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Control of Smart Aquarium Using Smartphone

Fauzan Kurnia Aditama[1], Riki Mukhaiyar[1]
[1]Department of Electrical Engineering, Faculty of Engineering, Universitas Negeri Padang, Padang, Indonesia

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ABSTRACT

Effective water quality management is the key to maintaining a healthy and sustainable aquarium. The water quality in the aquarium affects the health of fish, plants, and other microorganisms, so it requires monitoring and control. Some water quality parameters that must be considered in ornamental fish aquariums are water pH, water turbidity, and water level in the aquarium. Along with the rapid development of technology, it is expected to make it easier for humans. This study aims to design an aquarium water quality control tool with control using a smartphone. In making this tool, Arduino is used as the control center. In addition, this tool also uses a pH sensor to measure the acidity level of water in the aquarium, uses a Turbidity sensor to measure the turbidity level of water in the aquarium and an Ultrasonic sensor to calculate the water level in the aquarium. The results of the sensor measurements will be displayed on the LCD screen and the Blynk application. The Blynk application display gets data from the NodeMCU ESP32 which is used to send sensor reading data to the Arduino online using the Internet of Things (IoT). In addition to being used for monitoring, the Blynk application can be used to control water quality control pumps.

Corresponding Author:

Fauzan Kurnia Aditama
Department of Electrical Engineering, Faculty of Engineering, Universitas Negeri Padang
Kampus UNP Pusat, Jl. Prof. Hamka, Air Tawar, Padang 25131, Indonesia
Email: fkurnia26@gmail.com

1. INTRODUCTION

Keeping ornamental fish in aquariums is one of the hobbies that is quite popular with the public [1]. With this hobby, the increase in ornamental fish cultivation has also increased and is able to increase the economic value of the community [2]. Things that need to be considered in keeping ornamental fish in aquariums are water quality. Poor water quality can increase the acidity level of the water (pH) and also high ammonia levels in the water [3]. Some parameters that must be considered in the quality of water in aquariums include the acidity level (pH) and water turbidity [4]-[5]. In overcoming the problem of water quality in aquariums, the latest breakthroughs have been made in the application of technology that can help the efficient water management process [6]. The use of the Internet Of Things (IoT) is a technology that can expand the benefits of internet connections, and is connected in real time. With the Internet Of Things (IoT), the idea was obtained to create a tool that would work continuously and carry out measurable water quality control according to predetermined parameters [7]-[8].

Based on previous research, the use of NodeMCU 8266 produced results in the form of a tool that is able to carry out the temperature automation process using a temperature sensor, then can also monitor pH values using a pH sensor, and use a telegram bot in the implementation of the Internet Of Things (IoT) [9]. The use of a temperature sensor that is less effective for controlling aquarium water temperature, which from the results of research on changes in average temperature does not affect much on environmental temperature conditions. This shows that the use of a temperature sensor in an aquarium does not have a major effect because it is located indoors [10].

In this final project, the author designed a water quality control tool using Arduino as the brain that controls all inputs and outputs so that sensors and other components can work [11]. Combined with the use of the Blynk application as an implementation of the use of the Internet Of Things (IoT) which can function as a monitoring tool and also control the quality of aquarium water [12]. To regulate the acidity level of the water in the aquarium, a pH sensor is used to read the pH value of the aquarium water [13]. In addition, a Turbidity sensor is also used which functions to measure the turbidity level of the water in the aquarium [14]. The water level must also be maintained optimally, so an ultrasonic sensor is used to read the water level in the aquarium [15].

2. METHOD

The research method used in designing this tool is experimental research (Experiment Research) which includes tool design, working principles and analysis of tool test results. Planning is an important stage in making a tool, because by planning the components used, the tool to be made can work as expected. This tool is made into 3 parts, including an input system in the form of an ultrasonic sensor that is processed by the Arduino nano microcontroller as the input control center that will produce output in the form of data display on the LCD and android.

