, and an ultrasonic sensor which functions to measure the water level in the water sample box. Then, 3 actuators are used, namely a water pump to remove water from the water sample box, a water pump from the pond that functions as a sample of pond water, and a solenoid valve which functions as a filler for clean water.

The calibration process is carried out on each sensor used to monitor the quality of clean water.

2.1. Calibrate The Temperature Sensor

The DS18B20 temperature sensor calibration is carried out to improve the accuracy of the sensor. The calibration process is carried out by comparing the results of the alcohol thermometer with the DS18D20.

Table 1. Data on the output of thermometer alcohol with DS18D20

Thermometer alcohol (degree Celcius)	DS18B20 (degree Celcius)
25,0	22,9
30,0	27,8
35,0	34,4
40,0	37,7
45,0	43,3
50,0	47,7

Based on the data above, the following equation is obtained.

$$X = \left(\frac{y-(-1.70)}{1}\right) \quad (1)$$

Where x is the output and y is the result of DS18D20.

2.2. Calibrate The pH Sensor

The pH sensor calibration is carried out to determine the correlation between the 12 bit ADC value of the sensor and the actual water pH value. The calibration process is carried out by comparing the 12-bit ADC value from the sensor with the pH sensor calibration solution.

Table 2. Output pH calibration with 12 bit ADC pH sensor

pH calibration	12 bit ADC pH sensor
9,18	1542
6,86	1147
4	654

From the data above, the following equation is obtained.

$$X = \left(\frac{y-30.7}{171.44}\right) \quad (2)$$

2.3. Calibrate The Turbidity Sensor

The turbitity sensor calibration is performed to determine the correlation between the 12 bit ADC value of the sensor and the actual turbidity value. The calibration process is carried out by comparing the 12-bit ADC with a visibility distance to water.

Table 3. Output turbity calibration with 12 bit ADC pH sensor

Viewing distance (cm)	12 bit ADC
10	1360
20	1689
30	1884
60	2078

From the data above, the following equation is obtained.

$$X = \left(\frac{y-1362.84}{13.02}\right) \quad (3)$$

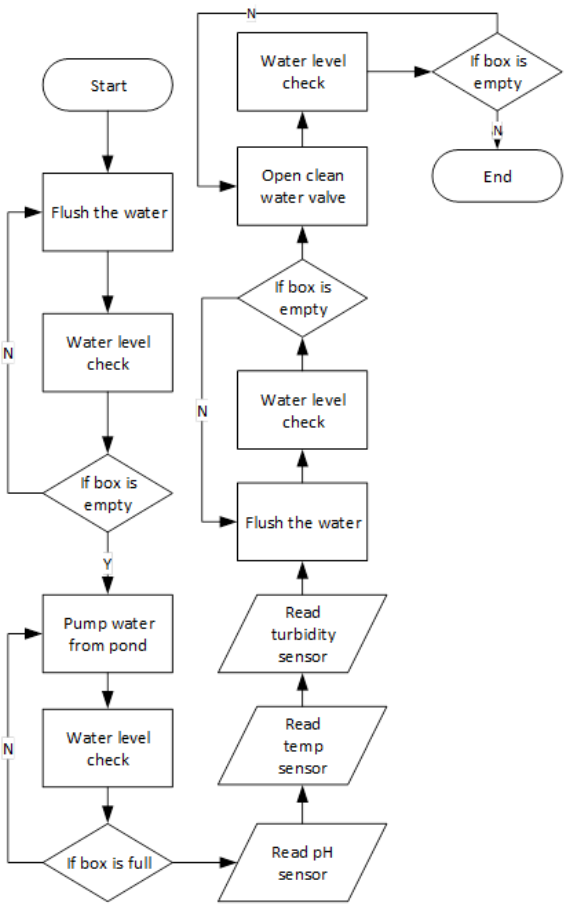


Figure 1 Flow diagram of the system work principle

3. RESULT AND DISCUSSION

The water quality monitoring system is a monitoring system that uses parameters such as pH, water temperature, and water turbidity generated from the *real-time* sampling of gouramy pond water. In the development process, there are 3 stages of testing to determine the performance of the system being developed, namely testing water pH, testing water temperature, and testing water turbidity.

