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Research Original Article

Design of Automatic Pond Water Quality Control in Koi Fish Farm

Muhammad Daud[1], **Rizqan Fachroji**✉[2], **Arnawan Hasibuan**[1], **Raihan Putri**[1], **I Made Ari Nratha**[3], **Muzamir Isa**[4]
[1] Electrical Engineering Department, Faculty of Engineering, Universitas Malikussaleh, Bukit Indah, 24352, Lhokseumawe, Indonesia
[2] Student Program in Electrical Engineering, Faculty of Engineering, Universitas Malikussaleh, Bukit Indah, 24352, Lhokseumawe, Indonesia
[3] Electrical Engineering Department, Faculty of Engineering, Universitas Mataram, Indonesia
[4] School of Electrical System Engineering, Universiti Malaysia Perlis, Perlis, Malaysia
✉Corresponding Author: **rizqan.180150124@mhs.unimal.ac.id** | Phone: **+6282288503100**

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Abstract
Koi fish is a type of freshwater ornamental fish that has high economic value. Koi fish have attractive body colors and ideal body shapes so they have good sales prospects. However, koi fish farming has several obstacles, one of which is the low recovery rate and the relatively slow growth of fish. Water quality is the main parameter in the success of a fishing effort. Therefore, this study designed a tool that can help koi fish farmers in unifying the quality of pond water so that koi fish can grow and develop properly. This monitoring system is designed by implementing an automatic control monitoring system to produce good water quality for koi fish farming. Data obtained from water quality monitoring are parameters of pH, ammonia, and water temperature. The results of this cultivator's research can monitor the quality of fish pond water and immediately get water quality control automatically.
Keywords: Water quality; Control; Koi Fish.

Introduction
Koi fish (Cyprinus carpio) is a type of freshwater ornamental fish that has high economic value, both in national and international markets (Hasibuan, Asran, et al., 2021) (Deriyanti, 2016). Koi fish have attractive body colors and ideal body shapes so they have good sales prospects. In addition, these koi fish are often used as aquarium decorations and are art consumption for devotees (Tambunan, 2018). The quality of water for koi fish cultivation must really be considered because it can affect the color of koi fish. Water quality is the main parameter in the success of a fishing business (Lembang & Rahman, 2022).

Koi fish cultivator is a fish cultivator in the freshwater fish sector. Koi fish is a type of freshwater ornamental fish commodity that has a very high economic value and has a very high level of ownership. This can be of interest to farmers to increase their business in the field of koi fish cultivation (Dwi Lestari, 2020). Koi fish farmers have ways to breed koi fish so that the quality of the koi fish provided is more suitable for international and local markets. Koi fish is a favorite ornamental fish in the country of Indonesia and is in great demand by the wider community, because their body is charming and the price is relatively expensive. At this time koi fish is still one of the most promising trading commodities in the field of fisheries (Kifly et al., 2020).

Power of Hydrogen (pH) is a term that expresses the intensity of the acidic or basic state of a liquid and is also a way to integrate the concentration of H+ ions. In aqueous solution, pH is one of the impacts that affect the quality of the processing water to be carried out. This results in the original water pH getting a pH value of 7. Then water with a pH above 7 is acidic and a pH below 7 is alkaline (Budiman et al., 2019) (Kit & Sen, n.d.).

In this study the data used to obtain water quality are parameters of pH and temperature. The value data is obtained from the readings of the pH probe sensor and ds18b20 sensor. The pH meter sensor consists of an electrode (measuring probe) connected to an electronic device that detects and displays the pH value parameter. A tool that can measure water quality and other parameters (Student, 2021). One of the Arduino compatible systems (Rosdiana et al., 2022), specifically designed for Arduino uno controllers to easily connect sensors with convenient connectors. The DS18B20 temperature sensor is a sensor that can detect water temperature, this sensor is water proof or waterproof.

Water with acidity (pH) that is too acidic or alkaline can cause fish farming to fail. Water temperature can also affect the death rate of fish (Fakhriza et al., 2021). Therefore this study designed a tool that can help koi fish farmers in monitoring the quality of pond water so that koi fish can grow and develop properly. This monitoring system is designed by implementing an automatic control monitoring system to produce good water quality for koi fish farming.

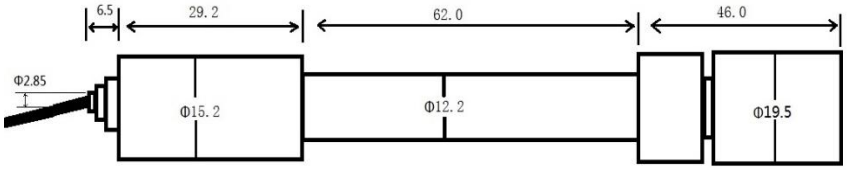
Basic Theory
1. Sensors

A sensor is a tool or device used to convert physical quantities into electrical quantities. Sensors are devices used to

detect induced signals originating from the conversion of an energy such as electrical energy, physical energy, chemical energy, biological energy, mechanical energy and others. Sensors can also function in implementing a device that can work automatically when using the sensor used (Maulana, 2014).

