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Development of IoT-Based Aquarium Control System

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ABSTRACT

The purpose of this research is to create an IoT-based aquarium control system. This tool is made using 4 electronic sensors. These sensors include turbidity sensor, pH sensor, ultrasonic sensor, temperature sensor. In this research, a control system has been successfully made and tested. The result is that the tool functions well 80% to read turbidity levels, pH, altitude and temperature in aquarium water. Iot (Internet of Things) is needed in making a tool to find out the turbidity, pH, altitude, temperature of the water as an intermediary for exchanging data remotely with Thinger.io media.

Keywords: Turbidity sensor; pH; Ultrasonic; Temperature; IoT

1. INTRODUCTION

Each aquarium must have a control system (1-2). Aquarium is an artificial vessel generally made of glass to raise and exhibit aquatic animals especially types of fish (3-4). With the development of the times and technology, this can make it easier to find out the level of turbidity, pH, altitude, water temperature in the aquarium at any time (5-6). IoT (Internet of Things) is a network of physical objects embedded with electronics, software, sensors, and network connectivity, which allows objects to collect data and exchange data. IoT enables objects to be remotely controlled in existing network infrastructure (7-8).

In this case Thinger.io will be a remote control that can be accessed at any time while there is still an internet network connected. To determine the turbidity of water, a tool is needed, namely the Turbidity sensor. To determine the pH of water, a tool is needed, namely a pH sensor. To find out the water level, a tool is needed, namely an ultrasonic sensor. To find out the water temperature, a tool is needed, namely the DS18B20 sensor (9-10).

Based on website information, the IoT-based fish environmental parameter monitoring system that has been developed has generally not been optimized in terms of the cost of making the monitoring system, especially in home-scale ornamental fish aquariums. IoT systems can be built using open source components so that they will reduce production costs (11-13).

In this research the control system created already has multiple sensors. The multi-sensor system in question is that there are 4 sensors attached, the sensors are turbidity sensors, pH sensors, ultrasonic sensors, temperature sensors (2-4). The purpose of this research is to develop or create an IoT-based aquarium control system(14-15).

2. LITERATURE REVIEW

2.1 Research Materials

The materials needed in making an IoT-based aquarium control system are as follows.

a. Turbidity Sensor, pH, Ultrasonic, DS18B20

b. NodeMCU ESP8266 microcontroller

c. RTC DS1307

d. Relays

e. Arduino IDE

f. Arduino pcb board

g. Mini USB Charging Adapter

h. 12V DC water pump

i. Jumper Cable

j. Thinker.io

k. Aquarium

2.2 Research Tools

The tools needed to make an IoT-based aquarium control system consist of hardware and software.

a. Hardware :

1. Laptop Asus Intel Celeron N3350 Ram 4GB

2. Mini USB Charging Cable

b. Software

1. Arduino IDE software

2.Thinger.io App

2.3 Tool design drawings

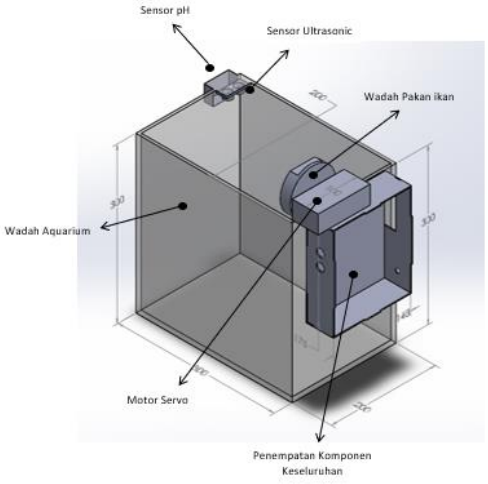


Figure.1. Tool Design

2.4 Flowcard System

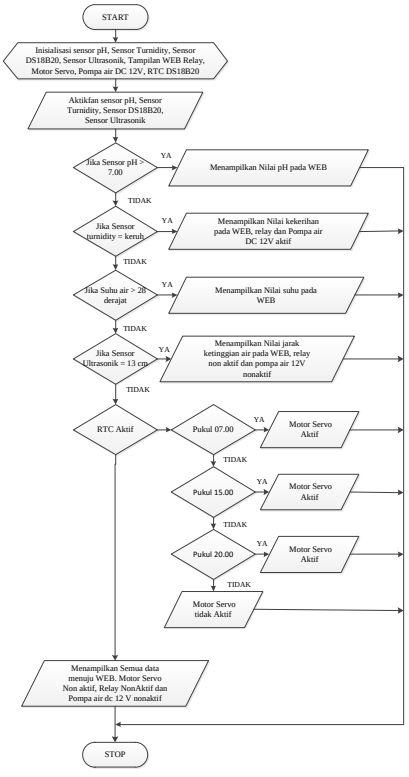


Figure.2. System Flowcard

2.5 Working principle of the tool

Where the working principle of the tool is to measure the pH value and water turbidity in ornamental fish aquariums. And the tool will measure the height and temperature values in the

water for 24 hours to keep the ornamental fish alive. The RTC will automatically provide fish feed automatically by providing fish feed 3 times a day, where the times shown are at 07.00, 15.00 and 20.00. if all the data has been obtained then the data will be processed by the ESP32 microcontroller by sending it via the Wifi network to the WEB.