3.1 Water pH test results

The pH test is carried out for 4 types of water that have been mentioned.

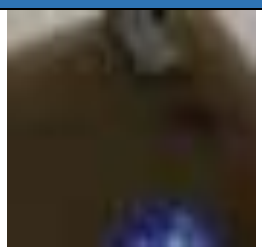
Table 4 Water pH test results

Type of Water	Reading result
Very cloudy	7.72
Cloudy	7.69
Not too cloudy	7.65
Clean	7.63

3.2 Water turbidity test results

The water turbidity test is carried out to determine the reading using the type of water that has been mentioned.

Table 5 Water turbidity test result

Type of water	Picture	Sensor reading results
The water is very cloudy		0 cm
Cloudy water		25 cm
The water is not too cloudy		40 cm
Clearwater		54 m

3.3 Water temperature test results

Table 6. Water temperature test results

Type of water	Temperature sensor results	Thermometer results
Very cloudy	26.7	 26.1
Cloudy	27.6	
Not too cloudy	26.7	 26.8
Clear	26.2	

4. CONCLUSION

This section will discuss the conclusions obtained after designing and testing the system. From the test results, the three parameters can be used as an indication of water quality for gouramy. In testing the pH of the type of clean water, the pH level was 7.63 and the highest was 7.72 in the type of very cloudy water. In testing the turbidity of water in clear water, the sensor results are 54 cm and in turbid water, the sensor results are 0 cm, the higher / greater the distance value read, the clearer the pond water is good for gouramy. In the clear water test, the water temperature reached 26.2 ° C while in the cloudy type the water temperature reached 27 ° C

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REFERENCES

[1] M. Kumar Jha, R. Kumari Sah, M. S. Rashmitha, R. Sinha, B. Sujatha, and K. V. Suma, “Smart Water Monitoring System for Real-Time Water Quality and Usage Monitoring,” *Proc. Int. Conf. Inven. Res. Comput. Appl. ICIRCA 2018*, no. Icirca, pp. 617–621, 2018, doi: 10.1109/ICIRCA.2018.8597179.

[2] J. Sulistyo and F. S. Mumpuni, “PERTUMBUHAN DAN KELANGSUNGAN HIDUP BENIH IKAN GURAMI (Osphronemus EKOR / LITER GROWTH AND SURVIVAL OF FISH FRY CARP (Osphronemus gouramy) ON THE RECIRCULATION SYSTEMS STOCKING DENSITY 5 , 7 AND 9 TAILS / LITER Metode Penelitian MATERI DAN METODE Waktu ,” vol. 7, 2016.

[3] T. Pangaribowo, “Jurnal Teknologi Elektro , Universitas Mercu Buana ISSN : 2086 - 9479 Sistem Monitoring Kualitas Air Pada Kolam Ikan Melalui Pengukuran kadar pH Berbasis Android,” *J. Tek. Elektro Univ. Mercu Buana*, vol. xx, no. xx, pp. 1–4, 2018.

[4] Puspita. D. 2018. Kajian Kesesuaian Air Untuk Budidaya Ikan Gurame di Desa Ngranti Kecamatan Boyolangu Kabupaten Tulungagung. Universitas Negeri Surabaya.

[5] Boyd, CE. 1990. Water Quality in Ponds for Aquaculture. Auburn University. Alabama.

[6] Gusrina. 2008. Budidaya Ikan jilid I Untuk SMK. Direktorat Pembinaan Sekolah Menengah Kejuruan. Jakarta.

[7] R. P. N. Budiarti, A. Tjahjono, M. Hariadi, and M. H. Purnomo, “Development of IoT for Automated Water Quality Monitoring System,” *Proc. - 2019 Int. Conf. Comput. Sci. Inf. Technol. Electr. Eng. ICOMITEE 2019*, vol. 1, pp. 211–216, 2019, doi: 10.1109/ICOMITEE.2019.8920900.