1) pH Probe Meter Sensors

A tool that can measure water quality by reading the value of water pH parameters. The principle of operation of the pH meter lies in the sensor probe in the form of a glass electrode by measuring the amount of H3O+ ions in solution. The tip of the glass electrode is a layer of glass (bulb) 0.1 mm thick. This bulb is mounted on a long cylinder of non-conductive glass or plastic, then filled with HCl solution (0.1 mol/dm3). In the HCl solution, a long silver electrode wire is embedded, forming an equilibrium compound AgCl on its surface. The constant amount of HCl solution in this system gives the Ag/AgCl electrode a stable potential value (Kit & Sen, n.d.).



Figuer 1. pH probe meter sensors

2) DS18b20 Sensors

The DS18S20 temperature sensor is a sensor that can detect water temperature, this sensor is water proof or waterproof. This sensor has 3 leg pins including vcc, data, and ground pins which can be connected to the microcontroller (Nrartha et al., 2022) (Rozaq & DS, 2017) (Shan, 2017).

Figure 2. DS18b20 sensors

2. Arduino UNO

This small board contains a microcontroller and multiple input/output (I/O), enabling the user to easily create specific electronics projects to meet the user's desired goals (Salam, 2019). Where this board is hardware that is open source (AFDALI et al., 2018). The purpose of making Arduino is to make it easier for users to carry out experiments or as an embodiment of equipment that is based on a microcontroller (Hasibuan, Rosdiana, et al., 2021).

Figure 3. Board arduino uno

3. Relay

Relays use the electromagnetic principle to turn the switch contacts into a small electric current (low power) that can flow higher voltage electricity. There are 2 types of contact points, namely, Normally Close (NC) and Normally Open (NO) (Hasibuan, Qodri, et al., 2021).

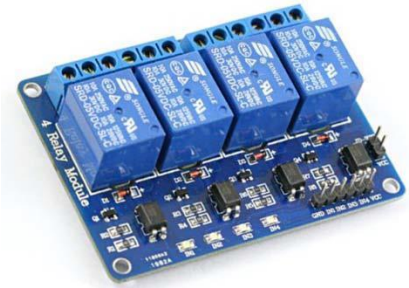


Figure 4. Relay

4. Direct Current (DC) Water Pump

The water pump motor is an electronic component consisting of a motor as a power source. The working principle of the pump motor is to use the impeller to displace a certain amount of water through the suction chamber to the discharge chamber, so that the entire air space is filled with water and liquid pressure is created, which is sucked from one place. to another (Nasution et al., 2018).

Research Method

From the flow chart above, it can be described as follows.

a) Literature study, namely conducting a literature review related to the issues discussed so as to provide confidence that this research can be carried out and also reduce errors in research.
b) Identification of needs and analysis of needs, namely identifying and analyzing needs of the problems discussed so that this research can be carried out.
c) The drafting technique, namely properly managing the design of the problems obtained and there are 3 parts to the process, namely mechanical design, electronic design, and program design.
d) System design, namely carrying out the overall design of the system to be implemented.
e) Testing techniques and data collection, namely conducting tests on designs that have been realized in the hope that the system will run smoothly.
f) Functional testing, namely testing the components used to determine whether the components are functioning as they should. Functional testing consists of testing sensors, Arduino UNO, NodeMCU, Relays, and Pumps.
g) Performance testing, namely conducting overall tests on the system to be designed. If the performance obtained does not work according to design then corrections and improvements are made.
h) Analysis and discussion techniques, namely conducting a review and analysis of the test data so as to find a new idea to draw conclusions