Before designing and making a tool, the first step is to create a block diagram for the working system of the tool to be made. A block diagram is a diagram in the form of a box (block) which functions to explain a work process. Figure 1 below is a block diagram of the tool, which consists of: Power Supply which functions to reduce and change the 220 volt AC voltage source to 12 Volt DC voltage as a voltage source for the water filter and pump, Module LM-2596 to reduce the 12 Volt DC voltage. to 5 Volt DC which will be used as a voltage source for the microcontroller, LCD and 4 channel relay, Arduino Nano as the main control center which will control the input and output so that it works according to the program used, Turbidity Sensor as input 1 which will read the level of water turbidity ornamental fish aquarium, pH sensor as input 2 which will read the pH of the water in the ornamental fish aquarium, Ultrasonic sensor as input 2 which will read the water level of the ornamental fish aquarium, Blynk application to give a signal/input command to start the program and as output to display the output of the previously given command, Liquid Crystal Display (LCD) 20 x 4 to display the water conditions in the aquarium in real-time, Filter as an output that will work to clear cloudy aquarium water, pH Up Pump as an output that will work For adding pH-enhancing fluid into the ornamental fish aquarium, the pH Down Pump which will work to add pH-lowering fluid into the ornamental fish aquarium and the Water Reservoir Pump which functions as an output to control the water level that is not good in the ornamental fish aquarium.

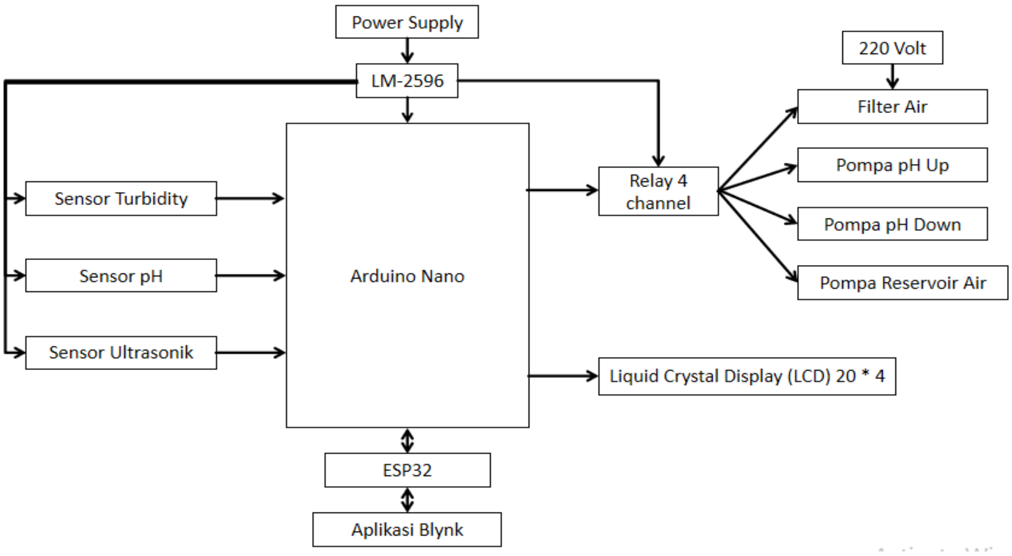

Figure 1. Diagram block of proposed system

All components are assembled so that they can function and work as desired. Figure 2 shows the electronic circuit schematic of the tool proposed in this study. Electronic design or hardware design is a design related to the components that will be used in the tool assembly process. This design includes determining the nature and specifications of the tool, selecting components, creating circuit designs and installing components..

