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Smart Aquarium Based Microcontroller

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***Abstract*—Indonesia is an endemic area for the spread of one of the most popular ornamental fish, namely the largest betta fish in the world. In exploring their hobbies such as raising ornamental fish such as betta fish, efficient and automatic tools are more needed by betta fish farmers in aquariums today, when they have no free time or are drained by other work. This study aims to be a more automatic and efficient tool for everyone to feed fish, provide lighting, and drain aquarium water automatically, so that owners of ornamental fish do not have to worry about what ornamental fish need in the aquarium. The feeding system, in this case uses an Arduino-based control that controls the servo motor as an open and close system as the exit of fish feed into the aquarium. Aquarium lighting system, in this system uses a light sensor type LDR (Light Dependent Resistor). Automatic aquarium drain system, controlled by Arduino with water pump output. In the research, the LDR sensor will give a signal to the relay and give output to the 220 V lamp, that is, if the light intensity is below 028.7 Lux, which is above half past 6 pm and will turn off the 220 volt lamp if the light intensity is above 203.4 Lux, which is above 6 am. The servo motor will operate twice a day for feeding according to the betta fish feed needs, which is 2 times a day. The water pump will work every 4 days to drain the water automatically according to the turbidity of the water based on the time and number of betta fish in the aquarium.**

Keywords*—*Aquarium, Ornamental Fish, Livestock, Automatic

I. INTRODUCTION

In everyday life, everyone has different habits in filling their free time and life. It can be filled with hobbies that make the heart happy, namely hobbies. Hobby is an activity that is often done by humans and makes humans who do it can be entertained. Some examples of hobbies that humans do are fishing, futsal, basketball, raising livestock.

For example, when someone has a hobby of raising ornamental fish. Farming ornamental fish is a hobby that requires a lot of time and money. Meanwhile, in addition to the hobby of raising ornamental fish, a person also has time in his life to fulfill his needs and sometimes also travels with a long free time.

Indonesia is an endemic area for the spread of one of the most popular ornamental fish, namely the largest betta fish in the world. Betta fish are divided into 13 species groups in terms of their morphological characters (Tan, 2011, Goldstein, 2004).

In exploring their hobbies such as raising livestock, efficient and automatic tools are more needed by fish breeders in aquariums today, when they don't have free time or are drained by other jobs. In terms of raising, of course there is something to do with feeding. To live a healthy and optimal life, ornamental fish need food. In fish cultivation in ponds, ponds and in aquariums to meet their nutritional needs (M. Ghufran H. Kordi K., 2019). In addition, maintaining ornamental fish also requires lighting that functions as a substitute for light that supports the life of ornamental fish. Another function of lighting is to help shape the color of the scales and fins of ornamental fish. If the lighting in the aquarium is lacking, the fish's body will appear pale or dull (Bambang Priono, 2012). And also water is the most vital medium for fish life in raising fish, water quality that meets the requirements is the key to the success of raising

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fish. Therefore fish also need good water, because Hydrogen Sulfide or sulfuric acid is a toxic gas that can dissolve in water. Sourced from the decomposition of fish waste, and other organic materials (M. Ghufran H. Kordi K., 2019). Therefore, it is also necessary to periodically drain the water in the fish's habitat, for example ornamental fish in an aquarium.

The purpose of this activity is to determine the work of the Microcontroller that controls the servo motor for feeding fish automatically according to a predetermined time, to know the work of the light sensor for aquarium lighting that works automatically according to the specified time, and to know the work of the Microcontroller that controls the water pump as a water drain aquarium automatically according to the specified time.

From these problems, we need a tool that can feed fish automatically, which is capable of feeding fish automatically at predetermined times. Feeding time can be done in the morning, afternoon, afternoon or evening (M. Ghufran H. Kordi K., 2019). And automatic lighting to replace the light needed by ornamental fish (Bambang Cahyono, 2000). And also regular draining of water so that the water supply for raising fish remains adequate for the day (M. Ghufran H. Kordi K., 2019). Therefore, it is designed a tool that can be applied in everyday life that is very effective.