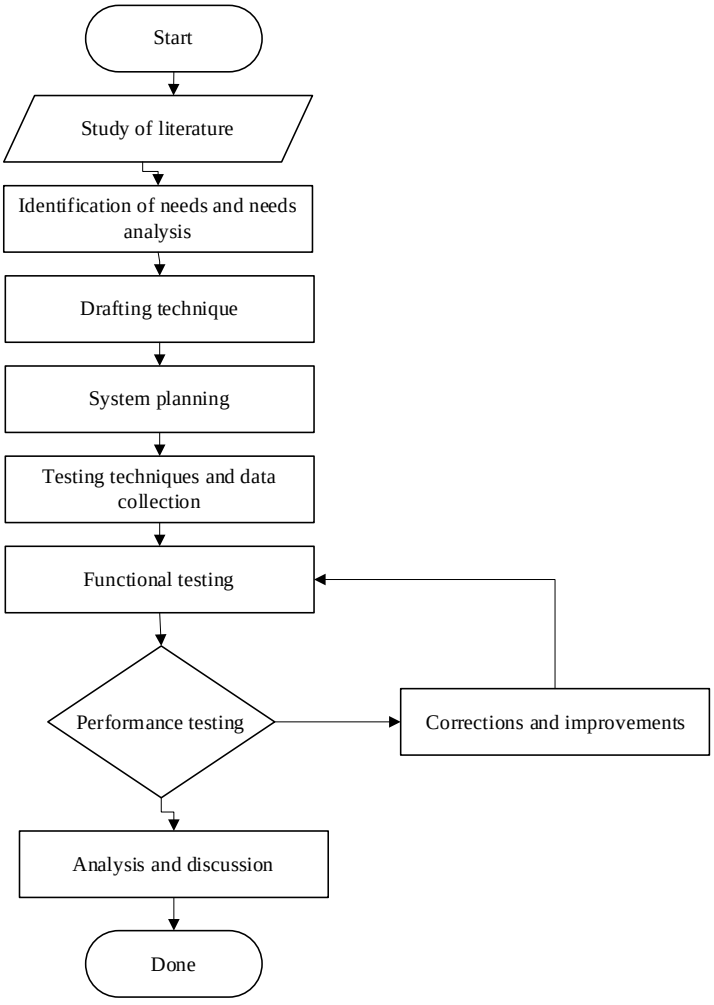


Figure 5. Flowchart research

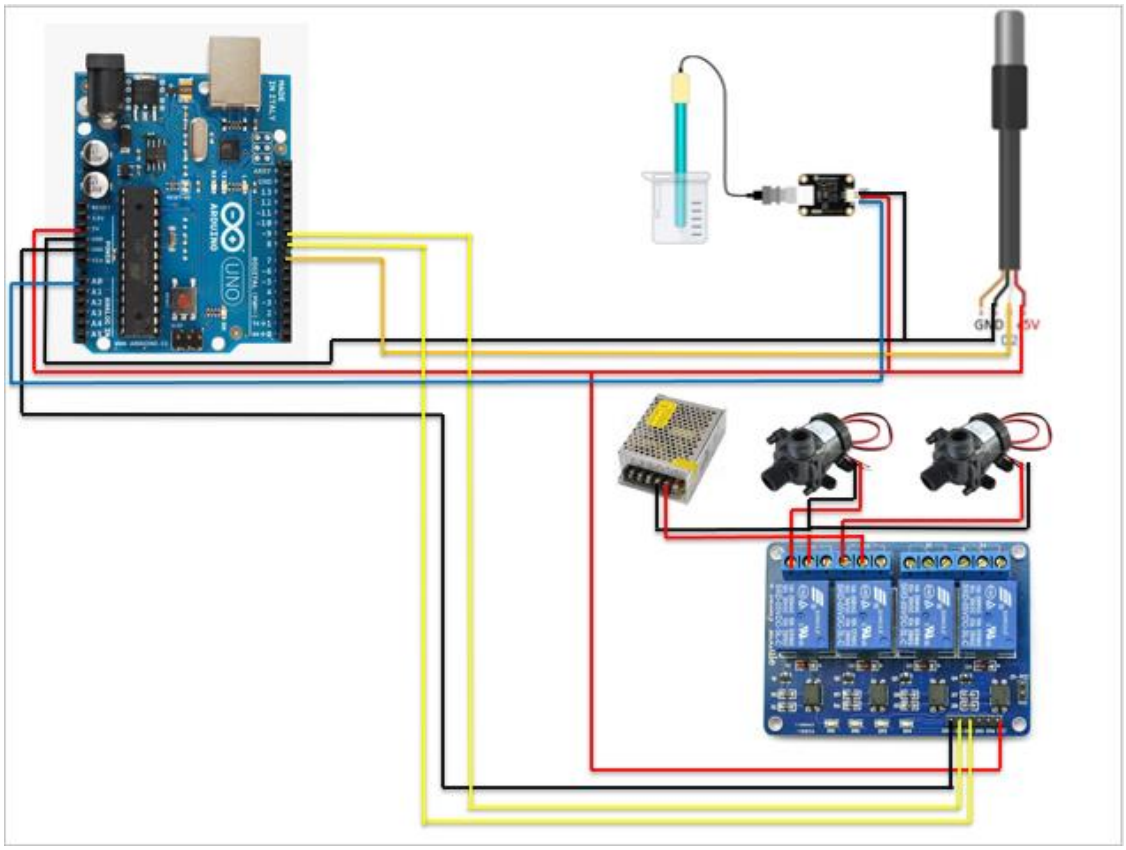


Figure 6. Water quality automatic control circuit

The entire design is made by following the stages of research. All control components used for the automatic water quality control process in the circuit according to the pin configuration of the Arduino UNO can be seen in Figure 6. above. the entire control circuit is installed in the panel box to see the system performance of the tool can work according to the Arduino IDE program that has been made.