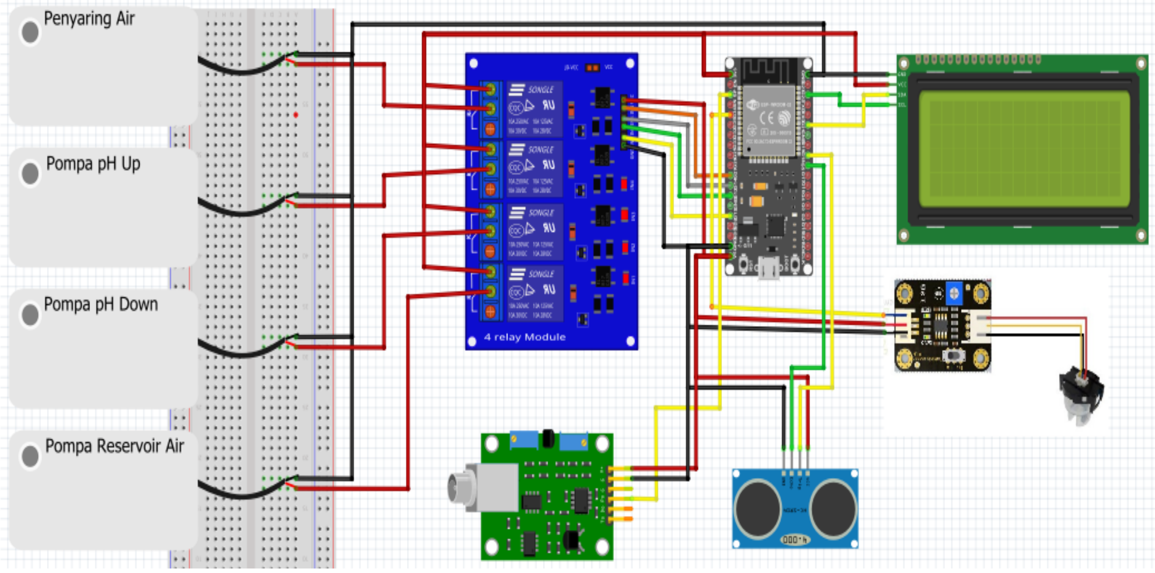

Figure 2. Scheme of electronic circuit for smart aquarium

All of these components are arranged and placed in a container, such as the mechanical design of the tool shown in Figure 3. Mechanical design is a stage or process in making hardware. This design aims to facilitate and reduce the level of error in making hardware, so as to obtain optimal results. With the mechanical design, the system can be tested in real terms whether this tool can work well or not..

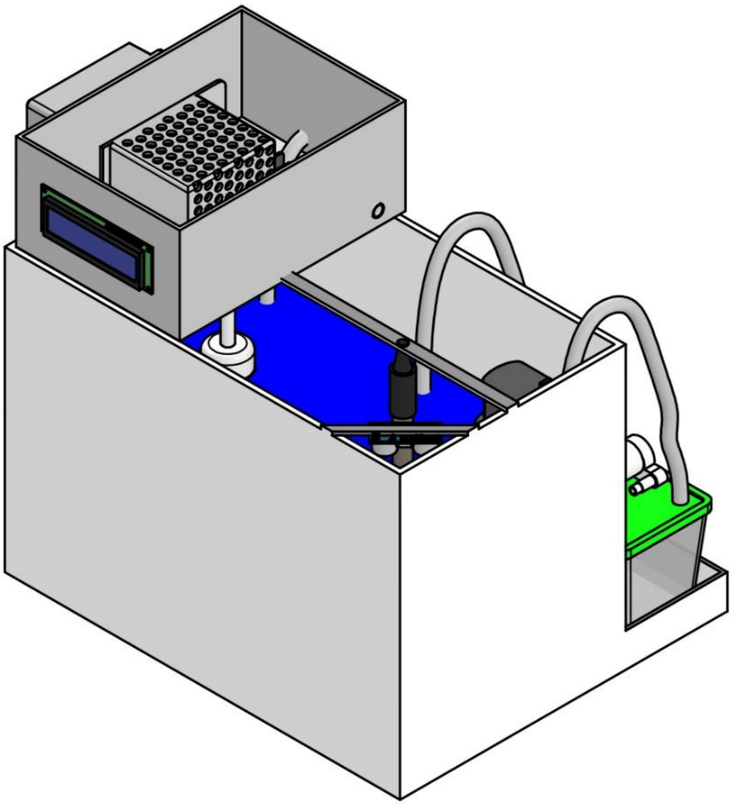

Figure 3. Mechanical design of smart aquarium

This aquarium water quality monitoring and control tool works automatically. The working principle of this tool is controlled by Arduino and data transmission using ESP32 to the Blynk application. When the tools are connected to each other, this tool can be accessed via a smartphone. The Ph sensor is used to detect the acidity level in aquarium water. The Turbidity sensor is used to detect the turbidity level of water and the Ultrasonic sensor is used to detect the water level in the aquarium. All data is processed by Arduino and the results of the measurements of these sensors are displayed on the LCD and monitored via a smartphone. The working process of the proposed tool is described in the flowchart, as shown in Figure 4.