II. METHODS

A. Product Design

1. Feeding System

Figure 1. *Drawing of Feeding System Product Design*

Feeding System: In this case it uses an Arduino-based control that controls the servo motor as an open and close system as the exit of fish feed into the aquarium.

2. Aquarium Lighting System

Figure 2. Image of Aquarium Lighting System Product Design

Aquarium Lighting System: This system uses a light sensor type LDR (Light Dependent Resistor). The LDR functions as a light sensor in various electronic circuits such as an automatic switch based on light which if the sensor is exposed to light then the electric current in the lamp will flow (ON) and vice versa if the sensor is in low light (dark) conditions then the electricity flow in the lamp will be blocked (OFF).

3. Aquarium Drain System

Figure 3. *Product Design Drawing of Aquarium Drainage System*

Automatic Aquarium Drain System: Arduino will send a signal to the input relay and will control the water pump that will suck the cloudy water into the reservoir. Second, after between 3-4 minutes, the rotary pump sucking up the turbid water stops. Third, after the turbid water suction rotary pump stops, the clean water supply

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rotary pump will work until it runs out of water in the clean water reservoir with an interval of 3-5 minutes and the clean water for fish in the aquarium can be used for fish life in the aquarium.

B. Scope

To produce a discussion, preparation and manufacture of tools that are in accordance with the objectives and are not widespread in the discussion, the problem must be limited. In this research, which will be designed and discussed include:

1. This research is limited to explaining only including automatic feeding in the aquarium.
2. This research is limited to explaining only including providing lighting automatically using a light sensor.
3. This research only explains how to drain the aquarium water automatically according to a predetermined time. This only drains some of the water but does not completely clean it.

D. Data Presentation

Data presentation is a series of activities in the process of completing research results by using analytical methods in accordance with the desired objectives. This is done in order to facilitate the data that has been collected (Yuni, 2011). After obtaining the data, usually the data obtained can be presented in 2 forms, namely tabular form and diagrammatic form. This research project will describe the presentation of data from 3 automation systems, namely the feeding system, the lighting system in the aquarium and the automatic drainage system in the aquarium.

1. Fish Feeding

The test data taken and collected is the output data of fish feed weight in grams. This data is to determine the amount of feed given according to the needs of the ornamental fish, namely 7 betta fish. The feed weight output data was obtained from the data collection process carried out at home. After the data collection process is then implemented in the betta fish aquarium. Data was taken using a measuring instrument in grams. The number of test data taken is 5 times the weight of the feed based on the feed requirements needed with a servo motor rotation of 145° and the data is recorded and displayed in tabular form.

Figure 4. *Weighing fish feed*

The tool was tested for 5 trials and then weighed the feed weight to find out how much feed weight output was carried out for 5 trials.

2. Aquarium Lighting

At this stage the operation of the aquarium lights will be controlled through the LDR Sensor, which is a type of resistor whose resistance value changes due to the influence of light. When the light is dark the value of the resistance is getting bigger, and vice versa. In testing the sensor is given a voltage of 5V and a resistor of 100 KΩ is given, then brought it closer to the light source. The LDR resistance value changes with changes in the intensity of the light hitting it.

This data retrieval is taken from the readings of the light intensity measuring instrument which is measured near the LDR sensor, the light intensity is measured with a Luxmeter type measuring instrument. The purpose of this measurement is to determine the light intensity required by the LDR sensor which will provide input to the relay and provide output to the 220 Volt lamp. The test results data are as shown in table 3.

Table 3. *Data on the results of measuring light intensity with Luxmeter*

No	Measurement	Light Intensity (Lux)	Result of Lamp Reaction (220 Volts)	
			On	Off
1	1st Measurement	249.4		√
2	2nd Measurement	028.7	√	
3	3rd Measurement	203.4		√
4	4th Measurement	351.6		√
5	5th Measurement	334.4		√
6	6th Measurement	020.1	√	
7	7th Measurement	025.5	√	

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Figure 5. *The lamp lights up at a light intensity of 025.5 Lux*

Figure 6. *The light turns off at a light intensity of 249.4 Lux*

Table 3. is the result of the LDR sensor test data on the Luxmeter measuring instrument. The table explains that the light intensity changes all the time depending on the location where the light intensity is high or not. From the table, it can be seen that the highest value of light intensity that is read in Luxmeter is 351.6 Lux, while the lowest value is 020.1 Lux. From the table it can be seen that the sensitivity of the LDR sensor used in this study is in good condition and ready for use.