3. EXPERIMENTAL

This research has been successfully developed to produce an IoT-based aquarium control systemtool. The series of tools in the IoT-based aquarium control system can be seen in

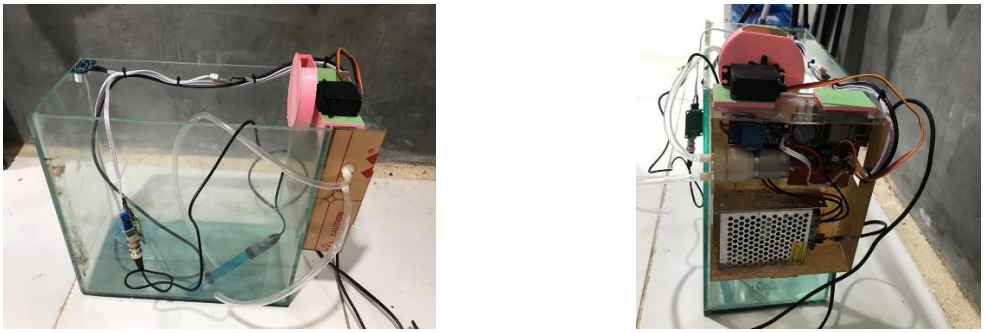
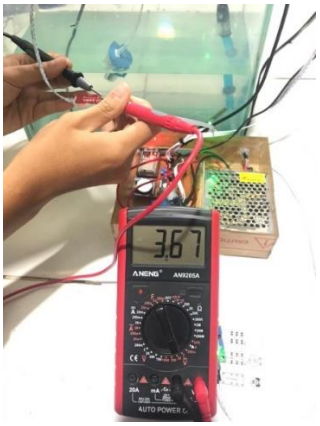


Figure.3. Tool Implementation

3.1 Turbidity sensor measurement results



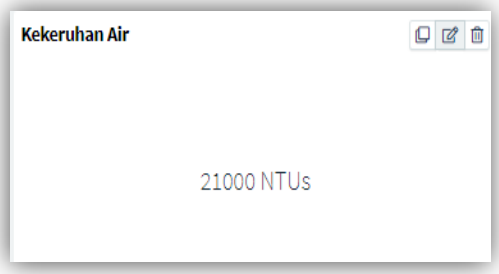


Figura.4. Voltage measurement and value display in clear water

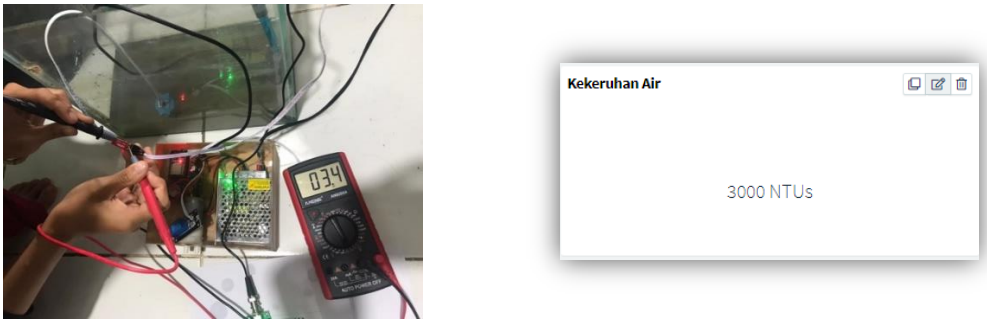


Figura.5. Voltage measurement and value display in turbid water

Table 1 Turbidity Sensor Measurement Results

No	Measurement Point	Water Conditions	Vout (Multimeter)	Vout (Formula)
1	TP1	Clear water	3,67 V	5V
2		Turbid Water	3,4 V	1,30V

In this test, it aims to find out how much the accuracy of the sensor is, by comparing the sensor with the web, so that the level of accuracy of the sensor can be known. The measurement point on the pH sensor aims to find out the voltage that will be measured when the sensor is in a condition where the pH value is read as follows (17-20).