Results and Discussion

The results of the Arduino UNO test are carried out by looking at the pin and functional connections between the Arduino UNO and other components as shown in the figure. The picture above shows that the control circuit is in the panel box, that the Arduino UNO pin configuration is going well. The configuration for sending serial communication data between Arduino UNO and NodeMCU was successful in sending, although it takes a time delay when sending takes place.

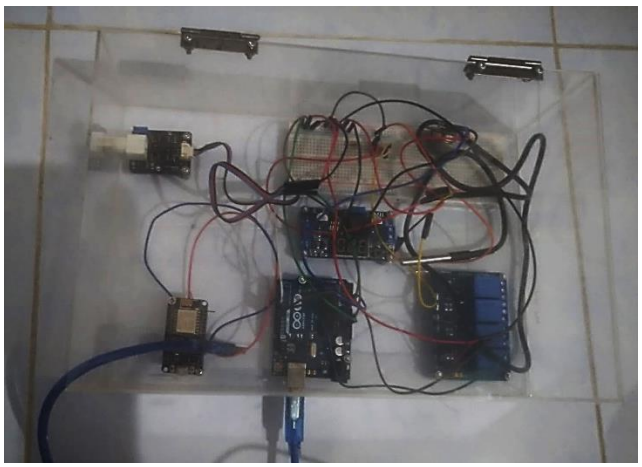


Figure 7. Arduino uno test results

This test is carried out on an automatic control work system on water quality by reading the values of sensors, relays and other control components. The test also looks at the work of controlling the water pump to circulate water in the container that has been made. Pump control is carried out by giving the specified variable value to the sensor and seeing the execution carried out by the relay.

Table 1. Component configuration pins to arduino uno

No	Component	PIN	Function	Information
1	pH Sensors	A0	Can read the pH of aqueous solutions	Valid
2	DS18b20 Sensors	7	Can read water temperature	Valid
3	Relay	4,5	Can do the process on / off	Valid

Table 2. Automatic control test results

No	Sensor Readings		Pump Condition	Information
	pH	Temperature		
1	8.21	27.86	ON	Valid
2	7.31	29.87	ON	Valid
3	6.52	25.51	OFF	Valid
4	6.96	26.34	OFF	Valid
5	8.89	30.16	ON	Valid
6	4.67	24.63	ON	Valid
7	4.24	25.48	ON	Valid

From the Table 2. it can be seen the results of measuring the readings of each sensor which are carried out, by setting the variable value limits to be able to execute the water pump with the work system process from the relay. Data collection tests were carried out 7 times with different readings for each sensor. From the 7 tests the value of the ammonia level in the water did not change much, this shows that the water contained in the container is within the normal limits of water quality for koi fish life.

The relay will work if the limit value for sensor readings for water quality is not normal and needs an indication of improving the water quality so that it can be repaired automatically. The relay process when it stops working, if the water quality in the container shows normal value limits and there is no need to control the water.

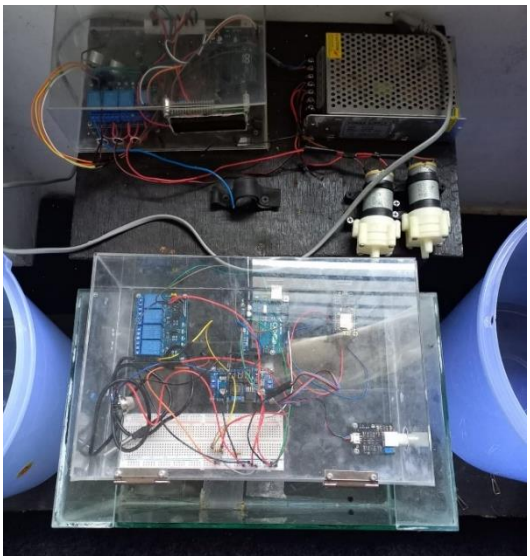


Figure 8. Realization of automatic control testing

Figure 9. Realization of koi fish pond

Conclusions

Based on the results and discussion of the system that has been made, several conclusions are obtained, namely: The design of automatic control on water quality works according to the design that has been designed and can be realized in fish ponds. The results of the automatic control test were carried out by testing seven times with different water qualities. the results of this show the results of reading the parameters of pH and water temperature by obtaining different variable values. Tests 3 and 4 show normal water quality readings with pH values and temperatures according to normal limits for koi fish cultivation. While the results of tests 1, 2, 5, 6, and 7 the water quality is not normal and there needs to be improvement to the water quality, the water pump motor will live during the process of improving the pool water quality. After the pool water quality is normal, the water pump will automatically turn off. The research results can be implemented in koi fish farming according to the required water control. Sensors and actuators can be added as needed in automatic control.

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