3. Aquarium Drain

This data collection was viewed from the condition of the aquarium with a length of 50 cm, a width of 30 cm and a height of 30 cm and the number of fish was 7 betta fish. The process of draining water in the aquarium has been tested based on the schedule settings specified by the user. Setting the aquarium drain pump every 4 days is due to the fact that the aquarium water is very cloudy so that it can interfere with the light levels that enter the aquarium needed by the fish in it. The process of draining water with this drain pump and water filler pump will work automatically. The water in the aquarium will not be completely depleted at the time of draining, where there will be a little water left for the fish to keep swimming and then the water will fill again until it is full of clean water.

Figure 7. *Aquarium water condition after 4 days*

Table 4. *The level of cloudy water in days based on the number of betta fish*

No	Number of fish	Cloudy Water Stage in Days
1	3	9 Day
2	5	6 Day
3	7	4 Day
4	9	3 Day

This test is carried out based on the level of clarity which if under normal conditions, with clear or less clear water status then the pump is off temporarily if the water is cloudy then pump 1 (drain) will work and will die if the Arduino delay timer has given a signal to the relay accordingly. the time specified in the measurement which can be obtained how many minutes the water will be the minimum limit which means that the water has been drained. Then Arduino will read so that it activates pump 2 (filler) and the filler pump will turn off if the Arduino delay timer has shown the

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maximum limit that has been previously measured and shows that the water in the aquarium is filled with clean water.

Figure 8. *The condition of the aquarium water after it is filled automatically*

From these data, it can be analyzed that in the experiment that if the water in the aquarium is cloudy during the maintenance of ornamental fish for 4 days, the pump will automatically drain and after the draining process is complete the drain pump will die, then the filler pump will work.

III. RESULTS AND DISCUSSION

Data analysis is a process that organizes the sequence of data, then organizes it into a pattern, form and basic unit of description. This is done to get conclusions at the end that are easy to digest (Lexy J, 2002). In the analysis of this research will describe the analysis of data from 3 automation systems, namely the feeding system, the lighting system in the aquarium and the automatic drainage system in the aquarium.

1. Fish Feeding

After obtaining the results from the experimental tool, namely the servo motor, the average weight, time, and number of fish were obtained which were then compared with the feed requirements by obtaining the formula:

Daily Feed Requirement = A (Number of Fish) / B (Average Weight of Fish) x 50%,
= C (Yield) Gram

Based on the formula that has been described (M. Ghufran H. Kordi K., 2019), the daily feed requirement for betta fish is 12.5 grams. This result is obtained from the average fish weight of 28 grams which is multiplied by the number of fish in the aquarium, namely 7 betta fish and multiplied by 50% for the results to be rounded up in grams. With calculations according to the formula above as follows:

Known: A = 7 Tails B = 28 Grams
Asked: C?
Answer:
= 7 : 28 x 50
= 12.5 grams.

With the data from the measurement of the weight of the feed, the total servo motor operating is 3 seconds.

The need for feed is 12.5 grams in one time feeding fish in the aquarium which per day is feeding the ornamental fish 2 times a day (M. Ghufran H. Kordi K., 2019), so the total feeding in the aquarium is 12, 5 x 12.5 = 25 grams per day and the tool can be used for routine feeding.

Table 5. *Analysis of fish feed needs with the time required to work the tool, namely the servo motor according to the number of betta fish*

No	Number of Fish	Formula	Heavy Needs Feed (Grams)	Tool Working Time (seconds)
1	3	3 : 28 x 50	5,3 Gram	1,1 Detik
2	5	5 : 28 x 50	8,9 Gram	2 Detik
3	7	7 : 28 x 50	12,5 Gram	3 Detik
4	9	9 : 28 x 50	16 Gram	4 Detik

The table above is the result of an analysis of the weight requirements of betta fish feed in an aquarium that has been formulated which is then finalized by the time the servo motor operates. The table is a reference if you keep more than 7 betta fish or less than 7 betta fish. Obstacles when someone is out of town or traveling far to take a long time and days, surely things like this can