3.2 Results of pH Sensor Measurements

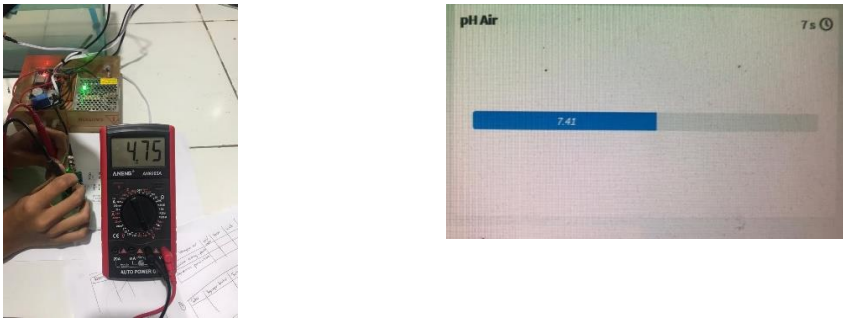


Figura.6. Measurement of pH sensor voltage and display of the pH value on Thinger.io when the water is clear

Table 2 Results of pH Sensor Measurements

No	Measurement Point	Condition	Vout	Ph value
1	TP1	Clear	4,75 V_{DC}	7,41
2		Cloudy	4,76 V_{DC}	7,41

The measurement results obtained on the pH sensor are 4.75 VDC using the unit value on a digital multimeter, namely x20 where the measuring instrument can only measure DC voltage units in the maximum voltage range of 20Volt. And the pH value that appears on the thingerio is 7.41.Namely experiencing a change in the measured voltage value on the measuring instrument which is equal to 4.76. This means that there is a voltage change that is not too high but indicates that the pH sensor can read changes in the value of the cloudy pH of the water. And for the pH value, a pH value of 7.41 was still obtained (21-23).

3.3 Ultrasonic sensor measurement results

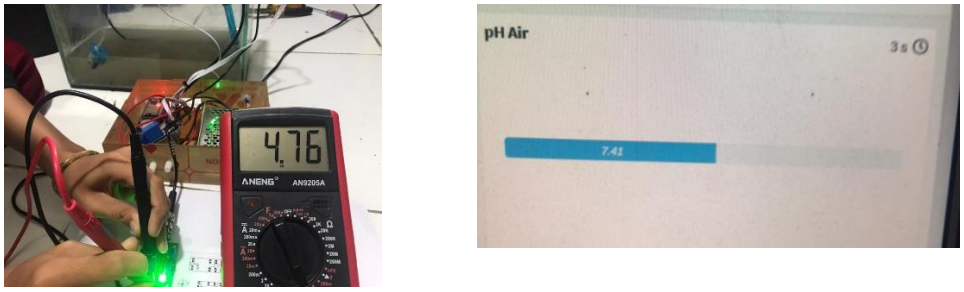
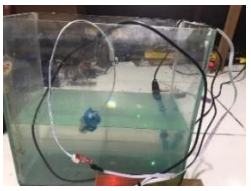
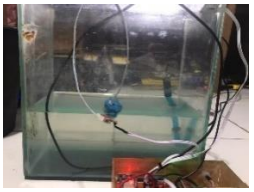
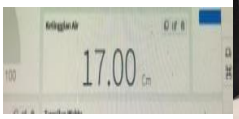
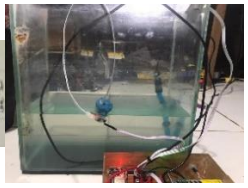
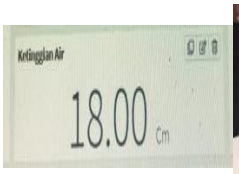
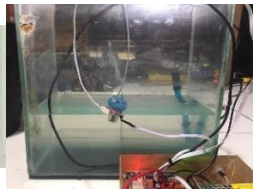
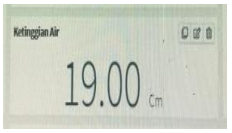
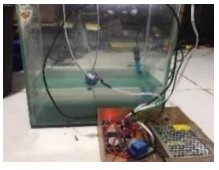
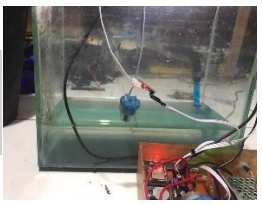
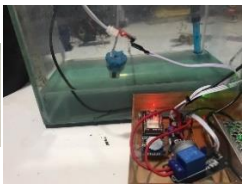
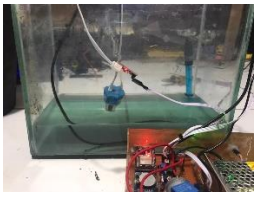


Figura .7. Measurement of pH sensor voltage and display of the pH value on Thinger.io when the water is cloudy