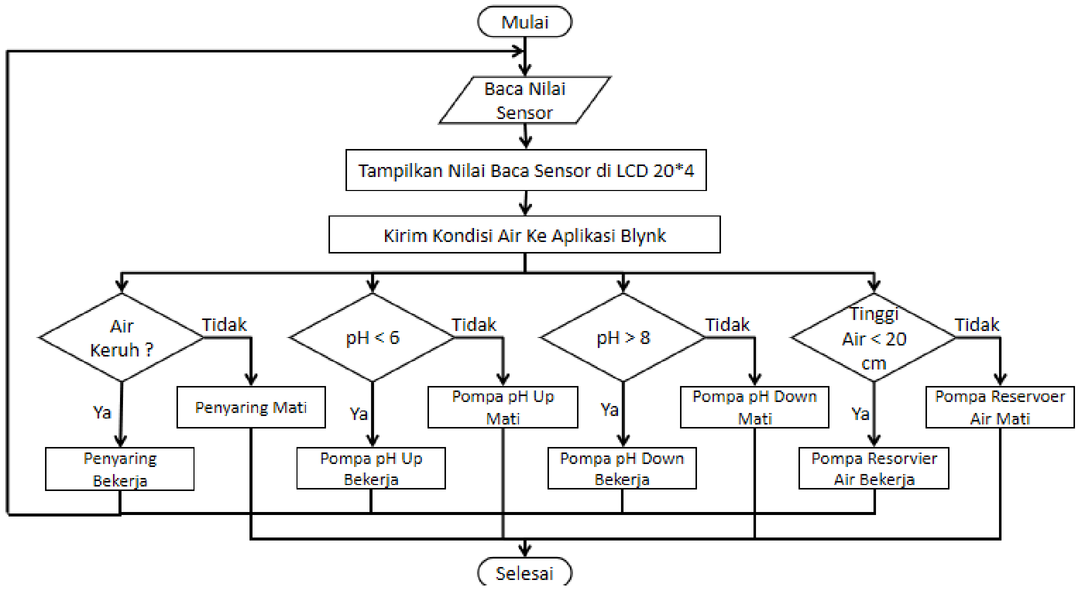

Figure 4. System flowchart

3. RESULTS AND DISCUSSION

After carrying out various stages of design including electronic, mechanical, and software design stages, the next step is to conduct testing to see how far the tool is designed well or not. This overall testing is carried out to find out whether the system can work together well. This aims to see whether this final assignment is running according to the previous plan and as a sign that the making of this final assignment is running according to plan. Figure 5 shows the smart aquarium that has been completed.

Figure 5. The completed aquarium

Next, the smart aquarium that has been completed is tested. The performance of the device is seen from the functionality of the control devices and data that can be displayed on smartphones and LCDs.

Figure 6. Screen display of both LCD and smartphone

Figure 6 shows that the data obtained from the sensor has been successfully displayed on the LCD screen and on the smartphone screen. Based on these sensor data, the relay will work to turn the pump motor on or off. Based on the tests conducted, it can be concluded that the tool has successfully worked well. The pump motors can work automatically based on the data obtained from the sensor. The test results are described in Table 1 below.

Table 1. The experimental results

Control actions on smartphone				Relay status			
PH up	PH down	Pump	Filter	PH up	PH down	Pump	Filter
ON	OFF	OFF	OFF	ON	OFF	OFF	OFF
OFF	ON	OFF	OFF	OFF	ON	OFF	OFF
OFF	OFF	ON	OFF	OFF	OFF	ON	OFF
OFF	OFF	OFF	ON	OFF	OFF	OFF	ON
ON	ON	ON	ON	ON	ON	ON	ON

4. CONCLUSION

Based on the results of the design, manufacture, testing and analysis of the system in the final project entitled design and construction of aquarium water quality control devices with smartphone control, it can be concluded that this device has been successfully made according to the design and works according to the programmed system. Where the device that was made can run and function properly. The test results of this device show that the device can work properly and according to the measurement results. This can be seen from the component parts that also work according to the planned design. This water quality control device prototype can measure the pH level of aquarium water, the turbidity level of aquarium water and also see the water level conditions in the aquarium. The use of the blynk application can also be used to control and monitor sensor measurement results.

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