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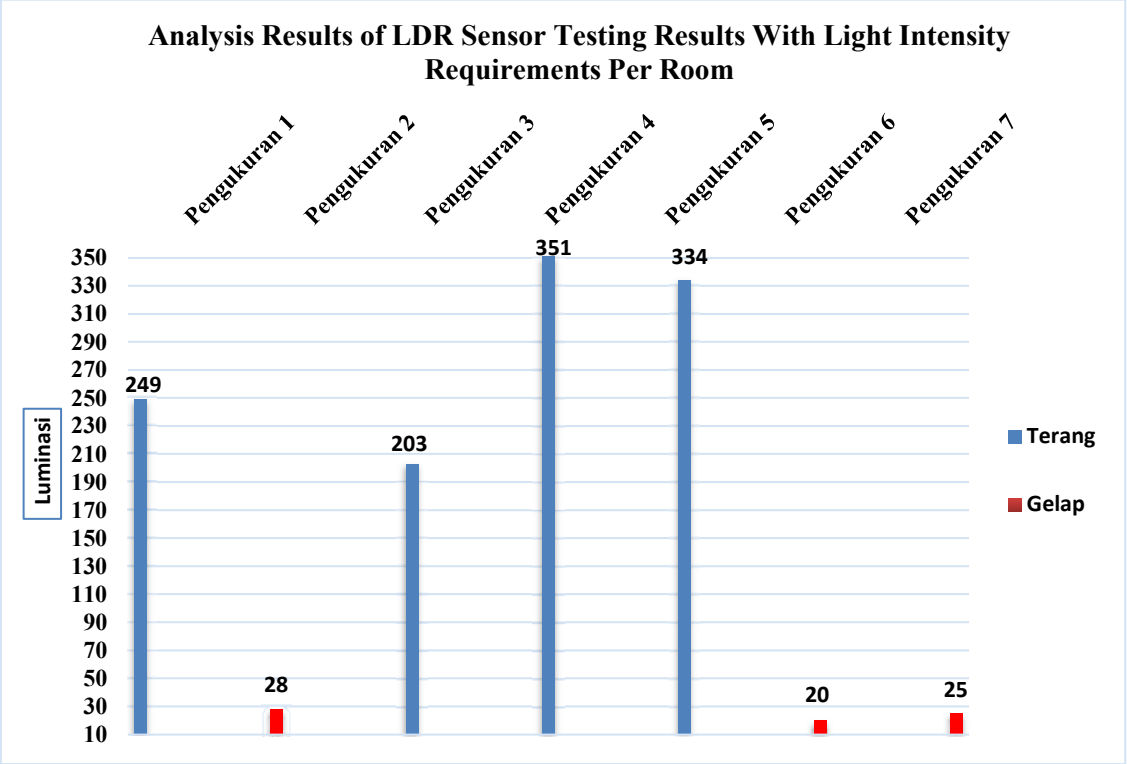
hamper the process of feeding the fish and can make the fish die because unscheduled fish feeding can be overcome automatically (Harifuzzumar et al. al., 2018).

2. Aquarium Lighting

It can be seen that the results of the measurement of lighting in the indoor area due to the placement of the aquarium will be placed in the indoor room, namely in the living room and can be determined by the ornamental fish keeper separately with reference to the recommended level of illumination.



Graph 1. *The results of the analysis of the LDR sensor test based on the need for light intensity*

In chapter 2 in table 2.3.1. It has been described for the light intensity in the living room, which is 120-250 Lux because the placement of the aquarium in this study will be placed in the living room, so if the light intensity is 203.4 Lux, the 220 volt lamp in the living room turns off, which is above 6 am. And the 220 volt lamp will light up at a light intensity below 028.7 Lux which is above half past 6 in the afternoon according to the experimental testing of the tool with Luxmeter. The selection of the type of lamp is also one of the important components that affect the level of lighting in a room. This type of fluorescent lamp has good energy efficiency, good color, dimming, and many other features as a light source (Erniwati Ibrahim, Syamsuar Manyullei, 2019).