Table 3 Results of measurement of ultrasonic sensor distance values

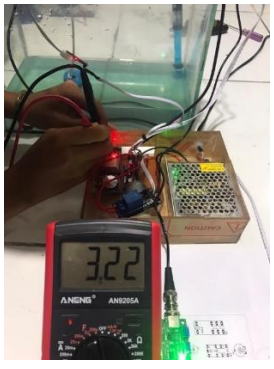
Measurement Point	**Rated Voltage (Volt)**	**Proximity sensor (cm)**	**Meter (cm)**	**Difference in distance values**	**Display Photo**	
					WEB	**Aquarium scalable**

			(cm)		
TP1	4,9V	15	13cm	2	 
TP1	4,9V	16	12cm	4	 
TP1	4,9V	17	11cm	6	 
TP1	4,9V	18	10cm	8	 
TP1	4,9V	19	9cm	10	 
TP1	4,9V	20	8cm	12	 

TP1	4,9V	21	7cm	14		
TP1	4,9V	22	6cm	16		
TP1	4,9V	23	5cm	18		

The analysis obtained from the measurements in the table above is the value of measuring the distance from the meter to the sensor, which has a good measurement value, namely the distance that is read with a difference of 2 cm aims to see and compare values when the water is full and good for fish, so the sensor can reading the distance between the sensor to the water is 15cm while on the measuring instrument the value measured between the sensor to the water is 13cm. and so on until the water is empty when the water is too turbid, which is 23 cm and on the meter is 5 cm. the difference of 2cm here is that the sensor is not in a bad condition but the distance that will be used because of the condition of the pump speed to fill or empty the aquarium. Meanwhile, the measured voltage on the sensor is 4.9VDC (25-27).

3.4 DS18B20 sensor measurement results



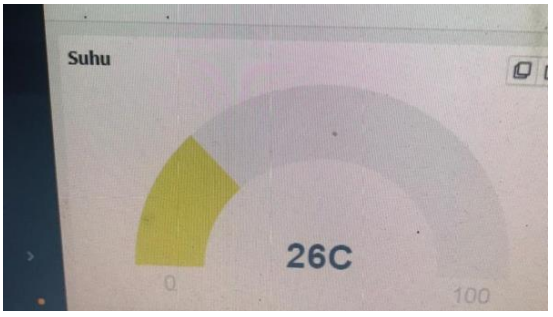


Figura.8. Temperature measurement using multimeter and temperature display on thingerio

Table 4 Ultrasonic Sensor Measurement Results

No	Measuring point	Rated voltage (V_{OUT})	Water Conditions	Temperature (^{0}C)
1	TP1	3,22 V_{DC}	Clear and Turbid	26^{0}C

Namely when the temperature value is measured in an aquarium with clear or turbid water, the temperature obtained is 260 Celsius while the value measured on the measuring instrument is 3.22 VDC. for more details will be described in the description of the table below. The ability of this sensor to control reaches 80% (28-32).

4. RESULTS AND DISCUSSION

4.1 IoT-based data comparison in 3 days

The purpose of testing the tool in 3 days is to see a value that focuses on changing the readings of some water that has been put into the aquarium and tested through sensor readings that are displayed on the internet of things display and also the data display on the serial monitor.

Date	Turbidity (NTUs)	Temperature ($°C$)	pH	Height (cm)	Water Type
07 Januari 2023	2443.14 NTUs	27.38$°C$	2	21cm	Clear Water / Well
	105538.69 NTUs	27.56 $°C$	7	20cm	Pool Water
	5000.47 NTUs	28.19$°C$	10	17cm	River water
	9443.14	28.50$°C$	6	17 cm	Coffee Water

	NTUs				
	94535.56 NTUs	27.25°C	6	18 cm	Powder Water The
	8043.14 NTUs	28.38°C	11	17 cm	Vinegar Water
08 Januari 2023	90721.33 NTUs	26.50°C	7	20 cm	Clear Water / Well
	70840.57 NTUs	29.19°C	5	23 cm	Pool Water
	92908.69 NTUs	29.06°C	10	20 cm	River water
	78841.88 NTUs	26.81°C	6	23 cm	Coffee Water
	99586.41 NTUs	26.69°C	6	22 cm	Powder Water The
	99698.67 NTUs	26.88°C	7	20 cm	Vinegar Water
09 Januari 2023	91618.64 NTUs	26.88°C	7	21 cm	Clear Water / Well
	52477.82 NTUs	28.31°C	5	23 cm	Pool Water
	91113.89 NTUs	29.06°C	10	20 cm	River water
	105482.52 NTUs	28.88°C	6	20 cm	Coffee Water
	98800.73	27.38°C	6	20 cm	Powder Water The

NTUs				
93020.88 NTUs	27.56°C	7	22 cm	Vinegar Water

5. CONCLUSION

The tool used has been successfully designed and made using 4 sensors, the sensors include, turbidity sensor, pH sensor, ultrasonic sensor, temperature sensor. The water turbidity control system is carried out in real time.Tool capability reaches 80%..

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