3. Aquarium Drain

From the results of table 4 data, the cloudy water has been described in a matter of days according to the type and number of ornamental fish in the aquarium. Betta fish have the fastest percentage of turbidity stage because these fish have a unique shape and character with a tendency to be aggressive when defending their territory (Julis Tamadji, 2021), so that with this many movements, the aquarium water is easily cloudy compared to guppies whose size is smaller than fish. hickey and likes calm waters (Nasution, 2013), so the water in the aquarium does not turn cloudy quickly.

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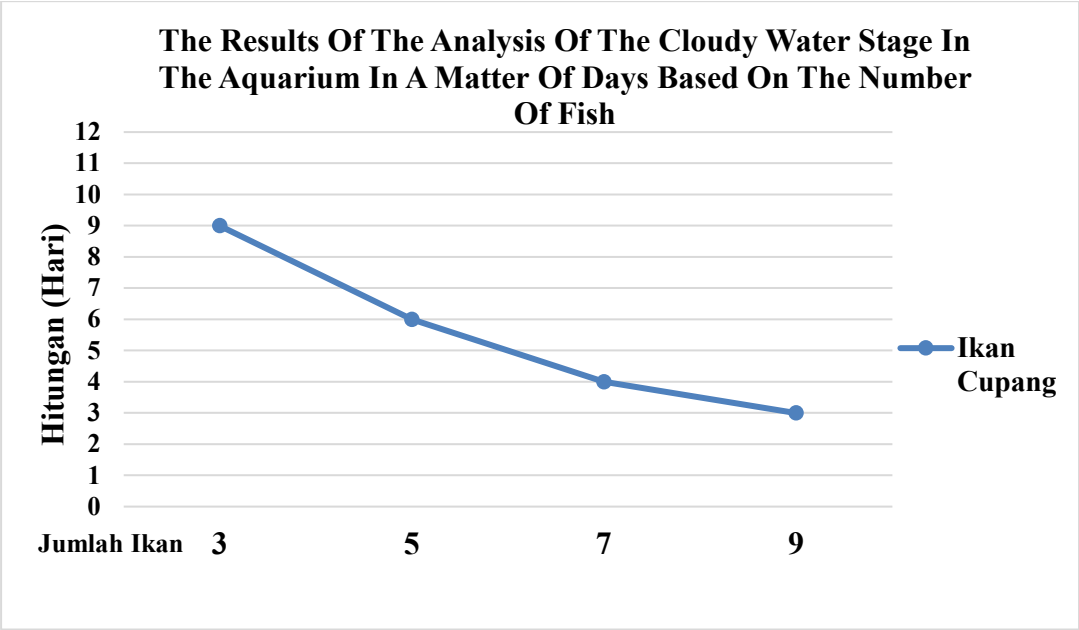

Graph 2. *The results of the analysis of cloudy water on the type of betta fish and the number of betta fish in the aquarium*

Turbidity is caused by the presence of suspended and dissolved organic and inorganic materials (eg mud and fine sand), as well as inorganic and organic materials in the form of plankton and other micro-organisms (Muddin et al., 2020).

IV. CONCLUSIONS

Based on the results of the research and discussion that has been described in the previous chapters, it can be concluded as follows:

1. The servo motor can provide fish feed automatically which is controlled by Arduino with a feed output of 12.5 grams which is adjusted to the condition of the number of ornamental fish in the aquarium, which is 7 fish and the daily feed needs of the ornamental fish.
2. The servo motor can work to feed fish automatically according to the daily feed needs of ornamental fish in the morning at 07.00 WIB and at night at 19.00 WIB with a delay time of 3 seconds.
3. This LDR (Light Dependent Resistor) type light sensor will give a signal to the relay and will turn on the 220 volt lamp if the light intensity is below 028.7 Lux, which is above half past 6 pm and will turn off the 220 volt lamp if the light intensity is above 203.4 Lux, which is above the hour 6 am.
4. The water pump functions as an automatic drainer and water filler which is controlled by the Arduino according to the turbidity of the water in the aquarium by obtaining a signal from the Arduino.
5. The drain water pump is capable of draining 30 liters of water in 2 minutes and the filling water pump is able to drain 28 liters of water in 4 minutes.

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